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SD 71-215-1

MODULAR space station

PHASE B EXTENSION

PRELIMINARY PERFORMANCE SPECIFICATION

Volume I · Initial Station Systems

PREPARED BY PROGRAM ENGINEERING
3 DECEMBER 1971

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Approved by

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TECHNICAL REPORT INDEX/ABSTRACT

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DESCRIPTIVE TERMS

Modular Space Station *Preliminary Performance Specification *
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ABSTRACT

This volume of the specification defines the general, operational, design/construction, and subsystem design requirements for a Solar Powered Modular Space Station System. The subsystem requirements specified reflect the results of trades and analyses conducted during the Phase B Extension Period study, and also include the results of preliminary design to a Phase B level.

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FOREWORD

This document is one of a series required by Contract NAS9-9953, Exhibit C, Statement of Work for Phase B Extension-Modular Space Station Program Definition. It has been prepared by the Space Division, North American Rockwell Corporation, and is submitted to the National Aeronautics and Space Administration's Manned Spacecraft Center, Houston, Texas, in accordance with the requirements of Data Requirements List (DRL) MSC-T-575, Line Item 66.

Total documentation products of the extension period are listed in the following chart in categories that indicate their purpose and relationship to the program.

ADMINISTRATIVE REPORTS	TECHNICAL REPORTS		STUDY PROGRAMMATIC REPORTS	DOCUMENTATION FOR PHASES C AND D	
				SPECIFICATIONS	PLANNING DATA
EXTENSION PERIOD STUDY PLAN DRL-62 DRD MA-207T SD 71-201	MSS PRELIMINARY SYSTEM DESIGN DRL-68 DRD SE-371T SD 71-217	MSS DRAWINGS DRL-67 DRD SE-370T SD 71-216	EXTENSION PERIOD EXECUTIVE SUMMARY DRL-65 DRD MA-012 SD 71-214	MSS PRELIMINARY PERFORMANCE SPECIFICATIONS DRL-66 DRD SE-369T SD 71-215	MSS PROGRAM MASTER PLAN DRL-76 DRD MA-209T SD 71-225
QUARTERLY PROGRESS REPORTS DRL-64 DRD MA-208T SD 71-213, -235, -576	MSS MASS PROPERTIES DRL-69 DRD SE-372T SD 71-218, -219	MSS MOCKUP REVIEW AND EVALUATION DRL-70 DRD SE-373T SD 71-220			MSS PROGRAM COST AND SCHEDULE ESTIMATES DRL-77 DRD MA-013(REV. A) SD 71-226
FINANCIAL MANAGEMENT REPORTS DRL-63 DRD MF-004	MSS INTEGRATED GROUND OPERATIONS DRL-73 DRD SE-376T SD 71-222	MSS KSC LAUNCH SITE SUPPORT DEFINITION DRL-61 DRD AL-005T SD 71-211			MSS PROGRAM OPERATIONS PLAN DRL-74 DRD SE-377T SD 71-223
	MSS SHUTTLE INTERFACE REQUIREMENTS DRL-71 DRD SE-374T SD 71-221	INFORMATION MANAGEMENT ADVANCED DEVELOPMENT DRL-72 DRD SE-375T SD 72-11			
	MSS SAFETY ANALYSIS DRL-75 DRD SA-032T SD 71-224				

This volume, volume 1 of two volumes, defines the Modular Space Station System and the requirements and characteristics of each of its subsystems. Volume 2 defines the Modular Space Station Program Element and its interfaces with other NASA Program Elements.

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1.0 SCOPE

THE MODULAR SPACE STATION PROGRAM ELEMENT PERFORMANCE AND DESIGN REQUIREMENTS ARE DEFINED BY A TWO VOLUME PRELIMINARY PERFORMANCE SPECIFICATION. THIS VOLUME OF THE SPECIFICATION, VOLUME 1, DEFINES THE GENERAL, OPERATIONAL, DESIGN/CONSTRUCTION, AND SUBSYSTEM DESIGN REQUIREMENTS FOR THE SOLAR POWERED MODULAR SPACE STATION SYSTEM. THE REQUIREMENTS DEFINED HEREIN APPLY TO THE SYSTEM (LEVEL 4) AND SUBSYSTEM (LEVEL 5) LEVELS OF THE PHASE B STUDY WITH DEFINITION DOWN TO THE THIRTY-SEVEN MAJOR ASSEMBLIES (LEVEL 6) THAT COMPRISE THE SEVEN FUNCTIONAL SUBSYSTEM GROUPINGS OF THE SYSTEM. THIS SPECIFICATION APPLIES ONLY TO THE INITIAL STATION SYSTEM. THE SYSTEM IS,HOWEVER, READILY ADAPTABLE TO A GROWTH CONFIGURATION BY THE ADDITION OF A SHORT CORE MODULE AND TWO STATION MODULES. IN ADDITION, THE 7,000 SQUARE FOOT SOLAR ARRAY PACKAGE MUST BE REPLACED BY A 10,000 SQUARE FOOT PACKAGE TO SATISFY GROWTH POWER NEEDS.

THE SUBSYSTEM REQUIREMENTS (SECTIONS 3.3.1 THRU 3.3.7) ARE THE RESULTS OF TRADES AND ANALYSES CONDUCTED DURING THE STUDY. THE REQUIREMENTS ALSO INCLUDE THE RESULTS OF THE PRELIMINARY DESIGN PHASE.

VOLUME 2 OF THE SPECIFICATION DESCRIBES THE FOUR SYSTEMS OF THE MODULAR SPACE STATION PROJECT AND DEFINES THE INTERFACES BETWEEN THIS PROJECT AND THE SHUTTLE PROJECT, THE TRACKING AND DATA RELAY SATELLITE PROJECT AND AN ARBITRARILY DEFINED EXPERIMENT PROJECT. THE EXPERIMENT PROJECT WAS SYNTHESIZED FROM INTERNAL EXPERIMENTS, DETACHED RESEARCH AND APPLICATION MODULES, AND ATTACHED RESEARCH AND APPLICATION MODULES SUCH THAT A SET OF INTERFACE REQUIREMENTS ARE DEFINED WHICH WILL SUPPORT MULTIPLE COMBINATIONS OF THESE ELEMENTS EXPECTED DURING THE MODULAR SPACE STATION MISSION.

2.0 APPLICABLE DOCUMENTS

MIL-B-50878 BONDING, ELECTRICAL AND LIGHTNING PROTECTION FOR AEROSPACE SYSTEMS

MIL-E-6051D ELECTROMAGNETIC CAPABILITY REQUIREMENTS, SYSTEMS AMEND I

MIL-STD-461 ELECTROMAGNETIC CHARACTERISTICS, REQUIREMENTS FOR EQUIPMENT - EXHIBIT C - STATEMENT OF WORK FOR PHASE B EXTENSION MODULAR SPACE STATION PROGRAM DEFINITION

MSC-03696 - GUIDELINE AND CONSTRAINTS DOCUMENT MODULAR SPACE STATION DEFINITION PHASE B REV. 7

MSC-02466 SD71-201 MODULAR SPACE STATION EXTENSION PERIOD STUDY PLAN

MSC-02469 SD71-512-1 MODULAR SPACE STATION PRELIMINARY PERFORMANCE SPECIFICATION INITIAL STATION SYSTEMS

MSC-02471 SD71-217 MODULAR SPACE STATION PRELIMINARY SYSTEM DESIGN - 7 VOLUMES

MSC-02472 SD71-219 MODULAR SPACE STATION MASS PROPERTIES - MASS

MSC-02474 SD71-221 MODULAR SPACE STATION SHUTTLE INTERFACE REQUIREMENTS

MSC-02476 SD71-222 MODULAR SPACE STATION INTEGRATED GROUND OPERATIONS

MSC-02477 SD71-223 MODULAR SPACE STATION PROGRAM OPERATIONS PLAN

MSC-02479 SD71-225 MODULAR SPACE STATION PROGRAM MASTER PLAN

MSC-PA-D-67-13 NON-METALLIC MATERIALS REQUIREMENTS

MC 999-0058 APPROVAL OF NON-METALLIC MATERIALS FOR USE IN THE APOLLO SPACECRAFT, GENERAL SPECIFICATION FOR

MSC-NA-D-68-I NONMETALLIC MATERIALS DESIGN GUIDELINES AND TEST DATA HANDBOOK

NHB 7150.1 PRELIMINARY EDITION OF REFERENCE EARTH ORBITAL RESEARCH AND APPLICATIONS INVESTIGATIONS (BLUE BOOK) JAN. 1971 - 8 VOLUMES

U.S. DEPARTMENT OF COMMERCE NBS, BUILDING SCIENCE SERIES SMOKE AND GASES PRODUCED BY BURNING AIRCRAFT INTERIOR MATERIALS

SD71-206 MODULAR SPACE STATION PHASE B DEFINITION - SHUTTLE MODEL REVISED AND REISSUED JUNE 1971.

MA0615-012 COMBUSTION RATE TESTING ON NON-METALLIC MATERIALS (TM) AND CONFIGURATIONS (TC) FOR MANNED SPACECRAFT

MA0615-015 VACUUM STABILITY TESTING OF POLYMERIC MATERIALS FOR SPACECRAFT APPLICATIONS

STANFORD RESEARCH INSTITUTE REPORT - POLYMERS FOR SPACECRAFT APPLICATIONS SEPTEMBER 15, 1967

3.0 REQUIREMENTS

3.1 PERFORMANCE

3.1.1 CHARACTERISTICS

THE INITIAL MSS WILL BE A SEMI-PERMANENT CLUSTER OF MODULES, EACH OF WHICH CAN BE TRANSPORTED TO AND FROM ORBIT IN THE CARGO BAY OF A SPACE SHUTTLE. THE INITIAL MSS COMPLEX, WITH ALL ITS MODULES CONNECTED COMPRISES A SPACE STATION CAPABLE OF SUPPORTING A CREW OF 6 AND PROVIDING AN EARLY BENEFIT RETURN EXPERIMENT PROGRAM FOR EXTENDED MISSION DURATIONS. IN ITSELF, THE INITIAL MSS SHALL BE SELF-SUFFICIENT WITHIN THE LIMITS OF ITS CONSUMABLES (PROPELLANTS, FOODSTUFFS, CREW STAY TIME, ETC.).

A. CONFIGURATION (INITIAL STATION MSS COMPLEX)

CONFIGURATION - STATION MODULES SHALL BE LOCATED IN THE X-Z PLANE. RAMS AND CARGO MODULES WILL BE LOCATED IN THE X-Y PLANE. REFER TO FIGURES 3.2.14-1,2,3 FOR AXIS DEFINITION.

ELECTRICAL POWER - TWO DEGREE OF FREEDOM SOLAR ARRAY

DUAL EGRESS - DUAL EGRESS SHALL BE PROVIDED. MODULES WHICH ARE OCCUPIED GREATER THAN 2 PERCENT OF THE TOTAL CREW HOURS AVAILABLE PER MONTH SHALL BE PROVIDED WITH DUAL SHIRTSLEEVE EGRESS FACILITIES.

PRESSURE ISOLATION - MINIMUM OF TWO SEPARATE PRESSURE HABITABLE VOLUMES WITH INDEPENDENT LIFE SUPPORT CAPABILITY AND PROVISIONS AND OTHER ESSENTIAL SERVICES WILL BE PROVIDED AT EACH MANNED STAGE OF CLUSTER BUILD-UP AND OPERATION.

CREW QUARTERS - PRIVATE CREW QUARTERS SHALL BE PROVIDED FOR THE NOMINAL CREW (6) WITH DOUBLE OCCUPANCY CAPABILITY DURING CREW OVERLAP PERIODS. THE CREW QUARTERS SHALL BE EQUALLY DIVIDED BETWEEN THE TWO PRESSURE HABITABLE VOLUMES.

RAM CAPABILITY - CAPABILITY TO SUPPORT TWO ATTACHED OR DETACHED RAMS SHALL BE PROVIDED.

CARGO MODULE - ONE CARGO MODULE WILL BE REQUIRED FOR INITIAL OPERATIONAL CAPABILITY SUPPORT AND TWO ADDITIONAL CARGO MODULES TO PROVIDE LOGISTIC SUPPORT.

B. CONFIGURATION (MODULES)

LAUNCH WEIGHT - THE MSS SHUTTLE TRANSPORTED MODULE SHALL BE CONFIGURED NOT TO EXCEED A TARGET WEIGHT OF 20,000 LBS FOR THOSE MODULES REQUIRED TO RENDEZVOUS. THE MODULES SHALL BE DESIGNED TO STRUCTURAL LOADS RESULTING FROM A MAXIMUM WEIGHT OF 25,000 LBS.

EXTERNAL DIMENSIONS - THE MAXIMUM EXTERNAL DIMENSIONS OF THE 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, BERTHING MECHANISMS, STORAGE FITTINGS, THRUSTERS, ETC., SHALL BE CONTAINED AT LAUNCH WITHIN AN ENVELOPE 15 FEET IN DIAMETER AND 60 FEET IN LENGTH.

ARTIFICIAL G - MODULES ARE TO BE ADAPTABLE TO AN ARTIFICIAL G OPERATIONAL MODE WITH MINIMUM REDESIGN.

PRESSURIZATION - EACH MODULE SHALL BE NORMALLY LAUNCHED PRESSURIZED, HOWEVER, THE SYSTEM SHALL BE CAPABLE OF ACCOMMODATING ANY MODULE THAT BECOMES DEPRESSURIZED PRIOR TO DELIVERY TO THE STATION. MODULE HARDWARE SHALL BE CAPABLE OF SURVIVING REPEATED LOSS OF PRESSURE FOR UP TO 60 DAYS PRIOR TO MANNING.

COMMONALITY - AS A GOAL, COMMON MODULE STRUCTURES, SYSTEMS, SUBSYSTEMS, AND ASSEMBLIES FOR SPACE STATION MODULES SHOULD BE DEVELOPED.

COMMON REFERENCE - EACH MODULE SHALL BE DESIGNED AROUND A COMMON REFERENCE. THAT REFERENCE SHALL BE SUCH THAT THE CREW AND EQUIPMENT IS ORIENTED ORTHOGONAL TO THE MODULE X-AXIS. AS A GOAL, ALL COMMON MODULES WILL HAVE THE SAME REFERENCE.

WINDOWS - THE DESIGN FOR WINDOWS SHALL STANDARDIZE ON THE MSC 14.75 INCH DIAMETER WINDOW ASSEMBLY SIZE EXCEPT FOR FLEXPORT HATCH WINDOWS WHICH SHALL USE A 4.0 INCH DIAMETER SIZE.

FLOORS - STATION MODULES SHALL BE DESIGNED FOR LONGITUDINAL FLOORS LOCATED IN THE X-Y PLANE (+/-Y) WITH RESPECT TO MODULE COORDINATES (Y-Z PLANE WITH RESPECT TO STATION FLIGHT COORDINATES).

C. OPERATIONS

MANNING LEVEL - THE STATION MANNING LEVEL PROVISIONS SHALL BE FOR A CREW OF 6 WITH CAPABILITY OF ADDITIONAL 6 MAN OVERLAP FOR UP TO 5 DAYS. CREW OVERLAP SHALL BE PERMITTED ONLY WHEN A SHUTTLE IS IN THE NEAR

VICINITY OF THE SPACE STATION.

CONSUMABLE RESERVE - CONSUMABLE RESERVE CAPABILITY SHALL BE 30 DAYS BEYOND SCHEDULED RESUPPLY EXCEPT FOR BUILDUP.

BERTHING CAPABILITY - THE MODULAR SPACE STATION SHALL BE CAPABLE OF BERTHING WITH A SPACE SHUTTLE ORBITER. SUITABLE ATTACH FITTINGS SHALL BE PROVIDED TO ALLOW BERTHING USING ORBITER MANIPULATORS. THE DESIGN OF THE BERTHING PROVISIONS SHALL BE ADAPTABLE FOR DIRECT DOCKING CAPABILITY.

SHUTTLE LAUNCH FREQUENCY - THE SHUTTLE LAUNCH SPACING SHALL BE AT A MINIMUM OF 30 DAY INTERVALS WITH THE MAXIMUM INTERVAL LIMITED TO CREW STAY TIME (WHEN MANNED).

EMERGENCY CREW RETURN - STATION EMERGENCY CREW TRANSFER WITHIN 48 HOURS OF EMERGENCY INITIATION SHALL BE ACCOMPLISHED.

EXPERIMENTS - THE INITIAL SPACE STATION SHALL INCLUDE A GENERAL PURPOSE LABORATORY AND PROVISIONS FOR SUPPORT OF TWO ATTACHED OR DETACHED RAMS.

THE INITIAL SPACE STATION SHALL BE CAPABLE OF SUPPORTING SELECTED, PARTIAL, MODIFIED, OR COMBINED FPE'S FROM THE 1971 NASA BLUE BOOK. BLUE BOOK EXPERIMENTS AND RAM'S ARE TO BE SCHEDULED IN ACCORDANCE WITH STATION CAPABILITY. MODIFIED FPE'S WILL REQUIRE NASA APPPROVAL.

FLIGHT MODE - THE INITIAL SPACE STATION SHALL NORMALLY FLY WITH A LOCAL VERTICAL ORIENTATION. PROVISION SHALL BE PROVIDED TO FLY IN AN INERTIAL ORIENTATION FOR SHORT PERIODS.

ORBIT PROFILE - 55 DEGREE INCLINATION AT ALTITUDE BETWEEN 240 TO 270 NAUTICAL MILES.

INDEPENDENT OPERATIONS - THE INITIAL SPACE STATION SHALL HAVE THE CAPACITY FOR INDEPENDENT OPERATIONS WITH THE FULL CREW FOR A PERIOD OF 120 DAYS. THIS CAPACITY CAN BE INCLUDED IN THE CARGO MODULE.

RADIATION LIMITS - CREW RADIATION SHALL BE CONTAINED WITHIN THOSE LIMITS SPECIFIED BY THE DESIGN MISSION RADIATION MODEL.

ORGAN	LIMIT DOSE (REM)					
	DEPTH	DAILY*	30 DAY	QUARTERLY**	YRLY	CAREER
SKIN	(0.1MM)	0.6	75	105	225	1200
EYE	(3.0MM)	0.3	37	52	112	600
MARROW	(5.0CM)	0.2	25	35	75	400

* ONE YEAR AVERAGE
** MAY BE ALLOWED FOR TWO CONSECUTIVE QUARTERS WITH SIX MONTHS RESTRICTION FROM FURTHER EXPOSURE TO MAINTAIN YEARLY LIMIT.

IRRADATION DIAGNOSTIC DEVICES FOR MEDICAL EXAMINATION/TREATMENT SHALL BE SHIELDED SUCH THAT RADIATION PROTECTION IS AFFORDED THE OPERATOR AND INFLIGHT PERSONNEL OTHER THAN THE PATIENT. SHIELDING SHALL BE OF SUCH DESIGN THAT FLIGHT CREW IN THE VICINITY OF OPERATING IRRADIATION DEVICES WILL NOT ACCUMULATE A RADIATION DOSE, INCLUDING THE NATURAL RADIATION, GREAT ENOUGH TO EXCEED THE PRECEDING RADIATION LIMITS.

BUILDUP - A MINIMUM OF TWO SEPARATE PRESSURE ISOLATABLE VOLUMES WITH INDEPENDENT LIFE SUPPORT CAPABILITY AND PROVISIONS AND OTHER ESSENTIAL SERVICES SHALL BE PROVIDED AT EACH MANNED STAGE OF CLUSTER BUILDUP AND OPERATION.

WITH ANY SINGLE PRESSURE ISOLATABLE VOLUME INACTIVE AND INACCESSIBLE. THE REMAINING PROVISIONS AND HABITABLE FACILITIES SHALL BE ADEQUATE TO SUSTAIN THE ENTIRE CREW FOR A MINIMUM OF 96 HOURS.

AT EACH PHASE OF THE ON-ORBIT BUILDUP, THE CREW SHALL HAVE THE CAPABILITY AND RESOURCES TO CHECKOUT AND VALIDATE THE OPERATIONAL AND TECHNICAL ADEQUACY OF THE MODULAR CLUSTER FOR MISSION (BUILDUP) CONTINUATION.

GROUND OPERATIONS - MANAGEMENT OF LONG RANGE OVERALL MISSION PLANNING FOR THE STATION SHALL BE PERFORMED ON THE GROUND.

EVA/IVA - MORE THAN ONE MEANS SHALL BE PROVIDED TO PERMIT CREW INGRESS AND EGRESS FOR EVA/IVA OPERATIONS. READY ACCESS TO AN EVA/IVA SUIT STATION SHALL BE PROVIDED FOR ALL CREDIBLE EMERGENCY CONDITIONS.

PREMANNING - THE CAPABILITY SHALL BE PROVIDED FOR MONITORING THE SPACE STATION IN AN UNMANNED CONDITION TO CONFIRM THE EXISTANCE OF A HABITABLE ENVIRONMENT. THE FUNCTIONAL CAPABILITIES OF CRITICAL LIFE

SUSTAINING SUBSYSTEMS VERIFICATION CAN BE ACCOMPLISHED BY SHIRTSLEEVE OR IVA INGRESS.

DATA TRANSMISSION - SYSTEM AND MISSION STATUS WILL NOT NECESSARILY BE TRANSMITTED TO THE GROUND ON A REAL-TIME BASIS, BUT REAL-TIME CAPABILITY SHALL EXIST.

COMMUNICATIONS - THE INITIAL SPACE STATION SHOULD PLAN FOR USE OF SHARED RELAY SATELLITES TO PROVIDE NEARLY CONTINUOUS ACCESS DUPLEX VOICE LINKS TO THE GROUND.

THE INITIAL SPACE STATION MUST PROVIDE COMMUNICATIONS WITH GROUND NETWORKS (SUCH AS THE MSFN), AND OTHER COOPERATING SPACECRAFT (SUCH AS THE SHUTTLE AND FREE-FLYING EXPERIMENT MODULES). THESE LINKS NEED NOT BE CAPABLE OF SIMULTANEOUS OPERATION. INTERRUPTIONS AS LONG AS 5 HOURS IN COMMUNICATION WITH THE GROUND NETWORK ARE ACCEPTABLE.

WASTE DISPOSAL - SOLID WASTES WILL NOT BE DUMPED TO SPACE.

FIRST MODULE LAUNCH - JULY 1981

INITIAL STATION IOC - JANUARY 1982

D. SUBSYSTEMS (GENERAL GUIDELINES)

1. ALL COMPONENTS ASSOCIATED WITH ENABLING THE CREW TO RECOGNIZE, ISOLATE AND CORRECT CRITICAL SUBSYSTEM MALFUNCTIONS FOR A GIVEN SPACE STATION MODULE SHALL BE LOCATED ONBOARD AND BE FUNCTIONALLY INDEPENDENT OF GROUND SUPPORT AND EXTERNAL INTERFACES.

2. ONBOARD EQUIPMENT SHALL BE PROVIDED FOR CHECKOUT, MONITORING, WARNING, AND FAULT ISOLATION TO A LEVEL CONSISTENT WITH SAFETY AND WITH THE IN-ORBIT MAINTENANCE AND REPAIR APPROACH SELECTED. EMERGENCY CONTROL AND REPAIR OF FAILURES OR DAMAGE WILL ALSO BE PROVIDED. AS A GOAL THE OVERALL STATION OPERATIONS WILL NOT BE SUBSTANTIALLY DEGRADED BY SELECTED REPAIR MODES.

3. THE SPACE STATION SHALL BE DESIGNED FOR EASE OF MANUFACTURE, ASSEMBLY, INSPECTION, AND MAINTENANCE. INSOFAR AS PRACTICABLE, SPACE STATION COMPONENT PARTS SHALL BE INTERCHANGEABLE OR REPLACEABLE. WHEN PRACTICAL, MODULAR PACKAGING OF HARDWARE, INCLUDING MODIFICATIONS, SHALL PROVIDE INTERCHANGEABILITY.

4. VEHICLE FLUID SYSTEMS AND THEIR SERVICING EQUIPMENT SHALL BE DESIGNED TO PERMIT COMPLETE FLUSHING AND DRAINING DURING GROUND CHECK-OUT.

5. AS A GOAL, NO ORIENTATION RESTRICTIONS WILL BE IMPOSED BY SUB-SYSTEMS.

6. THE SPACE STATION WILL BE CAPABLE OF ACCOMMODATING A MIXED MALE-FEMALE CREW.

3.1.1.1 MISSION PERFORMANCE

THE MODULAR SPACE STATION (MSS) IS TO BE A GENERAL PURPOSE EARTH ORBITAL FACILITY CAPABLE OF SUPPORTING THE CONDUCT OF A VARIETY OF SCIENTIFIC AND TECHNOLOGY EXPERIMENTS. THE INITIAL STATION, WHEN FINALLY CONFIGURED, WILL HAVE THE CAPABILITY TO SUPPORT AT LEAST SIX (6) CREWMEN, HAVE A GENERAL PURPOSE LABORATORY CAPABILITY, AND THE ABILITY TO ACCOMMODATE TWO RESEARCH AND APPLICATION MODULES.

THE MSS IS CAPABLE OF OPERATING AT ALTITUDES BETWEEN 240 AND 270 NAUTICAL MILES AT AN INCLINATION OF 55 DEGREES. SUBSYSTEM SIZING SHALL BE BASED ON AN ORBITAL OPERATING ALTITUDE OF 240 NAUTICAL MILES WITH AN ATMOSPHERE EQUIVALENT TO THE JANUARY 1982 TWO SIGMA JACCHIA MEAN ATMOSPHERE. SIZING TO THIS ALTITUDE PROVIDES THE STATION WITH THE CAPABILITY OF OPERATING ACROSS THE SPECIFIED ALTITUDE SPECTRUM ALTHOUGH RESUPPLY OF CONSUMABLES WILL BE LESS FREQUENT AT THE HIGHER ALTITUDES.

3.1.1.1.1 GUIDELINES AND CONSTRAINTS

3.1.1.1.1.1 INITIAL STATION BUILDUP OPERATIONS

A. GUIDELINES AND CONSTRAINTS AFFECTING OPERATIONS AND REQUIREMENTS DURING BUILDUP ARE -

ENVIRONMENT - A SHIRTSLEEVE ENVIRONMENT WILL BE PROVIDED WITHIN HABITABLE AREAS FOR CREW ACTIVITIES DURING THE BUILDUP, ACTIVATION PERIODS AND MODULE REPLACEMENT PERIODS.

B. FUNCTIONAL REQUIREMENTS DERIVED IN ORDER TO MEET PRECEDING GUIDELINES AND CONSTRAINTS DURING BUILDUP ARE -

ON-ORBIT (UNMANNED OPERATIONS)

TELEMETRY AND TRACKING LINKS SHALL BE PROVIDED BETWEEN THE UNMANNED MODULAR ASSEMBLY AND THE SHUTTLE AND/OR GROUND STATIONS WHICH PROVIDE SUBSYSTEM STATUS AUTONOMOUSLY AND BY REMOTE COMMAND.

REMOTE CONTROL OF POWER, THERMAL, ATMOSPHERE, STABILIZATION AND ATTITUDE ORIENTATION OF THE UNMANNED MODULAR ASSEMBLY SHALL BE PROVIDED.

REMOTE ACTIVATION OF RENDEZVOUS AND BERTHING AIDS ONBOARD THE MODULAR ASSEMBLY SHALL BE PROVIDED.

ON-ORBIT (MANNED OPERATIONS)

MONITORING BY THE SHUTTLE OF HAZARDOUS MATERIALS/EQUIPMENT IN THE MODULE BEING DELIVERED TO ORBIT SHALL BE PROVIDED.

CAPABILITY TO CONNECT AND ASSEMBLE MODULES TO THE DESIRED CONFIGURATION SHALL BE PROVIDED.

VERIFICATION OF, AND PROVISION FOR, A HABITABLE ENVIRONMENT ONBOARD THE MODULAR ASSEMBLY SHALL BE PROVIDED.

ACTIVATION AND SUBSEQUENT CHECKOUT OF THE OPERATIONAL INTEGRITY OF THE MODULAR ASSEMBLY SHALL BE PROVIDED.

VOICE COMMUNICATIONS LINKS BETWEEN THE SHUTTLE AND MODULAR ASSEMBLY SHALL BE PROVIDED.

3.1.1.1.1.2 INITIAL STATION ROUTINE OPERATIONS

A. THE PRINCIPAL GUIDELINES AND CONSTRAINTS IMPACTING OPERATIONS DURING THE ROUTINE OPERATIONS PHASE ARE -

MODULE DEACTIVATION/REPLACEMENT - PROVIDE THE CAPABILITY FOR MODULE REPLACEMENT.

MAINTENANCE AND REPAIR - ALL NORMAL MAINTENANCE WILL BE PERFORMED ON-ORBIT AT ESTABLISHED IFRU LEVELS.

NO ROUTINE PLAN FOR MODULE REPLACEMENT (BUT CAPABILITY AS AN UNPLANNED EVENT WITH REDUCED OPERATIONS CAPABILITY EXISTS), ALLOCATE FUNCTIONS TO PERMIT MISSION CONTINUATION AT A REDUCED LEVEL DURING MODULE DEACTIVATION/REPLACEMENT.

3.1.1.1.2 MISSION OPERATIONS

THE MISSION OPERATIONS REQUIRED FOR MSS BUILDUP, ROUTINE, AND PERIODIC OPERATIONS ARE DESCRIBED IN THIS SECTION.

3.1.1.1.2.1 BUILDUP OPERATIONS

A. SEQUENCE OF OPERATIONS

THE BUILDUP SEQUENCE SELECTED FOR THE INITIAL MSS CONSISTS OF 7 STEPS AND

IS SUMMARIZED IN FIGURE 3.1.1.1.2.1-1. SINCE THE ASSEMBLY PERIOD IS CONSTRAINED BY THE SHUTTLE LAUNCH FREQUENCY OF ONE EVERY THIRTY DAYS, THE OVERALL BUILDUP TIME ASSOCIATED WITH THE SELECTED SEQUENCE REQUIRES AT LEAST 180 DAYS. TABLE 3.1.1.1.2.1-1 SUMMARIZES THE MODULES DESIGNATION, NAME, AND MAJOR FUNCTIONS ALLOCATED TO IT.

CORE MODULE DELIVERY - ON DAY 0 THE INITIAL MODULE (CORE MODULE) IS DELIVERED TO ORBIT BY THE SHUTTLE. IT TAKES APPROXIMATELY 4 HOURS FROM LAUNCH FOR SHUTTLE ASCENT TO THE OPERATIONAL ALTITUDE. UPON REACHING THE DESIRED ALTITUDE, THE CORE MODULE IS ACTIVATED IN THE SHUTTLE'S CARGO BAY. THIS ACTIVATION INCLUDES ENERGIZING POWER BUSSES, ACTIVATING FUEL CELLS, VERIFYING ISS OPERATION, ECS COOLANT LOOP OPERATION, COMMUNICATIONS, IMU OPERATIONS AND CONTROL FUNCTIONS. AFTER THE OPERATIONAL INTEGRITY OF THE CORE MODULE'S SUBSYSTEMS HAVE BEEN VERIFIED, THE INTERFACES BETWEEN THE MODULE AND THE SHUTTLE ARE DISCONNECTED. THE CORE MODULE IS THEN DEPLOYED OUT OF THE CARGO BAY BY THE SHUTTLE MANIPULATOR AND POSITIONED FOR FINAL OPERATIONAL VERIFICATION PRIOR TO RELEASE. AFTER THE CORE MODULE HAS BEEN DEPLOYED, THE SPECIAL TWO MAN CREW ABOARD THE SHUTTLE CONDUCTS A FINAL RF LINK AND RENDEZVOUS AID(S) CHECK OF THE MODULE, ENABLES THE CORE MODULE RCS AND THEN RELEASES THE MODULE. AFTER SEPARATION, THE CORE MODULE'S RCS SYSTEM WILL DAMP THE SEPARATION TRANSIENTS AND UPON COMMANDS FROM THE MODULE'S IMU, STABILIZE THE MODULE IN A GRAVITY GRADIENT ATTITUDE. UPON COMPLETION OF THESE MANEUVERS, THE SHUTTLE SPECIAL CREW PREPARES THE CORE MODULE FOR ITS QUIESCENT OPERATIONAL MODE. THIS INCLUDES SHUTTING DOWN THE RCS AND G AND C SUBSYSTEMS BY REMOTE RF COMMANDS. THIS MODE WILL BE MAINTAINED UNTIL THE MODULE IS AWAKENED AND ITS SUBSYSTEMS ACTIVATED PRIOR TO THE NEXT MODULE DELIVERY, APPROXIMATELY 27 DAYS LATER. DURING THE QUIESCENT OPERATIONAL PERIOD THE CORE MODULE WILL TRANSMIT ITS SUBSYSTEM STATUS ONCE A DAY. AFTER VERIFYING THE FINAL OPERATIONAL STATUS OF THE CORE MODULE, THE SHUTTLE WILL REMAIN ON-ORBIT AND STATION KEEP IN THE VICINITY OF THE CORE MODULE FOR AT LEAST ONE DAY BEFORE RETURNING TO EARTH. THIS WILL ENABLE THE CREW TO VISUALLY OBSERVE AND VERIFY THE ATTITUDE STABILITY OF THE CORE MODULE.

TABLE 3.1.1.1.2.1-1 MSS MODULE DESIGNATIONS

MODULE		
DESIGNATION	NAME	MAJOR FUNCTIONS
CM-1	CORE MODULE	EVA/IVA AIRLOCK, G&C, RCS, CMG'S, POWER GENERATION & CONVERSION
PM	POWER MODULE	SOLAR ARRAY, EMERGENCY HATCH
SM-1	CREW/CONTROL	EXEC/COMMANDER STATEROOM, BACK-UP MEDICAL, CC NO. 1, DATA ANALYSIS, PHOTO LAB, PERSONAL HYGIENE, 2 CREW STATEROOMS, WASTE & WATER MANAGEMENT EQUIPMENT
SM-2	ECS/LABS	MECH. LAB, OPTICS/ELEC LAB, EXPERIMENT OPERATIONS AREA, NADIR AIRLOCK, AIR REVITALIZATION EQUIPMENT VOL 2
SM-3	ECS/LABS	GALLEY, ZENITH AIRLOCK, PHYSICS/BIOMEDICAL LAB, EXPERIMENT OPERATIONS AREA, DINING & RECREATION, AIR REVITALIZATION VOL 1
SM-4	CREW/CONTROL	EXEC/COMMANDER STATEROOM, 2 STATEROOMS, MEDICAL & CREW CARE, PERSONAL HYGIENE, WASTE & WATER MANAGEMENT EQUIPMENT, CONTROL CENTER NO. 2

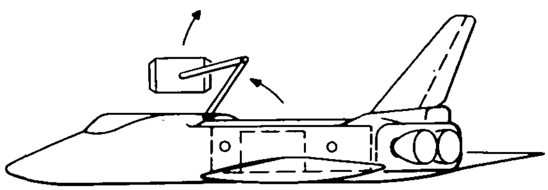
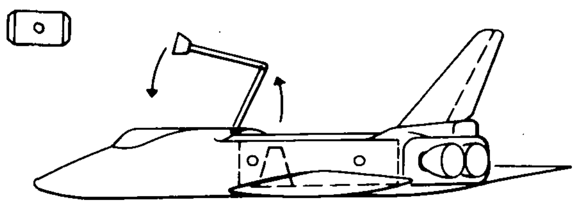
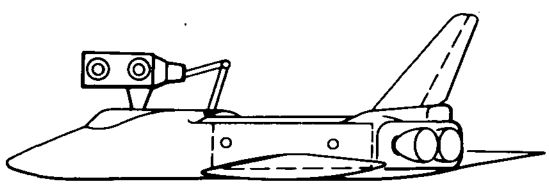
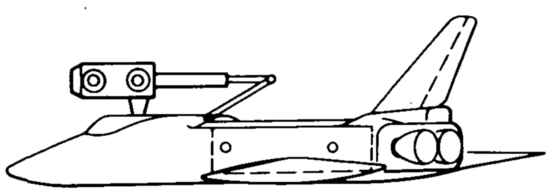
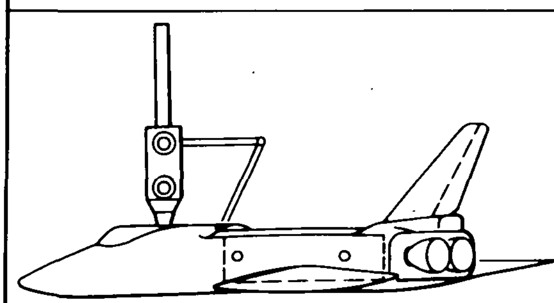
MODULE DELIVERED	PRINCIPAL OPERATIONS		ORBITAL CONFIGURATION
CORE		• ACTIVATE • CHECKOUT • DEPLOY	 CORE
POWER		• REMOVE AND BERTH ADAPTER	 POWER
		• ATTACH MANIPULATOR TO CORE MODULE AND BERTH TO ADAPTER	
		• REMOVE POWER MODULE AND BERTH TO CORE MODULE	
		• REBERTH CORE AND POWER MODULE CLUSTER TO ADAPTER • DEPLOY MODULE CLUSTER	

FIGURE 3.1.1.1.2.1-1 INITIAL SPACE STATION BUILDUP SEQUENCE

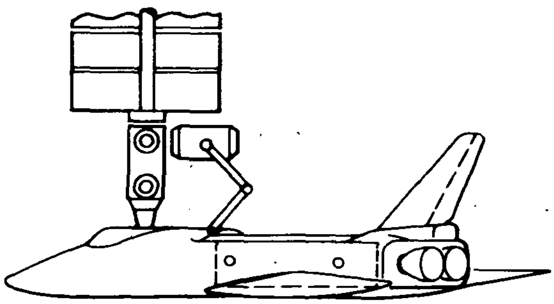
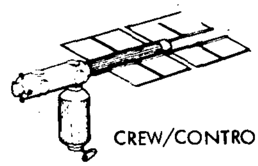
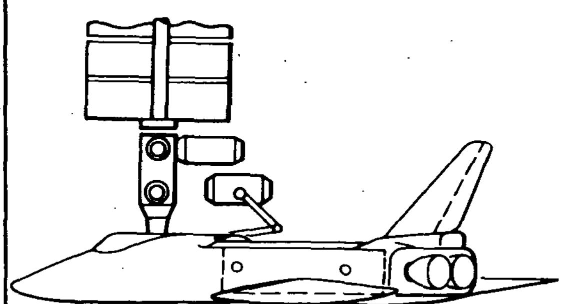
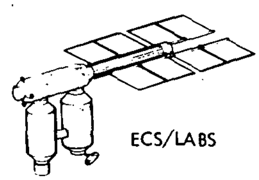
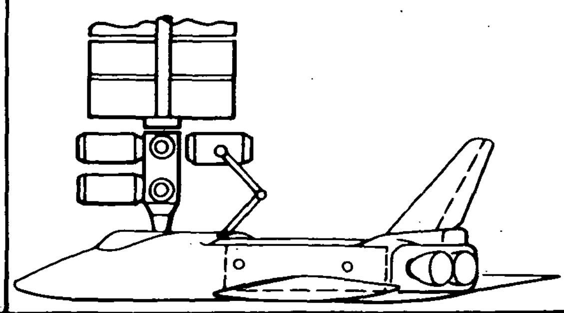
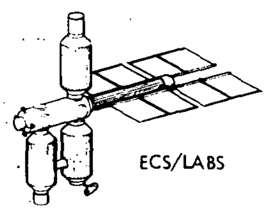
MODULE DELIVERED	PRINCIPAL OPERATIONS		RESULTANT CONFIGURATION
SM-1 (CREW/ CONTROL)		• BERTH CORE AND POWER MODULE CLUSTER • REMOVE SM-1 AND BERTH TO CORE MODULE • PARTIALLY ACTIVATE SM-1 • PARTIALLY DEPLOY SOLAR ARRAY (25%) • DEPLOY MODULE CLUSTER	 CREW/CONTROL
SM-2 (ECS/LABS)		• BERTH MODULE CLUSTER • REMOVE SM-2 AND BERTH TO CORE MODULE • PARTIALLY ACTIVATE SM-2 • DEPLOY MODULE CLUSTER	 ECS/LABS
SM-3 (ECS/LABS)		• BERTH MODULE CLUSTER • REMOVE SM-3 AND BERTH TO CORE MODULE • PARTIALLY ACTIVATE SM-3 • DEPLOY MODULE CLUSTER	 ECS/LABS

FIGURE 3.1.1.1.2.1-1 INITIAL SPACE STATION BUILDUP SEQUENCE (CON'T)

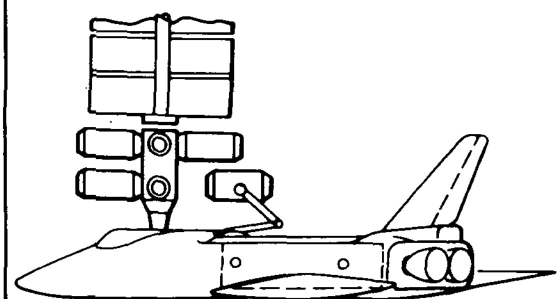
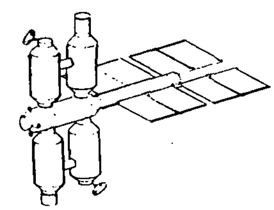
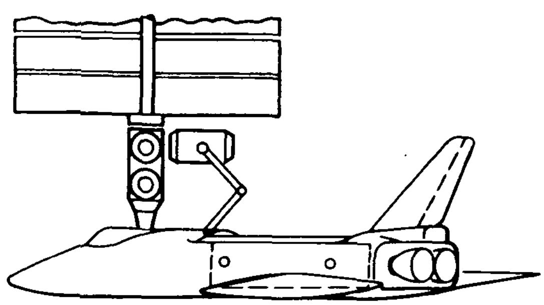
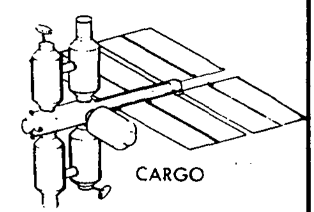
MODULE DELIVERED	PRINCIPAL OPERATIONS		RESULTANT CONFIGURATION
SM-4 (CREW/ CONTROL)		•BERTH MODULE CLUSTER •REMOVE SM-4 AND BERTH TO CORE MODULE •PARTIALLY ACTIVATE SM-4 •DEPLOY MODULE CLUSTER	CREW/CONTROL 
CARGO MODULE		•BERTH MODULE CLUSTER •FULLY DEPLOY SOLAR ARRAY •REMOVE CARGO MODULE AND BERTH TO CORE MODULE •FULLY ACTIVATE INITIAL SPACE STATION •DEPLOY INITIAL SPACE STATION •COMMENCE ROUTINE SPACE STATION OPERATIONS	

FIGURE 3.1.1.1.2.1-1 INITIAL SPACE STATION BUILDUP SEQUENCE (CON'T)

POWER MODULE DELIVERY - ON DAY 30, THE POWER MODULE IS LAUNCHED. THE POWER MODULE IS THE SECOND MODULE DELIVERED TO ORBIT. PRIOR TO LAUNCHING THIS MODULE, GROUND STATIONS REMOTELY AWAKEN AND VERIFY THE OPERATIONAL INTEGRITY OF THE ORBITING CORE MODULE SUBSYSTEMS. THIS INCLUDES ACTIVATION OF THE CORE MODULE RCS, G AND C AND RENDEZVOUS AIDS. THE TIME REQUIRED FROM LAUNCH UNTIL THE SHUTTLE ACCOMPLISHES ON-ORBIT RENDEZVOUS WITH THE CORE MODULE CAN VARY FROM 4 UP TO 26 HOURS SINCE PHASING IS REQUIRED BETWEEN THE SHUTTLE AND CORE MODULE. AFTER THE SHUTTLE ACCOMPLISHES RENDEZVOUS WITH THE CORE MODULE, THE SHUTTLE/MSS ADAPTER IS DISCONNECTED FROM THE CARGO BAY MOUNTS AND, BY USE OF THE SHUTTLE MANIPULATOR, DEPLOYED AND BERTHED TO THE PASSENGER DOCKING PORT ON THE SHUTTLE. THE SHUTTLE SPECIAL CREW THEN COMMANDS THE CORE MODULE TO MANTAIN A STABLE INERTIAL ATTITUDE PREPARATORY TO RETRIEVAL AND BERTHING. THE SHUTTLE THEN CLOSES WITH THE CORE MODULE, THE SHUTTLE MANIPULATOR ATTACHES TO THE CORE MODULE, THE MODULE RCS AND G AND C SUBSYSTEMS ARE DEACTIVATED BY RF COMMANDS AND THE MODULE BERTHED TO THE ADAPTER. THE CORE MODULE DOCKING PORT USED IS ON THE +Z AXIS NEAREST THE POWER MODULE/CORE MODULE INTERFACE. FURTHER, THE CORE MODULE IS BERTHED SUCH THAT ITS LONGITUDINAL AXIS IS ROTATED 45 DEGREES TO THE RIGHT OF SHUTTLE'S ROLL AXIS. THIS UNIQUE BERTHING ORIENTATION IS USED TO MINIMIZE MANIPULATOR REACH REQUIRE-MENTS DURING BERTHING OF THE POWER MODULE TO THE CORE MODULE. AFTER THE CORE MODULE HAS BEEN BERTHED TO THE ADAPTER, THE CORE MODULE/ADAPTER COMBINATION IS BERTHED TO THE SHUTTLE. THE ADAPTER IS PRESSURIZED, UTILITY INTERFACES CONNECTED AND THE CORE MODULE THEN REPRESSURIZED TO 14.7 PSIA AND ITS ENVIRONMENT VERIFIED. THE POWER MODULE IS DISCONNECTED FROM THE SHUTTLE CARGO BAY INTERFACES, THEN DEPLOYED AND BERTHED TO THE +X-AXIS PORT ON THE CORE MODULE BY THE SHUTTLE MANIPULATOR. THE SPECIAL CREW (2 MEN) ENTER THE CORE MODULE, CONNECT AND VERIFY THE POWER MODULE/ CORE MODULE INTERFACES AND CONFIGURE THE ASSEMBLY FOR DETACHED OPERATIONS (POWER MODULE SUBSYSTEMS ARE NOT ACTIVATED AT THIS TIME). THE SPECIAL CREW RETURNS TO THE SHUTTLE AND THE INTERFACES BETWEEN THE ADAPTER AND CORE MODULE ARE DISCONNECTED. THE SHUTTLE MANIPULATOR(S) ARE THEN USED TO DETACH THE CM FROM THE ADAPTER. THE CORE/POWER MODULE ASSEMBLY ARE THEN ROTATED TO A VERTICAL POSITION WITH RESPECT TO THE SHUTTLE'S PITCH PLANE, AND THE CORE MODULE REBERTHED TO THE ADAPTER AT THE CORE MODULES' -X AXIS PORT. THE ADAPTER ON THE -X AXIS PORT OF THE CORE MODULE WILL REMAIN ON-ORBIT WITH THE ASSEMBLY AND IS THE DESIGNATED SHUTTLE/MODULAR ASSEMBLY BERTHING INTERFACE FOR THE REMAINDER OF THE BUILDUP OPERATIONS AS WELL AS FOR SUBSEQUENT ROUTINE OPERATIONS.

AFTER THE ADAPTER/CORE MODULE INTERFACE IS VERIFIED THE ADAPTER/CORE MODULE/ POWER MODULE ASSEMBLY IS DISCONNECTED FROM THE SHUTTLE AND POSITIONED FOR FINAL OPERATIONAL VERIFICATION PRIOR TO RELEASE. THROUGH RF LINK(S), THE SPECIAL CREW CONDUCTS FINAL CHECKOUT AND ACTIVATION OF THE

CM SUBSYSTEMS AND THE MODULAR ASSEMBLY RELEASED. AUTONOMOUSLY THE SEPARATION TRANSIENTS ARE DAMPENED AND THE GRAVITY GRADIENT ATTITUDE MODE ATTAINED BY THE CM SUBSYSTEMS. THE ASSEMBLY IS THEN CONFIGURED FOR QUIESCENT OPERATIONS AND ITS SUBSYSTEM OPERATIONAL STATUS VERIFIED BY THE SHUTTLE CREW PRIOR TO DEPARTURE AND EARTH RETURN. THIS MODE IS MAINTAINED UNTIL THE MODULAR ASSEMBLY IS AWAKENED AND ITS SUBSYSTEMS ACTIVATED PRIOR TO THE NEXT MODULE DELIVERY, APPROXIMATELY 26 DAYS LATER. AS BEFORE, DURING QUIESCENT OPERATIONS, THE MODULAR ASSEMBLY SHALL TRANSMIT SUBSYSTEM STATUS ONCE A DAY.

SM-1 DELIVERY - SIXTY DAYS AFTER THE CORE MODULE IS LAUNCHED, THE THIRD MODULE, SM-1, IS LAUNCHED. PRIOR TO LAUNCHING THIS MODULE, THE CM/PM ASSEMBLY SUBSYSTEMS OPERATIONAL STATUS IS VERIFIED. SINCE PHASING IS REQUIRED, THE ELAPSED ASCENT TIME FROM LAUNCH TO RENDEZVOUS CAN VARY FROM 4 TO 26 HOURS. AFTER THE SHUTTLE ACCOMPLISHES RENDEZVOUS, THE CM/PM ASSEMBLY IS COMMANDED TO STABILIZE AND MAINTAIN ATTITUDE AND CONFIGURED FOR BERTHING BY RF COMMANDS FROM THE SHUTTLE SPECIAL CREW. THE SHUTTLE THEN CLOSES WITH THE MODULAR ASSEMBLY AND THE CM/PM IS RETRIEVED BY THE SHUTTLE'S MANIPULATOR(S). THE ASSEMBLY'S RCS IS DEACTIVATED AND THE ASSEMBLY BERTHED TO THE SHUTTLE'S PASSENGER BERTHING PORT. FOR ALL STATION MODULE, CARGO MODULE AND RAM DELIVERIES TO THE INTIAL STATION, THE BERTHED ORIENTATION OF THE CORE MODULE Y AND Z AXES ARE SKEWED 45 DEGREE WITH RESPECT TO THE LOGITUDINAL AXIS OF THE SHUTTLE. (THIS BERTHING ORIENTATION IS USED TO MINIMIZE MANIPULATOR REACH REQUIREMENTS DURING BERTHING OR UNBERTHING OF MODULES AS WELL AS TO PROVIDE MANIPULATOR ARM (AND ELBOW) CLEARANCE IN THE REMOVAL AND REPLACEMENT OF MODULES IN THE CARGO BAY). THE MODULAR ASSEMBLY IS REPRESSURIZED TO 14.7 PSIA AFTER THE ADAPTER HAS BEEN PRESSURIZED AND INTERFACES CONNECTED IN THE SAME MANNER AS WAS DONE PREVIOUSLY DURING POWER MODULE DELIVERY. AFTER VERIFICATION OF THE CM/PM HABITABLE ENVIRONMENT, THE SPECIAL CREW ENTERS THE BERTHED ASSEMBLY AND CONFIGURES IT FOR SM-1 ATTACHMENT TO THE FORWARD +Z AXIS PORT ON THE CM. THE SPECIAL CREW THEN ENTER THE BERTHED ASSEMBLY AND CONFIGURE IT FOR SM-1 ATTACHMENT TO THE FORWARD +Z AXIS PORT ON THE CM. SM-1 IS THEN DISCONNECTED FROM THE SHUTTLE BAY INTERFACES AND ROTATED OUT OF THE CARGO BAY AND BERTHED TO THE DESIGNATED PORT ON THE CM BY THE SHUTTLE MANIPULATOR. THE SPECIAL CREW ENTERS THE CM AND CM/SM-1 ELECTRICAL AND FLUID INTERFACE CONNECTIONS ARE ASSEMBLED AND A HABITABLE ENVIRONMENT ESTABLISHED AND VERIFIED IN SM-1.

THE CREW ENTERS SM-1 AND THE CONTROL CENTER IS ACTIVATED FOR MODULAR ASSEMBLY SUBSYSTEMS INTEGRATION AND CHECKOUT. THE SOLAR ARRAY PANELS ARE DEPLOYED 25 PERCENT AND THEIR OPERATION AND ELECTRICAL POWER OUTPUT (4.871KW) VERIFIED AND PRIMAPY POWER BUSSES ARE ENGAGED. PRIMARY POWER IS THEN TRANSFERRED FROM FUEL CELLS TO SOLAR ARRAY. THE ELECTROLYSIS UNITS

(RCS AND FUEL CELLS) ARE ACTIVATED AND THE ASSEMBLY'S SUBSYSTEMS OPERATION CHECKED OUT. THE MODULAR ASSEMBLY IS THEN CONFIGURED FOR FREE FLIGHT, THE SHUTTLE/MODULAR ASSEMBLY INTERFACE DISCONNECTED AND THE ASSEMBLY DEPLOYED AND POSITIONED FOR RELEASE BY THE SHUTTLE'S MANIPULATOR. A FINAL OPERABILITY CHECK ON THE MODULAR ASSEMBLY'S SUBSYSTEMS IS PERFORMED, THE RCS ENABLED, THE SOLAR ARRAY PANELS UNINHIBITED AND THE ASSEMBLY RELEASED. SEPARATION TRANSIENTS ARE DAMPENED AND A PRINCIPLE AXIS ATTITUDE FLIGHT MODE ACCOMPLISHED AUTONOMOUSLY BY THE MODULAR ASSEMBLY. THE PRINCIPAL AXIS ATTITUDE WILL BE MAINTAINED FOR 25 DAYS UNTIL THE NEXT SHUTTLE VISIT WHEN THE MODULE IS COMMANDED TO FLY AN X-POP INERTIAL ATTITUDE PRIOR TO BERTHING. THE ASSEMBLY IS CONFIGURED FOR QUIESCENT OPERATIONS AND ITS STATUS VERIFIED BY THE SHUTTLE CREW PRIOR TO DEPARTURE AND EARTH RETURN. DURING THE UNMANNED QUIESCENT PERIOD, THE MODULAR ASSEMBLY SHALL TRANSMIT ITS SUBSYSTEM STATUS ONCE A DAY.

SM-2 DELIVERY - NINETY DAYS AFTER THE CORE MODULE IS LAUNCHED, THE FOURTH MODULE, SM-2, IS LAUNCHED. ASCENT TIME FROM LAUNCH TO RENDEZVOUS MAY VARY FROM 4 TO 26 HOURS SINCE PHASING WITH THE ORBITING MODULAR ASSEMBLY IS REQUIRED. AFTER THE SHUTTLE ACCOMPLISHES RENDEZVOUS, THE MODULAR ASSEMBLY IS COMMANDED TO ASSUME AND MAINTAIN AN X-POP INERTIAL FLIGHT ATTITUDE, AND IS CONFIGURED FOR BERTHING, WHICH INCLUDES INHIBITING THE SOLAR ARRAY PANELS. THE SHUTTLE THEN CLOSES WITH THE ASSEMBLY AND THE ASSEMBLY IS RETRIEVED BY THE SHUTTLE'S MANIPULATORS. THE MODULAR ASSEMBLY'S RCS IS DEACTIVATED AND THE ASSEMBLY BERTHED TO THE SHUTTLE'S PASSENGER BERTHING PORT. THE MODULAR ASSEMBLY/SHUTTLE INTERFACE(S) ARE VERIFIED AND CM/PM/SM-1 HABITABLE ENVIRONMENT ESTABLISHED. THE SPECIAL CREW THEN ENTER THE BERTHED ASSEMBLY AND CONFIGURE IT FOR SM-2 ATTACHMENT TO THE AFT +Z AXIS PORT ON THE CM BY THE SHUTTLE'S MANIPULATOR. THE SPECIAL CREW AGAIN ENTERS THE CM AND CM/SM-2 INTERFACE IS COMPLETED AND A HABITABLE ENVIRONMENT ESTABLISHED AND VERIFIED IN SM-2. THE CREW ENTERS SM-2 AND THE FLEXPORT IS EXTENDED AND CONNECTED TO THE FLEXPORT HATCH ON SM-1. THE MODULAR ASSEMBLY (CM/PM/SM-1/SM-2) IS CONFIGURED FOR FREE FLIGHT, THE SHUTTLE/MODULAR ASSEMBLY INTERFACE DISCONNECTED AND THE ASSEMBLY DEPLOYED AND POSITIONED FOR RELEASE BY THE SHUTTLE MANIPULATOR. A FINAL OPERABILITY CHECK ON THE MODULAR ASSEMBLY'S SUBSYSTEMS IS PERFORMED, THE RCS ENABLED, THE SOLAR ARRAY PANELS UNINHIBITED AND THE ASSEMBLY RELEASED. SEPARATION TRANSIENTS ARE THEN DAMPENED AND A PRINCIPAL AXIS ATTITUDE FLIGHT MODE ACCOMPLISHED BY THE MODULAR ASSEMBLY. THE PRINCIPAL AXIS ATTITUDE WILL BE MAINTAINED FOR 26 DAYS UNTIL THE NEXT SHUTTLE VISIT. THE ASSEMBLY IS CONFIGURED FOR QUIESCENT OPERATIONS AND ITS STATUS VERIFIED BY THE SHUTTLE CREW PRIOR TO DEPARTURE AND EARTH RETURN. AS BEFORE, DURING THE UNMANNED QUIESCENT OPERATIONS PHASE, THE MODULAR ASSEMBLY SHALL TRANSMIT ITS SUBSYSTEM STATUS ONCE A DAY.

SM-3 DELIVERY - SM-3 IS THE FIFTH MODULE DELIVERED TO ORBIT AND IT IS LAUNCHED 120 DAYS AFTER THE LAUNCH OF THE CORE MODULE. THE ASCENT, AWAKENING RETRIEVAL, BERTHING, ATTACHMENT, INTERFACING, ETC., OPERATIONS ARE SIMILAR TO THOSE PREVIOUSLY DESCRIBED FOR SM-2 WITH THE EXCEPTION THAT THE FLEXPORT EXTENSION AND CONNECTION IS NOT ACCOMPLISHED UNTIL SM-4 IS DELIVERED. SM-3 IS BERTHED TO THE FORWARD -Z AXIS PORT ON THE CORE MODULE. THE CM/PM/SM-1/SM-2/SM-3 ASSEMBLY WILL FLY A PRINCIPAL AXIS ATTITUDE MODE DURING ITS QUIESCENT OPERATIONS PHASE WHICH LASTS FOR 26 DAYS AND SHALL TRANSMIT ITS SUBSYSTEMS STATUS ONCE A DAY.

SM-4 DELIVERY - SM-4 IS THE SIXTH AND LAST OF THE STATION MODULES, WHICH MAKE UP THE BASIC INITIAL MSS, TO BE DELIVERED. THIS MODULE IS LAUNCHED 150 DAYS AFTER THE INITIAL LAUNCH OF THE CORE MODULE AND IS ATTACHED TO THE AFT -Z AXIS PORT ON THE CORE MODULE. THE ASCENT, RETRIEVAL, BERTHING, ETC., OPERATIONS ARE SIMILAR TO THOSE PREVIOUSLY DESCRIBED FOR SM-2 INCLUDING THE FLEXPORT EXTENSION AND ATTACHMENT OPERATION BETWEEN SM-4 AND SM-3. IN ADDITION, THE SECOND CONTROL CENTER, SIMILAR TO THAT ON SM-1 IS ACTIVATED, CONNECTED TO THE DATA BUS AND CHECKED OUT. THE UNMANNED MODULAR SPACE STATION WILL FLY A PRINCIPAL AXIS ATTITUDE MODE DURING ITS QUIESCENT OPERATIONS PHASE WHICH LASTS FOR 26 DAYS AND WILL TRANSMIT ITS SUBSYSTEMS STATUS ONCE A DAY.

CARGO MODULE DELIVERY - ONE HUNDRED EIGHTY (180) DAYS AFTER THE LAUNCH OF THE CM, THE FIRST CARGO MODULE AND INITIAL SIX (6) MAN STATION CREW ARE LAUNCHED (THE CREW IS LOCATED IN THE SHUTTLE FOR ASCENT TO ORBIT). AS BEFORE, THE ASCENT TIME WILL TAKE FROM 4 TO 26 HOURS, THE UNMANNED MSS SUBSYSTEMS ARE STATUSED PRIOR TO SHUTTLE LAUNCH, AND SUBSEQUENT TO RENDEZVOUS THE STATION IS COMMANDED TO AN X-POP INERTIAL MODE AND ITS SOLAR ARRAY PANELS INHIBITED IN PREPARATION FOR RETRIEVAL AND BERTHING. AFTER THE UNMANNED STATION IS RETRIEVED AND BERTHED TO THE PASSENGER BERTHING PORT OF THE SHUTTLE, THE SHUTTLE/STATION INTERFACES ARE VERIFIED AND A HABITABLE ENVIRONMENT VERIFIED IN THE STATION.

THE INITIAL MANNING CREW THEN ENTERS THE STATION, THE SOLAR ARRAY PANELS ARE FULLY DEPLOYED, BOTH CONTROL CENTERS FULLY ACTIVATED, AND ALL SUB-SYSTEMS BROUGHT ONTO LINE AND CHECKED OUT. AFTER THE OPERATIONAL INTEGRITY OF THE STATION HAS BEEN ESTABLISHED, THE CARGO MODULE/SHUTTLE CARGO BAY INTERFACES ARE DISCONNECTED, AND THE CARGO MODULE DEPLOYED AND BERTHED TO THE STATION BY THE SHUTTLE MANIPULATOR. THE CARGO MODULE MAY BE BERTHED TO EITHER OF THE FORWARD Y-AXIS (+OR-) PORTS. THE STATION/ CARGO MODULE INTERFACES ARE SECURED AND THE SHUTTLE PREPARES FOR EARTH RETURN. THE CARGO MODULE STAYS WITH THE STATION AND ACTS AS A SUPPLY CENTER AS WELL AS PROVIDING A 96-HOUR EMERGENCY LIFE SUPPORT CAPABILITY. THE SHUTTLE/STATION INTERFACES ARE DISCONNECTED, THE SHUTTLE

PERFORMS A SEPARATION MANEUVER FROM THE STATION AND CONFIGURES FOR EARTH RETURN. AT THIS TIME, APPROXIMATELY 185 DAYS AFTER THE LAUNCH OF THE CM, THE STATION IS FULLY ASSEMBLED, ACTIVATED, MANNED AND CAPABLE OF INITIATING ROUTINE OPERATIONS.

B. SHUTTLE ASCENT PROFILE

THE MSS RELIES UPON THE SHUTTLE FOR DELIVERY OF THE MODULES THAT MAKE UP THE STATION. FIGURE 3.1.1.1.2.1-2 DEPICTS THE SEQUENCE OF EVENTS REQUIRED FOR DELIVERY OF THE FIRST STATION MODULE (CORE MODULE) AND ALL SUBSEQUENT SHUTTLE FLIGHTS KNOWN AS REVISIT MISSIONS. SINCE THERE IS NO RENDEZVOUS REQUIRED FOR THE INITIAL CORE MODULE (CM) LAUNCH, NO ORBIT PHASING IS REQUIRED. THIS RESULTS IN A TIME OF ASCENT TO FINAL ORBIT CIRCULARIZATION OF APPROXIMATELY 4 HOURS. ALL SUBSEQUENT SHUTTLE LAUNCHES REQUIRE RENDEZVOUS WITH THE ON-ORBIT MODULAR ASSEMBLY (STATION) AND REQUIRE TIME FOR INTERMEDIATE (100 NM) ORBIT PHASING. CONSEQUENTLY, THE TIME FROM LAUNCH TO RENDEZVOUS AND CIRCULARIZATION VARIES FROM 8.5 TO 26.0 HOURS, DEPENDING UPON THE PHASING ANGLE AT LAUNCH.

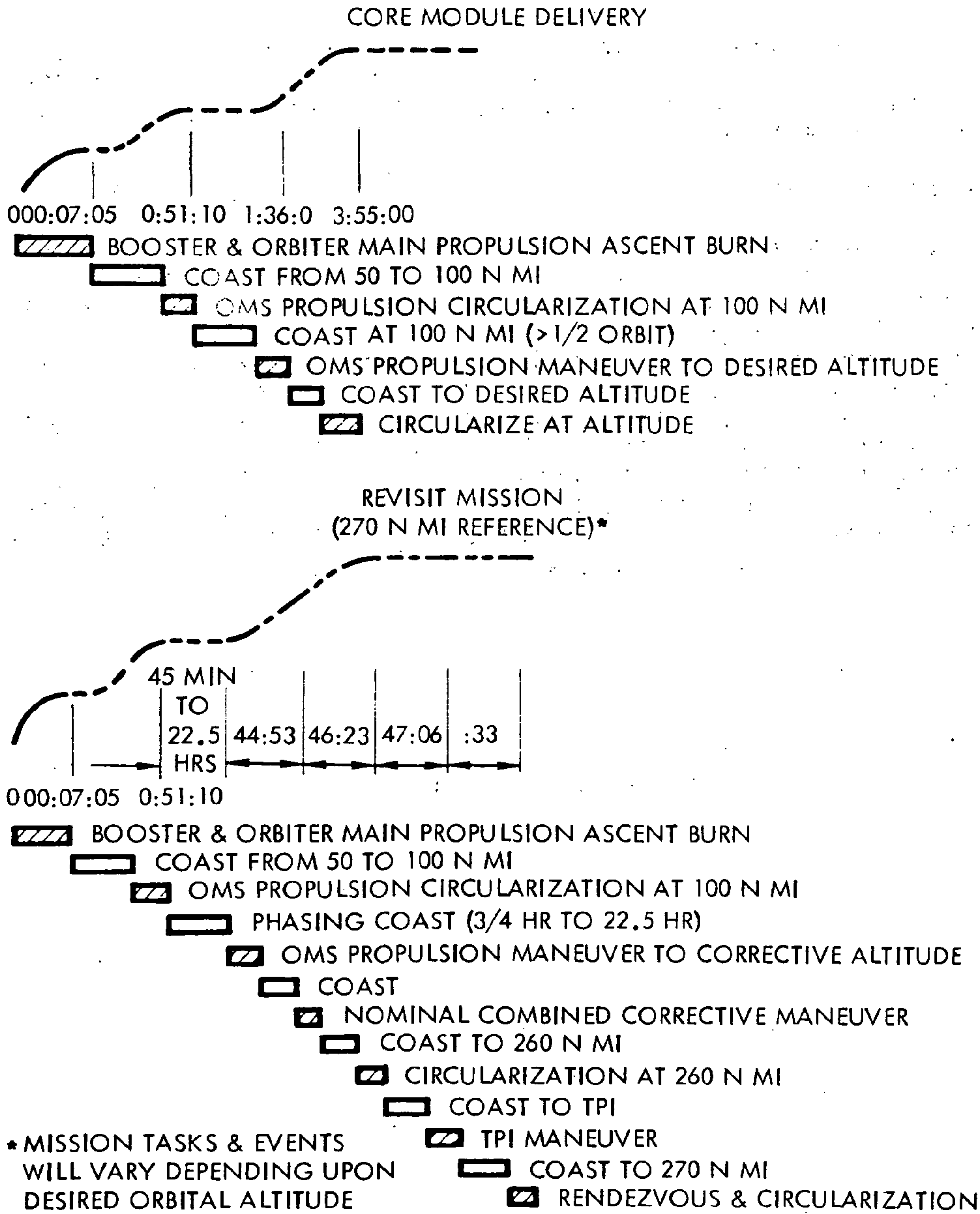


FIGURE 3.1.1.1.2.1-2 MODULE DELIVERY SEQUENCE

C. FUNCTIONAL REQUIREMENTS

FUNCTIONAL REQUIREMENTS GENERATED DURING MSS BUILDUP ARE SUMMARIZED IN THE TYPICAL DELIVERY OPERATIONS SEQUENCE DIAGRAM PRESENTED IN FIGURE 3.1.1.1.2.1-3. ALL OR PART OF THE FUNCTIONS LISTED ARE REQUIRED DURING EACH STAGE OF BUILDUP WITH THE EXCEPTION OF THE DELIVERY OF THE INITIAL MODULE, THE CORE MODULE. THE INITIAL DELIVERY IS UNIQUE IN THAT THE CORE MODULE SUBSYSTEMS ARE ACTIVATED AND CHECKED OUT PRIOR TO DEPLOYMENT AND WHILE THE MODULE IS IN THE SHUTTLE CARGO BAY. A SPECIFIC SHUTTLE/CORE MODULE INTERFACE IS REQUIRED TO ENABLE THE SHUTTLE CREW TO ACTIVATE AND SHUTDOWN SUBSYSTEMS IN THE CORE MODULE.

D. SUBSYSTEM ACTIVATION

THE LEVEL OF SUBSYSTEM ACTIVATION DURING EACH STAGE OF BUILDUP IS LIMITED TO THAT REQUIRED FOR MISSION (BUILDUP) CONTINUATION. FIGURE 3.1.1.1.2.1-4 PRESENTS A TIME HISTORY OF SUBSYSTEM ACTIVATION DURING BUILDUP. FUNCTIONS SUCH AS CO2 MANAGEMENT, WASTE MANAGEMENT, ETC., ARE NOT ACTIVATED UNTIL BUILDUP IS COMPLETE AND CONTINUOUS MANNED OPERATIONS INITIATED. THE REACTION CONTROL SUBSYSTEM (RCS) USAGE IS LIMITED IN THE FIRST TWO MODULE DELIVERIES TO THAT REQUIRED FOR CONFIGURATION RETRIEVAL STABILIZATION. SUBSEQUENT QUIESCENT USAGE OF THE RCS IS THAT REQUIRED FOR ORBIT MAKEUP, ATTITUDE CONTROL, ETC. THE THIRD LAUNCH PROVIDES A FULL INFORMATION SUBSYSTEM CAPABILITY PERMITTING ARRAY DEPLOYMENT, ATTITUDE CONTROL, AND ACTIVE THERMAL CONTROL. DURING BUILDUP, THE SOLAR ARRAY PANELS ARE DEPLOYED ONLY 25 PERCENT TO PROVIDE ELECTRICAL POWER PRIOR TO INITIAL MANNING. THE ARRAYS ARE FULLY DEPLOYED ON INITIAL MANNING.

E. FLIGHT MODE

THE MODULAR ASSEMBLY FLIGHT MODE SELECTIONS USED DURING BUILDUP ARE LIMITED BY THE OPERATIONAL CAPABILITY OF THE ON-ORBIT ASSEMBLY AND THE CONSTRAINT TO MINIMIZE RCS PROPELLANT EXPENDITURE. TABLE 3.1.1.1.2.1-2 LISTS THE SELECTED FLIGHT MODES RELATIVE TO CONFIGURATION AND OPERATIONAL PHASE.

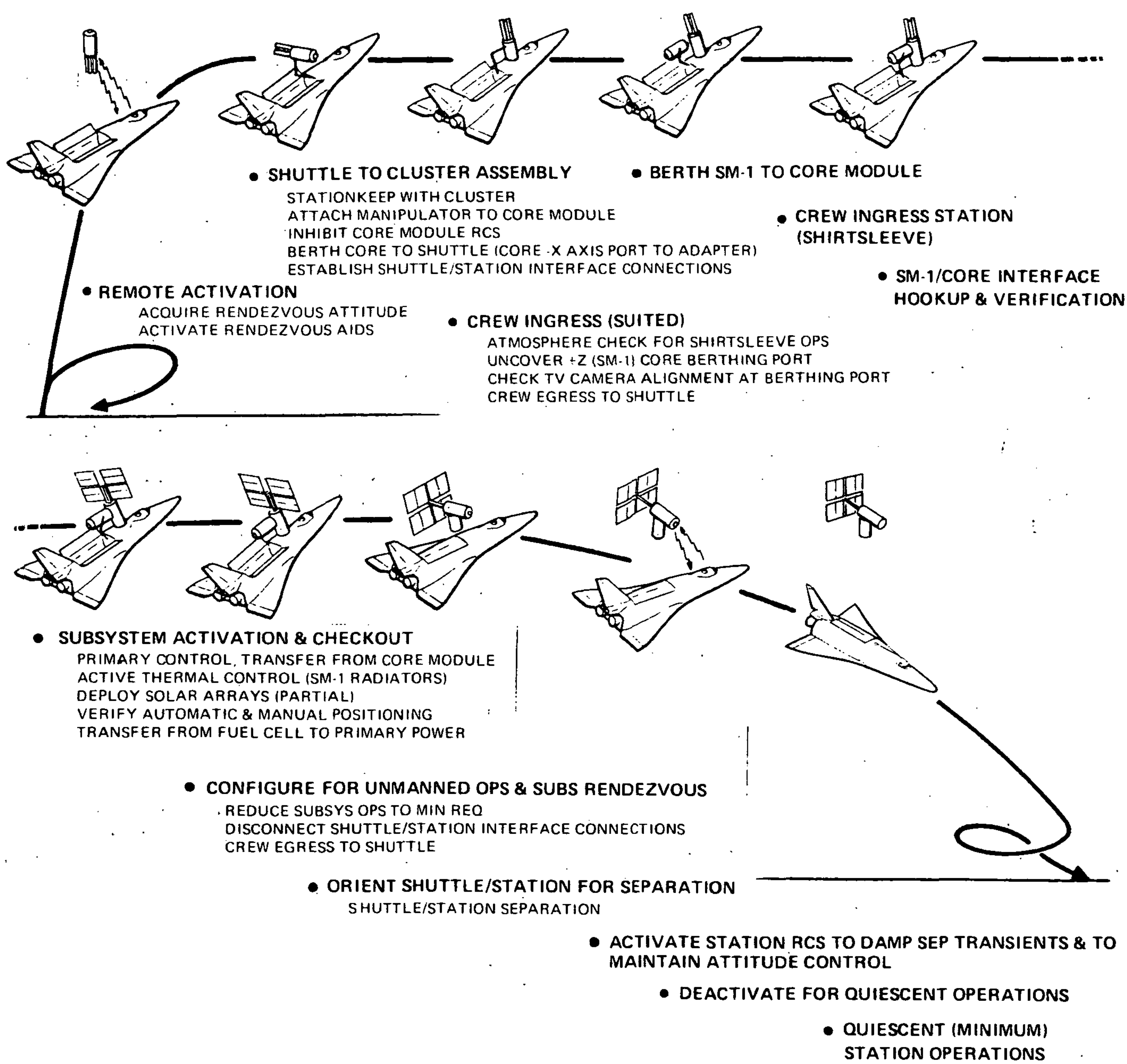


FIGURE 3.1.1.1.2.1-3 DELIVERY SEQUENCE FUNCTIONAL REQUIREMENTS

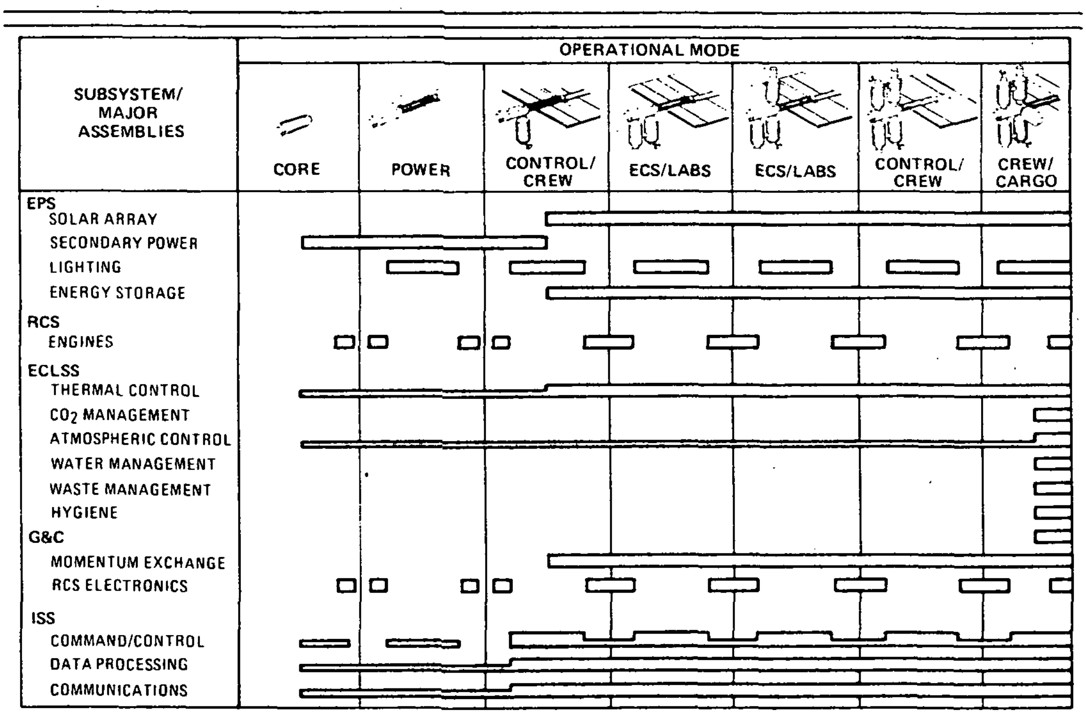


FIGURE 3.1.1.1.2.1-4 SUBSYSTEM ACTIVATION REQUIREMENTS

TABLE 3.1.1.1.2.1-2 MSS FLIGHT MODE SELECTION

CONFIGURATION	QUIESCENT OPERATIONS	RENDEZV./BERTH/UNBERTH	SHUTTLE BERTHED
CORE	GRAVITY GRADIENT	X-POP INERTIAL	SHUTTLE PREFERRED
CORE/POWER	GRAVITY GRADIENT	↓	SHUTTLE PREFERRED
CORE/POWER/SM-1	PRINCIPAL AXIS	↓	PRINCIPAL AXIS OR SHUTTLE PREFERRED
ABOVE +SM-2 ABOVE +SM-3 ABOVE +SM-4	↓	↓	↓

F. ORBIT MAKEUP (BASED ON 2 MEAN JACCHIA ATMOSPHERE JULY 1981)
TO PRECLUDE ORBIT MAKEUP DURING THE INITIAL PHASES OF THE MODULAR SPACE STATION BUILDUP, THE CORE MODULE IS PLACED IN A 272 NAUTICAL MILE CIRCULAR ORBIT. DURING THE FOLLOWING QUIESCENT PERIOD AND WHILE THE CORE IS IN A GRAVITY GRADIENT FLIGHT MODE, THE ORBIT IS ALLOWED TO DECAY. THIRTY DAYS AFTER THE INITIAL LAUNCH, THE SHUTTLE DELIVERS THE POWER MODULE AND RENDEZVOUS WITH THE CORE MODULE AT 271 NAUTICAL MILES ALTITUDE. AFTER ASSEMBLY, THE CORE MODULE/POWER MODULE ARE LEFT IN A GRAVITY GRADIENT MODE AND THE ORBIT ALLOWED TO DECAY DURING THE SECOND QUIESCENT PHASE. SIXTY DAYS AFTER THE CORE MODULE IS INSERTED INTO ORBIT, THE SHUTTLE DELIVERS SM-1 AND RENDEZVOUS WITH THE CM/PM ASSEMBLY, AT 270 NM ALTITUDE. AFTER SM-1 HAS BEEN ATTACHED TO THE MODULAR ASSEMBLY, THE ISS ACTIVATED, AND THE SOLAR ARRAY DEPLOYED, THE ASSEMBLY WILL FLY A MINIMUM PROPELLANT FLIGHT MODE - PRINCIPAL AXIS ORIENTATION - DURING THE SUBSEQUENT QUIESCENT PHASES. ORBIT MAKEUP IS TO BE PERFORMED DURING THOSE PHASES AND WILL BE CONDUCTED IN CONJUNCTION WITH CMG DESATURATION.

3.1.1.1.2.2 ROUTINE OPERATIONS

ROUTINE OPERATIONS CONSTITUTE THE MAJOR PORTION OF THE MODULAR SPACE STATION MISSION. ROUTINE OPERATIONS COMMENCE FOLLOWING FULL STATION ACTIVATION AND INTIAL MANNING BY A SIX MAN CREW AND IS COMPLETED WHEN DEACTIVATION AND DISPOSITION OF THE STATION IS INITIATED. DURING THIS MISSION PHASE, THE PRINCIPAL OPERATIONAL ACTIVITIES ARE -

A. FPE OPERATIONS

FUNCTIONAL PROGRAM ELEMENT (FPE) OPERATIONS INCLUDE THE ROUTINE DAY-TO-DAY SCIENTIFIC AND ENGINEERING OPERATIONS NEEDED TO PERFORM THE GENERIC EXPERIMENTS SPECIFIED BY THE NASA BLUE BOOK. THESE OPERATIONS INVOLVE THE OPERATION AND CONTROL OF INTEGRAL EXPERIMENTS AND OF ATTACHED AND DETACHED RESEARCH AND APPLICATION MODULES (RAMS).

B. FPE SUPPORT OPERATIONS

FPE SUPPORT OPERATIONS CONSIST OF THE CREW AND PRIMARY SUBSYSTEM OPERATIONS DIRECTLY SUPPORTING THE EXPERIMENT OPERATIONS
PRIMARY SUBSYSTEM OPERATIONS ARE PROVIDING EXPERIMENT ELECTRICAL POWER, STABILITY AND CONTROL, ENVIRONMENTAL CONTROL AND DATA HANDLING.

C. STATION OPERATIONS

STATION OPERATIONS INVOLVE THE FLIGHT, ADMINISTRATION/MANAGEMENT, MAINTENANCE AND HOUSEKEEPING OPERATIONS WHICH INDIRECTLY SUPPORT THE EXPERIMENT OPERATIONS AND CREW. FLIGHT OPERATIONS INCLUDE COMMUNICATION, UTILITY SUBSYSTEM MANAGEMENT, MONITOR AND WARNING, AND INTEGRAL FLIGHT CONTROL. ADMINISTRATIVE MANAGEMENT OPERATIONS INCLUDE STATION COMMAND, DATA MANAGEMENT, LOGISTICS INVENTORY CONTROL AND CREW CARE. HOUSEKEEPING OPERATIONS INCLUDE FOOD MANAGEMENT AND PREPARATION, CLEANING, TRASH DISPOSAL AND CARGO HANDLING.

D. STATION FLIGHT MODE

STATION ATTITUDE FLIHT MODES ARE PREDICATED ON EXPERIMENT REQUIREMENTS, SUBSYSTEMS PERFORMANCE AND OPERATIONAL INTERFACES WITH OTHER PROGRAM ELEMENTS. THE NOMINAL FLIGHT MODE SELECTED FOR USE DURING ROTUINE OPERATIONS IS AN X-POP/Z-LV/Y-OVV ATTITUDE. FIGURE 3.1.1.1.2.2-1 ILLUSTRATES THE STATION FLYING IN THE NOMINAL MODE AND SHOWS ITS PRINCIPLE AXIS RELATIVE TO THE DIRECTION OF FLIGHT. TABLE 3.1.1.1.2.2-1 LISTS ADDITIONAL FLIGHT MODES SELECTED FOR DIFFERENT STATION CONFIGURATIONS AND OPERATIONAL PHASES ENCOUNTERED DURING ROUTINE OPERATIONS.

E. STATION ATTITUDE MANEUVERS

STATION ATTITUDE MANEUVERS CONSIST OF THE MANEUVERS REQUIRED TO MAKE CHANGES IN THE ORIENTATION OF THE STATION. THE STATION WILL PRIMARILY UTILIZE AN X-POP/Z-LV/Y-OVV ATTITUDE DURING ROUTINE OPERATIONS. HOWEVER, THE STATION WILL BE REQUIRED TO CAHNGE TO AN X-POP INERTIAL MODE FOR SPECIFIC OPERATIONS SUCH AS SHUTTLE RENDEZVOUS, BERTHING AND DEBERTHING AND ASTRONOMICAL OBSERVATIONS. PROVISIONS FOR CONDUCTING THESE MANEUVERS SHALL BE ACCOUNTED FOR IN THE STATION IMPULSE BUDGET. THE REFERENCE 120-DAY STATION IMPULSE BUDGET CALLS FOR 47,750 LBS-SEC WHICH PROVIDES THE CAPABILITY TO PERFORM A TYPICAL COMPLETE MANEUVER CYCLE, I.E., X-POP/Z-LV/Y-OVV TO X-POP INERTIAL TO X-POP/Z-LV/Y-OVV ONCE EVERY SIX DAYS.

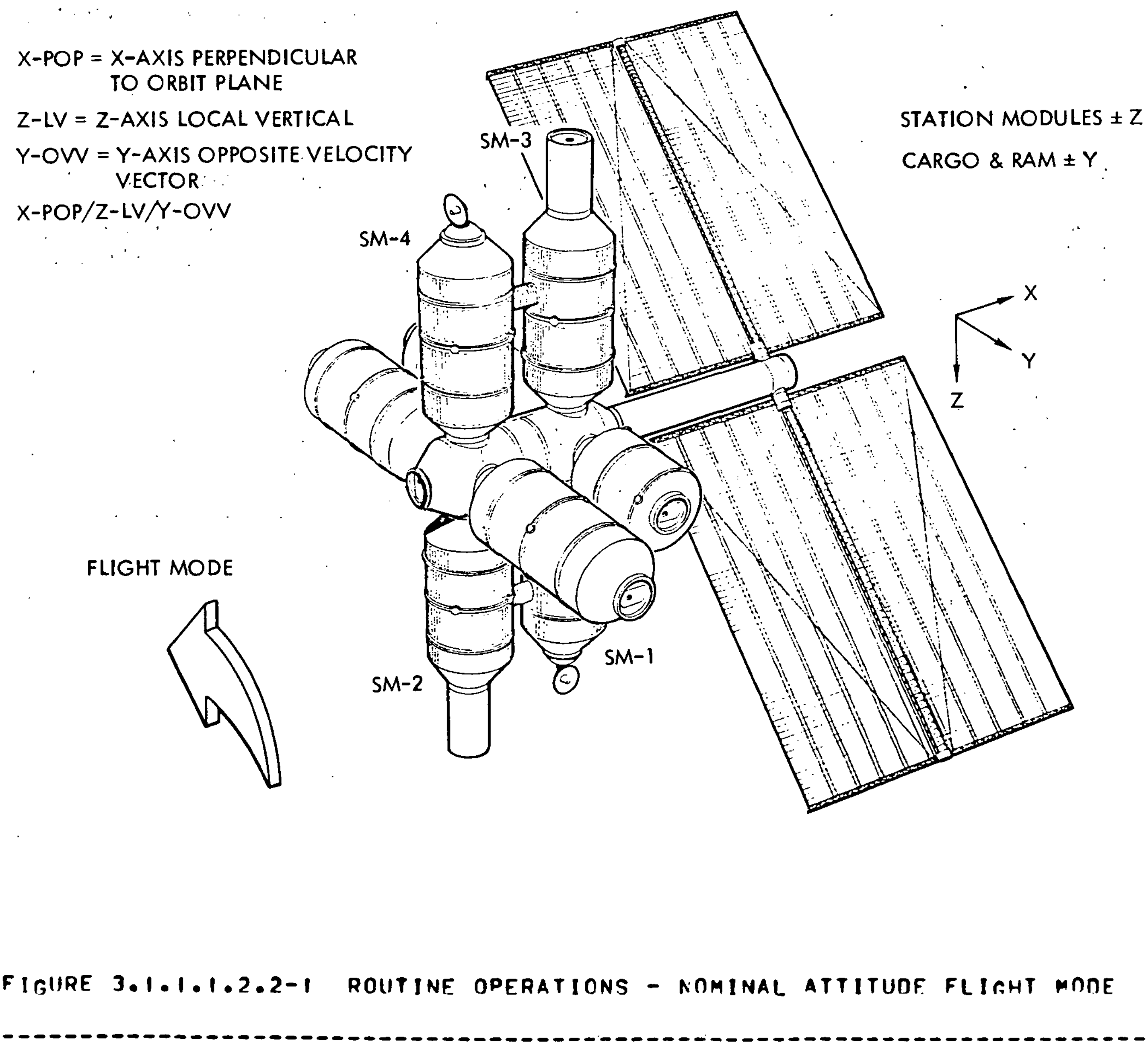


FIGURE 3.1.1.1.2.2-1 ROUTINE OPERATIONS - NOMINAL ATTITUDE FLIGHT MODE

TABLE 3.1.1.1.2.2-1 MSS FLIGHT MODE SELECTION DURING ROUTINE OPERATIONS

	NORMAL OPERATIONS	RENDEZ./BERTH/UNBERTH	SHUTTLE BERTHED
STATION[(1)]+CARGO (ISS)	X-POP Z-LV Y-OV[(2)]	X-POP INERTIAL	PRINCIPAL AXIS OR SHUTTLE PREFERRED
ABOVE + RAM 1	↓	↓	↓
ABOVE + RAM 2	↓	↓	↓
GROWTH SPACE STATION	↓	↓	↓

(1) STATION -- CORE MODULE/POWER MODULE/SM-1/SM-2/SM-3/SM-4
(2) FLIGHT MODE IN INERTIAL ATTITUDE FOR ASTRONOMY OBSERVATIONS

F. ORBIT MAKEUP/CMG DESATURATION REQUIREMENTS

ORBIT MAKEUP INVOLVES THE MAKEUP MANEUVERS PERFORMED AND IMPULSE REQUIRED IN ORDER TO PROVIDE ATTITUDE CONTROL FOR EARTH VIEWING, ASTRONOMY, BIOLOGY, AND PHYSICS EXPERIMENTS. MAKEUP REQUIREMENTS ARE BASED ON THE JACCHIA 240 NM ALTITUDE MODEL ATMOSPHERE SHOWN IN FIGURE 3.1.1.1.2.2-2. SUBSYSTEM SIZING AND (DESIGN TO) REQUIREMENTS ARE BASED ON THE 20 MEAN ANNUAL AVERAGE DENSITY FOR FEBRUARY 1982.

ORBIT MAKEUP WILL NORMALLY BE CONDUCTED CONCURRENT WITH CMG DESATURATION AND WILL UTILIZE TWO RCS JETS IN THE STATION X-Z PLANE. THE NOMINAL TIME BETWEEN CMG DESATURATION SHALL NOT BE LESS THAN TWELVE (12) HOURS AND VENTING OF OTHER GASES/LIQUIDS WILL BE SCHEDULED DURING DESATURATION. THIS LATTER REQUIREMENT PROVIDES A TEN (10) HOUR 'CLEAR' PERIOD FOR EARTH SURVEY AND ASTRONOMY OBSERVATIONS ASSUMING TWO (2) HOURS WILL BE ADEQUATE FOR THE DISSIPATION OF VENTED GASES/LIQUIDS.

G. SOLAR ARRAY ORIENTATION

THE STATION PRIMARY POWER SYSTEM UTILIZES A SOLAR ARRAY PANEL SYSTEM WITH TWO DEGREES OF FREEDOM. THIS SYSTEM PROVIDES THE MAXIMUM AVAILABLE SOLAR POWER AND IS COMPATIBLE WITH THE SELECTED X-POP/Z-LV/Y-OVV NOMINAL ATTITUDE MODE. FIGURE 3.1.1.1.2.2-3 DEFINES THE REQUIRED ORIENTATION TIME HISTORY RELATIVE TO THE STATIONS ORBIT POSITION FOR THE X-POP/Z-LV FLIGHT MODE.

H. DETACHED RAM OPERATION

DETACHED RAM MANAGEMENT OPERATIONS CONSIST OF THE RETRIEVAL, SERVICING, MAINTENANCE, REFURBISHING, AND DEPLOYMENT OPERATIONS INVOLVED IN THE UTILIZATION OF DETACHED EXPERIMENT MODULES. FLIGHT OPERATIONS SUPPORT PROVIDED BY THE STATION CONSISTS OF TRACKING, COMMUNICATION AND COMMAND CONTROL. THE FREQUENCY WITH WHICH THE MODULES ARE REPOSITIONED IS DETERMINED BY THE RELATIVE POSITION HISTORIES AND OPERATIONAL CONSTRAINTS. THE FUNDAMENTAL OPERATIONAL CONSTRAINT IS THAT THE MODULE MUST NOT EXCEED A 450 NM MAXIMUM RANGE FROM THE STATION.

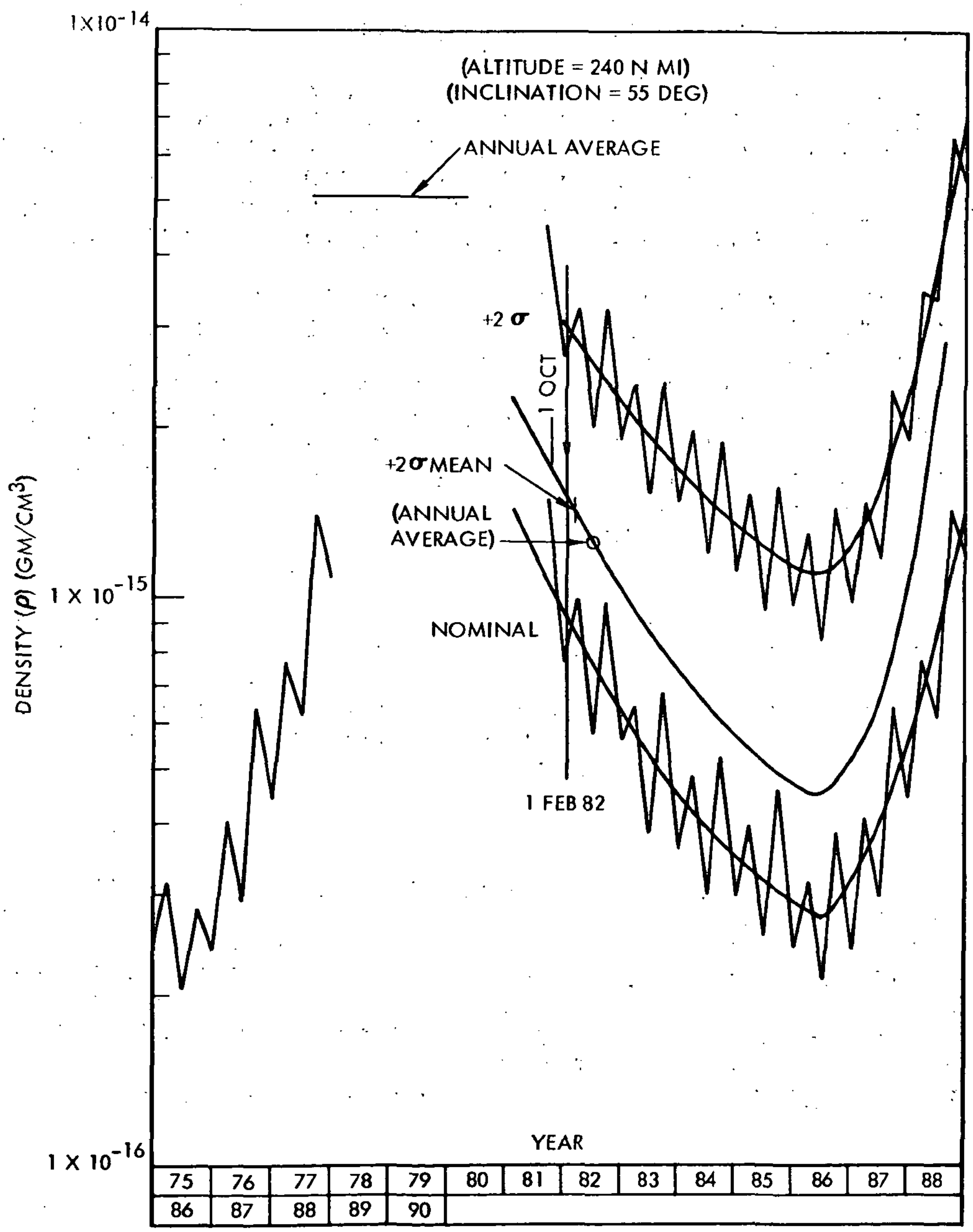


FIGURE 3.1.1.1.2.2-2 ATMOSPHERIC DENSITY

SOLAR ARRAY ORIENTATION

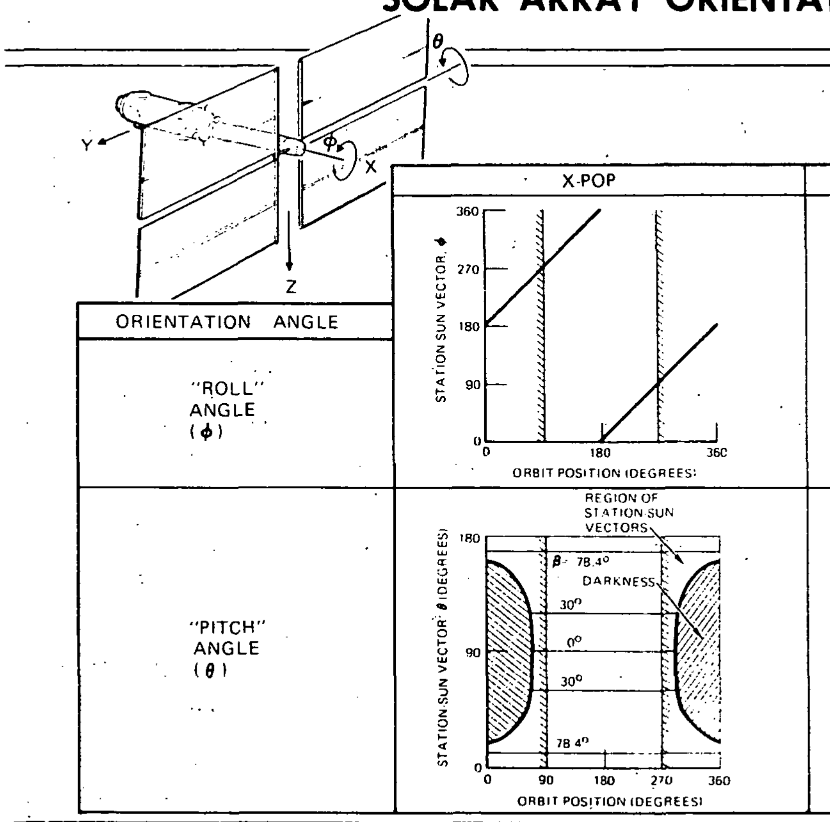


FIGURE 3.1.1.1.2.2-3 SOLAR ARRAY ORIENTATION

3.1.1.1.2.3 PERIODIC OPERATIONS

PERIODIC OPERATIONS OCCUR CONCURRENTLY WITH ROUTINE OPERATIONS. PERIODIC OPERATIONS ARE THOSE MAJOR ACTIVITIES WHICH OCCUR ON A CYCLICAL, RECURRING, INTERMITTENT OR INFREQUENT BASIS. THEY INCLUDE SUCH OPERATIONS AS -

A. LOGISTICS RESUPPLY

LOGISTICS RESUPPLY OPERATIONS ARE DEFINED AS THE FLIGHT OPERATIONS NEEDED FOR THE DELIVERY AND RETURN OF CREWMEN AND CARGO TO AND FROM THE STATION. THE FREQUENCY OF LOGISTIC FLIGHTS IS DICTATED BY THE SUPPORT REQUIREMENTS (CONSUMABLES, SPARES, REPLACEMENTS, WASTE, DOWN EXPERIMENT DATA AND CREW ROTATION) BUT IS ALWAYS LESS THAN 180 DAYS, THE MAXIMUM CREW ROTATION INTERVAL. STATION OPERATIONS IN SUPPORT OF BERTHING, CREW AND CARGO TRANSFER AND ATTITUDE AND STABILITY CONTROL OPERATIONS.

IN THE LOGISTIC CONCEPT SELECTED FOR THE MSS, THE CARGO MODULE IS EMPLOYED AS A SUPPLY CENTER, OR PANTRY, FOR STATION AND EXPERIMENT CONSUMABLES, AS WELL AS PROVIDING THE LIFE SUPPORT CONSUMABLES FOR THE 96 HOUR EMERGENCY REQUIREMENT. IN THIS CONCEPT, A CARGO MODULE IS REQUIRED CONTINUOUSLY AND ONE IS ALWAYS BERTHED TO EITHER ONE OR THE OTHER OF THE TWO FORWARD Y-7XIS PORTS ON THE CM.

A TYPICAL CARGO MODULE DELIVERY/REPLACEMENT BEGINS WITH THE SHUTTLE DELIVERY OF THE NEW CARGO MODULE TO THE VICINITY OF THE STATION. THE STATION THEN TRANSFERS TO AND STABILIZES IN AN X-POP INERTIAL ATTITUDE MODE AND THE SHUTTLE IS CLEARED TO INITIATE BERTHING OPERATIONS. THE SHUTTLE MANIPULATOR ATTACHES TO THE STATION ADAPTER ON THE -X AXIS CM PORT AND BERTHS THE STATION TO THE SHUTTLE PASSENGER PORT.

AFTER THE SHUTTLE/STATION INTERFACES ARE VERIFIED, THE NEW STATION CREW, IF ONE HAS BEEN BROUGHT UP, WILL EXIT THE CARGO MODULE AND ENTER THE STATION THROUGH THE SHUTTLE. THE NEW CARGO MODULE SHUTTLE CARGO BAY INTERFACES ARE DISCONNECTED AND THE MODULE LIFTED OUT OF THE BAY AND BERTHED TO THE 'FREE' FORWARD Y-AXIS PORT ON THE CM BY THE MANIPULATOR. THE USED CARGO MODULE/STATION INTERFACES ARE THEN DISCONNECTED AND THE MODULE DETACHED AND STOWED IN THE SHUTTLE CARGO BAY BY THE MANIPULATOR. AFTER THE USED CARGO MODULE/SHUTTLE INTERFACES HAVE BEEN CONNECTED AND VERIFIED, THE SHUTTLE/STATION INTERFACES ARE DISCONNECTED AND THE SHUTTLE PREPARED FOR EARTH RETURN. IF A STATION CREW IS BEING RETURNED TO EARTH, THE RETURNING CREW WILL EXIT THE STATION THROUGH THE ADAPTER AND ENTER THE USED CARGO MODULE THROUGH THE

SHUTTLE AFTER THE CARGO MODULE/SHUTTLE INTERFACES AND CARGO MODULE HABITABLE ENVIRONMENT HAVE BEEN ESTABLISHED.

B. RESEARCH AND APPLICATION MODULE (RAM) DELIVERY

RAM DELIVERY OPERATIONS INCLUDE THE SHUTTLE OPERATIONS NEEDED TO DELIVER ATTACHED AND DETACHED RAMS TO THE STATION. THE TIMING OF THOSE FLIGHTS WILL DEPEND ON THE ACTUAL EXPERIMENT PROGRAM SCHEDULE. STATION OPERATIONS IN SUPPORT OF THOSE OPERATIONS INCLUDE COMMAND CONTROL, BERTHING CONTROL AND ATTITUDE AND STABILITY CONTROL. A TYPICAL RAM DELIVERY BEGINS WITH THE SHUTTLE DELIVERY OF THE RAM TO THE VICINITY OF THE STATION. THE STATION THEN TRANSFERS TO AND STABILIZES IN AN X-POP INERTIAL ATTITUDE MODE AND THE SHUTTLE IS CLEARED TO INITIATE BERTHING OPERATIONS. THE SHUTTLE MANIPULATOR ATTACHES TO THE STATION ADAPTER ON THE -X AXIS CM PORT AND BERTHS THE STATION TO THE SHUTTLE PASSENGER INGRESS/EGRESS PORT. AFTER THE SHUTTLE/STATION INTERFACES ARE CONNECTED, THE RAM IS LIFTED OUT OF THE CARGO BAY AND BERTHED TO THE DESIGNATED AFT Y AXIS PORT ON THE CM BY THE MANIPULATOR. IF NO RAMS ARE TO BE RETURNED TO EARTH OR REPLACED IN ORBIT, THE SHUTTLE IS DETACHED AND SEPARATED FROM THE STATION AND BOTH ELEMENTS (STATION AND SHUTTLE) ARE CONFIGURED FOR THEIR SUBSEQUENT RESPECTIVE MISSION PHASE. IF A RAM IS TO BE RETURNED TO EARTH OR PLACED IN ORBIT, THE MANIPULATOR OF THE ATTACHED SHUTTLE WILL LATCH ONTO THE DESIGNATED RAM, THE STATION/RAM INTERFACES DISCONNECTED, AND THE RAM DETACHED AND STOWED IN THE SHUTTLE CARGO. THE SHUTTLE/STATION INTERFACES ARE THEN DIS-CONNECTED, THE SHUTTLE SEPARATED AND BOTH ELEMENTS CONFIGURED FOR THEIR NEXT MISSION PHASE.

C. SOLAR ARRAY REPLACEMENT

PLANNED OR UNPLANNED SOLAR ARRAY REPLACEMENTS MAY BE REQUIRED DURING THE OPERATIONAL LIFE OF THE MSS. THE PRIMARY SOLAR ARRAY REPLACEMENT OPERATIONS CONSIST OF - A SHUTTLE LAUNCH TO DELIVER THE REPLACEMENT ARRAY AND RETURN THE USED ARRAY; A POWER TRANSFER TO THE FUEL CELL POWER SYSTEM; ELECTROLYSIS UNITS SHUTDOWN; FOLDING BACK (RETRACTING) THE OLD ARRAY PANELS; DETACHMENT AND STOWAGE OF THE USED ARRAY; ATTACHMENT OF THE NEW ARRAY TO THE BOOM; DEPLOYMENT OF THE NEW ARRAY PANELS; TRANSFER OF POWER SOURCE FROM FUEL CELL TO SOLAR ARRAY; AND ELECTROLYSIS UNITS ACTIVATION.

DURING SOLAR ARRAY REPLACEMENT, FUEL FOR FUEL CELL OPERATION AT AN AVERAGE 10 KW USABLE FOR FIVE DAYS MUST BE PROVIDED AS WELL AS A FIVE DAY SUPPLY OF GASES FOR STATION ATMOSPHERIC MAKEUP AND RCS REQUIRMENTS. ATTENDANT TANKS, PUMPS, AND LINES FOR STORING AND TRANSFERRING/PUMPING

THE GASES TO THE STATION'S FUEL CELLS, ECS, AND RCS MUST ALSO BE PROVIDED. THESE CONSUMALBES AND ASSOCIATED STORING AND TRANSFER EQUIPMENT WILL BE DELIVERED ON THE SAME LAUNCH THAT BRINGS UP THE NEW SOLAR ARRAY.

THE OPERATIONAL REQUIREMENTS ATTENDANT WITH SOLAR ARRAY REMOVAL AND REPLACEMENT ARE ILLUSTRATED IN THE SEQUENCE OF SKETCHES IN FIGURE 3.1.1.1.2.3-1. THE SEQUENCE BEGINS AFTER THE SHUTTLE HAS REMOVED THE BERTHING ADAPTER FROM -X AXIS STATION LOCATION AND HAS BERTHED TO THE POWER BOOM (THE SOLAR ARRAYS HAVE BEEN RETRACTED AND FOLDED AND STATION POWER IS OBTAINED FROM THE FUEL CELLS). THE OLD ARRAY IS SEPARATED FROM THE POWER BOOM USING THE MANIPULATOR. THE SHUTTLE MOVES TO A STATION KEEPING POSITION TO PERFORM THE ARRAY EXCHANGE SHOWN IN SKETCHES 4 THROUGH 7. THE OLD ARRAY IS BERTHED TO THE FIXTURE AT THE END OF THE CARGO BAY. THE NEW ARRAY IS POSITIONED ON THE BERTHING ADAPTER (SKETCH 5). PRIOR TO REBERTHING THE NEW ARRAY TO THE STATION, THE LAUNCH SUPPORT STRUCTURE (WHICH SUPPORTS THE ARRAY IN THE CARGO BAY) IS MOVED FROM THE NEW ARRAY TO THE OLD ARRAY AS SHOWN IN SKETCH 6. THE OLD ARRAY IS THEN STOWED IN THE CARGO BAY, WITH THE MANIPULATOR, THE POWER BOOM OF THE STATION IS CAPTURED AND BERTHED TO THE NEW ARRAY. AFTER SHUTTLE/ADAPTER SEPARATION, THE NEW SOLAR ARRAYS ARE UNFOLDED, EXTENDED, AND ACTIVATED AND THE BERTHING ADAPTER IS REPLACED ON THE CORE MODULE -X AXIS PORT.

D. SPACE STATION DISPOSITION

WHEN THE SPACE STATION IS OF NO FURTHER USE, IT WILL BE RETURNED TO EARTH BY THE SHUTTLE. RESEARCH AND APPLICATION MODULES WILL BE RETURNED FIRST FOLLOWED BY A PLANNED DISASSEMBLY OF THE STATION IN THE REVERSE SEQUENCE USED FOR BUILDUP. THE PRIMARY EXCEPTION TO THE REVERSE SEQUENCE IS THAT THE CARGO MODULE (FOR CRYOGENIC PROPELLANTS OR GASES) WILL REMAIN ATTACHED TO THE CORE MODULE UNTIL ALL THE STATION MODULES AND THE POWER MODULE ARE RETURNED. THE FINAL RETURN SEQUENCE WILL BE - STATION MODULES, POWER MODULE, CARGO MODULE, AND CORE MODULE.

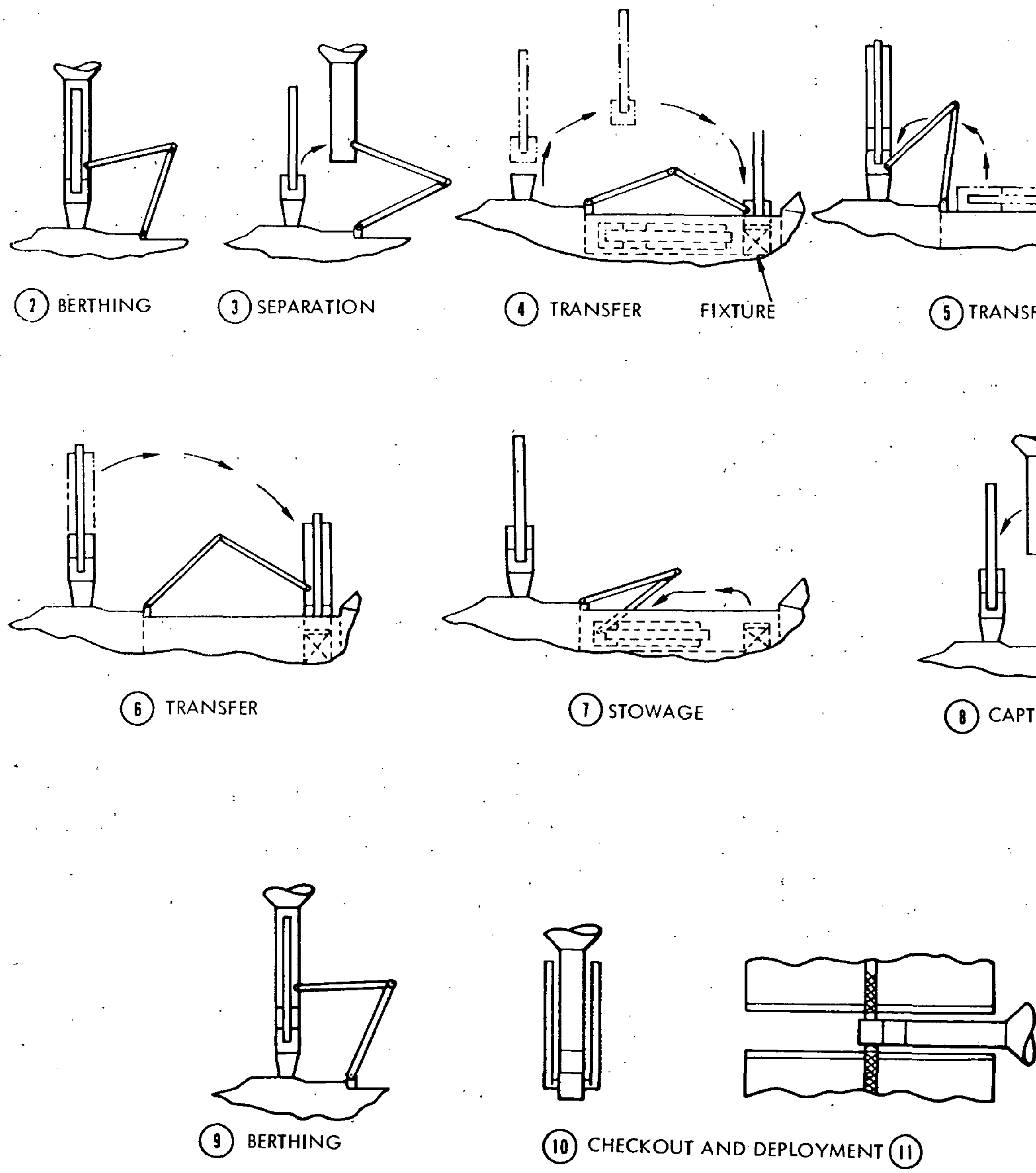


FIGURE 3.1.1.1.2.3-1 SOLAR ARRAY/TURRET REPLACEMENT SEQUENCE

3.1.1.1.3 SYSTEM INTERFACES

3.1.1.1.3.1 PRE-MISSION OPERATIONS SUPPORT

THE PREMISSION OPERATIONS SUPPORT SYSTEM SHALL PROVIDE THE CAPABILITY TO CHECKOUT INDIVIDUAL MODULES (IN AS FLIGHT READY CONDITION AS PRACTICAL).

THE PREMISSION OPERATIONS SUPPORT SYSTEM SHALL PROVIDE THE CAPABILITY TO TRANSPORT INDIVIDUAL MODULES BY AIR.

THE PREMISSION OPERATIONS SUPPORT SYSTEM SHALL PROVIDE THE CAPABILITY TO VALIDATE THE COMPATIBILITY AND INTEGRATED OPERATION OF THE FIRST FOUR FLIGHT MODULES (CORE MODULE, POWER MODULE, SM-1 MODULE, AND SM-4 MODULE) TO A LEVEL CONSISTANT WITH THE OVERALL TEST LOGIC.

THE INDIVIDUAL MODULES SHALL BE CAPABLE OF BEING TRANSPORTED WITH THEIR LONGITUDINAL AXIS IN THE HORIZONTAL PLANE BY AIR OR GROUND WITH A LIMITED ENVIRONMENTAL PROTECTION.

3.1.1.1.3.2 MISSION OPERATIONS SUPPORT

THE MISSION OPERATIONS SUPPORT SYSTEM SHALL PROVIDE THE SITES, FACILITIES, EQUIPMENT, AND SERVICES FOR THE EXECUTIVE DIRECTION, MANAGEMENT, PLANNING AND OPERATIONAL SUPPORT OF THE SPACE STATION MISSION.

A. MISSION MANAGEMENT SITE

THE MISSION MANAGEMENT SITE (MMS) SHALL PROVIDE THE MANAGEMENT AND THE LONG RANGE PLANNING FUNCTION FOR THE SPACE STATION MISSION. THE FUNCTIONS OF MISSION PLANNING, FLIGHT OPERATIONS MANAGEMENT, LOGISTICS INVENTORY MANAGEMENT, EXPERIMENT OPERATIONS AND PLANNING, AND EXPERIMENT OPERATIONS MANAGEMENT SHALL BE PROVIDED BY THIS SITE. THE MISSION MANAGEMENT SITE SHALL BE CO-LOCATED WITH THE GROUND COMMUNICATIONS NETWORK SWITCHING CENTER. THE MISSION MANAGEMENT SITE SHALL PROVIDE -

1. MISSION PLANNING - MISSION PLANNING SHALL PROVIDE THE EXECUTIVE FUNCTION OF THE MISSION OPERATIONS SUPPORT SYSTEM BY INTEGRATING AND CONTROLLING PLANS AND SCHEDULES FOR LAUNCH, RESUPPLY, AND CREW ROTATION. THE SPACE STATION SYSTEM SHALL PROVIDE (THROUGH THE MISSION SUPPORT SITES) THE OPERATIONAL STATUS, EXPERIMENT PROGRAM PROGRESS, CONSUMABLES STATUS, AND CREW STATUS NECESSARY FOR THE CONDUCT OF THE LONG-TERM MISSION PLANNING FUNCTION. THE SPACE STATION SHALL PROVIDE THE CAPABILITY FOR SHORT-TERM, DAY-TO-DAY, SPACE STATION OPERATIONAL SCHEDULING WITHIN THE RESOURCE LIMITS PROVIDED BY THE SPACE STATION.

2. FLIGHT OPERATIONS MANAGEMENT - FLIGHT OPERATIONS MANAGEMENT SHALL MAINTAIN EXECUTIVE CONTROL OF THE MISSION AND INTEGRATES ANALYSES OF SPACE STATION STATUS AND EXPERIMENT OBJECTIVE ACCOMPLISHMENT. IT ALSO PROVIDES THE CENTRALIZED CONTROL OF COMMUNICATION WITH THE SPACE STATION MISSION ELEMENTS. THE SPACE STATION SYSTEM SHALL PROVIDE (THROUGH THE MISSION SUPPORT SITES) THE OPERATIONAL STATUS AND EXPERIMENT PROGRAM PROGRESS.

3. LOGISTICS INVENTORY MANAGEMENT - ACTING ON THE PLANS AND SCHEDULES DEVELOPED AND INTEGRATED BY MISSION PLANNING, LOGISTICS INVENTORY MANAGEMENT SHALL PROVIDE THE EQUIPMENT, CONSUMABLES, SPARES, AND EXPERIMENTS NECESSARY FOR SPACE STATION MISSION CONTINUATION.

4. EXPERIMENT OPERATIONS PLANNING - EXPERIMENT OPERATIONS PLANNING SHALL PROVIDE THE PROCEDURES, TIMELINE REQUIREMENTS, AND SCHEDULING REQUIREMENTS TO MISSION PLANNING FOR INTEGRATION INTO THE OVERALL MISSION MANAGEMENT. THE SPACE STATION SHALL PROVIDE (THROUGH THE MISSION SUPPORT SITES) THE EXPERIMENT PROGRAM PROGRESS, SIGNIFICANT EXPERIMENT RESULTS AND/OR CONCLUSIONS, DEVIATIONS FROM EXPECTED EXPERIMENT RESULTS, AND FUTURE (LONG TERM) EXPERIMENT SCHEDULING RECOMMENDATIONS. NEAR-TERM (DAY-TO-DAY) EXPERIMENT OPERATIONS SCHEDULING SHALL BE PROVIDED BY THE SPACE STATION WITHIN THE OVERALL MISSION SCHEDULING CONSTRAINTS AND THE SPACE STATION RESOURCE LIMITS.

5. EXPERIMENT OPERATIONS MANAGEMENT - THE CONTROL OF EXPERIMENT DATA FLOW AND PROCESSING SHALL BE PROVIDED BY EXPERIMENT OPERATIONS MANAGEMENT. IT SHALL PROVIDE THE ANALYSIS FUNCTION FOR ASSESSMENT OF EXPERIMENT PERFORMANCE BASED ON EXPERIMENT DATA PROVIDED BY THE SPACE STATION THROUGH THE MISSION SUPPORT SITES AND IN THE FORM OF DOWN LOGISTICS CARGO (DATA TAPES, SPECIMENS, FILMS, NOTES, ETC.).

B. MISSION SUPPORT SITES

THE MISSION SUPPORT SITES SHALL PROVIDE THE OPERATIONAL SUPPORT FOR FLIGHT OPERATIONS MANAGEMENT AND EXPERIMENT OPERATIONS MANAGEMENT IN COMMUNICATING WITH AND ACQUIRING DATA FROM FLIGHT ELEMENTS. MISSION SUPPORT SITES SHALL INCLUDE THE TDRS SYSTEM AND GROUND NETWORK, INCLUDING THE SWITCHING CENTER.

1. TRACKING

(A) THE TRACKING SITES SHALL PROVIDE EPHEMERIS DATA FOR ALL FLIGHT ELEMENTS OF THE SPACE STATION MISSION. TRACKING ACCURACY SHALL BE

PROVIDED TO AN ACCURACY OF TBD.

(B) THE SPACE STATION SHALL PROVIDE TRACKING AIDS TO PERMIT GROUND TRACKING AT SPACE STATION ALTITUDES UP TO 270 NM.

2. COMMUNICATIONS

(A) THE COMMUNICATION SITES SHALL PROVIDE THE ACQUISITION CONTROL, DISPLAY, DATA PROCESSING AND RELAYING OF INFORMATION FROM THE FLIGHT ELEMENTS AND PROVIDE RELAYING AND TRANSMISSION OF INFORMATION TO THE FLIGHT ELEMENTS.

C. CREW TRAINING SITES

THE CREW TRAINING SITES SHALL PROVIDE THE INDOCTRINATION, FAMILIARIZ-ATION, AND PROCEDURAL PRACTICE REQUIRED FOR SPACE STATION CREW MEMBERS.

1. OPERATIONS TRAINING SITES - THE OPERATIONS TRAINING SITES SHALL PRO-VIDE TRAINING IN ORBITAL FLIGHT CONTROL, SUBSYSTEM OPERATIONS, AND EXP-ERIMENT OPERATIONS.

2. ENVIRONMENTAL ACCLIMATION SITES - THE ENVIRONMENT ACCLIMATION SITES SHALL PROVIDE CREW TRAINING IN THE ENVIRONMENTAL EFFECTS TO BE ENCOUNT-ERED DURING THE SPACE STATION MISSION.

3.1.1.1.3.3 CARGO MODULE SYSTEM

THE CARGO MODULE SYSTEM WILL PROVIDE THOSE SPACE STATION RELATED INTER-FACES NECESSARY FOR THE TRANSFER OF CREW AND/OR CARGO FROM THE CARGO MODULE TO THE SPACE STATION AND FROM THE SPACE STATION TO THE CARGO MODULE. THE INTERFACES WHICH ARE REQUIRED BETWEEN THE CARGO MODULE SYSTEM AND THE SPACE STATION AFTER THE CARGO MODULE HAS BEEN BERTHED TO THE SPACE STATION CORE MODULE ARE DEFINED IN THIS SECTION.

A. THE CARGO MODULE SYSTEM WILL PROVIDE THE STORAGE CAPABILITY FOR 1392 LBS/120 DAYS OF ECLSS RESUPPLY WATER. THE CAPABILITY WILL BE PROVIDED FOR TRANSFER OF THE ECLSS RESUPPLY WATER FROM THE CARGO MODULE SYSTEM TO THE SPACE STATION SYSTEM AT A PRESSURE OF 300 PSIA.

B. THE CARGO MODULE SYSTEM WILL PROVIDE STORAGE CAPABILITY FOR THE FOLLOWING TYPES AND QUANTITIES OF GASES TO SUPPORT SPACE STATION ECLSS OPERATIONS -

SUPPORT FUNCTION	GAS TYPE - QTY IN LBS			INTERFACE PRESSURE PSIA
	O2	H2	N2	
EMERGENCY ECLSS	222			300
EMERGENCY EPS	160	20		300
EMERGENCY RCS	22	3		300
LEAKAGE MAKEUP			985	300
EVA RESUPPLY	128			GREATER THAN 1400

C. THE CARGO MODULE WILL PROVIDE ITS OWN REPRESSURIZATION GASES.

D. THE SPACE STATION SHALL PROVIDE THE CAPABILITY TO EQUALIZE THE PRESSURE BETWEEN THE SPACE STATION AND THE BERTHING PORT INTERFACE VOLUME FOLLOWING BERTHING OF THE CARGO MODULE AND PRIOR TO OPENING THE SPACE STATION HATCH.

E. THE CAPABILITY SHALL BE PROVIDED TO EQUALIZE THE PRESSURE BETWEEN SPACE STATION AND THE CARGO MODULE PRIOR TO OPENING THE CARGO MODULE HATCH.

F. THE CAPABILITY SHALL BE PROVIDED TO VERIFY THE HABITABILITY (PRESSURE, TEMPERATURE AND CO2 PARTIAL PRESSURE) OF THE CARGO MODULE PRIOR TO OPENING THE CARGO MODULE HATCH.

G. THE SPACE STATION SYSTEM SHALL PROVIDE THE CARGO MODULE ATMOSPHERIC CONTROL WHEN THE CARGO MODULE IS BERTHED TO THE SPACE STATION. THE CARGO MODULE SYSTEM INTERIOR WALL AND EQUIPMENT SURFACE TEMPERATURES SHALL BE MAINTAINED BETWEEN 57 F AND 105 F. THE INTERIOR TEMPERATURE SHALL BE MAINTAINED AT A NOMINAL 70 F.

H. THE CAPABILITY WILL BE PROVIDED TO CIRCULATE THE AIR WITHIN THE CARGO MODULE BETWEEN 15 AND 100 FEET PER MINUTE.

I. THE CARGO MODULE SYSTEM WILL BE CAPABLE OF OPERATING IN THE ENVIRONMENT IMPOSED BY THE RCS JETS LOCATED ON THE SPACE STATION CORE MODULE SUCH THAT EXHAUST PLUME IMPINGEMENT ON THE CARGO MODULE SYSTEM MAY OCCUR.

J. THE SPACE STATION SYSTEM SHALL PROVIDE ELECTRICAL POWER FOR CARGO MODULE INTERIOR LIGHTING, CIRCULATION FANS, ETC.

K. THE SPACE STATION/CARGO MODULE SYSTEM SHALL PROVIDE AN INTERFACE FOR

WATER COOLANT LINES FOR THERMAL CONTROL OF THE CARGO MODULE SYSTEM.

L. THE CARGO MODULE SYSTEM AND SPACE STATION SYSTEM SHALL PROVIDE DEVICES FOR TRANSPORTING CREW AND/OR CARGO BETWEEN THE CARGO MODULE AND THE SPACE STATION. THE TRANSPORT DEVICE SHALL BE CAPABLE OF ACCOMMODATING PACKAGES UP TO TBD POUNDS.

M. THE CARGO MODULE AND SPACE STATION SYSTEMS SHALL PROVIDE CREW MOBILITY AIDS IN THE FORM OF HANDHOLDS, GUIDE RAILS, AND OTHER DEVICES TO FACILITATE CREW LOCOMOTION, STABILIZATION, AND BRACING. THE MOBILITY AIDS SHALL BE CAPABLE OF USE IN EITHER A SHIRTSLEEVE OR SUITED/PRESSURIZED MODE OF OPERATION.

N. THE CARGO MODULE SYSTEM WILL PROVIDE CREW RESTRAINT DEVICES SUCH AS TETHERS/TETHER ATTACH FITTINGS, HARNESSES, BELTS AND STRAPS, VARIOUS FOOT RESTRAINT DEVICES, AND ARTICULATED OR EXTENSIBLE MECHANICAL DEVICES FOR BRACING AND STABILIZATION OR PREVENTION OF INADVERTENT DRIFT OF A CREWMEMBER IN A ZERO-G ENVIRONMENT. THESE DEVICES SHALL BE COMPATIBLE FOR USE IN A SUITED/PRESSURIZED MODE OF OPERATION.

O. THE CARGO MODULE SYSTEM WILL PROVIDE RADIATION DOSIMETERS TO MEASURE AMBIENT RADIATION LEVELS IN THE CARGO MODULE AS WELL AS CUMULATIVE RADIATION DOSAGE.

P. THE CARGO MODULE SYSTEM WILL PROVIDE NORMAL AND EMERGENCY LIGHTING TO SUPPORT CREW ACTIVITIES.

Q. THE CARGO MODULE SYSTEM WILL PROVIDE STORAGE CAPACITY FOR SPACE STATION RESUPPLY EXPENDABLES AND SPARES. THE TYPES AND QUANTITIES ARE TBD.

R. THE CARGO MODULE SYSTEM WILL PROVIDE ALARMS AND DISPLAYS TO ALERT THE CREW TO THE PRESENCE OF A DANGEROUS OR POTENTIALLY DANGEROUS SITUATION. THE NATURE OF THE DISPLAYS AND THE INFORMATION TO BE DISPLAYED IS TBD.

S. THE CARGO MODULE SYSTEM WILL PROVIDE TWO-WAY INTERCOMMUNICATION DEVICES COMPATIBLE WITH THE SPACE STATION SUBSYSTEM INTERCOMMUNICATION SYSTEM. THE TYPES AND QUANTITIES ARE TBD.

T. THE SPACE STATION SYSTEM SHALL PROVIDE CAPABILITIES FOR MONITORING THE STATUS OF AND CONTROLLING THE CARGO MODULE SUBSYSTEMS. THE TYPES AND QUANTITIES OF DATA TO BE ACQUIRED, PROCESSED, DISTRIBUTED, ANALYZED, AND STORED ARE TBD.

U. THE CARGO MODULE WILL PROVIDE THE CAPABILITY TO INTERFACE WITH SPACE

STATION CLOSED CIRCUIT TV SYSTEM.

3.1.1.2 LOGISTICS

3.1.1.2.1 LOGISTICS CONSIDERATIONS

THE TOTAL LOGISTICS REQUIREMENTS NECESSARY TO SUPPORT THE SPACE STATION AND EXPERIMENT OPERATIONS ARE SHOWN IN TABLE 3.1.1.2.1. APPROXIMATELY 1900 POUNDS PER MONTH ARE REQUIRED FOR BASIC OPERATIONS OF THE INITIAL SPACE STATION. BASED ON THE EXPERIMENT SCHEDULING, APPROXIMATELY 1,000 POUNDS PER MONTH ARE REQUIRED FOR OPERATIONS OF THE INITIAL SPACE STATION EXPERIMENTS. THE EXPERIMENT LOGISTICS REQUIREMENTS SHOWN ARE AN AVERAGE VALUE OF THE REQUIREMENTS FOR CONSUMABLES AND EXPERIMENT EQUIPMENT WHICH MUST BE DELIVERED DURING THE OPERATION OF THE SPACE STATION. AN ADDITIONAL LOGISTICS REQUIREMENT IS IMPOSED BY THE NEED FOR O2 AND N2 FOR EMERGENCY OPERATIONS. THE RESULTANT CUMULATIVE REQUIREMENTS ARE SHOWN IN FIGURE 3.1.1.2.1 WHERE THE LOWER LINE REPRESENTS THE CUMULATIVE REQUIREMENTS FOR BASIC STATION OPERATIONS AND THE UPPER LINE REPRESENTS THE TOTAL INCLUDING EXPERIMENT OPERATIONS.

3.1.1.2.2 MAINTENANCE

THE MODULAR SPACE STATION SHALL BE 100 PERCENT MAINTAINABLE ON ORBIT AS THE NOMINAL OPERATIONAL MODE WITH EXPENDABLES, SPARES, AND IFRU'S SUPPLIED VIA CARGO MODULES. THE LOGISTICS SUPPORT REQUIRED SHALL BE AS SPECIFIED IN PARAGRAPH 3.1.1.2.1 ABOVE.

LOGISTICS ITEM	RESUPPLY REQUIREMENT (LB/30 DAYS) INITIAL
CLOTHING	76
LINENS	62
GROOMING	10
MEDICAL	15
UTENSILS	56
FOOD	650
GASEOUS	
STORAGE – O_2	3
– N_2	247
WATER	369
SPECIAL LIFE	
SUPPORT LiOH	10
WATER MANAGEMENT	40
ATMOSPHERIC	
CONTROL	217
CO_2 MANAGEMENT	57
WASTE MANAGEMENT	27
HYGIENE	11
SPARES	34
SUBTOTAL	1884
AVERAGE EXPERIMENT RESUPPLY	1000
TOTAL 30-DAY AVERAGE	2884
UP-DOWN EMERGENCY (96 HR) O_2	404
H_2	23
TOTAL EMERGENCY	427

TABLE 3.1.1.2.1 AVERAGE LOGISTICS REQUIREMENTS

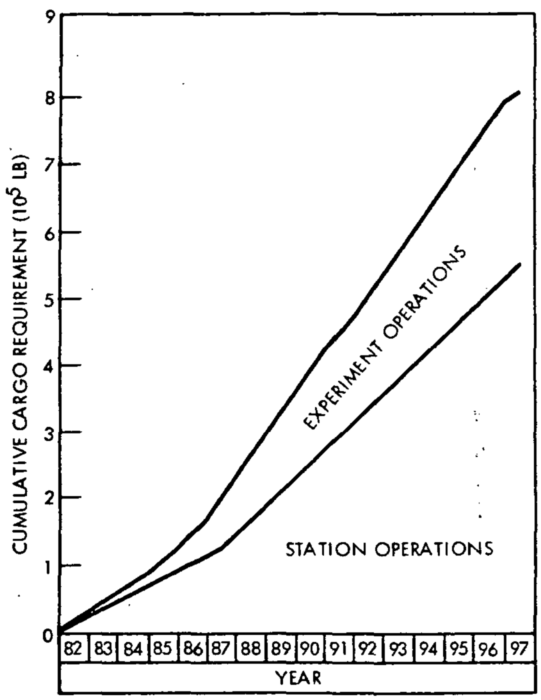


FIGURE 3.1.1.2.1 CUMULATIVE LOGISTICS REQUIREMENTS

3.1.1.3 PERSONNEL AND TRAINING

3.1.1.3.1 PERSONNEL ACTIVITY REQUIREMENTS

THE BASIC CREW WORK DAY HAS BEEN ESTABLISHED AS TEN HOURS, SIX DAYS PER WEEK. OVERALL CREW FUNCTIONS ARE CONSIDERED IN TERMS OF EXPERIMENT, EXPERIMENT SUPPORT, AND STATION OPERATIONS. TABLE 3.1.1.3.1 IDENTIFIES THESE FUNCTIONS.

TABLE 3.1.1.3.1 CREW RELATED ON-ORBIT FUNCTIONS

CREW PERSONAL ACTIVITIES	VEHICLE OPERATIONS	EXPERIMENT OPERATIONS (FPES)	CREW INTEGRATED OPERATIONS
EATING	FLIGHT OPERATIONS	DATA COLLECTION	EXPERIMENT SUPPORT
SLEEPING	ADMINISTRATION AND MANAGEMENT	ANALYSIS	INTEGRATED CREW ACTIVITIES
EXERCISE	MAINTENANCE	OBSERVATION	
RECREATION AND EDUCATION	HOUSEKEEPING AND SANITATION	MEASUREMENT	
PERSONAL HYGIENE	EMERGENCY OPERATIONS	FABRICATION AND TEST	
		OPERATIONS APPLICATION	

3.1.1.3.2 CREW SKILLS AND TRAINING

THE TWENTY-SEVEN IDENTIFIED CREW SKILLS AND THEIR ASSOCIATION WITH THE VARIOUS DISCIPLINES REQUIRED BY MODULAR SPACE STATION MISSIONS ARE SHOWN IN TABLE 3.1.1.3.2.

THE PROCESS BY WHICH DETAILED REQUIREMENTS ARE PROVIDED IS DEPENDENT ON MISSION AND OPERATIONS FUNCTIONS, THE CREW INTERFACE WITH THESE FUNCTIONS, AND THE MAN-MACHINE TRADE DECISIONS MADE DURING DESIGN DEFINITION.

CREW TASKS AND SKILLS REQUIREMENTS ARE BASED ON MISSION AND OPERATIONAL FUNCTIONAL ANALYSES AND ON HARDWARE MANAGEMENT AND OPERATION REQUIREMENTS. THE CREW TASKS ARE BROKEN DOWN INTO ELEMENTS OF WORK; AND FROM THESE DATA, THE TASKS AND ELEMENTS ARE LOGICALLY GROUPED TO IDENTIFY REQUIREMENTS FOR TRAINING, TRAINING EQUIPMENT, GRAPHICS, COURSES, AND COURSE MATERIAL.

TABLE 3.1.1.3.2 CANDIDATE CREW SKILLS VS DISCIPLINE

SKILLS / DISCIPLINE	BIOLOGICAL TECHNICIAN	MICROBIOLOGICAL TECH	BIOCHEMIST	PHYSIOLOGIST	ASTRONOMER/ASTROPHYSICIST	PHYSICIST	NUCLEAR PHYSICIST	PHOTO TECH/CARTOGRAPHER	THERMODYNAMICIST	ELECTRONIC ENGINEER	MECHANICAL ENGINEER	ELECTROMECHANICAL TECH	MEDICAL DOCTOR	OPTICAL TECHNICIAN	OPTICAL SCIENTIST	METEOROLOGIST	MICROWAVE SPECIALIST	OCEANOGRAPHER	PHYSICAL GEOLOGIST	PHOTO GEOLOGIST	BEHAVIORAL SCIENTIST	CHEMICAL TECHNICIAN	METALLURGIST	MATERIALS SCIENTIST	PHYSICAL CHEMIST	AGRONOMIST	GEOGRAPHER
LIFE SCIENCES	X	X	X	X								X	X	X							X	X					
ASTRONOMY					X	X				X		X		X	X												
COMM/NAVIGATION										X		X		X			X										
EARTH OBSERVATION												X		X													
TECHNOLOGY						X			X	X	X	X															
SPACE PHYSICS					X	X	X		X			X													X		
MATERIALS SCIENCE	X											X										X	X				

3.1.2 SYSTEM DEFINITION

THIS SECTION CONTAINS A DESCRIPTION OF THE MODULAR SPACE STATION SYSTEM. THE INTERRELATIONSHIP OF THE MODULAR SPACE STATION SYSTEM TO OTHER SYSTEMS WITHIN THE SPACE STATION PROJECT IS SHOWN IN THE SPECIFICATION TREE OF FIGURE 3.1.2-1.

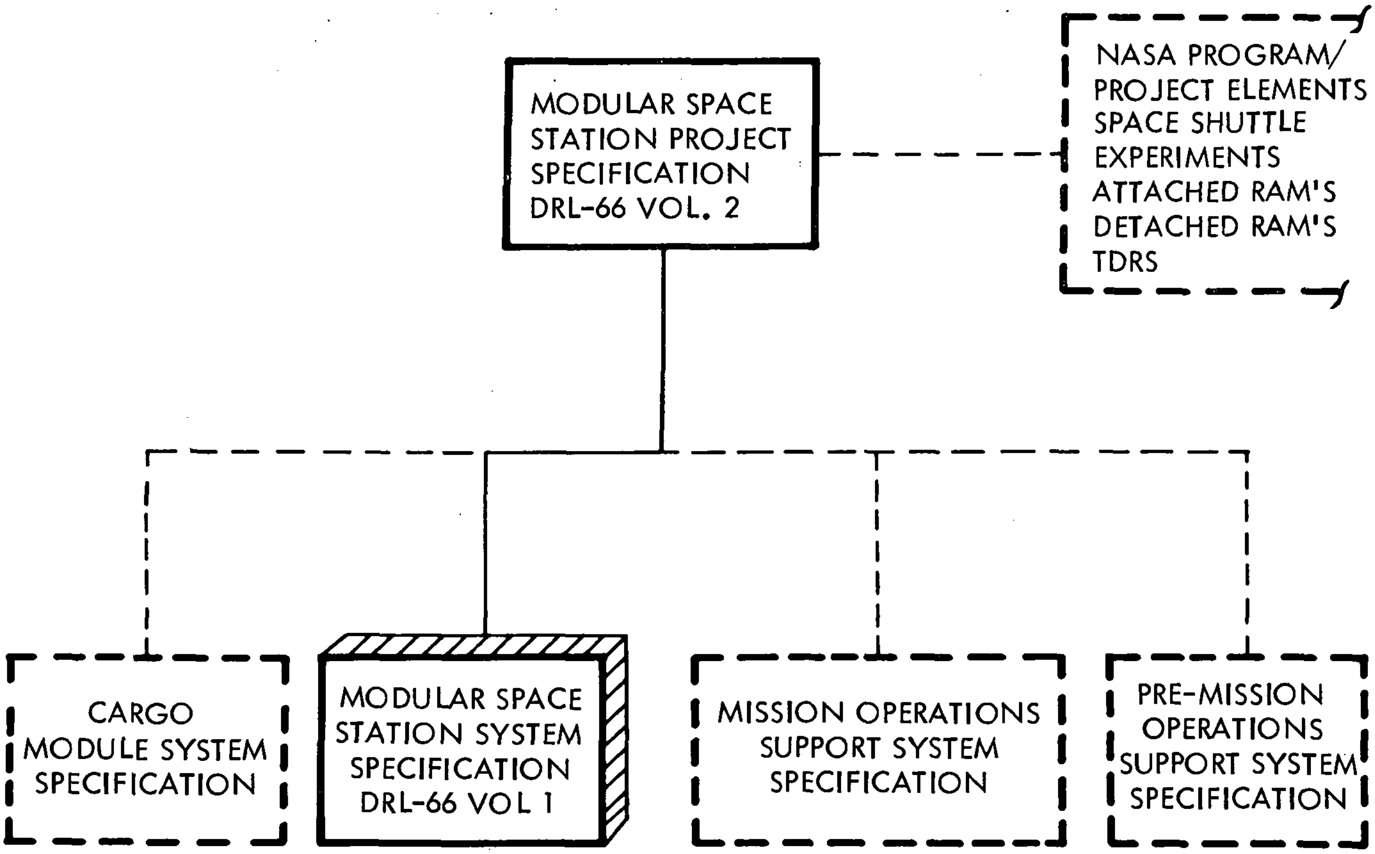


FIGURE 3.1.2-1 SPECIFICATION TREE

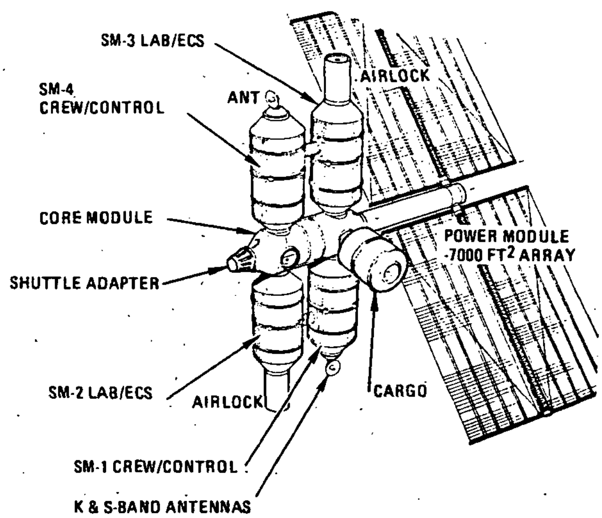
3.1.2.1 SYSTEM DESCRIPTION

THE MODULAR SPACE STATION SYSTEM CONSISTS OF A CLUSTER OF FOUR COMMON STATION MODULES, TWO SPECIAL MODULES (CORE AND POWER), AND A CARGO MODULE ARRANGED IN A CRUCIFORM CONFIGURATION AS SHOWN IN FIGURE 3.1.2.1-1 WITH DIMENSIONAL CHARACTERISTICS AS SHOWN IN FIGURE 3.1.2.1-2. EACH MODULE OF THE SYSTEM IS CAPABLE OF BEING TRANSPORTED TO AND FROM ORBIT INTERNAL TO THE SPACE SHUTTLE FOR ON-ORBIT ASSEMBLY.

THE INITIAL STATION SYSTEM HAS THE CAPABILITY TO SUPPORT AT LEAST SIX CREW-MEN, HAS A GENERAL PURPOSE LABORATORY (GPL) CAPABILITY, AND HAS THE ABILITY TO ACCOMMODATE TWO ATTACHED OR DETACHED RESEARCH AND APPLICATION MODULES. THE GPL CAPABILITY INCLUDES TWO AIRLOCKS, ONE EARTH ORIENTED, AND THE OTHER ZENITH ORIENTED.

THE MSS SYSTEM IS DESIGNED AND SIZED FOR OPERATION AT AN ALTITUDE OF 240 NAUTICAL MILES AND AN INCLINATION OF 55 DEGREES. THE BASIC FLIGHT MODE IS AN X-AXIS PERPENDICULAR TO THE ORBIT PLANE, THE Z-AXIS ALONG THE LOCAL VERTICAL, AND THE Y-AXIS OPPOSITE TO THE VELOCITY VECTOR (X-POP, Z-LV, Y-OVV). THIS MODE WILL BE FLOWN AT ALL TIMES EXCEPT FOR SHORT PERIODS OF INERTIAL FLIGHT FOR SOLAR/STELLAR VIEWING AND SHUTTLE APPROACH AND BERTHING UNBERTHING OPERATIONS. THE SYSTEM IS CAPABLE OF OPERATING AT ALTITUDES BETWEEN 240 AND 270 NAUTICAL MILES AT AN INCLINATION OF 55 DEGREES IN EITHER A LOCAL VERTICAL HOLD OR INERTIAL HOLD FLIGHT MODE, HOWEVER, THE NOMINAL MISSION IS 270 NAUTICAL MILES, 55 DEGREE INCLINATION, WITH THE ABOVE BASIC FLIGHT MODE.

ADDITIONAL SYSTEM CHARACTERISTICS ARE PRESENTED IN SUBSEQUENT PARAGRAPHS.



- MODULES
  - FOUR COMMON STATION MODULES
  - TWO SPECIAL MODULES
  - ONE CARGO MODULE
- ASSEMBLY/REPLACEMENT
  - MANIPULATOR BERTHING OR DIRECT DOCKING
  - ON-ORBIT REPLACEMENT ANTENNA PACKAGES, EXPERIMENT AIRLOCKS & SOLAR ARRAY

OPERATIONAL CONFIGURATION WITH TWO ATTACHED RAMS

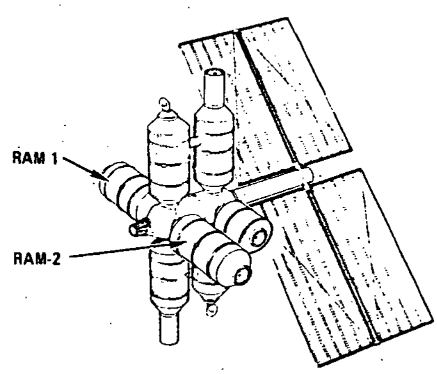


FIGURE 3.1.2.1-1 SPACE STATION CONFIGURATION

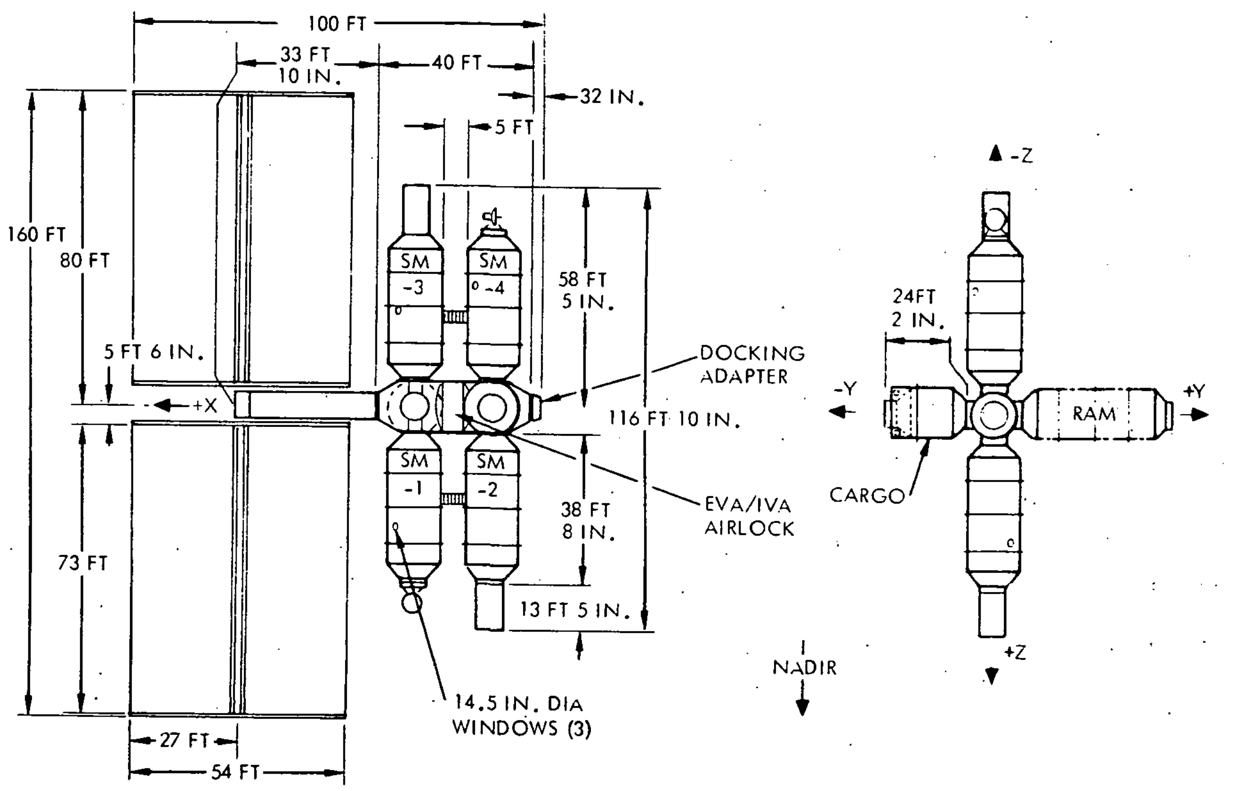


FIGURE 3.1.2.1-2 STATION DIMENSIONAL CHARACTERISTICS

3.1.2.2 SYSTEM MODULES (END ITEM LIST)

THE END ITEMS COMPRISING THE MODULAR SPACE STATION CONSIST OF TWO SPECIAL MODULES AND FOUR COMMON MODULES. THESE ARE DESCRIBED IN THE FOLLOWING SUBPARAGRAPHS.

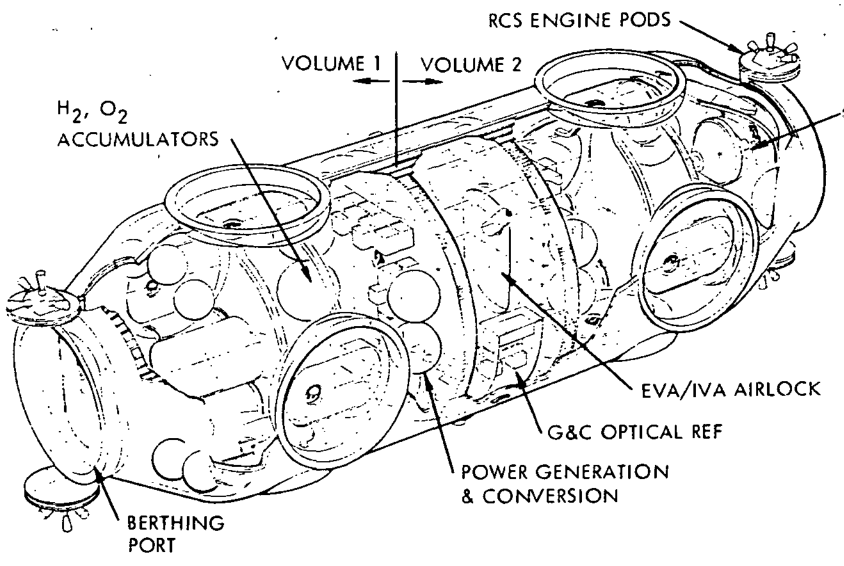
A. CORE MODULE

THE CORE MODULE IS 40 FEET LONG BETWEEN BERTHING INTERFACES AND IS 12 FOOT 8 INCHES OUTSIDE DIAMETER. THE 15-FOOT-DIAMETER ENVELOPE INTERSECTS THE EDGES OF THE SIDE-BERTHING PORTS CLUSTER. LIGHTWEIGHT SKIN (0.040-INCH ALUMINUM) AND STRINGER CONSTRUCTION IS UTILIZED. THE EIGHT SIDE-BERTHING PORTS ARE SPACED 20 FEET APART, WHICH ALLOWS A 5-FOOT CLEARANCE BETWEEN THE STATION MODULES. THE FOUR SIDE PORTS ARE PROVIDED WITH THERMAL COVERS. THERMAL CONTROL OF THE VERTICAL PORTS IS PROVIDED DURING BUILDUP WITH SPECIAL INSULATION PANELS.

THE INSTALLED SUBSYSTEMS ARE DISTRIBUTED BETWEEN THE V1 AND V2 VOLUMES SEPARATED BY THE EVA/IVA AIRLOCK. THE AIRLOCK PROVIDES AN EQUIVALENT FLOOR OF APPROXIMATELY 5 FEET BY 7 FEET. ALL OF THE HATCHES OPEN OUTWARD FROM THE AIRLOCK. THE EVA HATCH (40-INCH-DIAMETER CLEAR OPENING) IS LOCATED AT A 45-DEGREE ANGLE WHICH PROVIDES THE MAXIMUM CLEARANCE BETWEEN ATTACHED MODULES. THE G-C OPTICAL REFERENCE AND CMG'S ARE LOCATED ADJACENT TO THE RAM BERTHING PORTS.

CERTAIN BUILDUP EQUIPMENT IS ACCOMMODATED SUCH AS THE ANTENNAS, THERMAL CONTROL RADIATORS, RCS PROPELLANT, AND INITIAL POWER. ALL SUBSYSTEM COMPONENTS ARE INSTALLED WITH ON-ORBIT SHIRTSLEEVE MAINTENANCE ACCOMMODATIONS INCLUDING MAINTENANCE OF THE RCS ENGINE ASSEMBLIES. THE UTILITIES ROUTING THROUGHOUT THE MODULE FROM BERTHING PORT TO BERTHING PORT AND END TO END OF THE MODULE ARE REDUNDANT AND SEPARATED FOR DAMAGE CONTAINMENT AND SAFETY.

CORE MODULE



- MAX DIMENSIONS
  - LENGTH - 40 FT
  - DIA - 15 FT
- MAIN UTILITY DISTRIBUTION
  - WIRING
  - DUCTS
  - PLUMBING
  - REDUNDANT & SEPARATED
- DUAL VOLUME
  - SEPARATED FUNCTIONS
- LOW CREW OCCUPANCY
- CENTRALIZE G&C
  - RAM INTERFACE
  - ALIGNMENT
  - STABILITY

FIGURE 3.1.2.2-1 CORE MODULE

B. POWER MODULE

THE POWER MODULE CONSISTS OF TWO ASSEMBLIES, A POWER BOOM AND A SOLAR ARRAY. THE SOLAR ARRAY ASSEMBLY CONSISTS OF THE ARRAYS AND AN ORIENTATION DRIVE AND POWER TRANSFER MECHANISM. SHIRTSLEEVE MAINTENANCE OF THE MECHANISMS IS PROVIDED. THE SOLAR ARRAY ASSEMBLY IS REPLACEABLE AND UTILIZES THE STANDARD BERTHING PORT.

THE POWER BOOM IS 88 INCHES OUTSIDE DIAMETER BY 27 FEET 6 INCHES LONG AND 33 FEET 10 INCHES OVERALL LENGTH WITH THE ORIENTATION DRIVE AND POWER TRANSFER MECHANISM (ODAPT) ATTACHED. THE 88-INCH-DIAMETER BOOM ALLOWS THE SOLAR ARRAY PANELS TO STOW WITHIN THE 15-FOOT-DIAMETER SHUTTLE PAYLOAD ENVELOPE. THE BOOM IS OF MONOCOQUE CONSTRUCTION UTILIZING 0.145-INCH THICK ALUMINUM WHICH INCREASES ITS STIFFNESS AND CONSEQUENTLY INCREASES THE NATURAL FREQUENCY OF THE TOTAL SPACE STATION ASSEMBLY. HIGH-PRESSURE GAS STORAGE BOTTLES FOR REPRESSURIZATION ARE PLACED IN THE BOOM. SHIRTSLEEVE MAINTENANCE AND REPLACEMENT IS PROVIDED EVEN THOUGH THE MODULE IS NORMALLY OPERATED UNPRESSURIZED.

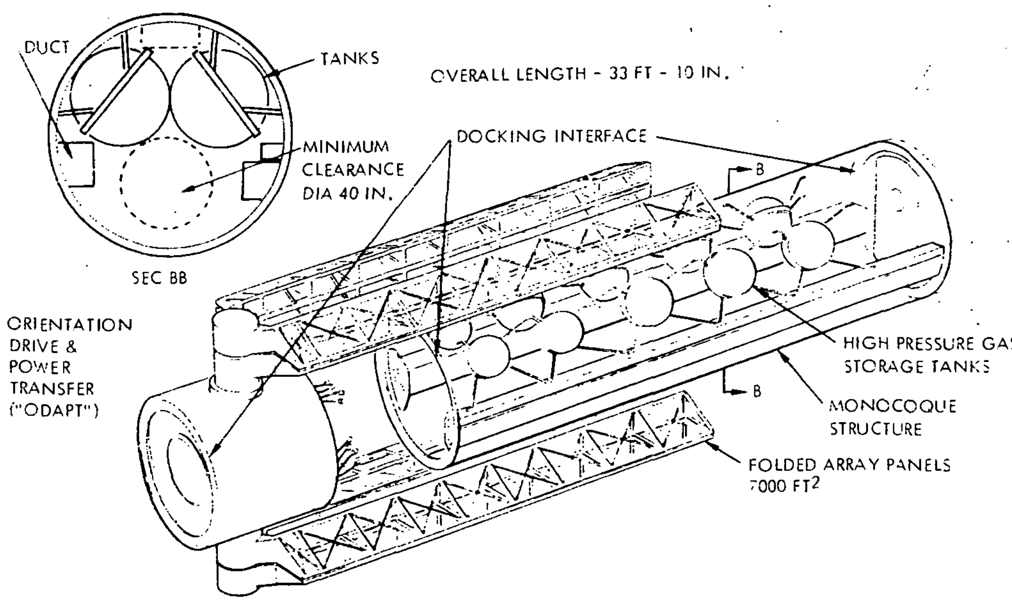


FIGURE 3.1.2.2-2 POWER MODULE

C. STATION MODULE FEATURES

ALL OF THE MODULES ARE 38 FEET 8 INCHES LONG BETWEEN BERTHING INTERFACES AND PROVIDE A 13-FOOT 8-INCH CLEAR INSIDE DIAMETER. THE EXTERNAL FRAMES AND ATTACH POINTS EXTEND TO 15 FEET. AN ACTIVE BERTHING PORT IS PROVIDED AT THE CORE MODULE INTERFACE AND A PASSIVE PORT AT THE OTHER END. THE INTERFACE PROVISIONS ACROSS THE BERTHING PORTS ARE IDENTIAL. EACH MODULE CONTAINS FOUR MANIPULATOR SOCKETS FOR SHUTTLE DEPLOYMENT AND FOUR SHUTTLE BAY ATTACH FITTINGS. RADIATORS COVER THE EXTERIOR OF THE CYLINDRICAL PORTION OF THE MODULES.

THE LONGITUDINAL FLOOR PROVIDES A SINGLE STRUCTURAL COMPONENT FOR MOUNTING OF EQUIPMENT BOTH ABOVE AND BELOW DECKS, GREATLY SIMPLIFYING THE MANUFACTURING INSTALLATION AND DESIGN DETAILS. THE LONGITUDINAL ORIENTATION ALSO SIMPLIFIES OTHER GROUND OPERATIONS OF MODULE ASSEMBLY, CHECKOUT, AND SHUTTLE INSTALLATION.

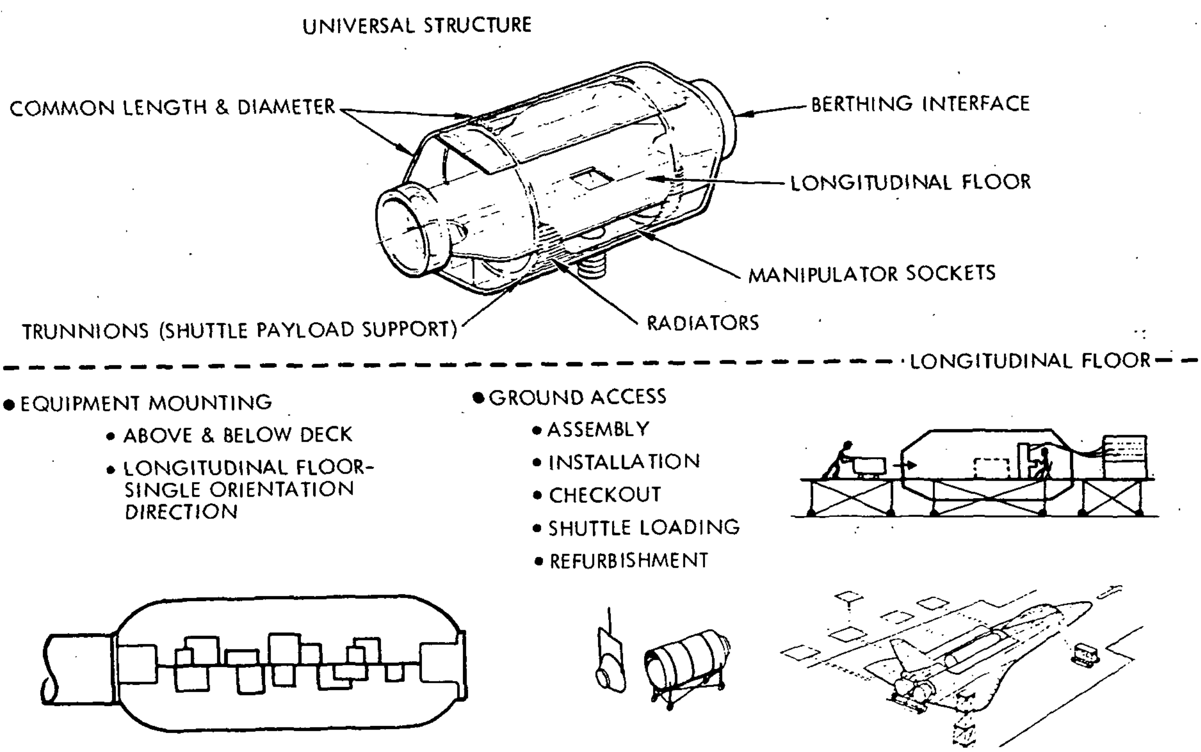


FIGURE 3.1.2.2-3 STATION MODULE FEATURES

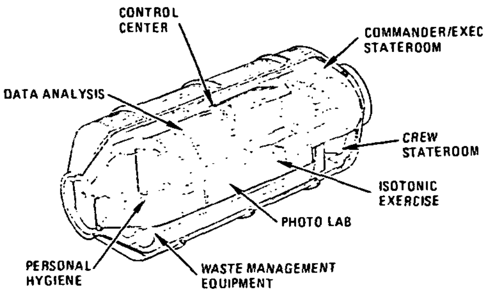
D. CREW/CONTROL STATION MODULES

THE TWO CREW/CONTROL MODULES, SM-1 AND SM-4, HAVE COMMON FUNCTIONAL ALLOCATIONS AND EQUIPMENT LOCATION. EACH MODULE PERFORMS A SIMILAR FUNCTION IN EACH OF THE TWO PRESSURE-ISOLATABLE VOLUMES OF THE STATION. WHERE BACKUP FUNCTIONS ARE PROVIDED, THEY ARE LOCATED IN SIMILAR AREAS IN THE MODULE OF THE OPPOSITE VOLUME.

BOTH SM-1 AND SM-4 CONTAIN A COMMANDER/EXECUTIVE TYPE STATEROOM AND TWO CREW STATEROOMS IN A SPLIT-LEVEL ARRANGEMENT. CONTROL CENTERS ARE LOCATED ON THE UPPER DECK OF EACH MODULE OUTSIDE THE STATEROOM. THE PERSONAL HYGIENE FACILITIES ARE IN SIMILAR LOCATION; HOWEVER, ONLY SM-1 CONTAINS A SHOWER. THE WASTE MANAGEMENT EQUIPMENT IS LOCATED BELOW DECK NEAR THE PERSONNEL HYGIENE FACILITY TO SIMPLIFY SEWAGE TRANSPORT AND PROCESSING.

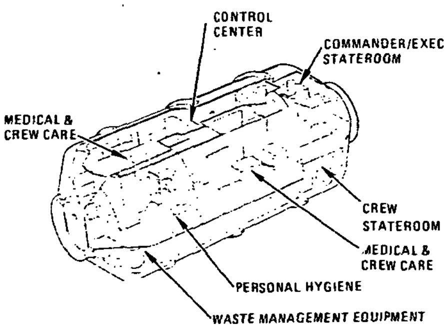
THE AREA ABOVE DECK IN SM-1 CONTAINS THE EXPERIMENT DATA ANALYSIS EQUIPMENT, INCLUDING A DATA ANALYSIS CONTROL CONSOLE, A PHOTO-PROCESSING LAB, AND AN ISOTONIC EXERCISE AREA. THE EXERCISE AREAS ARE ALSO EQUIPPED TO SERVE AS A BACKUP MEDICAL FACILITY. THE AREA ABOVE DECK IN SM-4 CONTAINS THE PRIMARY MEDICAL AND CREW CARE FACILITIES.

SM-1



• EQUIPMENT MOUNTING
  • LONGITUDINAL FLOOR-SINGLE ORIENTATION DIRECTION
  • COMMON MAINTENANCE & SERVICE ACCESS & TRAFFIC PATTERNS

• ACCOMMODATION COMMONALITY
  • STATEROOMS
  • CONTROL CENTERS
  • HYGIENE



SM-4

FIGURE 3.1.2.2-4 CREW/CONTROL STATION MODULES

E. LAB/ECS STATION MODULES

THE TWO LAB/ECS MODULES, SM-2 AND SM-3, ARE IN DIFFERENT ISOLATABLE VOLUMES OF THE STATION. WHERE BACKUP FUNCTIONS ARE PROVIDED, THEY ARE LOCATED IN SIMILAR AREAS IN THE MODULE OF THE OPPOSITE VOLUME.

THE LOWER DECK AREA OF STATION MODULES SM-2 AND -3 CONTAIN ENVIRONMENTAL CONTROL SUBSYSTEM ASSEMBLIES FOR AIR REVITALIZATION (CO2 MANAGEMENT AND ATMOSPHERE CONTROL). COMMON INSTALLATION ARRANGEMENTS PROVIDE EASY ACCESS FOR MAINTENANCE AND SERVICE. THE REMAINING LOWER DECK AREA IS FOR STORAGE OF STATION AND EXPERIMENT SUPPLIES.

THE ABOVE-DECK AREA IN SM-3 CONTAINS THE PRIMARY GALLEY/DINING AND RECREATION AREAS AS WELL AS GENERAL-PURPOSE LABORATORY FACILITIES. THE LAB CAPABILITY IS DESIGNED TO SUPPORT BOTH PHYSICS AND BIOMEDICAL EXPERMENTS. THE ABOVE-DECK AREA IN SM-2 CONTAINS PRIMARILY GENERAL-PURPOSE LABORATORY INSTALLATION; HOWEVER, A SMALL BACKUP GALLEY IS INSTALLED AT THE INBOARD END OF THE MODULE. GPL EQUIPMENT AND AREAS FOR MECHANICAL, ELECTRICAL, AND OPTICAL MAINTENANCE ARE PROVIDED.

A GENERAL-PURPOSE AIRLOCK IS ATTACHED TO THESE LAB MODULES. THE ONE ON SM-2 POINTS TO NADIR ON SM-3 TO ZENITH. AN EXPERIMENT OPERATIONS AREA AND AIRLOCK LOADING ACCESS SPACE IS PROVIDED IN EACH MODULE AT THE AIRLOCK END.

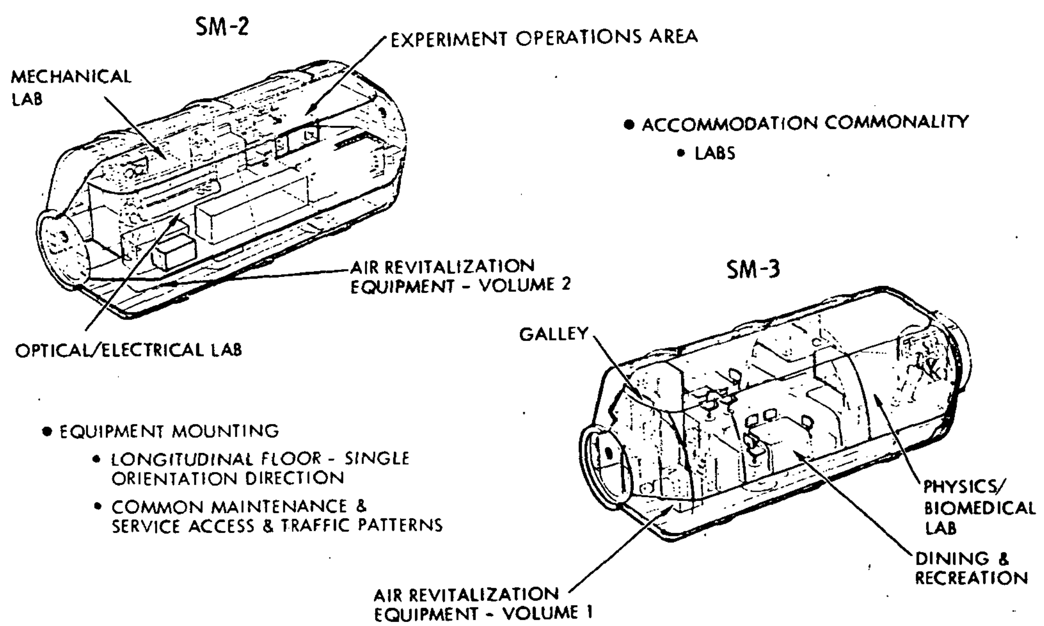


FIGURE 3.1.2.2-5 LAB/ECS STATION MODULES

3.1.2.3 STATION SUBSYSTEMS (SYSTEM ELEMENTS LIST)

THE SPACE STATION SYSTEM CONTAINS SEVEN FUNCTIONAL SUBSYSTEMS AS SHOWN IN FIGURE 3.1.2.3. THESE SUBSYSTEMS PROVIDE THE HARDWARE REQUIRED TO MEET THE DETAILED PERFORMANCE AND DESIGN REQUIREMENTS SPECIFIED IN PARAGRAPHS 3.3.1 THROUGH 3.3.7. A BRIEF FUNCTIONAL DESCRIPTION OF THE SUBSYSTEMS IS PRESENTED IN THE FOLLOWING PARAGRAPHS.

A. STRUCTURAL AND MECHANICAL SUBSYSTEM

THE STRUCTURAL AND MECHANICAL SUBSYSTEM PROVIDES THE SPACE STATION PRESSURE ENCLOSURE AS WELL AS THE LIVING AND WORKING QUARTERS CONTAINED WITHIN THE STRUCTURE. IT PROVIDES FOR THE MOUNTING OF ASSOCIATED SUBSYSTEM HARDWARE AND THE GENERAL PURPOSE LABORATORY PROVISIONS AND PROVIDES STORAGE FACILITIES. IT ALSO PROVIDES BERTHING PORTS AND MECHANISMS FOR CREW AND EQUIPMENT TRANSFER.

B. ENVIRONMENTAL CONTROL LIFE SUPPORT SUBSYSTEM

THE ENVIRONMENTAL CONTROL LIFE SUPPORT SUBSYSTEM (ECLSS) PROVIDES ESSENTIAL ATMOSPHERIC GASES, TEMPERATURE, PRESSURE, AND HUMIDITY CONTROL, FOOD STORAGE AND PREPARATION PROVISIONS, WATER AND WASTE MANAGEMENT, AND PERSONAL HYGIENE FACILITIES AND MATERIALS FOR MODULAR SPACE STATION OPERATION WITH A CREW OF SIX. THE SUBSYSTEM MAINTAINS THERMAL BALANCE OF THE MODULAR SPACE STATION AS WELL AS EMERGENCY REACTANT STORAGE FOR THE ELECTRICAL POWER AND REACTION CONTROL SUB-SYSTEMS. IN ADDITION, SPECIAL LIFE SUPPORT CAPABILITIES ARE PROVIDED FOR EMERGENCY CONDITIONS.

C. ELECTRICAL POWER SUBSYSTEM

THE ELECTRICAL POWER SUBSYSTEM SHALL STORE, GENERATE, REGULATE, CONTROL, AND CONDITION ELECTRICAL POWER REQUIRED BY THE MODULAR SPACE STATION FOR THE FULL DURATION OF THE MISSION, INCLUDING BACKUP AND EMERGENCY CONTINGENCIES (EXCEPT FOR EMERGENCY FUEL CELL REACTANTS WHICH ARE STORED BY THE ECLSS). IN ADDITION, THE ELECTRICAL POWER SUBSYSTEM SHALL BE CAPABLE OF TRANSFERRING POWER TO DOCKED LOGISTICS VEHICLES AND RESEARCH AND APPLICATIONS MODULES THROUGH ELECTRICAL INTERFACES. BESIDES POWER DISTRIBUTION, THE ELECTRICAL POWER SUBSYSTEM PROVIDES THE ELECTRICAL DISTRIBUTION WIRING OF ALL SUBSYSTEM INTERFACES.

THE ELECTRICAL POWER SUBSYSTEM SHALL PROVIDE FOR THE GENERAL LIGHTING NEEDS THROUGHOUT THE INTERIOR AND EXTERIOR OF THE SPACE STATION.

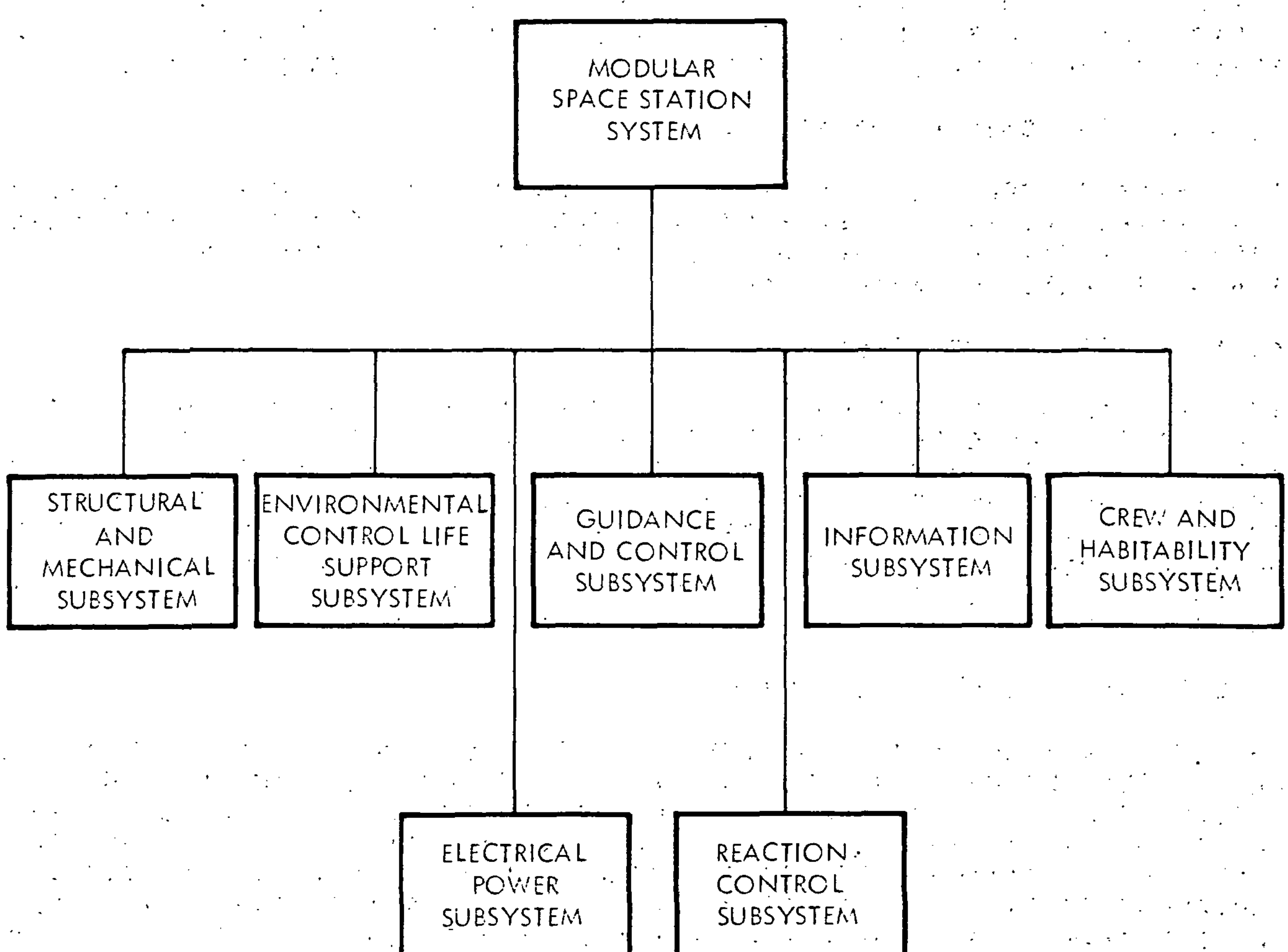


FIGURE 3.1.2.3 STATION SUBSYSTEMS

D. GUIDANCE AND CONTROL SUBSYSTEM

THE GUIDANCE AND CONTROL SUBSYSTEM (G AND C) DETERMINES THE ACTUAL AND DESIRED STATION STATE VECTOR, PROVIDES STABLE ATTITUDE FOR THE CONDUCT OF EXPERIMENT OPERATIONS, AND PROVIDES COMMANDS TO THE REACTION CONTROL SUBSYSTEM TO MANEUVER THE STATION TO THE DESIRED STATE VECTOR.

E. REACTION CONTROL SUBSYSTEM.

THE REACTION CONTROL SUBSYSTEM (TOGETHER WITH THE TORQUES SUPPLIED BY THE CONTROL MOMENT GYROSCOPES) PROVIDES THE FORCES AND MOMENTS NECESSARY FOR ATTITUDE CONTROL OF THE SPACE STATION AND THOSE FORCES REQUIRED FOR ORBIT ALTITUDE MAINTENANCE.

F. INFORMATION SUBSYSTEM

THE MODULAR SPACE STATION INFORMATION SUBSYSTEM PROVIDES THE EFFECTIVE ACQUISITION, PROCESSING, DISTRIBUTION, AND ANALYSIS OF DATA. IT SERVES MISSION PLANNING AND OPERATIONS SCHEDULING, COMMAND CONTROL, CHECKOUT, MONITOR AND ALARM, CONFIGURATION CONTROL, INVENTORY CONTROL, FLIGHT CONTROL, DATA MANAGEMENT, SUPPORT BETWEEN MSS SUBSYSTEMS, THE GROUND NETWORK, DOCKED VEHICLES (SPACE SHUTTLE, RAMS, AND CARGO MODULES), INTEGRAL EXPERIMENTS AND THE CREW USING COMMUNICATIONS, DISPLAYS AND CONTROLS, DATA PROCESSING, SOFTWARE, AND SPECIAL SUPPORT EQUIPMENT.

G. CREW HABITABILITY SUBSYSTEM

THE CREW HABITABILITY SUBSYSTEM SPECIFIES METABOLIC, ATMOSPHERIC, AND HABITABILY CRITERIA AND PROVIDES FOOD SUPPLIES, CLOTHING AND FURNISHINGS NECESSARY FOR CREW CONFORT, WELL BEING AND SURVIVAL. THE SUBSYSTEM PROVIDES GENERAL EQUIPMENT INCLUDING TOOLS, MOBILITY AIDES, EMERGENCY O2 MASKS AND RADIATION MONITORING DEVICES FOR THE CREW. IN ADDITION, EQUIPMENT IS PROVIDED FOR CREW RECREATION, EXERCISE, AND MEDICAL CARE. THE SUBSYSTEM ALSO PROVIDES PRESSURE SUITS, PORTABLE LIFE SUPPORT SYSTEMS AND RELATED EQUIPMENT FOR EVA/IVA OPERATIONS.

1.0 STRUCTURAL & MECHANICAL SUBSYSTEM

1.1 PRIMARY STRUCTURE

SIDEWALLS
BULKHEADS
FITTINGS (TRUNNION)
AIRLOCK

1.2 SECONDARY STRUCTURE

PARTITIONS
FLOORS
UTILITY DISTRIBUTION

DOORS/HATCHES
WINDOWS
CARGO HANDLING
FLEXPORTS
STORAGE

1.3 ENVIRONMENTAL SHIELD

THERMAL SHIELD
MICROMETEOROID SHIELD
RADIATION PROTECTION

1.4 BERTHING

MATING RING/LATCHES
UTILITIES INTERFACES

1.5 GENERAL PURPOSE LAB FURNISHINGS

AIRLOCKS
MEDICAL/BIOLOGICAL AREA
PHYSICS AREA
DATA ANALYSIS AREA
OPTICAL SUPPLY & MAINTENANCE AREA
ELECTRICAL/ELECTRONICS MAINTENANCE AREA
PHOTOGRAPHIC PROCESSING AREA
MECHANICAL MAINTENANCE AREA

2.0 ENVIRONMENTAL CONTROL LIFE SUPPORT SUBSYSTEM

2.1 GASEOUS STORAGE (O_2, N_2, H_2)

O_2 SUPPLY
N_2 SUPPLY
H_2 SUPPLY
PUMPDOWN

2.2 CO_2 MANAGEMENT

CO_2 REMOVAL
CO_2 REDUCTION
WATER ELECTROLYSIS

2.3 ATMOSPHERIC CONTROL

CIRCULATION
TEMPERATURE CONTROL
HUMIDITY CONTROL
PRESSURE CONTROL
CONTAMINANT CONTROL

2.4 THERMAL CONTROL

INTERNAL COOLANT LOOP
- RAM HX
- WATER PUMP PKG
- COLDPLATES

HEAT REJECTION LOOP
- RADIATORS
- FREON/WATER INTERCOOLER
- FREON PUMP PKG
- FREON RESERVOIR

2.5 WATER MANAGEMENT

WATER RECLAMATION
WATER STORAGE
PURITY CONTROL

2.6 WASTE MANAGEMENT

FECAL COLLECTION
URINE COLLECTION
TRASH PROCESSING

2.7 HYGIENE

FULL BODY WASHING
PARTIAL BODY WASHING
HOUSEKEEPING

2.8 SPECIAL LIFE SUPPORT

FIRE CONTROL
IVA SUPPORT
EVA/PLSS SUPPORT

3.0 ELECTRICAL POWER SUBSYSTEM

3.1 PRIMARY POWER GENERATION

SOLAR ARRAY
ORIENTATION DRIVE & POWER TRANSFER

3.2 SECONDARY POWER GENERATION

FUEL CELLS **

3.3 ENERGY STORAGE

FUEL CELLS
ELECTROLYSIS UNIT
STORAGE TANKS

3.4 POWER CONDITIONING

INVERTERS
REGULATORS
AUTOTRANSFORMERS
RECTIFIER - FILTER

3.5 DISTRIBUTION, CONTROL & WIRING

BUSES
WIRING
FEEDERS
EPS CONTROLS
CIRCUIT BREAKERS
CONTACTORS

3.6 LIGHTING

INTERNAL
EXTERNAL

** ENERGY STORAGE FUEL CELLS UTILIZED IN SECONDARY POWER GENERATION (EMERGENCY/BUILDUP POWER SOURCE)

4.0 GUIDANCE & CONTROL SUBSYSTEM

4.1 INERTIAL REFERENCE

STRAPDOWN IMU
IMU PREPROCESSOR

4.2 OPTICAL REFERENCE

HORIZON TRACKER (OPTICS & ELECTRONICS)
STAR TRACKER (OPTICS & ELECTRONICS)
SEXTANT/TELESCOPE
OPTICAL REFERENCE PREPROCESSOR
ALIGNMENT LINKS

4.3 RCS ELECTRONICS

JET DRIVER ELECTRONICS
RCS PREPROCESSOR

4.4 MOMENTUM EXCHANGE

CONTROL MOMENT GYROS
CMG PREPROCESSOR

4.5 COMPUTATION

SOFTWARE

5.0 REACTION CONTROL SUBSYSTEM

5.1 PROPELLANT ACCUMULATORS

H_2 ACCUMULATORS
O_2 ACCUMULATORS

5.2 PROPELLANT FEED CONTROLS

VALVES
REGULATORS

5.3 ENGINES

ENGINES/MOUNTS

6.0 INFORMATION SUBSYSTEM

6.1 DATA PROCESSING

DATA BUS CONTROL
CENTRAL TIMING
CENTRAL PROCESSOR
REMOTE PROCESSOR
RACU
BUILDUP DATA PROCESSOR

6.2 COMMAND/CONTROL AND MONITORING

OPERATIONAL CONTROL CONSOLE
COMMANDERS CONTROL CONSOLE
EMERGENCY G&C CONTROL
PORTABLE CONTROL UNIT
LOCAL MONITOR ALARM
MICROFILM PROJECTOR
SHUTTLE MOUNTED MONITOR

6.3 EXTERNAL COMMUNICATIONS

Ku BAND ANTENNA
Ku BAND ANTENNA MOUNTED ELECTRONICS
Ku BAND NON-INTEGRATED ELECTRONICS
S-BAND ANTENNA
S-BAND TRANSPONDER
VHF ANTENNA
VHF TRANSPONDER
BUILDUP COMMUNICATIONS

6.4 INTERNAL COMMUNICATIONS

COMMUNICATIONS RACK
RECORDING UNITS
AUDIO VIDEO UNITS
HARD WIRE INTERCOM
SHUTTLE/MODULE INTERFACE UNIT
TV CAMERAS COLOR
TV CAMERAS B&W
TV MONITORS COLOR

6.5 SOFTWARE

COMPUTER PROGRAMS
MICROFILM
PRINTER/FACSIMILE PAPER

7.0 CREW HABITABILITY SUBSYSTEM

7.1 PERSONAL EQUIPMENT

CLOTHING/LINENS
GROOMING AIDS
PERSONAL DOSIMETERS

7.2 GENERAL/EMERGENCY EQUIPMENT

TOOLS
PORTABLE LIGHTS
RADIATION DETECTION
EMERGENCY O_2 MASKS
PGA & SUPPORT
IVA UMBILICALS
PLSS + OPS
MOBILITY AIDS & RESTRAINTS
FIRST AID KITS

7.3 FURNISHINGS

SLEEPING RESTRAINTS/BUNKS
SEATING RESTRAINTS/CHAIRS
WORK SURFACES/DESKS
WORK SURFACES/TABLES
DINING SURFACE/TABLE

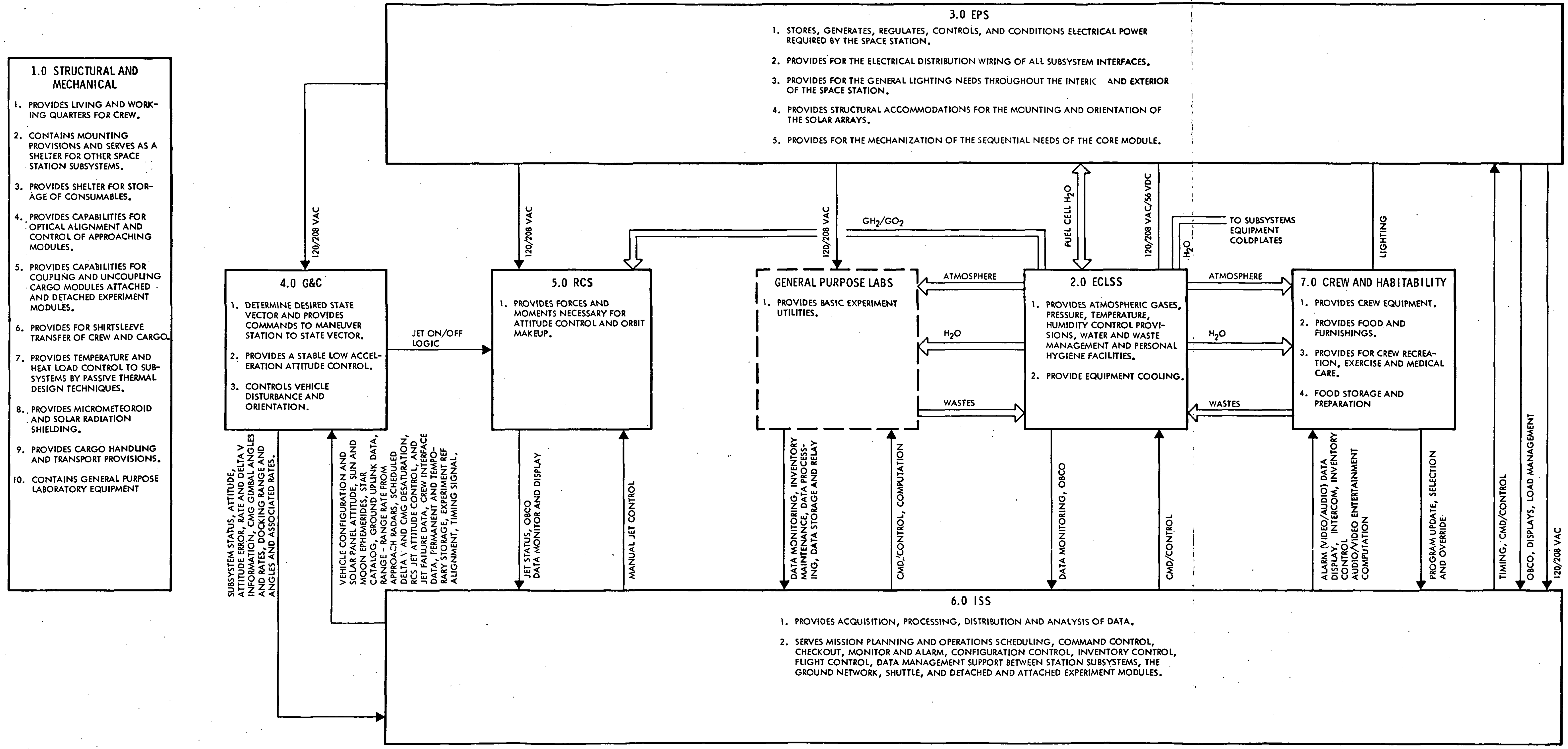
7.4 RECREATION/EXERCISE/CREW CARE

ACTIVE RECREATION DEVICES
PASSIVE RECREATION DEVICES
ERGOMETER/ISOTONIC EQUIP
MEDICAL/DENTAL EQUIP

7.5 FOOD MANAGEMENT.

SUPPLY
STORAGE
PREPARATION
SERVING AND CLEANUP
INVENTORY CONTROL

3.1.2.4 FUNCTIONAL HARDWARE TREE



3.1.2.5 FUNCTIONAL BLOCK DIAGRAM

3.1.2.6 FUNCTIONAL WEIGHT STATEMENT

MODULE DRY WEIGHT SUMMARY

	SUBSYSTEM/MAJOR ASSEM	CORE	POWER	SM-1	SM-2	SM-3	SM-4	TOTAL
WBS *	MODULE WBS *	01	02	03	04	05	06	
1	STRUCTURAL & MECHANICAL	12690	3670	10160	12330	10700	9490	59040
1.1	PRIMARY STRUCTURE	5742	1878	4700	4700	4700	4700	26420
1.2	SECONDARY STRUCTURE	3399	410	3218	3350	3446	3378	17201
1.3	ENVIRONMENTAL SHIELD	1119	582	746	735	746	746	4674
1.4	BERTHING	2430	800	490	490	490	490	5190
1.5	GENERAL PURPOSE LAB FURNISH	0	0	1006	3055	1318	176	5555
2	ENVIRONMENTAL CONTROL/LIFE SUPPORT	1619	849	3690	3310	3415	3420	16303
2.1	GASEOUS STORAGE	42	765	0	11	11	0	829
2.2	CO_2 MANAGEMENT	4	0	4	741	741	4	1494
2.3	ATMOSPHERIC CONTROL	750	84	587	876	876	554	3727
2.4	THERMAL CONTROL	681	0	1969	1570	1570	1969	7759
2.5	WATER MANAGEMENT	20	0	638	23	23	638	1342
2.6	WASTE MANAGEMENT	0	0	86	0	79	163	328
2.7	HYGIENE	0	0	370	27	53	56	506
2.8	SPECIAL LIFE SUPPORT	122	0	36	62	62	36	318
3	ELECTRICAL POWER	3790	7800	1762	545	545	1762	16204
3.1	PRIMARY POWER GEN	0	6676	0	0	0	0	6676
3.2	SECONDAY POWER GEN	0	0	0	0	0	0	0
3.3	ENERGY STORAGE	2449	985	766	0	0	766	4966
3.4	POWER CONDITIONING	379	0	16	16	16	16	443
3.5	DISTRIB. CONTROL & WIRING	776	115	834	383	383	834	3325
3.6	LIGHTING	186	24	146	146	146	146	794
4	GUIDANCE & CONTROL	1470	0	0	0	0	0	1470
4.1	INERTIAL REFERENCE	65						65
4.2	OPTICAL REFERENCE	346						346
4.3	RCS ELECTRONICS	75						75
4.4	MOMENTUM EXCHANGE	984						984
4.5	COMPUTATION	0						0
5	REACTION CONTROL	180	0	0	153	153	0	486
5.1	PROPELLANT ACCUMULATOR				88	88		176
5.2	PROP FEED CONTROLS	60			65	65		190
5.3	ENGINES	120						120
6	INFORMATION	462	116	2740	134	161	2640	6253
6.1	DATA PROCESSING	171	91	692	64	64	692	1774
6.2	COMMAND/CONTROL & MONITOR	59	4	478	40	40	478	1099
6.3	EXTERNAL COMMUNICATIONS	193	0	849	0	0	749	1791
6.4	INTERNAL COMMUNICATIONS	39	21	641	30	57	641	1429
6.5	SOFTWARE	0	0	80	0	0	80	160
7	CREW HABITABILITY	733	125	503	233	1271	990	3855
7.1	PERSONAL EQUIPMENT	0	0	0	0	0	0	0
7.2	GENERAL/EMERG EQUIP	733	125	145	145	145	145	1438
7.3	FURNISHINGS	0	0	220	0	160	206	586
7.4	RECREATION/EXER/CREW CARE	0	0	138	0	210	639	987
7.5	FOOD MANAGEMENT	0	0	0	88	756	0	844
SUBTOTAL (DRY WEIGHT)		20944	12560	18855	16705	16245	18302	103611

* WORK BREAKDOWN STRUCTURE CODE

3.1.2.7 FUNCTIONAL POWER STATEMENT

SUBSYSTEM/MAJOR ASSEMBLY		CORE	POWER	SM-1	SM-2	SM-3	SM-4	TOTAL
1.0	STRUCTURAL & MECHANICAL	0	0	0	0	0	0	0
2.0	ENVIRONMENTAL CONTROL/LIFE SUPPORT	489	5	2349	4109	308	799	8059
2.1	GASEOUS STORAGE	52						52
2.2	CO_2 MANAGEMENT	2		2	3229	2	2	3237
2.3	ATMOSPHERIC CONTROL	415	5	251	866	271	247	2055
2.4	THERMAL CONTROL			1500				1500
2.5	WATER MANAGEMENT			535			535	1070
2.6	WASTE MANAGEMENT			15		19	5	39
2.7	HYGIENE			36	4	6		46
2.8	SPECIAL LIFE SUPPORT	20		10	10	10	10	60
3.0	ELECTRICAL POWER	380	0	357	383	348	380	1848
3.1	PRIMARY POWER GEN							
3.2	SECONDARY POWER GEN							
3.3	ENERGY STORAGE							
3.4	POWER CONDITIONING							
3.5	DISTRIB. CONTROL & WIRING							
3.6	LIGHTING	380		357	383	348	380	1848
4.0	GUIDANCE & CONTROL	487	0	0	0	0	0	487
4.1	INERTIAL REFERENCE	145						
4.2	OPTICAL REFERENCE	195						
4.3	RCS ELECTRONICS	3						
4.4	MOMENTUM EXCHANGE	144						
4.5	COMPUTATION							
5.0	REACTION CONTROL	13	0	0	0	0	0	13
5.1	PROPELLANT ACCUMULATOR							
5.2	PROPELLANT FEED CONTROLS							
5.3	ENGINES	13						13
6.0	INFORMATION	372	138	1229	196	272	1557	3764
6.1	DATA PROCESSING	360	135	554	180	180	609	2018
6.2	COMMAND/CONTROL & MONITOR	6	1	442	12	12	475	948
6.3	EXTERNAL COMMUNICATIONS			98			175	273
6.4	INTERNAL COMMUNICATIONS	6	2	135	4	80	298	525
6.5	SOFTWARE							
7.0	CREW HABITABILITY	0	0	0	62	424	10	496
7.1	PERSONAL EQUIPMENT							
7.2	GENERAL/EMERG EQUIP.							
7.3	FURNISHINGS							
7.4	RECREATION/EXER/CREW CARE						10	10
7.5	FOOD MANAGEMENT				62	424		486
	SUBTOTAL	1741	143	3935	4750	1352	2746	14,667

3.1.2.8 EXPERIMENT PROVISIONS

THE MSS SHALL PROVIDE THE FOLLOWING SUPPORT CAPABILITY AT THE GPL AND/OR THE RAM INTERFACES.

A. FLOOR AREA-GPL

MEDICAL/BIOLOGICAL)	* 177
PHYSICS (SHARED SERIALLY)	
WITH MED/BIO))	
MECHANICAL MAINTENANCE)	
ELECTRICAL/ELECTRONIC MAINT)	273
OPTICAL SUPPLY-MAINTENANCE)	
DATA ANALYSIS	177
PHOTO PROCESSING	33
EXPERIMENT OPERATIONS	164
TOTAL	824

* SHARED BUT NOT SIMULTANEOUSLY

B. ELECTRICAL POWER - GPL AND ATTACHED RAMS

24 HOUR AVERAGE	4.5 KWATTS
PEAK POWER SUSTAINED FOR ONE HOUR OR ONE HOUR CUMULATIVE TIME IN ANY 12 HOUR PERIOD	7.0 KWATTS
MAX SUSTAINED (4 HR. CREW DAY)	6.29 KWATTS

NOTE - SECONDARY PERFORMANCE CAPABILITY - 30 KWH ANY 24 HOUR PERIOD

C. CREW MANPOWER - GPL AND RAMS

DEDICATED TO EXPERIMENTS	35 HOURS PER DAY

D. ENVIRONMENTAL CONTROL AND LIFE SUPPORT SUBSYSTEM - GPL AND RAMS

HABITABLE EXP. AREAS	SHIRT SLEEVE ENVIRON
AIRLOCK (EXP) PRESS/DEPRESS FREQUENCY	5 PER MO.
RAM PUMPDOWN AND REPRESS	EXP. PROVIDED
RAM LEAKAGE MAKEUP	1 LB/DAY

RAM ATMOS CIRCULATION AT INTERFACE	100 LBS/HOUR MAX
ATMOS PRESS. CONTROL	14.7 PSIA
HUMIDITY CONTROL (ABOVE CREW)	0.1 LB/DAY
CONTAMINATION CONTROL	STATION EQUIVALENT
EXP. ATMOS. THERMAL LOAD	EXP. PROVIDED
WATER COOLANT - GPL AND RAMS	4.5 KWATTS
POTABLE WATER FOR EXP.	35 LBS/DAY MAX
WASTE MANAGEMENT	67 LBS/MO.
HYGIENE - EXP.	EXP. PROVIDED
FOOD MGMT - EXP.	EXP. PROVIDED

E. GUIDANCE AND CONTROL -

ATTITUDE HOLD	
NADIR AND INERTIA	+/- 0.5 DEG
FINE POINTING	+/- 0.1 DEG FOR 30 MIN
STABILITY	
ANGULAR RATE LIMIT	0.05 DEG/SEC
FINE POINTING	0.01 DEG/SEC
INSTANT ATT. KNOWLEDGE	0.10 DEG
STATION POSITION EPHEMERIS	
ALTITUDE	+/- 1500 FT (1 SIGMA)
IN TRACK	+/- 3800 FT (1 SIGMA)
CROSS TRACK	+/- 2200 FT (1 SIGMA)
ORBITAL VELOCITY	+/- 3.5 FT/SEC
EXP ANGULAR IMPULSE	
24 HOUR AVE	10,000 FT-LB-SEC
EXPERIMENT TORQUE	100 FT-LB
OPERATIONAL ACCELERATIONS	
CMG DESATURATION AND ORBIT MAKEUP	1.4X10(-4)G MAX FOR 140 SEC
BERTHING	4.0X10(-2)G MAX FOR 0.3 SEC
QUIESENT - 6 HOURS CONTINUOUS	10(-4)G MAX
- 2 HOURS CONTINUOUS	10(-5)G MAX

F. INFORMATION SUBSYSTEM

COMMUNICATION - EXTERNAL

VOICE - FULL DUPLEX	4 CHANNELS MAX
EXP TLM - DRAM TO MSS	2 CHANNELS
EXP TLM - MSS TO GROUND	1 CHANNEL REALTIME

EXP CONTROL - MSS TO DRAM	2 CHANNELS SIMPLEX
DIGITAL TEXT/FACSIMILE	1 CHANNEL
TV - B/W OR COLOR - MSS TO GND	1 CHANNEL
TV - B/W DRAM TO MSS	2 CHANNELS

COMMUNICATION - INTERNAL

VOICE - PRIVATE/CONFERENCE/PA	TBD CHANNELS
CCTV - B/W OR COLOR	7 CHANNELS
RECORD/PLAYBACK -	AUDIO/VIDEO/DIGITAL REAL TIME

TRACKING - DRAMS 850 NM TO 1000 FT +/- 500 FT/0.5 FT/SEC

DATA PROCESSING

DATA ACQUISITION	2 MBPS
STORAGE	1 ARCHIVE RECORDER
PROCESS	0.8 CENTRAL COMPUTER TBD

3.1.2.8.1 MSS PROVIDED GPL EXPERIMENT SUPPORT FUNCTIONS

THE MSS SHALL PROVIDE THE FOLLOWING EXPERIMENT SUPPORT FUNCTIONS AS PART OF THE BASE GPL CONFIGURATION (CFE WITH MSS).

EXPERIMENT SUPPORT FUNCTIONS

NO	NAME	LAB AREA
A015	ANALYSIS, HYDROCARBON	BIOLOGICAL/BIOMEDICAL
A016	ANALYSIS, NITROGEN	BIOLOGICAL/BIOMEDICAL
A017	AIRLOCK PROVISION	PHYSICS
C005	CELL COUNTING	BIOLOGICAL/BIOMEDICAL
C006	COLORIMETRY	BIOLOGICAL/BIOMEDICAL
C007	CYTOLOGICAL STAIN PREP	BIOLOGICAL/BIOMEDICAL
C009	CULTURING, BACTERIA	BIOLOGICAL/BIOMEDICAL
C022	CRYO STORAGE	FLUID SYSTEMS TEST / MAINT.
C029	CENTRIFUGE CLINICAL (GD)	BIOLOGICAL/BIOMEDICAL
D014	DATA RETRIEVAL/VIEWING	DATA ANALYSIS
H001	HISTOLOGY	BIOLOGICAL/BIOMEDICAL
L002	LIGHTING, PHOTO AND TV	OPTICAL SUPPLY / MAINT.
L005	LYOPHILIZATION	BIOLOGICAL/BIOMEDICAL

M001	MAINT. AND CALIB. MECHANICAL	MECHANICAL MAINT.
M002	MAINT. AND CALIB. ELECTRICAL	ELECTRICAL MAINT.
M003	MAINT. AND CALIB. OPTICAL	OPTICAL SUPPLY / MAINT.
M004	MAINT. AND CALIB. FLUID SYSTEM	FLUID SYSTEM TEST / MAINT.
P002	PHOTOGRAPHY, CINE - INT	OPTICAL SUPPLY / MAINT.
P003	PHOTOGRAPHY, STILL	OPTICAL SUPPLY / MAINT.
P011	PHOTOGRAPHIC PROCESSING	PHOTO PROCESSING
P013	PRESERVATION, CULTURE (REFRIGERATION)	BIOLOGICAL/BIOMEDICAL
P014	PRESERVATION, CULTURE (OVEN)	BIOLOGICAL/BIOMEDICAL
S008	SPECTROMETRY, MASS	PHYSICS
S017	STERILIZATION	BIOLOGICAL/BIOMEDICAL
V004	VIEWING AIRLOCK WINDOW	PHYSICS

EXPERIMENT FUNCTION

R008	REFLECTOMETER, PORTABLE-MEASURING	PHYSICS

3.1.3 OPERABILITY

3.1.3.1 RELIABILITY

THE REDUNDANCY REQUIREMENTS UTILIZED FOR THE MSS SUBSYSTEMS ARE ESTABLISHED BY THE APPLICATION OF THE FAILURE TOLERANCE CRITERIA AND ASSOCIATED FAILURE DEFINITIONS. IN ADDITION TO THE FAILURE TOLERANCE CRITERIA, SPECIFIC REQUIREMENTS ARE ESTABLISHED FOR THOSE AREAS THAT ARE CONSIDERED UNIQUE. THE FOLLOWING TABLE DEFINES THE MINIMUM ALLOWABLE NUMBER OF COMPONENT FAILURES WHICH MAY RESULT IN THE INDICATED OPERATIONAL MODE.

	ALLOWABLE NUMBER OF COMPONENT FAILURES TO REACH OPERATIONAL MODE	
OPERATIONAL MODE	STATION OPERATION (MANNED)	BUILD-UP (UNMANNED)
NORMAL	0	0
NOMINAL	1	-
DEGRADED	2	1
EMERGENCY	3	2

A. THE STATION SHALL BE CAPABLE OF OPERATING WITH ALL CRITICAL FUNCTIONS PERFORMED WITHIN SPECIFIED VALUES FOLLOWING ONE COMPONENT FAILURE OR ANY PORTION OF A SUBSYSTEM INACTIVE FOR MAINTENANCE. THIS CONDITION SHALL CONTINUE UNTIL MAINTENANCE CAN BE PERFORMED.

B. THE STATION SHALL BE CAPABLE OF OPERATING WITH SOME CRITICAL FUNCTIONS PERFORMED AT A REDUCED LEVEL, BUT NOT BELOW THE LEVEL NECESSARY FOR CREW SURVIVAL, FOLLOWING ANY CREDIBLE COMBINATION OF TWO COMPONENT FAILURES OR ONE COMPONENT FAILURE WITH ANY PORTION OF A SUBSYSTEM INACTIVE FOR MAINTENANCE OR ANY CREDIBLE ACCIDENT (E.G., LOSS OF ANY PRESSURE ISOLATABLE VOLUME). THIS CONDITION SHALL CONTINUE UNTIL MAINTENANCE CAN BE PERFORMED, BUT NO MORE THAN 30 DAYS OR UNTIL ARRIVAL OF THE NEXT SCHEDULED SHUTTLE.

C. THE STATION SHALL BE CAPABLE OF CREW SURVIVAL FOR AT LEAST 96 HOURS TO PERMIT RESTORATION OF OPERATIONS OR RESCUE OF THE CREW BY EMERGENCY SHUTTLE FOLLOWING ANY CREDIBLE COMBINATION OF THREE COMPONENT FAILURES OR ANY CREDIBLE COMBINATION OF 3 COMPONENT FAILURES AND PORTIONS OF A SUB-SYSTEM INACTIVE FOR MAINTENANCE OR ANY CREDIBLE ACCIDENT (E.G., LOSS OF ANY PRESSURE ISOLATABLE VOLUME) AND ANY SINGLE COMPONENT FAILURE.

D. THE STATION (DURING STATION BUILDUP-PREMANNING) SHALL BE CAPABLE OF BEING MANNED (SHIRTSLEEVE OR IVA) FOR PERFORMANCE OF MAINTENANCE AND STATION ASSEMBLY TASKS FOLLOWING ANY ONE COMPONENT FAILURE. THIS CAPABILITY SHALL CONTINUE UNTIL ARRIVAL OF THE NEXT SCHEDULED SHUTTLE.

E. THE STATION (DURING STATION BUILDUP-PREMANNING) SHALL BE CAPABLE OF BEING MANNED (SHIRTSLEEVE OR IVA) FOR AT LEAST 96 HOURS TO ACCOMMODATE AN EMERGENCY SHUTTLE FLIGHT TO PERFORM MAINTENANCE FOLLOWING ANY TWO COMPONENT FAILURES.

F. NON-TIME CRITICAL FUNCTIONS, ULTIMATELY CRITICAL TO CREW SURVIVAL, REQUIRE STANDBY REDUNDANCY AS A MINIMUM.

G. SUBSYSTEM OR COMPONENT FAILURES SHALL NOT PROPAGATE SEQUENTIALLY, EQUIPMENT SHALL BE DESIGNED TO FAIL SAFE.

H. DESIGN APPLICATION OF ELECTRICAL AND ELECTRONIC COMPONENTS AND PARTS SHALL PROVIDE APPROPRIATE DERATING AND CONTROLLED MARGINS OF PERFORMANCE SUCH THAT, PERFORMANCE VARIABLES WILL NOT CAUSE UNACCEPTABLE SUBSYSTEM INTERACTIONS RELATED TO LONG USEFUL LIFE REQUIREMENTS.

I. ALL CRITICAL LIFE LIMITED COMPONENTS AND SUBSYSTEMS SHALL BE DESIGNED TO ALLOW GROUND AND ORBIT INSPECTION.

J. SPACE STATION CONFIGURATION DESIGN AND ARRANGEMENTS SHALL PROVIDE ACCESS FOR INSPECTION OF CRITICAL HARDWARE, INCLUDING PYROTECHNICS (ON THE GROUND) AFTER DEVICE INSTALLATION.

K. HARDWARE DESIGN SHALL CONSIDER STATE OF THE ART FOR MATERIAL SELECTION SUCH THAT WEAR, CORROSION, LUBRICANT DEPLETION, ETC., WILL NOT DEGRADE PERFORMANCE BEYOND SPECIFIED TOLERANCES FOR SUBSYSTEM OR STRUCTURAL PERFORMANCE.

L. EQUIPMENT OR MATERIAL SENSITIVE TO CONTAMINATION SHALL BE HANDLED IN A CONTROLLED ENVIRONMENT. FLUIDS AND MATERIALS SHALL BE COMPATIBLE WITH THE COMBINED ENVIRONMENT IN WHICH THEY ARE EMPLOYED. PROCESS SPECIFICATIONS SHALL BE FORMULATED TO PRESCRIBE HANDLING AND APPLICATION METHODS.

M. TIME CRITICAL FUNCTIONS AFFECTING CREW SURVIVAL REQUIRE AN ALTERNATIVE MEANS OF PROVIDING THE FUNCTION. THIS ALTERNATE MODE MUST BE PROVIDED BY ACTIVE REDUNDANCY, OR STANDBY REDUNDANCY AUTOMATICALLY ACTIVATED UPON FAILURE OF THE PRIME EQUIPMENT, OR BY OTHER EQUIPMENT PROVIDING NORMAL OPERATION FOR A TIME PERIOD EQUAL TO A MAINTENANCE CYCLE PLUS A MARGIN OF SAFETY FOR MAINTENANCE DIFFICULTIES INCLUDING LACK OF ACCESS DUE TO ISOLATION OF A DAMAGED MODULE.

N. NOTIFICATION OF LOSS OF ACTIVE REDUNDANCY FOR CRITICAL FUNCTIONS SHALL BE IMMEDIATELY AVAILABLE TO THE INFORMATION SUBSYSTEM AND THE CREW.

O. REDUNDANT PATHS, SUCH AS FLUID LINES, ELECTRICAL WIRING, AND CONNECTORS, SHALL BE LOCATED SO THAT AN EVENT WHICH DAMAGES ONE PATH IS NOT LIKELY TO DAMAGE THE OTHER.

P. CONSERVATIVE FACTORS OF SAFETY SHALL BE PROVIDED WHERE CRITICAL SINGLE FAILURE POINT MODES OF OPERATION CANNOT BE ELIMINATED (PRESSURE VESSELS, PRESSURE LINES, VALVES, ETC.).

Q. ALL OF THE SUBSYSTEMS THAT INCORPORATE AN AUTOMATED FAIL/OPERATIONAL CAPABILITY WILL BE DESIGNED TO PROVIDE CREW NOTIFICATION AND DATA MANAGEMENT SYSTEM COGNIZANCE OF COMPONENT MALFUNCTION UNTIL THE ANOMALY HAS BEEN CORRECTED.

R. ALL EQUIPMENT ASSOCIATED WITH VENTING TO SPACE SHALL BE DESIGNED IN SUCH A MANNER THAT A FAILURE OF ANY COMPONENT SHALL NOT RESULT IN THE LOSS OF THE ATMOSPHERE FROM A PRESSURE VOLUME.

3.1.3.2 MAINTAINABILITY

THE MAINTENANCE APPROACH ESTABLISHED FOR THE MSS IS 100 PERCENT ON ORBIT MAINTENANCE AS A GOAL UTILIZING THE IN FLIGHT REPLACEABLE UNIT CONCEPT. WHERE ON ORBIT REPLACEMENT APPEARS IMPRACTICAL, REQUIREMENTS FOR LONG LIFE ARE ESTABLISHED TO MINIMIZE THE NEED FOR MODULE RETURN. SPECIFIC REQUIREMENTS FOR AUTOMATIC AND MANUAL SWITCHING TO REDUNDANT MODES ARE PROVIDED IN THIS SECTION AS RELATED TO TIME CRITICAL AND NON-TIME CRITICAL FAILURES TO PROCLUDE MAINTENANCE CRISIS.

A. IN THE DESIGN OF SUCH THINGS AS INSULATION PANELS, BERTHING PORT SEALS AND RADIATOR PANELS, MATERIAL SELECTION SHALL AFFORD A USEFUL LIFE OF TEN YEARS.

B. THE MAXIMUM ENVELOPE SIZE FOR AN IFRU IS 40 X 40 X 50 INCHES EXCEPT IFRU'S AND EXPENDABLES FOR CRITICAL FUNCTIONS WHICH MUST BE CAPABLE OF PASSING THROUGH SECONDARY ACCESS HATCHES OF 22 X 22 X 50 INCHES.

C. IFRU'S WHICH ARE REQUIRED TO BE OPERATIONAL DURING VARIOUS PHASES OF BUILDUP, REQUIRE CONSIDERATIONS FOR IVA MAINTENANCE (I.E., PERFORMANCE OF MAINTENANCE BY A PRESSURE SUITED CREWMAN).

D. IFRU'S WHICH ARE PART OF TIME CRITICAL FUNCTIONS SHALL ALLOW FOR TWO CONSECUTIVE UNSUCCESSFUL REPAIRS BEFORE RESULTING IN A CRITICAL CONDITION.

E. ISOLATION VALVES FOR IFRU REPLACEMENT SHALL BE KEPT TO A MINIMUM WHERE THE IFRU HAS A LOWER RANDOM FAILURE RATE THAN THE ISOLATION VALVE OR WHERE REDUNDANT LOOPS CAN BE UTILIZED DURING MAINTENANCE.

F. A MINIMUM OF 0.5 HOURS SHALL BE ALLOWED FOR FAILURE DETECTION, ISOLATION AND VERIFICATION FOLLOWING REPAIR, IN ADDITION TO THE ESTIMATED REPAIR TIME, FOR EACH MAINTENANCE OR GROUP OF MAINTENANCE ACTIONS.

G. MAINTENANCE ACTIVITY MAY BE DEFERRED FOR A PERIOD OF 30 DAYS WHERE LOST FUNCTIONS ARE NOT CRITICAL TO CREW SAFETY OR SPACE STATION SURVIVAL.

H. EQUIPMENT DETERMINED TO BE CRITICAL FOR CREW LIFE SUPPORT OR SPACE STATION SURVIVAL REQUIRES ONBOARD SPARES.

I. REPLACEABLE UNITS SHALL BE DESIGNED SUCH THAT THE REMOVAL OF THE UNIT DOES NOT DISTURB INTEGRAL STRUCTURE OF THE MODULE.

J. PRIMARY MODULE THERMAL INSULATION SHOULD BE DESIGNED AND INSTALLED IN PANELS THAT CAN BE REMOVED AND REPLACED.

K. SCHEDULED MAINTENANCE SHALL NOT RESULT IN THE LOSS OF NORMAL SPACE STATION OPERATIONS.

L. SPARE IFRU'S SHALL BE LOCATED AS CLOSE TO THE POINT OF INTENDED USE AS PRACTICAL. CONSIDERATION MAY BE APPLIED TO DUPLICATE SPARES IN EACH PRESSURE ISOLATABLE VOLUME.

M. IFRU'S SHALL NOT EXCEED 60 POUNDS WHERE POSSIBLE (1-G LIMIT FOR ONE CREW MEMBER), 120 POUNDS AS AN UPPER LIMIT (ZERO-G LIMIT FOR ONE CREW MEMBER) WHERE PRACTICAL.

N. WHERE RECONFIGURATION IS ANTICIPATED AT SOME FUTURE DATE, PREPLANNED INSTALLATION TECHNIQUES SHOULD BE ESTABLISHED AND INCORPORATED BEFORE THE FIRST LAUNCH OF THE MODULE.

O. PROVISIONS SHALL BE INCORPORATED FOR LIMITED CHECKOUT OF NEW REPLACEMENT ITEMS BEFORE BRINGING THE SUBSYSTEM BACK ON LINE.

P. CONSIDERATIONS SHALL BE GIVEN TO THE PLACEMENT OF APPROPRIATE SENSORS FOR ALL ITEMS REQUIRING INSPECTION ON-ORBIT WHICH ARE INACCESSIBLE OR REQUIRE FREQUENT TESTING.

Q. UTILITY JUMPERS SHALL BE DESIGNED FOR A MINIMUM USEFUL LIFE OF TEN YEARS.

R. IF ALLOWABLE DOWNTIME IS ABOUT TO EXPIRE, REPAIR ACTIVITY WILL TAKE PRIORITY OVER SCHEDULED MAINTENANCE.

S. ATMOSPHERIC MAKE-UP SHOULD CONSIDER INCREASED STATION LEAKAGE DUE TO PROGRESSIVE SEAL DEGRADATION.

T. WHERE CRITICAL FUNCTIONS ARE INVOLVED, EQUIPMENT SPACE ALLOCATIONS SHALL ALLOW FOR PERFORMANCE OF IVA MAINTENANCE.

U. EQUIPMENT SHALL BE DESIGNED FOR ADJUSTMENT, MAINTENANCE, CALIBRATION, REPAIR AND REPLACEMENT WITHOUT TOOLS WHERE PRACTICAL, STANDARD TOOLS WHERE NECESSARY AND SPECIAL TOOLS WHERE ESSENTIAL. PRECISION ELEMENTS WILL BE PROVIDED WITH SUITABLE GUIDES AND LOCKING DEVICES TO AID REPLACEMENT.

V. EQUIPMENT WITH LIMITED LIFE COMPONENTS SHALL BE LOCATED FOR EASE OF ACCESSIBILITY CONSIDERING PERIODIC INSPECTION AND/OR REPLACEMENT REQUIREMENTS. VEHICLE DESIGN AND ARRANGEMENT SHALL PROVIDE ACCESS FOR INSPECTION, MAINTENANCE, OR REPAIR.

W. FOLLOWING A FAILURE IN A CRITICAL FUNCTION, AUTOMATIC SWITCHING FOR REDUNDANCY IS REQUIRED IF IMPAIRMENT OF FUNCTION OCCURS IN ONE HOUR OR LESS.

X. WHEN CRITICAL FUNCTIONS CAN BE PROVIDED FOR GREATER THAN ONE HOUR, FOLLOWING A FAILURE, MANUAL SWITCHING FOR REDUNDANT MODES IS ACCEPTABLE.

Y. CREW NOTIFICATION IS REQUIRED FOR AUTOMATIC SWITCHING TO REDUNDANT MODES. SUBSEQUENT FAILURES WITHIN THE REDUNDANT FUNCTION REQUIRES ADDITIONAL AND DIFFERENT NOTIFICATION.

Z. WHEN MANUAL SWITCHING IS UTILIZED FOR CRITICAL FUNCTIONS, NOTIFICATION OF FAILURE AND THAT CREW ACTION IS NECESSARY, IS REQUIRED.

AA. ELEMENTS OF MSS SUBSYSTEMS SHALL BE DESIGNED SUCH THAT MAINTENANCE AND REPAIR CAN BE SCHEDULED WITHIN THE CONSTRAINTS OF OTHER HIGH PRIORITY CREW ACTIVITIES.

BB. DESIGN FEATURES OF THE INFLIGHT REPLACEMENT LEVEL OF SHUTTLE LAUNCHED MODULES PHYSICAL IN PLACE INTERFACES, SHALL CONSIDER POTENTIAL WEAR AND DAMAGE DUE TO MULTIPLE REPLACEMENTS.

CC. MSS DESIGN SHALL INCLUDE THE FOLLOWING CONSIDERATIONS TO INSURE THE HIGHEST PRACTICAL LEVEL OF CLEANLINESS.

1. INACCESSIBLE AREAS WHERE DEBRIS AND FOREIGN MATERIAL CAN BECOME LODGED, TRAPPED, OR HIDDEN SHALL BE AVOIDED.

2. PROTECTIVE COVERS SHALL BE PROVIDED TO PREVENT ENTRANCE OF DEBRIS INTO INACCESSIBLE AREAS OR ACCESS PANELS SHALL BE PROVIDED FOR THE REMOVAL OF DEBRIS FROM THESE AREAS.

DD. MSS CONFIGURATION AND DESIGN AND ARRANGEMENTS SHALL PROVIDE ACCESS FOR GROUND AND/OR ORBIT ACCESS FOR INSPECTION OF CRITICAL LIMITED LIFE COMPONENTS AND HARDWARE, INCLUDING PYROTECHNICS AFTER DEVICE INSTALLATION.

EE. THE SUBSYSTEMS AND THEIR LINE REPLACEABLE UNITS SHALL BE DESIGNED TO MINIMIZE THE BREAKING OF ANY FUNCTIONAL FLIGHT CONNECTION OTHER THAN THOSE REQUIRED FOR THE REMOVAL OF THE FAULTY UNIT ITSELF. RETEST REQUIREMENTS SHALL NECESSITATE ONLY RETEST OF THE REPLACED IFRU FOR ITS PERFORMANCE WITHIN ITS SUBSYSTEM AND FUNCTIONAL INTERFACE COMPATIBILITY WITH INTERFACING SUBSYSTEMS.

FF. MSS FLUID SUBSYSTEMS AND THEIR SERVICING EQUIPMENT SHALL BE DESIGNED TO PERMIT COMPLETE FLUSHING AND DRAINING DURING GROUND CHECKOUT. THE FOLLOWING CONDITIONS SHALL BE SATISFIED AS A MINIMUM.

1. THE SUBSYSTEM SHALL BE FREE FROM DEADENDED PIPING OR PASSAGES THROUGH WHICH FLUSHING FLUIDS CANNOT BE MADE TO FLOW.

2. DRAIN PORTS SHALL BE LOCATED AT THE LOW POINTS IN THE SUBSYSTEM FOR GROUND CHECKOUT.

GG. POSITIVE MEASURES SHALL BE TAKEN TO PREVENT THE INCORRECT INSTALLATION OF FLUID LINE COMPONENTS WHOSE FUNCTION IS DEPENDENT ON DIRECTION OF FLOW.

1. WHERE FEASIBLE, THE DESIGN OF THESE FLUID LINE COMPONENTS SHALL INCORPORATE END FITTINGS OR CONNECTORS WHOSE DIMENSIONS OR CONFIGURATIONS WILL NOT PERMIT INCORRECT INSTALLATION OR SERVICING.

2. THE DIRECTION OF FLOW SHALL BE CLEARLY INDICATED WITH PERMANENT MARKINGS ON THE EXTERIOR OF COMPONENTS AND PARTS EVERY SIX INCHES ON FLUID LINES.

3. SUBSYSTEM MEDIA SHALL BE IDENTIFIED BY ANODIZING OR OTHER PERMANENT COLOR CODING ON THE EXTERIOR OF THE FLUID LINES/FITTINGS.

HH. GROUND SERVICING AND TEST PORTS, NOT REQUIRED TO FUNCTION INFLIGHT SHALL BE DESIGNED TO PRECLUDE LEAKAGE IN FLIGHT. IF CAPS ARE USED, MATERIAL SHALL BE COMPATIBLE WITH THE APPLICABLE MSS SUBSYSTEM AND THE EXPECTED ENVIRONMENT.

II. EQUIPMENT OR MATERIAL SENSITIVE TO CONTAMINATION SHALL BE HANDLED IN A CONTROLLED ENVIRONMENT. FLUIDS AND MATERIALS SHALL BE COMPATIBLE WITH THE COMBINED ENVIRONMENT IN WHICH THEY ARE EMPLOYED. PROCESS SPECIFICATIONS SHALL BE FORMULATED TO PRESCRIBE HANDLING AND APPLICATION METHODS.

JJ. OPTIMIZE ARRANGEMENTS AND ACCESSIBILITY OF SUBSYSTEMS AND COMPONENTS IN RELATIONSHIP TO FREQUENCY AND PRIORITY OF REPLACEMENT AND NATURE OF MAINTENANCE FUNCTION TO BE ACCOMPLISHED. IFRU'S SHALL BE READILY ACCESSIBLE WITH MINIMUM DISTURBANCE OF OTHER UNITS.

3.1.3.3 USEFUL LIFE

THE SUBSYSTEMS SHALL BE DESIGNED FOR THE OPERATIONAL LIFE OF THE STATION, WITH RESUPPLY OF CONSUMABLES AND REPLACEABLE ITEMS OF EQUIPMENT. THIS OPERATIONAL LIFE MAY BE OBTAINED THROUGH LONG-LIFE DESIGN, AND IN-PLACE REDUNDANCY FOR CRITICAL EQUIPMENT WHOSE FAILURE COULD DISABLE THE SPACE STATION OR IMPERIL THE CREW. AGE-SENSITIVE MATERIALS WILL BE AVOIDED OR PROTECTED FOR MINIMUM DEGRADATION. CONSIDERATION SHALL BE GIVEN TO STATE-OF-THE-ART FOR MATERIAL SELECTION AND RELATED DESIGN CHARACTERISTICS, SUCH THAT WEAROUT WILL NOT DEGRADE PERFORMANCE BEYOND ACCEPTABLE TOLERANCE(S), WITHIN SUBSYSTEM LIFE CYCLE REQUIREMENTS.

3.1.3.4 NATURAL ENVIRONMENT

SEE APPENDIX 10.3

THE NATURAL ENVIRONMENTAL EXTREMES WHICH MAY BE ENCOUNTERED DURING GROUND OPERATIONS (TRANSPORTATION, GROUND HANDLING, STORAGE, ETC.) BY THE MODULES/ MODULE EQUIPMENT MAY BE PROTECTED BY SUITABLE PACKAGING FOR TRANSPORTATION AND STORAGE, IF THESE ENVIRONMENTS EXCEED EQUIPMENT DESIGN.

3.1.3.5 TRANSPORTABILITY

3.1.3.5.1 SHUTTLE TRANSPORTABILITY

MODULES SHALL BE DESIGNED FOR EXPECTED SHUTTLE INDUCED AND NATURAL ENVIRONMENTS FROM LAUNCH PREPARATION TO ORBITAL DELIVERY. WHERE POSSIBLE, STANDARD MODULE ATTACH POINTS SHALL BE UTILIZED. PACKAGES AND COMPONENTS SHALL BE DESIGNED, WITH THE USE OF PROTECTIVE PACKAGING/INSTALLATIONS, FOR DELIVERY TO ORBIT IN MSS MODULES OR CARGO MODULES.

3.1.3.5.2 GROUND HANDLING AND TRANSPORTABILITY

FULL DESIGN RECOGNITION SHALL BE GIVEN TO THE DURABILITY REQUIREMENTS OF MSS EQUIPMENT AND SUBSYSTEMS DURING PREFLIGHT PREPARATION. WHEREVER POSSIBLE, EQUIPMENTS SHALL BE DESIGNED TO BE TRANSPORTED BY COMMON CARRIER WITH NORMAL PROTECTIVE DEVICES. MODULES SHALL BE DESIGNED TO BE TRANSPORTED BY SPECIAL AIR AND GROUND EQUIPMENT WITH LIMITED ADDITIONAL ENVIRONMENTAL PROTECTION.

3.1.3.6 HUMAN PERFORMANCE

THE MODULAR SPACE STATION SYSTEM SHALL BE DESIGNED TO INCORPORATE PHYSICAL ARRANGEMENT AND OPERATIONAL CHARACTERISTICS OF HUMAN ENGINEERING DESIGN CRITERIA TO PERMIT EASE OF OPERATION AND MAINTENANCE WITHIN NORMAL HUMAN CAPABILITIES OF MUSCULAR EXERTION, VISUAL PERCEPTION, AND PHYSICAL DEXTERITY. REQUIREMENTS FOR MANUAL OPERATIONS ACCESS, TOOL CLEARANCE, TUBING AND WIRE ROUTING, AND CONNECTOR IDENTIFICATION SHALL BE OBSERVED. EQUIPMENT DESIGN SHALL MINIMIZE THE NEED FOR SPECIAL TOOLS OR PROCEDURES. MIL-STD-1472 SHALL BE USED AS A GUIDE TO ESTABLISH THE ABOVE HUMAN ENGINEERING CRITERIA.

3.1.3.7 SAFETY

SAFETY IS A MANDATORY CONSIDERATION THROUGH THE TOTAL PROGRAM. AS A GOAL, NO SINGLE MALFUNCTION OR CREDIBLE COMBINATION OF MALFUNCTIONS AND/OR ACCIDENTS SHALL RESULT IN SERIOUS INJURY TO PERSONNEL OR TO CREW ABANDONMENT OF THE SPACE STATION.

A. PROVISIONS SHALL BE MADE FOR THE PROTECTION AND SURVIVAL OF THE WHOLE CREW DURING SOLAR STORM ACTIVITY AS DEFINED BY THE DESIGN MISSION RADIATION MODEL (PARAGRAPH 3.1.3.4). THE RADIATION DOSAGE LIMITATIONS DEFINED IN PARAGRAPH 3.1.1.1.1.8 SHALL APPLY.

B. PERSONNEL ESCAPE ROUTES SHALL BE PROVIDED IN ALL HAZARDOUS SITUATIONS. A DESIGN GOAL SHALL BE TO PROVIDE ALTERNATE ESCAPE ROUTES THAT DO NOT TERMINATE INTO A COMMON MODULE AREA.

C. THE SPACE STATION SHALL BE DIVIDED INTO AT LEAST TWO PRESSURIZED HABITABLE VOLUMES SO THAT ANY DAMAGED MODULE CAN BE ISOLATED AS REQUIRED. ACCESSIBLE MODULES WILL BE EQUIPED AND PROVISIONED SO THAT THE CREW CAN SAFELY CONTINUE A DEGRADED MISSION AND TAKE CORRECTIVE ACTION TO EITHER REPAIR OR REPLACE THE DAMAGED MODULE.

D. PROVISIONS AND HABITABLE FACILITIES SHALL BE ADEQUATE TO SUSTAIN THE ENTIRE CREW FOR A MINIMUM OF 96 HOURS DURING AN EMERGENCY SITUATION REQUIRING SHUTTLE RESCUE.

E. ATMOSPHERIC STORES AND SUBSYSTEM CAPACITY SUFFICIENT FOR ONE REPRESSURIZATION SHALL BE MAINTAINED ON/AT THE SPACE STATION DURING MANNED OPERATIONS TO INDEPENDENTLY SUPPLY EACH PRESSURIZED HABITABLE VOLUME.

F. ACCESS TO EVA AND IVA AIRLOCK SUIT STATION(S) SHALL BE PROVIDED FOR ALL CREDIBLE EMERGENCY CONDITIONS. AIRLOCK CHAMBER(S) SHALL BE PROVIDED TO PERMIT CREW ACCESS FOR EVA/IVA OPERATIONS.

G. TWO OR MORE SUITED CREWMEN WILL PARTICIPATE IN ANY PRESSURE SUIT ACTIVITY AND RESCUE PROVISIONS WILL BE PROVIDED.

H. THE ATMOSPHERE CONSTITUENTS, INCLUDING HARMFUL AIRBORNE TRACE CONTAMINANTS AND ODORS WILL BE MONITORED AND CONTROLLED IN EACH PRESSURIZED HABITABLE VOLUME.

I. IDENTIFIED HAZARDS SHALL BE ELIMINATED, REDUCED TO CONTROLLED HAZARDS, OR SPECIFIED AS RESIDUAL HAZARDS.

J. CAPABILITY SHALL BE PROVIDED FOR PERFORMING CRITICAL FUNCTIONS AT AN EMERGENCY LEVEL UNTIL THE CREW CAN BE RESCUED, WITH ANY ONE PRESSURE ISOLATABLE VOLUME AND THE SUPPLIES AND EQUIPMENT WITHIN IT UNAVAILABLE. IF THE CREW IS DIVIDED INTO TWO OR MORE PRESSURE ISOLATABLE VOLUMES WHICH ARE NOT SHIRTSLEEVE CONNECTED, THEN EACH OF THESE VOLUMES SHALL BE CAPABLE OF SUSTAINING THE WHOLE CREW. ELECTRICAL AND FLUID LINES IN THE AFFECTED VOLUME REQUIRED FOR CRITICAL FUNCTIONS SHALL BE PROTECTED AGAINST THE EFFECTS OF EXPLOSION, FIRE, VACUUM, AND CORROSION.

K. CAPABILITY SHALL BE PROVIDED FOR PERFORMING CRITICAL FUNCTIONS WITH THE PORTION OF ANY ONE SUBSYSTEM IN ONE PRESSURE ISOLATABLE VOLUME INACTIVATED AS A RESULT OF AN ACCIDENT AND A PORTION OF THE SUBSYSTEM IN THE OTHER PRESSURE ISOLATABLE VOLUME(S) INOPERTIVE FOR MAINTENANCE.

L. FOR THOSE MALFUNCTIONS AND/OR HAZARDS WHICH MAY RESULT IN TIME-CRITICAL EMERGENCIES, PROVISION SHALL BE MADE FOR THE AUTOMATIC SWITCHING TO A SAFE MODE OF OPERATION AND FOR CAUTION AND WARNING OF PERSONNEL.

M. TWO OR MORE ENTRY/EGRESS PATHS SHALL BE PROVIDED TO AND FROM EVERY MODULE, PRESSURE ISOLATABLE VOLUME, OR OTHER AREA WITH RESTRICTED ACCESS. THE TWO PATHS SHALL BE SEPARATED BY AIRTIGHT PARTITIONS, OR SHALL BE AT LEAST 10 FEET APART, AND SHALL EACH LEAD TO AN AREA IN WHICH THE CREW CAN SURVIVE UNTIL SHUTTLE RESCUE OR RESUPPLY.

N. PROVISIONS SHALL BE MADE FOR DETECTING CONTAINING (I.E. CONFINING) AND CONTROLLING (I.E. RESTORING TO A SAFE CONDITION) EMERGENCIES SUCH AS FIRES, TOXIC CONTAMINATION, DEPRESSURIZATION, STRUCTURAL DAMAGE, ETC.

O. PRIMARY PRESSURE STRUCTURAL MATERIALS SHALL BE NON-FLAMMABLE. INTERIOR WALLS AND SECONDARY STRUCTURE SHALL BE SELF-EXTINGUISHING.

P. ALL CONTINUOUS NONMETALLIC MATERIALS SHALL BE SELF-EXTINGUISHING IN THE MOST SEVERE OXIDIZING ENVIRONMENT TO WHICH THEY WILL BE EXPOSED. MEANS SHALL BE PROVIDED FOR FIREPROOF STORAGE OF MEDICAL SUPPLIES, MAINTENANCE SUPPLIES, FOOD, TISSUE, CLOTHING, TRASH, AND FOR OTHER NON-SELF-EXTINGUISHING ITEMS, WHEN THEY ARE NOT IN USE.

Q. MATERIALS USED IN THE HABITABLE AREAS SHALL NOT OUTGAS TOXIC CONSTITUENTS IN THE LOWEST PRESSURE ENVIRONMENT TO WHICH THEY WILL BE EXPOSED.

R. POTENTIALLY EXPLOSIVE CONTAINERS SUCH AS HIGH PRESSURE VESSELS OR VOLATILE GAS STORAGE CONTAINERS SHALL BE PLACED OUTSIDE OF AND AS REMOTELY AS POSSIBLE FROM PERSONNEL LIVING AND OPERATING QUARTERS. WHEREVER POSSIBLE THE CONTAINERS SHALL BE ISOLATED AND PROTECTED SO THAT FAILURE OF ONE WILL NOT PROPAGATE TO OTHERS.

S. REDUNDANT EQUIPMENT, LINES, CABLES, AND UTILITY RUNS WHICH ARE CRITICAL FOR SAFETY OF PERSONNEL OR MISSION CONTINUATION SHALL EITHER BE LOCATED AND ROUTED IN SEPARATE COMPARTMENTS (I.E. SEPARATED BY A STRUCTURAL WALL) OR SHALL BE PROTECTED AGAINST FIRE, SMOKE, CONTAMINATION, OVERPRESSURE, AND SHRAPNEL.

T. ALL WALLS, BULKHEADS, HATCHES AND SEALS WHOSE INTEGRITY IS REQUIRED TO MAINTAIN PRESSURIZATION SHALL BE READILY ACCESSIBLE FOR INSPECTION AND REPAIR BY CREWMEN IN PRESSURIZED SUITS.

U. ALL EVA AND UNPRESSURIZED COMPARTMENT IVA SHALL BE CONDUCTED USING THE 'BUDDY SYSTEM'. THE BUDDY SYSTEM SHALL ALSO BE USED DURING SHIRT-SLEEVE OPERATIONS IN HAZARDOUS AREAS.

V. A MARGIN OF CONSUMABLES SHALL BE PROVIDED ONBOARD, SUFFICIENT FOR PERFORMING CRITICAL FUNCTIONS FOR 96 HOURS AT A REDUCED LEVEL FOLLOWING ANY CREDIBLE ACCIDENT WHICH RENDERS ONE PRESSURE ISOLATABLE COMPARTMENT UNAVAILABLE.

W. THE CAPABILITY SHALL BE PROVIDED ON THE SPACE STATION FOR THE DETECTION OF MALFUNCTIONS AND/OR HAZARDS, TRACING TO THE FAILED REPLACE-ABLE UNIT AND THE DISPLAY OF INFORMATION TO THE CREW NECESSARY FOR CORRECTIVE ACTION.

X. RANGE SAFETY REQUIREMENTS AT KENNEDY SPACE CENTER AND THE AIR FORCE EASTERN TEST RANGE SHALL APPLY. WAIVERS REQUIRED TO MEET MISSION REQUIREMENTS WILL BE IDENTIFIED.

Y. AT LEAST TWO EGRESS PATHS SHALL BE AVAILABLE FROM EACH MODULE FOR EMERGENCY EGRESS OF PERSONNEL DURING MANNED GROUND OPERATIONS.

Z. EMERGENCY SUITS REQUIRED IN THE SPACE STATION CORE MODULE SHALL BE IN READILY ACCESSIBLE LOCATIONS WITHIN EACH PRESSURE ISOLATABLE VOLUME.

AA. PROVISIONS SHALL BE MADE FOR EMERGENCY MEDICAL TREATMENT FOR DURATIONS COMPATIBLE WITH THE RESCUE PROVISIONS.

BB. THE SAFE ENVIRONMENT AND THE SAFE OPERATIONAL STATUS OR ACTIVATED SUBSYSTEMS WITHIN THE SPACE STATION SHALL BE VERIFIED PRIOR TO PERSONNEL ENTRY, INITIALLY AND PRIOR TO RE-ENTRY FOLLOWING TEMPORARY STATION ABANDONMENT.

CC. DEPLOYMENT AND INITIATION OF OPERATIONS CONSIDERED HAZARDOUS SHALL BE CHECKED OUT FROM A SAFE LOCATION BEFORE EXPOSING CREWMEN TO THE POTENTIAL HAZARDS.

DD. ALL EVA SHALL BE CONDUCTED EITHER USING THE 'BUDDY SYSTEM' OR WITHIN VISUAL RANGE OF A SUITED CREWMAN READY TO EXIT.

EE. PROVISION SHALL BE MADE FOR THE RETURN OF A CREWMAN INCAPACITATED WHILE PERFORMING EVA.

FF. PROVISIONS SHALL BE MADE FOR THE CONTAINMENT AND/OR DISPOSAL OF TOXIC CONTAMINANTS.

GG. CONTAINMENT SHALL BE PROVIDED FOR MATERIALS REQUIRING RETURN VIA THE SHUTTLE TO PREVENT CONTAMINATION OF THE ENVIRONMENT AND REDUCE THE HAZARD OF POTENTIAL FIRE AND TOXIC CONDITIONS.

HH. TANKS USED AS GAS ACCUMULATORS IN INHABITED AREAS SHALL BE DESIGNED TO A FACTOR OF SAFETY OF 4.0 AS A MINIMUM. TANK SUPPORTS SHALL BE DESIGNED TO RESTRAIN THE TANK UNDER PROPULSIVE EFFECT OF RAPIDLY ESCAPING GAS.

II. DESIGN PROVISIONS SHALL BE INCORPORATED TO PREVENT UNCONTROLLABLE HATCH OPENING DUE TO PRESSURE DIFFERENTIALS.

3.1.3.7.1 CREDIBLE ACCIDENTS

THE SPACE STATION SHALL BE DESIGNED AND OPERATED SO THAT CREW SURVIVAL AND STATION SURVIVAL WILL BE ENSURED FOLLOWING THE ACCIDENTS DEFINED HEREWITH.

A. FIRE

A FIRE IN AN AREA CONTAINING SUBSYSTEMS EQUIPMENT, ELECTRICAL WIRING OR LABORATORY EQUIPMENT, WHICH DAMAGES AND PUTS OUT OF COMMISSION ALL UNPROTECTED OPERATING EQUIPMENT IN A COMPARTMENT. A COMPARTMENT, FOR THIS PURPOSE, IS A SPACE WHICH CAN BE CLOSED OFF BY DOORS AND HATCHES, BUT WHICH NEED NOT BE AIRTIGHT OR PRESSURE TIGHT. FLAME PROPAGATION WILL BE CONFINED TO THE ONE COMPARTMENT. SUFFICIENT SMOKE/FUMES WILL BE PRODUCED TO REQUIRE RAPID EVACUATION OF THE AFFECTED COMPARTMENT BY PERSONNEL. PERSONNEL IN OTHER AREAS WILL BE ABLE TO CONINTUE NORMAL OPERATIONS, BUT WILL REQUIRE FACE MASKS TO ENTER THE AFFECTED AREA. THE OPENING OF HATCHES AND OTHER OPENINGS TO THE AFFECTED AREA WILL BE MINIMIZED FOR 24 HOURS, WHILE FUMES ARE PRESENT. ELECTRICAL CABLE, SERVICE CONDUITS, PLUMBING LINES AND DUCTS MAY TEMPORARILY BECOME INOPERATIVE (E.G., POWER WILL BE REMOVED FROM ELECTRICAL CABLES, FLUID TRANSFER WILL BE INTERRUPTED, ETC.) BUT WILL NOT BE AFFECTED BY THE FIRE IF THEY WERE DESIGNED FOR FIRE PROTECTION, AND WILL BE BROUGHT ON-LINE AGAIN AFTER A SYSTEM CHECKOUT, WITHIN APPROXIMATELY AN HOUR. SIMILARLY, OPERATING EQUIPMENT SPECIFICALLY DESIGNED FOR PROTECTION FROM FIRE WILL BE TEMPORARILY INACTIVATED, BUT WILL BE BROUGHT ON-LINE AGAIN AFTER CHECKOUT.

B. MECHANICAL DAMAGE

MECHANICAL DAMAGE CAUSED BY A COLLISION INSIDE THE VEHICLE WITH LOOSE OUT-OF-CONTROL MASSES. A MOMENTUM EQUIVALENT TO A 50 LB. MASS MOVING AT 2 FT/SEC WILL BE INVOLVED. THE COLLISION MAY OCCUR WITH ANY EQUIPMENT WHICH IS EXPOSED TO A COLLISION PATH (I.E., NO INTERVENING EQUIPMENT) OF APPROXIMATELY FIVE FEET OR MORE, BUT NOT TO PRIMARY STRUCTURE. THE DAMAGE WILL BE CONFINED TO THE EQUIPMENT WITHIN A TWO FOOT RADIUS OF THE IMPACT POINT. ALL EQUIPMENT, CABLES, FLUID LINES, DUCTS, ETC. WILL BE DAMAGED AND PUT OUT OF COMMISSION UNTIL THEY CAN BE REPAIRED/REPLACED EXCEPT EQUIPMENT WHICH IS SPECIFICALLY ARMORED FOR PROTECTION AGAINST COLLISION.

C. EXPLOSION

AN EXPLOSION OF .025 LB TNT EQUIVALENT, RELEASING 50 BTU OF ENERGY IN THE FORM OF HEAT, SHOCK WAVES AND KINETIC AND THERMAL ENERGY OF SHRAPNEL DAMAGE WILL BE CONFINED TO ONE COMPARTMENT (SEE DEFINITION IN ITEM A) AND WILL CONSIST OF OVERPRESSURE, HEAT, SHRAPNEL AND ATMOSPHERIC CONTAMINANTS. ALL EQUIPMENT IN THE COMPARTMENT WILL BE DAMAGED AND MADE INOPERATIVE, UNLESS ARMOR PLATED FOR PROTECTION AGAINST THIS TYPE OF EXPLOSION. THE EQUIPMENT WILL REQUIRE REPAIR/REPLACEMENT, DEPENDING ON THE DAMAGE SUCH AN EXPLOSION CAN PRODUCE. FURTHER HAZARDS WHICH CAN RESULT IN THE COMPARTMENT BY SUCH AN EXPLOSION, SUCH AS FIRE, ETC., SHOULD ALSO BE CONSIDERED AS PART OF THIS ACCIDENT. WALLS AND PRIMARY STRUCTURE, OR EQUIPMENT OUTSIDE THE AFFECTED COMPARTMENT, WILL NOT BE DAMAGED.

D. LOSS OF PRESSURIZATION

A LOSS OF PRESSURIZATION IN A MODULE CAUSED BY AN ACCIDENTAL PENETRATION OF AN OUTSIDE WALL OR BULKHEAD, BY A FAULTY RELIEF VALVE, OR BY A LEAKING PRESSURE SEAL. THE TIME FROM DETECTION OF THE FAILURE TO REACHING A NON-HABITABLE ENVIRONMENT WILL BE APPROXIMATELY (TBD) CORRESPONDING TO A 2 1/2 INCHES DIAMETER HOLE. THIS ACCIDENT MAY REQUIRE EVACUATION OF THE AFFECTED PRESSURE ISOLATABLE VOLUME AND THE SUBSEQUENT DETECTION AND REPAIR OF THE SOURCE OF LEAKAGE BY TWO IVA PERSONNEL. NO EQUIPMENT WILL BE DAMAGED BY THE ACCIDENT ITSELF. BUT SINCE THE WHOLE OF THE AFFECTED PRESSURE VOLUME MAY BE EXPOSED TO VACUUM CONDITIONS, SENSITIVE EQUIPMENT MAY HAVE TO BE DEACTIVATED TO SURVIVE THE PERIOD UNTIL REPRESSURIZATION.

E. FLUID LEAKAGE

LEAKAGE OF ANY GAS OR LIQUID WHICH IS PRODUCED, STORED OR ROUTED THROUGH THE PRESSURIZED AREAS OF THE VEHICLE, INCLUDING ANY CHEMICALS USED OR THAT MAY BE PRODUCED IN EXPERIMENTS. THE LEAKAGE MAY OCCUR AT ANY POINT THROUGH WHICH THE FLUID IS ROUTED. THE AMOUNT OF LEAKAGE WILL VARY WITH THE PROVISIONS MADE FOR DETECTION AND WITH THE PROVISIONS FOR STOPPING THE LEAKAGE (DUMPING THE FLUID OVERBOARD, SHUTTING OFF THE PROCESS, TRANSFERRING TO ANOTHER TANK, ETC.). THIS QUANTITY SHOULD BE DEFINED FOR EVERY POTENTIALLY HAZARDOUS FLUID ONBOARD. FOLLOWING DETECTION, THE LEAKAGE MAY BE CONFINED TO THE AFFECTED AREA BY RESTRICTING AIR CIRCULATION AND PROVIDING A SLIGHT DUMP TO VACUUM IN THAT AREA. DAMAGE TO EQUIPMENT (E.G., FROM CORROSION, ETC.) AND THE POSSIBLE REQUIREMENT TO TEMPORARILY EVACUATE THE AREA MUST BE CONSIDERED SEPARATELY FOR EACH ONBOARD FLUID.

F. COLLISION

A GRAZING COLLISION WITH ANOTHER VEHICLE OR WITH SPACE DEBRIS WHICH DAMAGES EQUIPMENT OUTSIDE THE SPACECRAFT, SUCH AS RCS JETS, RADIATORS, SOLAR PANELS, ANTENNAS, TANKS, FLUID LINES, DOCKING MECHANISMS, ETC. THE COLLISION IS NOT SEVERE ENOUGH TO CAUSE A PENETRATION OF PRIMARY STRUCTURE, BUT MAY DAMAGE EXPOSED EQUIPMENT OVER A CIRCULAR AREA OF APPROXIMATELY THREE FOOT DIAMETER. THE DAMAGE WILL REQUIRE MAINTENANCE/REPAIR/REPLACEMENT, TO RESTORE THE FUNCTION. IF THE EQUIPMENT IS NOT MAINTAINABLE/REPAIRABLE/REPLACEABLE, THE DAMAGE IS TO BE REGARDED AS PERMANENT.

G. PERSONNEL LOSS

THE LOSS OF ANY ONE MAN THROUGH INJURY, ILLNESS, OR DEATH. PROVISIONS MUST BE MADE FOR MEDICAL TREATMENT UNTIL HIS RETURN TO EARTH, AND FOR CROSS-TRAINING TO ALLOW OTHER PERSONNEL TO TAKE OVER DUTIES NECESSARY FOR CREW SAFETY.

H. FOOD OR WATER CONTAMINATION

BIOLOGICAL OR TOXIC CONTAMINATION OF FOOD OR POTABLE WATER SUPPLY. ALL SIMILARLY PACKAGED FOOD STORED IN ANY ONE MODULE WILL BE ASSUMED UNFIT TO EAT. SIMILARLY ALL POTABLE WATER IN CONNECTED TANKS WILL ALSO BE ASSUMED TOXIC, THE WATER HOWEVER MAY BE REPROCESSED THROUGH THE WATER PURIFICATION SYSTEM AND THE TANKS DECONTAMINATED TO RENDER IT POTABLE.

I. ACCIDENT IN A HATCH

THE LOSS OF ACCESS TO ANY ONE HATCH ASSEMBLY, DOOR OR OTHER PERSONNEL OR CARGO TRANSFER OPENING BECAUSE OF JAMMING OF THE MECHANISM, EITHER OPEN OR CLOSED, OR BECAUSE OF OBSTRUCTION BY CARGO, OR BECAUSE OF A LOCALIZED HAZARDOUS SITUATION(FIRE, CHEMICAL SPILLAGE, ELECTRICAL HAZARD, ETC.). THE HAZARDOUS OR NON-ACCESSIBLE AREA MAY EXTEND OVER A VOLUME OF ABOUT 5 FT. X 5 FT. X 5 FT. AND BE SITUATED ANYWHERE WITHIN 5 FT. OF THE EDGE OF THE HATCH OR OPENING.

THIS ACCIDENT IS NOT TO BE CONSIDERED CREDIBLE WHERE TWO INDEPENDENT METHODS FOR OPENING A HATCH HAVE BEEN PROVIDED AND WHERE SPECIAL PROVISIONS HAVE BEEN TAKEN TO AVOID HAZARDOUS EQUIPMENT IN THE VICINITY OF THE HATCH.

J. INCAPACITATED EVA OR IVA MAN

AN OUT-OF-CONTROL AND INCAPACITATED MAN PERFORMING EVA OR IVA. RESCUE IS REQUIRED WITHIN 5 MINUTES BY A COMPANION ALREADY SUITED AND CONDITIONED TO THE SUIT ATMOSPHERE, WHO IS WAITING IN AN AIRLOCK OR IS ALSO PERFORMING EVA OR IVA.

K. METEROID PENETRATION

METEROID PENETRATION OF THE PRIMARY STRUCTURE. THE RESULTS WILL BE SIMILAR TO AN EXPLOSION, AS DESCRIBED IN ITEM C, RELEASING 50 BTU OF ENERGY. SUCH A METEROID HAS A 10 (-3) PROBABILITY OF IMPACT IN 10 YEARS, AND THE METEROID IS APPROXIMATELY 0.6 INS. IN DIAMETER. PHYSICAL DAMAGE WILL BE CONFINED TO ONE COMPARTMENT (SEE DEFINITION IN ITEM A), AND WILL CONSIST OF FINELY DIVIDED MOLTEN HIGH SPEED SHRAPNEL (FROM SPALLATION OF THE INNER WALL). ALL EQUIPMENT IN THE COMPARTMENT WILL BE DAMAGED AND MADE INOPERATIVE, UNLESS ARMOR PLATED FOR PROTECTION AGAINST THIS TYPE OF SHRAPNEL. DAMAGED EQUIPMENT WILL REQUIRE EXTENSIVE REPAIR/ REPLACEMENT. FURTHER HAZARDS WHICH CAN RESULT IN THE COMPARTMENT BY SUCH AN ACCIDENT, SUCH AS FIRE, ETC., SHOULD ALSO BE CONSIDERED AS PART OF THIS ACCIDENT. THE RESULTING PENETRATION OF THE PRESSURE WALL WILL BE 2 1/2 INCHES IN DIAMETER AND WILL CAUSE DEPRESSURIZATION OF THE VEHICLE TO AN UNSAFE LEVEL IN APPROXIMATELY (TBD).

L. LOSS OF ELECTRICAL POWER

LOSS OF THE AVAILABILITY OF ELECTRICAL POWER FROM LIKE POWER SOURCES (ALL SOLAR PANELS, OR ALL FUEL CELLS, OR ALL BATTERIES) IN ONE PRESSURE VOLUME OR ALL INVERTERS IN ONE VOLUME, AS THE RESULT OF AN ACCIDENT AND/OR A SEQUENCE OF UNEXPECTED FAILURES. THE LOSS WILL BE IMMEDIATE WITH NO ADVANCE WARNING.

M. ATMOSPHERIC CONTAMINATION

ATMOSPHERIC CONTAMINATION BY TOXIC OR OTHERWISE HAZARDOUS CONTAMINANTS THAT WILL REQUIRE PERSONNEL EVACUATION FROM ONE PRESSURE ISOLATABLE VOLUME WITHIN TWO MINUTES OF DETECTION. THE AFFECTED VOLUME WILL REQUIRE EITHER PURGING TO VACUUM AND SUBSEQUENT REPRESSURIZATION, OR, IF THE CONTAMINANT CAN BE REMOVED BY THE ECLSS, WILL REQUIRE PROCESSING OF THE ATMOSPHERE FOR TWO DAYS TO RESTORE A HABITABLE ENVIRONMENT. THE OTHER PRESSURE VOLUME WILL REMAIN HABITABLE.

N. ELECTRICAL SHOCK

ELECTRICAL SHOCK TO ANY ONE MAN WHILE PERFORMING MAINTENANCE OR WORKING WITH ELECTRICAL OR ELECTRONIC EQUIPMENT OR EXPERIMENTS. THE SHOCK MAY RESULT IN MOMENTARY (SECONDS TO MINUTES) LOSS OF PERFORMANCE CAPABILITY BY THE MAN, TO INJURY REQUIRING THE MAN'S EMERGENCY RETURN TO EARTH, AND/OR LOSS OF LIFE.

O. HAZARD IN A DOCKED MODULE

A HAZARD APPEARING ON A DOCKED CARGO, EXPERIMENTS OR OTHER MODULE, WHICH ARISES FROM ANY OF THE ABOVE ACCIDENTS OCCURRING ON THE MODULE, AS APPLICABLE. THE MODULE IS TO BE CONSIDERED AS A SEPARATE PRESSURE VOLUME FROM THE POINT OF VIEW OF ISOLATION, CONTAINMENT AND CONTROL. IF REQUIRED, ACCESS TO A DEPRESSURIZED OR CONTAMINATED MODULE WILL BE BY TWO IVA OR EVA PERSONNEL.

P. MODULE ABANDONMENT

A COMBINATION OF ACCIDENTS AND/OR EQUIPMENT DEGRADATION REQUIRING THE RETURN OF ANY ONE MODULE TO EARTH, FOR REPAIR OR REPLACEMENT. THE CREW MUST OPERATE IN THE REMAINDER OF THE STATION AT A REDUCED LEVEL UNTIL THE MODULE CAN BE REPLACED ON THE STATION.

Q. STATION ABANDONMENT

A COMBINATION OF ACCIDENTS AND/OR SUBSYSTEMS DEGRADATION REQUIRING THE ABANDONMENT OF THE STATION BY SOME OR ALL OF THE OCCUPYING PERSONNEL. SUCH ABANDONMENT WILL NOT BE A TIME-CRITICAL EMERGENCY, BUT A DELIBERATE ABANDONMENT PLANNED OVER A PERIOD OF DAYS TO MONTHS. THE WORST DESIGN CASE IS WHEN ONE OF THE SEPARATE PRESSURE VOLUMES HAS BEEN EVACUATED AND SEALED OFF FOR UP TO 30 DAYS BECAUSE OF MAJOR DAMAGE OR CONTAMINATION, AND ALL PERSONNEL ARE IN THE REMAINING VOLUME. FURTHERMORE, SUBSYSTEMS DEGRADATION IS NOW BECOMING APPARENT IN THIS VOLUME, RESULTING IN THE DECISION TO ABANDON, SUCH SUBSYSTEMS AS ARE CAPABLE OF SURVIVAL MUST BE SET IN A PASSIVATED OR QUIESCENT MODE TO ENSURE SAFE PERSONNEL ESCAPE AND TO MINIMIZE DAMAGE FOR POSSIBLE REOCCUPATION AT A LATER DATE.

3.1.3.8 DANGEROUS MATERIALS AND COMPONENTS

A. TOXIC FLUID CONTAINERS SHALL BE LOCATED IN UNPRESSURIZED VOLUMES, OR SHALL BE DOUBLE CONTAINED WITH THE CAPABILITY OF DUMPING THE FLUID TO SPACE OR OFF-LOADING TO ANOTHER DOUBLE CONTAINER, AND OF VENTING THE SPACE BETWEEN THE TWO CONTAINERS.

B. DOUBLE CONTAINED TOXIC FLUID CONTAINERS SHALL BE PROVIDED WITH MEANS TO DETECT LEAKAGE OF THE TOXIC FLUID INTO THE SPACE BETWEEN THE CONTAINERS, AND WITH MEANS TO DETECT PENETRATION OF THE OUTSIDE CONTAINER.

C. MEANS SHALL BE PROVIDED FOR DETECTING A TOXIC ENVIRONMENT WITHIN A SPACE STATION MODULE CONTAINING TOXIC OR POTENTIALLY TOXIC FLUIDS.

D. SPECIAL PROTECTIVE GARMENTS AND EQUIPMENT SHALL BE PROVIDED FOR PERSONNEL WORKING NEAR POTENTIALLY TOXIC MSS ELEMENS DURING GROUND HANDLING OR WORKING IN A TOXIC ENVIRONMENT.

E. CAPABILITY SHALL BE PROVIDED TO PURGE OR DUMP TO SPACE A TOXICALLY CONTAMINATED ATMOSPHERE IN A PRESSURIZED MODULE.

F. HAZARDOUS FLUIDS OR MATERIALS WILL BE DOUBLE CONTAINED DURING HANDLING AND TRANSFER IN PRESSURIZED AREAS. CAPABILITY SHALL BE PROVIDED TO VERIFY THE INTEGRITY OF BOTH CONTAINERS BEFORE AND AFTER TRANSFER.

G. CAPABILITY SHALL BE PROVIDED TO VENT THE SPACE BETWEEN DOUBLE WALLED CONTAINERS FOR HAZARDOUS FLUID HANDLING TO SPACE AND DUMPING THE FLUID TO SPACE OR OFF-LOADING TO ANOTHER CONTAINER.

H. PROCEDURES SHALL BE AVAILABLE FOR TRANSFERRING HAZARDOUS FLUIDS, OR MATERIALS IN A PRESSURIZED AREA FROM A SINGLY PENETRATED DOUBLE CONTAINER TO A STORAGE CONTAINER WITHOUT RELEASING FLUID OR MATERIAL TO THE MSS ATMSOPHERE.

I. DURING HANDLING AND TRANSFER OF HAZARDOUS FLUIDS OR MATERIALS, NO OTHER MANNED OPERATIONS SHALL BE PLANNED ALONG THE TRANSFER PATH.

J. THE PRESSURES, TEMPERATURES, OR OTHER PARAMETERS WHICH INDICATE THE STATUS OF HAZARDOUS FLUIDS OR MATERIALS SHALL BE VERIFIABLE.

K. TRANSFER LINES FOR HAZARDOUS FLUIDS SHALL BE LOCATED OUTSIDE THE PRESSURIZED VESSELS OR SHALL BE DOUBLE WALLED WITH THE CAPABILITY OF VENTING THE SPACE BETWEEN THE TWO CONTAINERS TO SPACE.

3.1.3.9 INDUCED ENVIRONMENT

SEE APPENDIX 10.4

3.1.3.10 LIFE SUPPORT

THE SPACE STATION SYSTEM SHALL BE DESIGNED TO MAINTAIN A CONTROLLED HEALTHFUL AND SAFE ENVIRONMENT AND TO PROVIDE FOR THE SUSTENANCE AND WELFARE OF PERSONNEL IN ACCOMPLISHING OPERATIONS, MAINTENANCE, AND CONTROL TASKS. DETAILED REQUIREMENTS SHALL BE AS SPECIFIED IN THE CREW HABITABILITY SUBSYSTEM, PARAGRAPH 3.3.7.

3.1.3.11 THERMAL CONTROL

A. THE THERMAL CONTROL SYSTEM SHALL BE DESIGNED TO PROVIDE THERMAL BALANCE OF THE SPACE STATION.

B. THE THERMAL CONTROL ASSEMBLY SHALL BE DESIGNED TO OPERATE NORMALLY IN A 240 NMI., 55 DEG INCLINATION, X-POP, Z-LV FLIGHT MODE.

C. THE THERMAL CONTROL SYSTEM SHALL LIMIT THE TEMPERATURE OF INTERIOR WALLS OF PRESSURIZED VOLUMES TO A MINIMUM OF 57 DEG F AND A MAXIMUM OF 105 DEG F DURING MANNED OPERATIONS AND A MINIMUM OF 40 DEG F TO A MAX- IMUM OF 135 DEG F DURING UNMANNED OPERATIONS.

D. THE THERMAL CONTROL SYSTEM SHALL PREVENT FORMATION OF CONDENSATION ON INTERNAL SURFACES.

E. THE THERMAL CONTROL SYSTEM SHALL LIMIT THE HEAT LOAD GAIN TO THE SPACE STATION INTERNAL ENVIRONMENT FROM THE EXTERNAL ENVIRONMENT TO A MAXIMUM OF 1000 BTU/HR/MODULE (STATION AND CORE).

F. THE THERMAL CONTROL SYSTEM SHALL LIMIT THE HEAT LOAD LOSS FROM THE SPACE STATION INTERNAL ENVIRONMENT TO THE EXTERNAL ENVIRONMENT TO A MAXIMUM OF 2000 BTU/HR/MODULE (STATION AND CORE).

G. THE THERMAL CONTROL SYSTEM SHALL PROVIDE FOR TRANSFER AND REJECTION OF HEAT TO SPACE VIA INTERNAL COOLING LOOPS AND EXTERNAL RADIATORS.

H. INTERNAL COOLANT LOOP FLUIDS SHALL BE NON-TOXIC AND NON-FLAMMABLE.

I. THERMAL CONTROL SYSTEM DESIGN SHALL CONSIDER OPERATION OF VARIOUS EQUIPMENT IN A QUIESCENT MODE AND DEPRESSURIZED STATE AS WELL AS NORMAL MANNED OPERATIONS.

J. THE THERMAL CONTROL SYSTEM SHALL BE CAPABLE OF ACCOMMODATING A MAXIMUM HEAT LOAD OF 105,000 BTU/HR AND A MINIMUM OF 10,140 BTU/HR DURING NORMAL MANNED OPERATIONS. HEAT LOADS TO BE ACCOMMODATED DURING BUILDUP QUIESCENT PERIODS OF OPERATION ARE 2574 BTU/HR CONTINUOUSLY AND 4737 BTU/HR INTERMITTENTLY FOR 1/2 HR EACH DAY AND 4 1/2 HRS PRIOR TO SHUTTLE ORBITER BERTHING. BUILDUP HEAT LOAD CAPABILITY SHALL ALSO ACCOMMODATE AN ADDITIONAL 700 BTU/HR/MAN DURING MANNED PERIODS OF OPERATION. ADDITIONAL EQUIPMENT HEAT LOADS TO BE ACCOMMODATED DURING MANNED PERIODS OF OPERATION DURING BUILDUP ARE TO BE DETERMINED. THE FOREGOING BUILDUP HEAT LOADS APPLY DURING BUILDUP OPERATIONS PRIOR TO DELIVERY OF STATION MODULE 1. THE NORMAL OPERATIONS THERMAL CONTROL PROVISIONS OF SM-1 WILL BE USED AS REQUIRED FOR SUBSEQUENT BUILDUP OPERATIONS. THE NORMAL OPERATIONS HEAT LOAD DISTRIBUTION IS SIMMARIZED IN THE FOLLOWING TABLE.

TABLE 3.1.3.11 HEAT LOAD DISTRIBUTION SUMMARY

HEAT SOURCE	MODULE MAXIMUM, CREW DAY HEAT LOAD BTU/HR			MSS TOTAL ** CREW DAY HEAT LOAD BTU/HR		
	ORBITAL AVERAGE			ORBITAL AVERAGE		
	AIR	LIQUID	TOTAL	AIR	LIQUID	TOTAL
CORE MODULE *	12065	39615	51680	10775	26690	37465
SM-1 MODULE	11206	20126	31332	9384	15670	25054
SM-2 MODULE	6185	8800	14985	5245	8660	13905
SM-3 MODULE	11400	11670	23070	6125	7375	13500
SM-4 MODULE	9857	20126	29983	5259	7902	13161
TOTAL	50713	100337	151050	36788	66297	103085

* PROVIDES COOLING FOR POWER BOOM
** DESIGN HEAT LOAD CONTRIBUTION TO MSS TOTAL

3.2 SYSTEM DESIGN AND CONSTRUCTION STANDARDS

3.2.1 DESIGN COMPATIBILITY

A. THE MAXIMUM EXTERNAL DIMENSIONS OF THE MODULES SHALL BE 14 FT. IN DIAMETER AND UP TO 58 FT. IN LENGTH. MECHANISMS THAT ARE EXTERNAL BUT ATTACHED TO THE MODULE, SUCH AS HANDLING RINGS, ATTACHMENTS FOR DEPLOYMENT, BERTHING MECHANISMS, STORAGE FITTINGS, THRUSTERS, ETC., SHALL BE CONTAINED, AT LAUNCH, WITHIN AN ENVELOPE OF 15 FT. DIAMETER AND 60 FT. LENGTH.

B. THE SPACE STATION MODULES WILL BE LAUNCHED PRESSURIZED.

C. THE SPACE STATION SHALL BE CAPABLE OF USE IN ORBITS OF 55 DEGREE INCLINATIONS AT ALTITUDES BETWEEN 240 AND 270 NAUTICAL MILES.

D. THE SPACE STATION SHALL BE DESIGNED TO SERVE, WITH MINIMUM INORBIT MODIFICATION, FOR THE GROWTH STATION WHICH WILL BE ASSEMBLED IN ORBIT AT A LATER DATE.

E. THE SPACE STATION DESIGN SHALL BE ADAPTABLE, THROUGH MINIMUM REDESIGN, TO ARTIFICIAL GRAVITY OPERATIONS.

F. POTENTIALLY EXPLOSIVE CONTAINERS SUCH AS HIGH PRESSURE VESSELS (GREATER THAN TBD PSI) OR VOLATILE GAS STORAGE CONTAINERS SHALL BE PLACED OUTSIDE OF AND AS REMOTELY AS POSSIBLE FROM PERSONNEL LIVING AND OPERATING QUARTERS, AND WHERE POSSIBLE ISOLATED AND/OR PROTECTED SO THAT A FAILURE OF ONE WILL NOT PROPOGATE TO OTHERS. THE CARGO MODULE IS ACCEPTABLE FOR STORAGE OF HIGH PRESSURE VESSELS.

G. THE DESIGN TO TARGET WEIGHT OF THE MODULES SHALL NOT EXCEED 20,000 POUNDS. TARGET WEIGHT INCLUDES DRY WEIGHT, CONSUMABLES, EXPERIMENT PROVISIONS, AND BUILDUP PROVISIONS. THE MODULE SHALL BE DESIGNED TO STRUCTURAL LOADS RESULTING FROM A MAXIMUM WEIGHT OF 25,000 POUNDS.

H. AS A GOAL, COMMON MODULE STRUCTURES, SYSTEMS, SUBSYSTEMS, AND ASSEMBLIES FOR SPACE STATION MODULES SHOULD BE DEVELOPED.

I. EACH MODULE SHALL BE DESIGNED AROUND A COMMON REFERENCE. THAT REFERENCE SHALL BE SUCH THAT THE CREW AND EQUIPMENT ORIENTATION IS CONSISTENT THROUGHOUT ANY SINGULAR MODULE. AS A GOAL, ALL COMMON MODULES WILL HAVE THE SAME REFERENCE.

J. THE SPACE STATION SHALL BE DESIGNED FOR EASE OF MANUFACTURE, ASSEMBLY,

INSPECTION, AND MAINTENANCE. INSOFAR AS PRACTICABLE, SPACE STATION COMPONENT PARTS SHALL BE INTERCHANGEABLE OR REPLACEABLE. WHEN PRACTICAL, MODULAR PACKAGING OF HARDWARE, INCLUDING MODIFICATIONS, SHALL PROVIDE INTERCHANGEABILITY.

K. VEHICLE FLUID SYSTEMS AND THEIR SERVICING EQUIPMENT SHALL BE DESIGNED TO PERMIT COMPLETE FLUSHING AND DRAINING DURING GROUND CHECKOUT.

L. AS A GOAL, NO ORIENTATION RESTRICTIONS WILL BE IMPOSED BY SUBSYSTEMS.

M. DESIGN FEATURES OF SPACE STATION SUBSYSTEM IFRU AND SUBSYSTEM PHYSICAL INPLACE INTERFACES, SHALL CONSIDER POTENTIAL WEAR AND DAMAGE DUE TO MULTIPLE REPLACEMENT.

N. SUBSYSTEM AND COMPONENT ARRANGEMENTS AND ACCESSIBILITY SHALL BE OPTIMIZED IN RELATIONSHIP TO FREQUENCY AND PRIORITY OF REPLACEMENT AND NATURE OF MAINTENANCE FUNCTION TO BE ACCOMPLISHED.

O. THE ATMOSPHERIC OVER PRESSURE RESULTING FROM RAPID RELEASE OF THE GAS FROM ANY SINGLE PRESSURE VESSEL OR MANIFOLDED COMBINATION OF PRESSURE VESSELS IN AN INHABITED MODULE SHALL NOT RESULT IN A STRUCTURAL FACTOR OF SAFETY OF LESS THAN 1.5. (MAXIMUM OVER PRESSURE IS 19.6 PSIA BASED ON NORMAL ATMOSPHERIC PRESSURE OF 14.7 PSIA.)

3.2.2 DESIGN CRITERIA

3.2.2.1 NATURAL ENVIRONMENT

THE SPACE STATION DESIGN SHALL PROTECT THE CREW AND WITHSTAND THE LOADS IMPOSED BY THE NATURAL ENVIRONMENTS AS DEFINED IN PARAGRAPH 3.1.3.4.

3.2.2.2 INDUCED ENVIRONMENT

THE SPACE STATION DESIGN SHALL PROTECT THE CREW AND WITHSTAND THE LOADS IMPOSED BY THE INDUCED ENVIRONMENTS AS DEFINED IN PARAGRAPH 3.1.3.9.

3.2.2.3 FACTORS OF SAFETY

THE FOLLOWING FACTORS OF SAFETY SHALL BE USED FOR STRUCTURAL DESIGN, APPLIED TO LIMIT LOAD -

CONDITION	FACTOR OF SAFETY	
	ULTIMATE	YIELD
UNMANNED	1.50	1.20
MANNED		
LONG-TERM SUSTAINED LOADS	2.00	1.50
SHORT-TERM TRANSIENT LOADS	1.75	1.30

ALL PRESSURE VESSELS SHALL BE DESIGNED WITH AN UTLIMATE FACTOR OF SAFETY OF 2.0. TANKS USED AS GAS ACCUMULATORS IN INHABITED AREAS SHALL BE DESIGNED TO A FACTOR OF SAFETY OF 4.0 AS A MINIMUM.

3.2.2.4 LIMIT CONDITION

NO SYSTEM SHALL BE DESIGNED INCAPABLE OF FUNCTIONING AT LIMIT LOAD CONDITIONS.

3.2.2.5 FAIL SAFE

SYSTEM OR COMPONENT FAILURE SHALL NOT PROPAGATE SEQUENTIALLY, I.E., DESIGN SHALL FAIL SAFE.

A. ALL VENT SYSTEMS SHALL BE DESIGNED IN SUCH A MANNER THAT A FAILURE OF ANY COMPONENT WILL NOT RESULT IN LOSS OF PRESSURE VOLUME ATMOSPHERE.

3.2.2.6 DESIGN MARGINS

ALL SPACE STATION SYSTEMS SHALL BE DESIGNED TO POSITIVE MARGINS OF SAFETY.

3.2.3 SELECTION OF SPECIFICATION AND STANDARDS

ALL SPECIFICATIONS AND STANDARDS APPLICABLE TO THE PREMISSION OPERATIONS SUPPORT SYSTEM LAUNCH ESSENTIAL OR MISSION ESSENTIAL EQUIPMENT AS WELL AS ALL FLIGHT EQUIPMENT SHALL BE SELECTED IN THE FOLLOWING ORDER OF PRECEDENCE, UNLESS SUCH SELECTION IS PROHIBITED BY THE CRITICALITY CATEGORY

OF QUALIFICATION REQUIREMENTS.

A. FEDERAL SPECIFICATIONS AND STANDARDS APPROVED FOR USE BY NASA

B. MILITARY SPECIFICATIONS AND STANDARDS (MIL, JAN, OR MS)

C. OTHER GOVERNMENT SPECIFICATIONS AND STANDARDS (NASA, ETC.)

D. INDUSTRY SPECS AND STANDARDS

E. NR/SD SPECIFICATIONS AND STANDARDS

3.2.4 MATERIAL, PARTS AND PROCESSES

MATERIAL, PARTS AND PROCESSES TO BE INCORPORATED SHALL BE SELECTED WITH THE FOLLOWING CONSIDERATIONS -

A. MATERIALS, PARTS, AND PROCESSES SHALL BE SUITABLE FOR THE PURPOSE INTENDED. SAFETY, PERFORMANCE, RELIABILITY, LONG LIFE AND MAINTAINABILITY OF THE ITEM ARE OF PRIMARY IMPORTANCE.

B. WHERE POSSIBLE, MATERIALS AND PARTS SHALL BE OF THE KIND AND QUALITY WIDELY AVAILABLE IN SUPPLY CHANNELS.

C. WHEN PRACTICABLE, MATERIALS AND PARTS SHALL BE NONPROPRIETARY.

D. WHENEVER POSSIBLE, SINGLE SOURCE ITEMS SHALL BE AVOIDED.

F. WHEN PRACTICABLE, EQUIPMENT SHALL BE DESIGNED WITH A MINIMUM OF ADJUSTABLE COMPONENTS.

3.2.5 STANDARD AND COMMERCIAL PARTS

INTENDED USE, COMMONALITY, AVAILABILITY, AND COST CONSIDERATIONS WILL GOVERN THE SELECTION BETWEEN GOVERNMENT STANDARD AND COMMERCIAL PARTS.

3.2.6 MOISTURE AND FUNGUS RESISTANCE

FUNGUS-INERT MATERIALS SHALL BE USED TO THE GREATEST EXTENT PRACTICABLE. FUNGUS-NUTRIENT MATERIALS MAY BE USED IF PROPERLY TREATED TO BECOME FUNGUS RESISTANT. THE TREATED MATERIAL SHALL MEET THE FUNGUS TEST IN MIL-STD-810. MATERIALS THAT ARE NOT FUNGUS RESISTANT MAY BE USED IN HERMETICALLY SEALED EQUIPMENT AND OTHER QUALIFIED USES THAT SHALL NOT ADVERSELY AFFECT EQUIPMENT PERFORMANCE OR SERVICE LIFE.

3.2.7 CORROSION OF METAL PARTS

DESIGN SHALL USE METALLIC MATERIALS CHOSEN FOR THEIR CORROSION RESISTANCE CHARACTERISTICS. ALL METAL PARTS SHALL BE SUITABLY PROTECTED TO RESIST CORROSION DURING NORMAL SERVICE LIFE.

3.2.8 ELECTRICAL CONDUCTIVITY

MATERIALS USED IN ELECTRONICS OR ELECTRICAL CONNECTIONS SHALL HAVE SUCH CHARACTERISTICS THAT, DURING SPECIFIED ENVIRONMENTAL CONDITIONS, THERE SHALL BE NO ADVERSE EFFECT UPON THE CONDUCTIVITY OF THE CONNECTIONS.

3.2.9 INTERCHANGEABILITY AND REPLACEABILITY

DESIGN SHALL INCLUDE EASE OF MANUFACTURE, ASSEMBLY, INSPECTION, AND MAINTENANCE. INSOFAR AS PRACTICABLE, COMPONENT PARTS SHALL BE INTERCHANGEABLE OR REPLACEABLE IN ACCORDANCE WITH MIL-I-8500. WHEN PRACTICAL, MODULAR PACKAGING OF HARDWARE, INCLUDING MODIFICATIONS, SHALL PROVIDE INTERCHANGEABILITY.

3.2.10 WORKMANSHIP

ALL PARTS AND ASSEMBLIES, SHALL BE DESIGNED, CONSTRUCTED, AND FINISHED IN A THOROUGHLY WORKMANLIKE MANNER. CONTRACTUAL SPECIFICATIONS, WHERE APPLICABLE, SHALL BE THE GOVERNING CRITERIA FOR WORKMANSHIP. AREAS INVOLVING WORKMANSHIP NOT COVERED BY CONTRACTUAL SPECIFICATIONS SHALL BE IN ACCORDANCE WITH BEST ACCEPTED MANUFACTURING PRACTICES AND OF QUALITY TO ASSURE SAFETY, PROVIDE OPERATION AND SERVICE LIFE. SPECIAL ATTENTION SHALL BE GIVEN TO NEATNESS AND THOROUGHNESS OF ASSEMBLY, WIRING, MARKING OF PARTS AND ASSEMBLIES, FINISHING, FITTING, AND FREEDOM OF PARTS FROM BURRS, SHARP EDGES, AND PROTUBERANCES.

3.2.11 ELECTROMAGNETIC INTERFERENCE

3.2.11.1 SUBSYSTEM INTERFERENCES

THE DESIGN REQUIREMENTS INCORPORATED TO ASSURE ELECTROMAGNETIC INTERFERENCE-FREE OPERATION SHALL BE THOSE SPECIFIED BY MIL-STD-461 FOR ELECTROMAGNETIC EMISSION AND SUSCEPTIBILITY, AND MIL-B-5087 FOR ELECTRICAL BONDING. DETAILS OF THESE REQUIREMENTS SHALL BE DEFINED IN THE MIL-E-6051 REQUIRED ELECTROMAGNETIC INTERFERENCE CONTROL PLAN.

3.2.11.2 SYSTEM COMPATIBILITY

THE DESIGN REQUIREMENTS INCORPORATED TO ASSURE TOTAL END ITEM ELECTROMAGNETIC COMPATIBILITY SHALL BE THOSE SPECIFIED BY MIL-E-6051.

3.2.12 STORAGE

STORAGE REQUIREMENTS SHALL BE IN ACCORDANCE WITH SPECIFICATIONS AND STORAGE REQUIREMENTS APPPOVED BY NASA.

3.2.13 DRAWING STANDARDS

THE SPACE STATION DRAWINGS ASSOCIATED LISTS AND MARKINGS SHALL BE IN ACCORDANCE WITH THE SPACE STATION CONFIGURATION MANAGEMENT REQUIREMENTS PLAN REF SD 70-141 (MSC 00714).

3.2.14 COORDINATE SYSTEM STANDARDS

THE COORDINATE SYSTEM TO BE USED FOR DESIGN AS A COMMON FRAME OF REFERENCE IS SHOWN IN FIGURE 3.2.14-1. ORBITER INSTALLATION COORDINATES ARE SHOWN IN FIGURE 3.2.14-2. FOR REFERENCE, THE MSS ASSEMBLY COORDINATES ARE SHOWN IN FIGURE 3.2.14-3.

3.2.15 CONTAMINATION

EQUIPMENT OR MATERIAL SENSITIVE TO CONTAMINATION SHALL BE HANDLED IN A CONTROLLED ENVIRONMENT. FLUIDS AND MATERIALS SHALL BE COMPATIBLE WITH THE COMBINED ENVIRONMENT IN WHICH THEY ARE EMPLOYED. PROCESS SPECIFICATIONS WILL BE FORMULATED TO PRESCRIBE HANDLING AND APPLICATION METHODS.

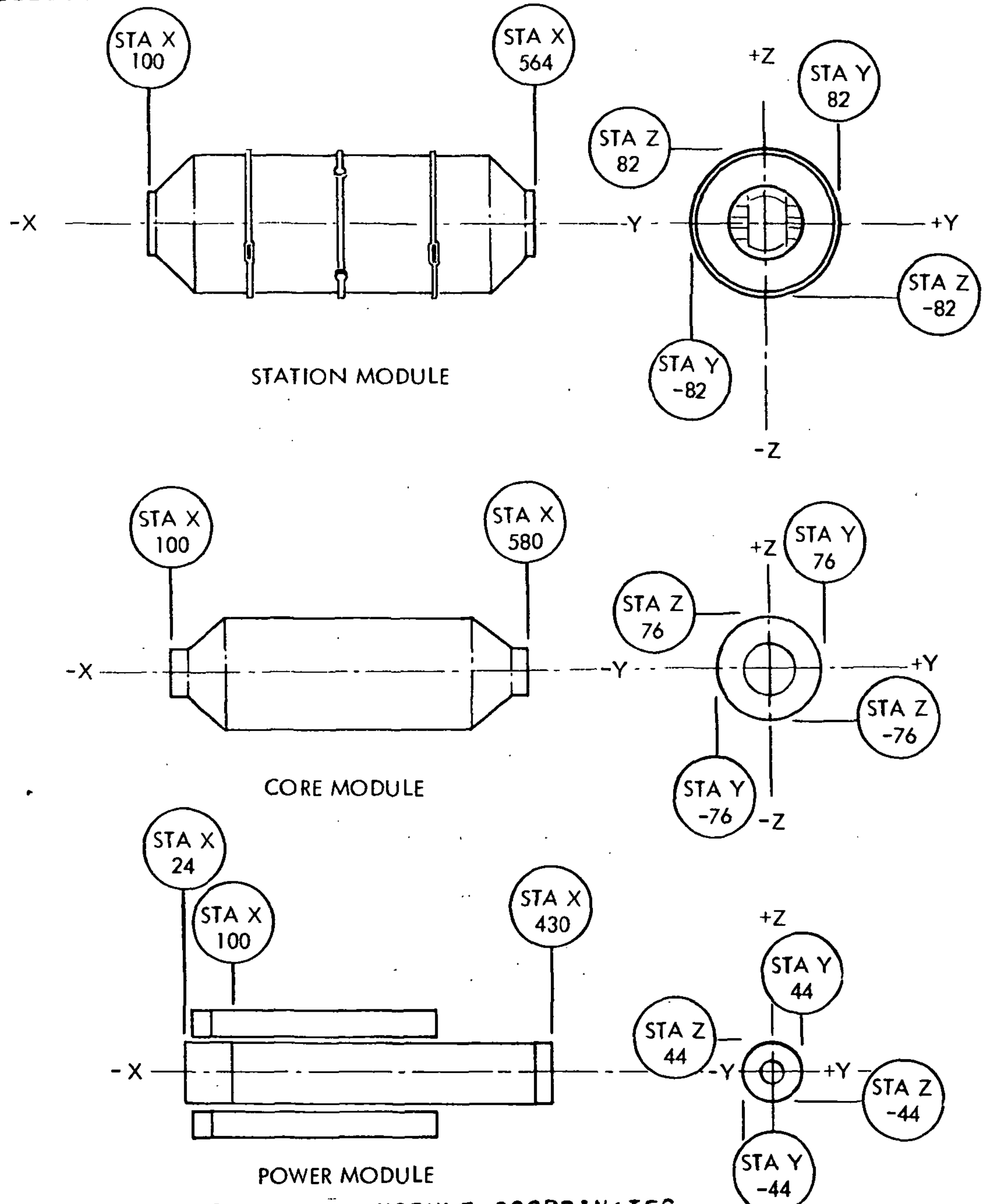


FIGURE 3.2.14-1 MODULE COORDINATES

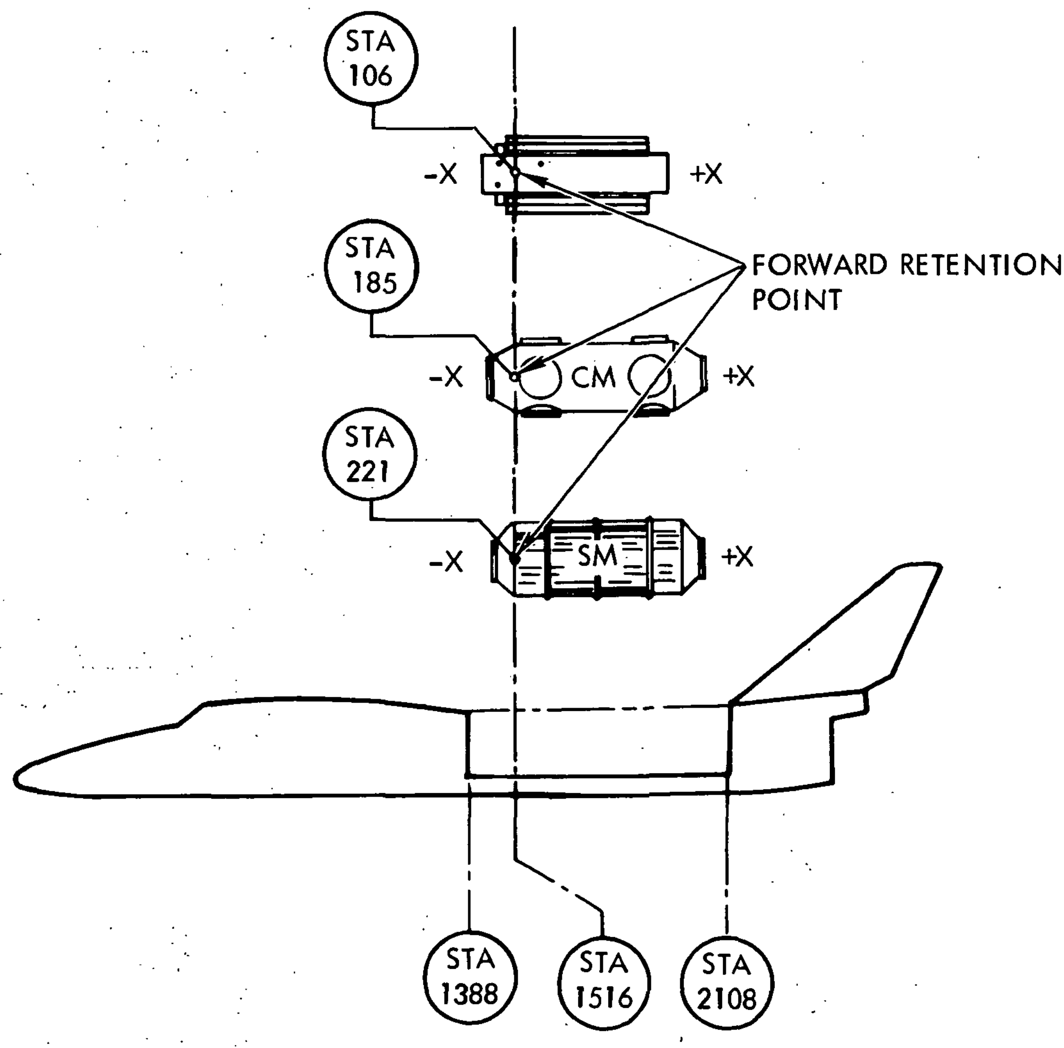


FIGURE 3.2.14-2 ORBITER INSTALLATION COORDINATES

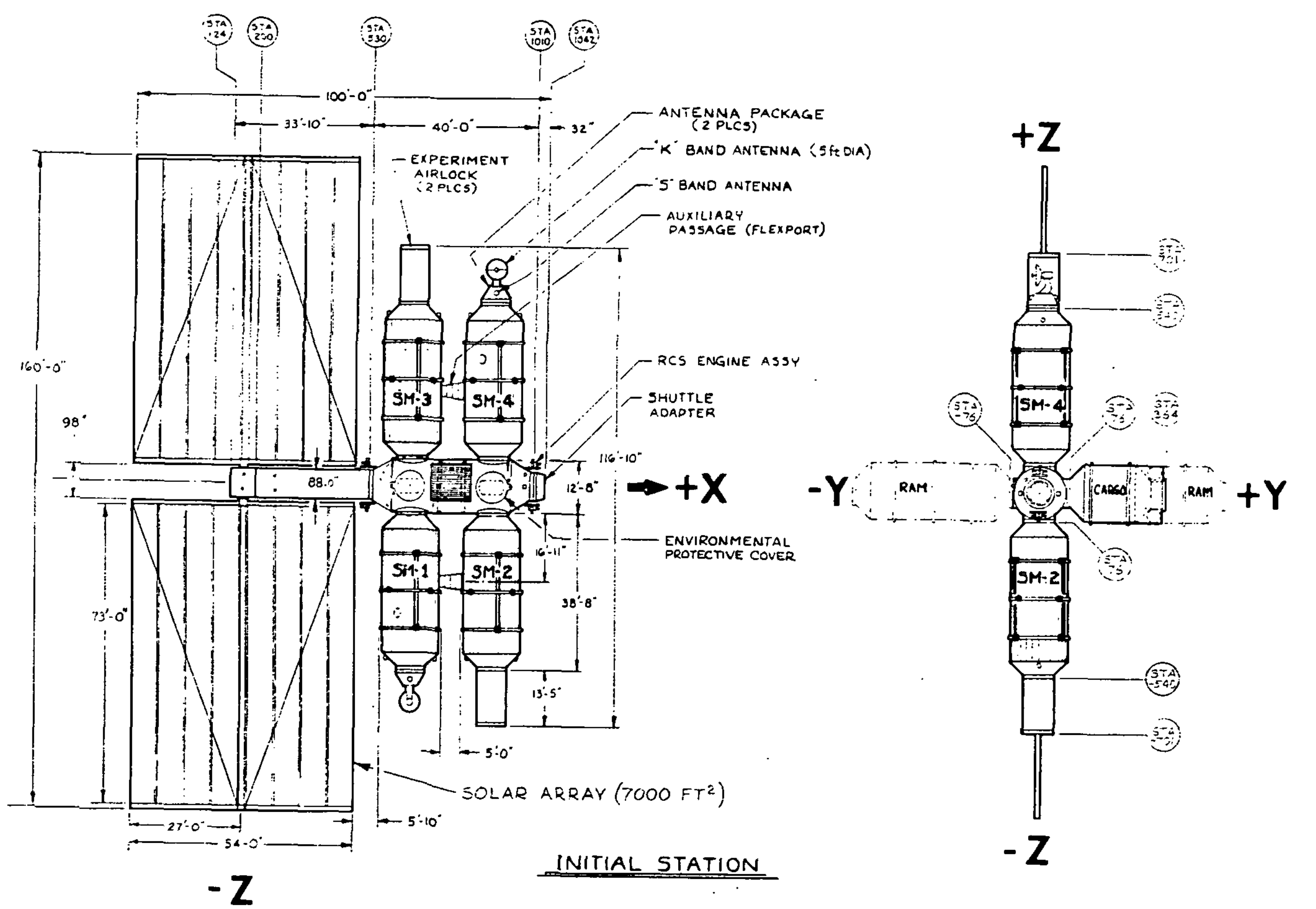


FIGURE 3.2.14-3 ASSEMBLED STATION COORDINATES

MODULAR SPACE STATION - INITIAL STATION SYSTEM
3.3.1 STRUCTURAL AND MECHANICAL

THIS SUBSYSTEM IS ONE OF THE SEVEN FUNCTIONAL GROUPINGS OF MAJOR SUBSYSTEMS THAT COMPRISE THE SHUTTLE LAUNCH MODULAR SPACE STATION.

PREPARED	R. M. Meyers	SYSTEM RQMTS/INTERFACES
APPROVAL	G. J. Goble	SUBSYSTEM PROJECT ENGR
APPROVAL	[illegible]	SUBSYSTEM PROJECT MGR
APPROVAL	[illegible]	PROJECT ENGINEERING MGR

3.3 SUBSYSTEM REQUIREMENTS

3.3.1 STRUCTURAL/MECHANICAL SUBSYSTEM

THE STRUCTURAL AND MECHANICAL SUBSYSTEM PROVIDES THE SPACE STATION PRESSURE ENCLOSURE AS WELL AS THE LIVING AND WORKING QUARTERS CONTAINED WITHIN THE STRUCTURE. IT PROVIDES FOR THE MOUNTING OF ASSOCIATED SUBSYSTEM HARDWARE AND THE GENERAL PURPOSE LABORATORY PROVISIONS AND PROVIDES STORAGE FACILITIES. IT ALSO PROVIDES BERTHING PORTS AND MECHANISMS FOR CREW AND EQUIPMENT TRANSFER.

3.3.1.1 PERFORMANCE REQUIREMENTS

3.3.1.1.1 NORMAL OPERATIONS

3.3.1.1.1.1 PRIMARY STRUCTURE REQUIREMENTS

A. THE STRUCTURE SHALL WITHSTAND WITHOUT EXCESSIVE DEFLECTION OR FAILURE THE INDUCED ENVIRONMENTS OF NORMAL SPACE SHUTTLE FLIGHT AND THE NORMAL LANDING LOADS AS SPECIFIED IN PARAGRAPH 3.1.3.9.

B. THE STRUCTURE SHALL WITHSTAND WITHOUT EXCESSIVE DEFLECTION OR FAILURE THE NATURAL ENVIRONMENTAL CONDITIONS SPECIFIED IN PARAGRAPH 3.1.3.4.

C. THE PRIMARY STRUCTURE SHALL BE DESIGNED IN ACCORDANCE WITH THE FACTORS OF SAFETY SPECIFIED IN PARAGRAPH 3.2.2.3.

D. THE EXTERNAL DIMENSIONS OF THE MODULES SHALL BE 14 FOOT DIAMETER AND A MAXIMUM LENGTH OF 58 FEET. MECHANISMS THAT ARE EXTERNAL BUT ATTACHED TO THE MODULE, SUCH AS HANDLING RINGS, ATTACHMENTS FOR DEPLOY-MENT, STORAGE FITTINGS, THRUSTERS, ETC., SHALL BE CONTAINED AT LAUNCH WITHIN AN ENVELOPE 15 FEET IN DIAMETER AND 60 FEET IN LENGTH. LOCAL-IZED EXTERNAL STRUCTURAL FRAMING BEYOND THE 14 FOOT DIAMETER, BUT WITHIN 15 FOOT DIAMETER IS ACCEPTABLE.

E. THE PRIMARY STRUCTURE SHALL BE DESIGNED FOR A USEFUL LIFE OF 10 YEARS WITHOUT REPLACEMENT OR EXTENSIVE RECONDITIONING.

F. THE STRUCTURE SHALL WITHSTAND THE FORCES IMPOSED BY MANIPULATOR EX-TRACTION FROM THE SPACE SHUTTLE CARGO BAY AND BERTHING TO THE MSS WITHOUT EXCESSIVE DEFLECTION OR FAILURE.

G. DESIGN OF THE BASIC STRUCTURAL ELEMENT SHALL BE SUCH THAT ALL BERTHING AND PRESSURE LOADS ARE TAKEN THROUGH THE PRIMARY STRUCTURE TO ALLOW

MAXIMUM FLEXIBILITY FOR INTERNAL ARCHITECTURAL ARRANGEMENTS. PRIMARY STRUCTURE IS DEFINED AS THAT STRUCTURE COMMON TO ALL BASIC STRUCTURAL ELEMENTS. FLOORS, PARTITIONS, EQUIPMENT MOUNTING, AND OTHER STRUCTURE PECULAR TO A PARTICULAR CONFIGURATION SHALL BE SECONDARY STRUCTURE.

H. STRUCTURAL MECHANISMS SHALL BE CAPABLE OF FULFILLING ALL REQUIRED FUNCTIONS WITH NO RESTRICTIONS ON STATION ORIENTATION RELATIVE TO THE SUN AND EARTH.

I. AS A DESIGN GOAL, THE STRUCTURE OF EACH STATION MODULE SHALL BE DESIGNED TO LIMIT LEAKAGE FROM THE MODULE TO 0.5 LB/DAY BASED ON A 14.7 PSIA O2/N2 ATMOSPHERE.

J. SPACE STATION MODULE STRUCTURAL ARRANGEMENT SHALL BE SUCH THAT THE MODULE CG IS LOCATED WITHIN THE SHUTTLE PAYLOAD CG ENVELOPE AS ILLUSTRATED IN FIGURE 3.3.1.1.1.1-1.

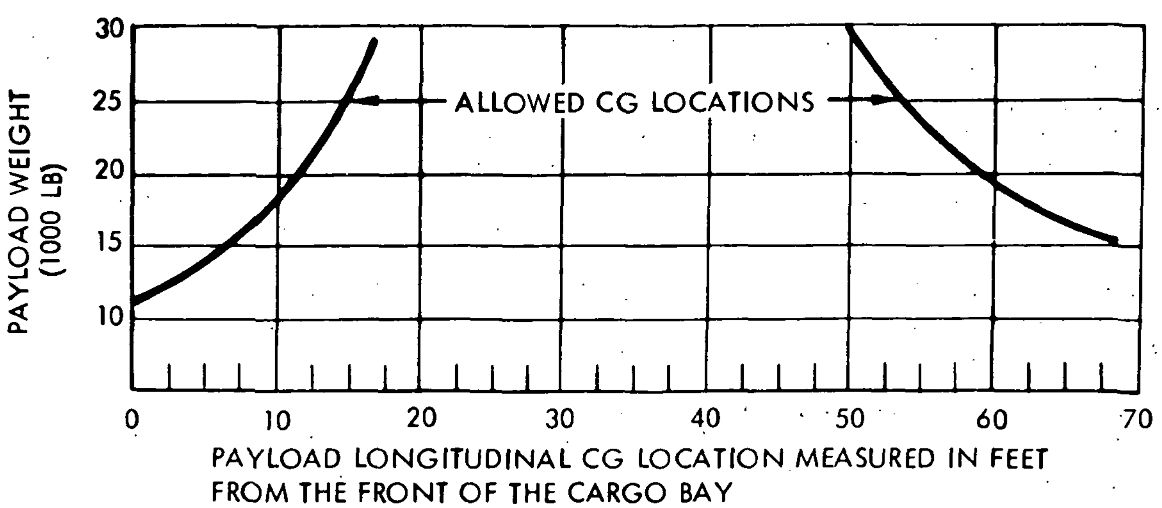


FIGURE 3.3.1.1.1.1-1 SHUTTLE ORBITER PAYLOAD CG ENVELOPE

K. AS A GOAL, THE FUNDAMENTAL BENDING/TORSIONAL NATURAL FREQUENCY MODE OF THE SPACE STATION CONFIGURATION SHALL BE GREATER THAN ONE HZ.

L. EVA/IVA AIRLOCKS SHALL BE LOCATED TO PERMIT EVA AND IVA CREW ACCESS TO AND FROM EACH PRESSURE ISOLATABLE VOLUME. THERE SHALL BE AT LEAST ONE IVA AIRLOCK AND THIS WILL ALLOW IVA INTO EACH PRESSURE ISOLATABLE VOLUME. THERE SHALL BE AT LEAST ONE EVA AIRLOCK ACCESSIBLE FROM EITHER PRESSURE ISOLATABLE VOLUME INDEPENDENT OF ANY ONE EVA AIRLOCK. AIRLOCKS IN THIS CONTEXT CAN BE DEFINED AS A SPECIALLY DESIGNED INTERMEDIATE CHAMBER, INDIVIDUAL MODULE, PRESSURE VOLUME, OR VARIATION THEREOF WHICH CAN SATISFY THE IVA/EVA FUNCTION REQUIREMENTS.

M. THE CAPABILITY FOR RAPID DEPRESSURIZATION AND REPRESSURIZATION EVA/IVA AIRLOCKS IS REQUIRED. DEPRESSURIZATION CONTROL SHOULD BE POSSIBLE FROM INSIDE AND OUTSIDE THE SPACE STATION AS WELL AS FROM INSIDE THE AIRLOCK. REPRESSURIZATION CONTROL SHOULD BE POSSIBLE FROM BOTH INSIDE THE SPACE STATION AND INSIDE THE AIRLOCK.

N. FOUR MANIPULATOR SOCKETS 90 DEGREES APART LOCATED APROXIMATELY ON THE MODULE CG SHALL BE PROVIDED ON ALL MODULES.

O. MODULE TRUNNION SUPPORTS SHALL BE PROVIDED TO ACCOMMODATE SHUTTLE PAYLOAD TRUNNION RETENTION LATCH MECHANISMS.

3.3.1.1.1.2 SECONDARY STRUCTURE REQUIREMENTS

A. FLOORS SHALL BE DESIGNED TO CARRY THE CONVENTIONAL LOADS OF THE ARCHITECTURAL DESIGN AND THE EQUIPMENT INSTALLED ON THEM. FLOORS SHALL BE SUPPORTED TO ALLOW FOR THERMAL AND PRESSURE EXPANSION/CONTRACTION. THEY SHALL NOT BE A PART OF THE PRIMARY STRUCTURE. STATION MODULE FLOOR ORIENTATION SHALL BE IN THE X-Y PLANE WITH RESPECT TO MODULE COORDINATES.

B. AS A GOAL, EQUIPMENT AND EQUIPMENT SUPPORTS SHALL BE ARRANGED OR MOUNTED SUCH THAT THE ENTIRE INSIDE SURFACE OF THE PRESSURE SHELL CAN BE EXPOSED FOR LEAK DETECTION AND REPAIR.

C. ALL EQUIPMENT INSTALLATIONS WITHIN THE SPACE STATION SHALL BE CAPABLE OF USE FOR PUSH-OFF, AND SHALL BE CAPABLE OF REACTING TO CREW IMPACT LOADS (300 POUNDS LIMIT APPLIED IN ANY DIRECTION).

D. BERTHING PORT HATCHES SHALL PROVIDE A NOMINAL OPENING OF 5 FEET AND SHALL ACCOMMODATE THE PASSAGE OF CREW IN PRESSURE SUITS AND PACKAGE SIZES OF 40 X 40 X 50 INCHES.

E. WINDOW AND OPTICAL PENETRATION REQUIREMENTS

1. THE MSC 14.75 WINDOW DESIGN SHALL BE UTILIZED AS A STANDARD SPACE

STATION WINDOW.

2. WINDOW AND OPTICAL PENETRATION DESIGN AND INSTALLATION SHALL PROVIDE FOR SHIRTSLEEVE REMOVAL AND REPLACEMENT.

3. PLACEMENT OF WINDOWS AND OPTICAL PENETRATIONS SHALL BE SELECTED ON THE BASIS OF MINIMIZING LOCAL WINDOW OPTICAL CONTAMINATION AND ADVERSE ENVIRONMENTAL CONDITIONS (I.E. MICROMETEOROID PENETRATION).

4. HEAT TRANSFER THROUGH THE WINDOWS SHALL BE MINIMIZED.

5. WINDOW LOCATIONS

EVA-	STANDARD WINDOWS SHALL BE PROVIDED IN THE EVA EXTERNAL AND INTERNAL HATCHES.
IVA	STANDARD WINDOWS SHALL BE PROVIDED IN EACH HATCH.
BERTHING	STANDARD WINDOWS SHALL BE PROVIDED AT EACH DOCKING/BERTHING PORT HATCH.
FLEXPORTS	A 4 INCH DIAMETER WINDOW SHALL BE LOCATED IN EACH FLEXPORT HATCH.
EXPERIMENTS	BERTHING PORT HATCH WINDOWS MAY BE UTILIZED BY THE EXPERIMENTS.

WINDOWS SHALL BE PROVIDED AT THE PRIMARY CONTROL STATIONS TO ENABLE THE CREW TO CONFIRM OR CONTROL THE ATTITUDE OF THE VEHICLE BY REFERENCE TO THE EXTERNAL SCENE. IN THE NORMAL FLIGHT ATTITUDES, THE SIZE AND LOCATIONS OF THE WINDOWS SHOULD ALLOW A CREW MEMBER TO CHECK OR CONTROL ALL THREE AXES OF CONTROL OF THE STATION. AS A GOAL, THESE WINDOWS SHOULD BE PLACED IN A MANNER THAT WILL ALLOW CORRELATION OF THE OBSERVED SCENE TO THE STATION CONTROL AXIS WITHOUT THE CREW PERFORMING A MENTAL COORDINATE TRANSFORMATION. AT LEAST ONE WINDOW SHALL BE LARGE ENOUGH TO ALLOW THE CONTROL OF TWO OF THE VEHICLE AXES SIMULTANEOUSLY WITHOUT REFERENCE TO A SECOND WINDOW OR TO ANY INSTRUMENT. PROVISIONS SHOULD BE PROVIDED AT APPROPRIATE WINDOWS TO ALLOW FOR QUALITATIVE EVALUATION OF THE VEHICLE'S ATTITUDE, RATES AND DEADBANDS.

THERE SHALL BE A WINDOW OR WINDOWS ON THE STATION TO ENABLE VISUAL CONTACT WITH THE SHUTTLE OR FREE FLYING MODULES DURING THEIR TERMINAL PHASES OF RENDEZVOUS (LAST 5000 FEET) WITH THE STATION. AS A DESIGN

GOAL, THESE WINDOWS SHOULD BE LOCATED AT THE CONTROL STATION.

THERE SHALL BE A WINDOW OR WINDOWS IN THE MAIN CREW ASSEMBLY AREA (DINING FACILITY) TO PROVIDE VIEWING OF THE EARTH AND SPACE FROM THE NORMAL SPACE STATION FLIGHT ATTITUDE.

A WINDOW SHALL BE PLACED CLOSE TO THE MAIN AIRLOCK TO ALLOW AN OBSERVER TO HAVE VISUAL CONTACT WITH AN EVA ASTRONAUT IMMEDIATELY AFTER HE HAS LEFT THE AIRLOCK.

PROVISIONS SHALL BE MADE TO OBSERVE THE MOTION OF THE ARTICULATED SOLAR ARRAY PANELS FROM WITHIN THE SPACE STATION.

THERMAL COVERS SHALL BE PROVIDED FOR THE CONTROL CENTER WINDOWS AND THE MAIN CREW ASSEMBLY AREA WINDOW. THESE COVERS SHALL BE CAPABLE OF BEING OPENED AND CLOSED FROM WITHIN THE SPACE STATION AND BY EVA.

6. OPTICAL PENETRATIONS

SEXTANT/ TELESCOPE — THE SEXTANT/TELESCOPE SHALL BE LOCATED IN THE CORE MODULE IN CLOSE PROXIMITY TO THE EARTH OBSERVATION RAM. THE UNIT(S) SHALL BE MOUNTED TO PROVIDE BOTH EARTH AND CELESTIAL VIEWING WITH A FIELD OF VIEW OF 120 DEGREES.

HORIZON TRACKER	PENETRATION(S) ARE REQUIRED IN THE CORE MODULE FOR THE FOUR-HEAD HORIZON EDGE TRACKER ASSEMBLY. THE PENETRATIONS SHALL BE LOCATED SUCH THAT ALL FOUR TRACKER HEADS CAN SEE THE HORIZON AT ALL TIMES (X-POP MODE) WITH A FIELD OF VIEW OF 90 DEGREES.
STAR TRACKER	TWO PENETRATIONS ARE REQUIRED IN THE CORE MODULE. EACH PENETRATION SHALL PROVIDE CELESTIAL VIEWING WITH A FIELD OF VIEW OF 120 DEGREES AND SHALL BE ON THE SAME X-AXIS COORDINATES AS THE HORIZON TRACKER ASSEMBLY.
EXPERIMENTS	WINDOWS SHALL BE PROVIDED IN THE HATCHES BETWEEN THE STATION MODULES AND EXPERIMENT AIRLOCK LABORATORIES TO ALLOW TWO-WAY VIEWING INTO AND FROM THE AIRLOCKS. WINDOWS SHALL ALSO BE PROVIDED IN THE EXTERNAL HATCHES OF THE AIRLOCKS.

F. SUPPORTS FOR PRESSURE VESSELS SHALL BE DESIGNED TO RESTRAIN THE VESSEL UNDER PROPULSIVE EFFECTS OF RAPIDLY ESCAPING GAS.

3.3.1.1.1.3 ENVIRONMENTAL SHIELD REQUIREMENTS

A. ENVIRONMENTAL SHIELD SHALL PROVIDE PROTECTION FOR A PROBABILITY OF 0.9 OF NO MICROMETEOROID PENETRATION OF SPACE STATION MODULES FOR TEN YEARS.

B. THE STRUCTURE SHALL PROVIDE SHIELDING TO LIMIT CREW RADIATION DOSAGE TO LESS THAN THE ALLOWABLE DOSES AS SPECIFIED IN PARAGRAPH 3.1.1.1.1, ITEM C.

C. THERMAL SHIELDING SHALL BE PROVIDED TO SATISFY CRITERIA AS DEFINED IN PARAGRAPH 3.1.3.11, ITEMS E AND F.

3.3.1.1.1.4 BERTHING PORT REQUIREMENTS

A. BERTHING PORTS SHALL BE DESIGNED TO ACCOMMODATE ORBITER MANIPULATOR PERFORMANCE CHARACTERISTICS AS FOLLOWS -

AXIAL VELOCITY = 0.05 FPS	RADIAL ALIGNMENT = +/- 2 INCHES
RADIAL VELOCITY = 0.05 FPS	ANGULAR ALIGNMENT = +/- 1 DEGREE
ANGULAR VELOCITY = 0.1 DEG/SEC	

B. BERTHING PORTS SHALL PROVIDE UTILITY INTERFACES WITHIN THE PRESSURIZED VOLUME AS SHOWN IN TABLE 3.3.1.1.4-1.

TABLE 3.3.1.1.4-1. BERTHING PORT INTERFACE MATRIX

DUCTING AND PLUMBING UTILITIES										
INTERFACE	CORE / CORE	POWER	SM-1	SM-2	SM-3	SM-4	RAM	CARGO	ANT.PKG.	A/L EXP
FREON SUPPLY (PRI & SEC)	2		2	2	2	2				1
FREON RETURN (PRI & SEC)	2		2	2	2	2				1
H_2O COOLANT SUPPLY (PRI & SEC)	2		2	2	2	2	2	2	1	
H_2O COOLANT RETURN (PRI & SEC)	2		2	2	2	2	2	2	1	
H_2O POTABLE SUPPLY	1		1	1	1	1	1	1		
H_2O WASTE RETURN	1		1	1	1	1	1	1		
H_2O ELECTROLYSIS	1		1	1	1	1	1	1		
O_2 SUPPLY (& EPS)	2	2	2	1	1	2	1	1		1
N_2 SUPPLY	1	1	1	1	1	1	1	1		1
H_2 RCS OR EPS	2	2	2			2		1		
AIR PRESS./DEPRESS.	1	1	1	1	1	1	1	1	1	1
AIR PROCESSING DUCTS	2	2	2	2	2	2	2	2		
ELECTRICAL UTILITIES										
INTERFACE	CORE / CORE	POWER	SM-1	SM-2	SM-3	SM-4	RAM	CARGO	ANT.PKG	A/L EXP
POWER-PRIMARY (20KW)	8	8	2			2				
-SECONDARY (7KW)	4	4	2	2	2	2	2	2	4	2
G/N - RCS	•	•	•			•				
ECLSS	•	•	•	•	•	•	•	•		
ISS	•	•	•	•	•	•	•	•	•	
COMM-AUDIO/VISUAL	•	•	•	•	•	•	•	•	•	•
DATA-DIGITAL/ANALOG	•	•	•	•	•	•	•		•	•

THE CRITERIA FOR THE UTILITY INTERFACES IS AS FOLLOWS -

(1) HAZARDOUS FLUID AND GAS LINES SHALL BE BARRIERED AND PHYSICALLY SEPARATED FROM POWER WIRES AND EACH OTHER (GO2 LINES SHALL BE CONSIDERED HAZARDOUS IN INTERFACE AREAS).

(2) GH2 AND GO2 LINES SHALL BE BARRIERED AND SEPARATED BY A MINIMUM OF 45 DEGREES.

(3) REDUNDANT FLUID AND GAS LINES SHALL BE SEPARATED A MINIMUM OF 45 DEGREES.

(4) AS A GOAL, REDUNDANT CONNECTORS SHALL BE SEPARATED A MINIMUM OF 45 DEGREES (A CREDIBLE ACCIDENT TO, OR A CREDIBLE FAILURE OF AN INTERFACE FUNCTION OR ADJACENT FUNCTION SHALL NOT CAUSE THE LOSS OF THE REDUNDANTLY PROVIDED FUNCTION DUE TO PROXIMITY OF CONNECTORS).

(5) CONNECTORS THAT CONTAIN SIGNAL WIRES SHALL BE SEPARATED FROM CONNECTORS THAT CONTAIN POWER WIRES BY A MINIMUM OF 90 DEGREES.

(6) CARGO AND RAM CORE BERTHING PORTS SHALL BE STANDARD.

(7) AS A GOAL,BOTH CORE MODULE X-AXIS BERTHING PORTS SHALL BE STANDARD.

(8) ALL CORE MODULE BERTHING PORTS SHALL BE CAPABLE OF SUPPORTING ANY MODULE WITH BASIC UTILITIES.

(9) AS A GOAL, ALL CORE MODULE BERTHING PORTS THAT INTERFACE WITH STATION MODULES SHALL BE STANDARD.

(10) AS A GOAL, ALL -X STATION MODULE BERTHING PORTS SHALL BE STANDARD AND +X BERTHING PORTS SHALL BE STANDARD.

(11) UTILITY INTERFACES THAT ARE REQUIRED TO ESTABLISH A SHIRTSLEEVE ENVIRONMENT WITHIN A MODULE MUST BE CAPABLE OF BEING MATED BY A CREW MEMBER IN A PRESSURE SUIT.

C. EACH CORE MODULE BERTHING PORT SHALL BE CAPABLE OF PHYSICALLY MATING WITH ANY MODULE.

D. BERTHING PORTS SHALL BE LOCATED ON BOTH ENDS OF ALL THE MODULES.

E. CORE MODULE +/- Y AXIS BERTHING PORTS SHALL BE PROVIDED WITH THERMAL COVERS. ALL COVERS SHALL BE CAPABLE OF BEING OPENED AND CLOSED FROM

WITHIN THE SPACE STATION AND BY EVA.

F. BERTHING PORTS ON THE CORE MODULE SHALL BE LOCATED TO PROVIDE A 5 FOOT MINIMUM SPACE BETWEEN PARALLEL DOCKED MODULES TO RETAIN THE CAPABILITY FOR A DIRECT DOCKING MODE.

G. BERTHING PORTS SHALL BE ADAPTABLE (FIELD MODIFICATION ACCEPTABLE) FOR DIRECT DOCKING.

3.3.1.1.1.5 FACILITIES

THE SPACE STATION INTERIOR SHALL BE DESIGNED IN ACCORDANCE WITH GOOD ARCHITECTURAL AND DECORATOR PRACTICES IN ORDER TO PROVIDE COMFORTABLE, EFFICIENT AND ATTRACTIVE LIVING AND WORK SPACES. THE INTERIOR ARRANGEMENTS SHALL INSURE CREW COMFORT, EFFICIENCY, AND PHYSIOLOGICAL AND PSYCHOLOGICAL WELL BEING.

STRUCTURES SHALL PROVIDE, WITHIN THE MSS COMPLEX, TWO PRESSURE ISOLATABLE VOLUMES WITH FACILITIES ALLOCATED AS SHOWN IN PARAGRAPH 3.3.7.1, ITEM 8.

STRUCTURES SHALL PROVIDE FURNISHINGS FOR THE ABOVE FACILITIES AS NOTED IN PARAGRAPH 3.3.7.13.

3.3.1.1.2 EMERGENCY OPERATIONS

3.3.1.1.2.1 THE STRUCTURE SHALL BE DESIGNED SUCH THAT ANY HARDWARE BREAKUP THAT MAY OCCUR DURING A CRASH LANDING WILL BE CONTAINED WITHIN THE ORBITER CARGO BAY. DESIGN-TO CRASH LOADS ARE SPECIFIED IN PARAGRAPH 3.1.3.9.

3.3.1.1.2.2 DUAL EGRESS CAPABILITY SHALL BE PROVIDED FROM ALL MODULES AT ALL STAGES OF BUILDUP. PROVISIONS MAY BE IVA OR EVA.

3.3.1.1.2.3 DUAL SHIRTSLEEVE EGRESS SHALL BE PROVIDED AFTER INITIAL MANNING FOR ALL MODULES WHICH ARE OCCUPIED GREATER THAN 2 PERCENT OF THE CREW HOURS AVAILABLE PER MONTH. DUAL IVA OR EVA EGRESS IS ACCEPTABLE FOR THOSE MODULES WHICH ARE NOT OCCUPIED GREATER THAN 2 PERCENT OF THE TIME.

3.3.1.1.2.4 DUAL EGRESS PATHS SHALL BE SEPARATED BY PRESSURE AND EXPLOSION PROOF PARTITIONS OR SHALL BE AT LEAST 10 FEET APART AND SHALL EACH LEAD TO AN AREA IN WHICH THE CREW CAN SURVIVE UNTIL SHUTTLE RESCUE OR RESUPPLY.

3.3.1.1.3 BUILDUP OPERATIONS

MOUNTING PROVISIONS, AS REQUIRED, SHALL BE PROVIDED FOR TEMPORARY INSTALL-

ATION AND REMOVAL OF SUBSYSTEMS SPECIAL BUILDUP EQUIPMENT.

3.3.1.2 SECONDARY PERFORMANCE CHARACTERISTICS

3.3.1.2.1 PRIMARY STRUCTURE ASSEMBLY

NO SECONDARY PERFORMANCE CHARACTERISTICS IDENTIFIED.

3.3.1.2.2 SECONDARY STRUCTURE ASSEMBLY

A. AUXILIARY CREW PASSAGEWAYS PROVIDE AN ADDITIONAL MEANS FOR STATION MODULE INGRESS/EGRESS DURING NORMAL OPERATIONS.

B. SUBSEQUENT TO STATION BUILDUP, A THIRD EVA INGRESS/EGRESS PATH IS PROVIDED IN EACH PRESSURE ISOLATABLE VOLUME. THE EXTRA EVA PATH IN PRESSURE VOLUME 1 IS THROUGH THE POWER MODULE, AND THROUGH THE CORE MODULE AFT END (-X AXIS) IN PRESSURE VOLUME 2.

C. THE CAPABILITY TO CLOSE-OFF OR ISOLATE A MODULE AT EITHER SIDE OF THE INTERFACE VESTIBULE IS PROVIDED.

3.3.1.2.3 ENVIRONMENTAL SHIELD ASSEMBLY

NO SECONDARY PERFORMANCE CHARACTERISTICS IDENTIFIED.

3.3.1.2.4 BERTHING ASSEMBLY

NO SECONDARY PERFORMANCE CHARACTERISTICS IDENTIFIED.

3.3.1.2.5 GENERAL PURPOSE LABORATORY FURNISHINGS

NO SECONDARY PERFORMANCE CHARACTERISTICS IDENTIFIED.

3.3.1.3 EXPERIMENT PROVISIONS

STRUCTURES SHALL PROVIDE THE FOLLOWING GPL FACILITIES WITH THE ASSOCIATED AREA REQUIREMENTS -

- MEDICAL/BIOLOGICAL	177 SQ FT
- PHYSICS (SHARED SERIALLY WITH MED/BIO)	
- MECHANICAL MAINTENANCE	
- ELECTRICAL/ELECTRONIC MAINTENANCE	273 SQ FT
- OPTICAL SUPPLY AND MAINTENANCE	
- DATA ANALYSIS	177 SQ FT
- PHOTO PROCESSING	33 SQ FT
- EXPERIMENT OPERATIONS	164 SQ FT
- TOTAL	824 SQ FT

STRUCTURES SHALL PROVIDE TWO AIRLOCKS WITH ONE EARTH ORIENTED AND THE OTHER SHALL BE ZENITH ORIENTED.

STRUCTURES SHALL PROVIDE TWO DEDICATED BERTHING PORTS LOCATED ON THE +/-Y SIDE OF THE CORE MODULE.

STRUCTURES SHALL PROVIDE SUITABLE MOUNTING ACCOMMODATIONS FOR EXPERIMENTS SO THAT INSTALLATION, MAINTENANCE, AND REPLACEMENT MAY BE ACCOMPLISHED ON-ORBIT WITHOUT EVA.

3.3.1.4 SUBSYSTEMS DEFINITION

THE TECHNICAL DATA DESCRIBED IN THIS SECTION ARE NOT DESIGN-TO REQUIREMENTS, RATHER THEY REFLECT A CONCISE DESCRIPTION OF THE TECHNICAL PARAMETERS THAT FORM THE CURRENT BASELINE SUBSYSTEM DEFINITION. THE SUMMATION OF THESE CHARACTERISTICS ALONG WITH THOSE OF THE OTHER SIX FUNCTIONAL SUBSYSTEMS FORM THE BASIS FOR CONFIGURATION LAYOUTS, WEIGHT STATEMENTS AND POWER PROFILES.

3.3.1.4.1 MAJOR ASSEMBLIES

THE STRUCTURAL AND MECHANICAL SUBSYSTEM CONSISTS OF A SERIES OF PRIMARY STRUCTURE SUBASSEMBLIES (SIDEWALLS, BULKHEADS, LONGERONS, BERTHING RINGS, ETC.) WELDED TOGETHER TO FORM THE PRESSURE SHELL. THE OTHER ASSEMBLIES (SECONDARY STRUCTURE, ENVIRONMENTAL SHIELD, BERTHING, AND GENERAL PURPOSE LABORATORY FURNISHINGS) ARE RIVETED,BOLTED OR BONDED TO THE PRESSURE SHELL.

3.3.1.4.1.1 PRIMARY STRUCTURE ASSEMBLY

THE CORE MODULE IS OF SEMI-MONOCOQUE CONSTRUCTION WITH SIDEWALLS OF 0.040 THICKNESS INTEGRAL SKIN-STRINGER MACHINED 2219-T87 ALUMINUM. THERE ARE PASSIVE BERTHING PORTS ON EACH END OF THE MODULE AND TWO BANKS OF FOUR RADIAL PASSIVE BERTHING PORTS IN THE CYLINDRICAL PORTION. THE CORE MODULE PROVIDES AN IVA/EVA AIRLOCK BETWEEN TWO SEPARATE INTERNAL PRESSURIZABLE VOLUMES (V1 AND V2).

THE POWER MODULE IS A MONOCOQUE CYLINDER CONSTRUCTED FROM 0.145 THICKNESS 5052-H34 ALUMINUM. THIS MODULE SUPPORTS THE SOLAR ARRAY ASSEMBLY AT ONE END VIA A TURRET AND ORIENTATION DRIVE AND POWER TRANSFER MECHANISM. THE MODULE IS PRESSURIZABLE FOR MAINTENANCE ACTIVITIES, HOWEVER, IT IS NORMALLY UNPRESSURIZED FOR ORBITAL OPERATIONS.

THE STATION MODULE PRIMARY STRUCTURE IS A MONOCOQUE CYLINDER CONSTRUCTED OF 0.145 THICKNESS 5052-H34 ALUMINUM. ALL STATION MODULES HAVE A COMMON STRUCTURAL DESIGN. THESE MODULES PROVIDES THE LIVING AND WORKING QUARTERS FOR THE CREW, AND MOUNTING OF EQUIPMENT COMPONENTS.

ALL MODULES CONTAIN FOUR SHUTTLE ATTACH TRUNNION FITTINGS AND FOUR MANIPULATOR FITTINGS. THE POWER MODULE HAS FOUR ADDITIONAL MANIPULATOR FITTINGS ON THE TURRET SECTION.

3.3.1.4.1.2 SECONDARY STRUCTURE ASSEMBLY

SECONDARY STRUCTURES ARE RIVETED, BOLTED, AND BONDED TO THE PRIMARY

STRUCTURE AND ARE USED TO SUPPORT AND DISTRIBUTE THE WEIGHT OF THE SUBSYSTEMS EQUIPMENT. PARTITIONS ARE USED AS DIVIDING WALLS TO PROVIDE PRIVATE AREAS AND TO SEPARATE DIFFERENT FUNCTIONAL AREAS. LONGITUDINAL FLOORS ARE USED IN THE STATION MODULES AND ARE DESIGNED FOR WORST CASE EQUIPMENT DISTRIBUTION AND CRASH LANDING LOADS. DUCTS ARE PROVIDED TO PROTECT THE UTILITIES THAT ARE DISTRIBUTED THROUGH THE MODULES TO SUPPORT SUBSYSTEMS EQUIPMENT REQUIREMENTS. DOORS AND HATCHES PROVIDE FOR CREWMAN PASSAGE AND/OR CARGO TRANSFER FROM ONE HABITABLE VOLUME TO ANOTHER AND, WHEN CLOSED, PROVIDE A PRESSURE SEAL. WINDOWS ARE PROVIDED IN ALL HATCHES AND IN CONTROL STATION AND RECREATION AREAS. A SYSTEM FOR HANDLING CARGO IS PROVIDED ALONG WITH EFFICIENT STOWAGE OF SUPPLIES AND RETURNABLE WASTES. FLEXPORTS SERVE AS AUXILIARY CREW PASSAGEWAYS BETWEEN STATION MODULES.

3.3.1.4.1.3 ENVIRONMENTAL SHIELD ASSEMBLY

THREE BASIC FUNCTIONS ARE PROVIDED BY THIS ASSEMBLY, THERMAL PROTECTION, METEOROID PROTECTION, AND RADIATION PROTECTION.

THERMAL PROTECTION CONSISTS OF ENVIRONMENTAL SHIELD PANELS WHICH COVER THE END DOMES AND CYLINDRICAL SURFACES OF THE MODULES. THE OUTER SURFACE OF THE PANELS SERVE AS THE PRIMARY METEOROID BUMPER AND ALSO PROVIDE THE MEANS FOR SUPPORTING THE INSULATION BLANKETS. THESE BLANKETS CONSISTS OF APPROXIMATELY 60 LAYERS OF ALUMINIZED MYLAR ENCLOSED IN A 10-MIL THICK KAPTON FILM FOR PROTECTION AGAINST HANDLING DAMAGE AND PERMEATION OF CABIN ATMOSPHERE LEAKAGE.

METEOROID PROTECTION FEATURES DUAL BUMPERS TO FRAGMENT THE METEOROID PARTICLES AND REDUCE THEIR CAPABILITY TO PENETRATE THE PRESSURE SHELL. THE OUTER PRIMARY BUMPER CONSISTS OF A .030-INCH FIBERGLASS LAMINATE FOR THE POWER AND CORE MODULES AND .030-INCH THICK ALUMINUM FOR THE STATION MODULES. THE SECONDARY BUMPER CONSISTS OF THE 10-MIL THICK KAPTON FILM WHICH IS USED TO ENCLOSE THE THERMAL INSULATION BLANKETS.

RADIATION PROTECTION IS PROVIDED BY THE INHERENT SHIELDING DUE TO MASS OF STRUCTURE, FURNISHINGS, AND EQUIPMENT.

3.3.1.4.1.4 BERTHING ASSEMBLY

THE BERTHING ASSEMBLY IS AN INTEGRATED MECHANISM, STRUCTURE AND UTILITIES INTERFACE THAT PROVIDES FOR THE IMPACT, CAPTURE, MATING, AND ATTACHING OF MODULES TO FORM A FUNCTIONAL SPACE STATION. BERTHING IS DEFINED AS EMPLOYING A MANIPULATOR TO BRING THE MODULES TOGETHER SLOWLY, THUS REQUIRING MINIMUM OR NO ATTENUATION. EACH MODULE BERTHING PORT CONTAINS AN

ACTIVE OR PASSIVE RING-CONE ASSEMBLY, A PRESSURE HATCH, AND A UTILITIES INTERFACE ASSEMBLY. ALL LINKAGE AND HATCH MECHANISMS AND UTILITIES ASSEMBLIES ARE COMPLETELY SHIRTSLEEVE ACCESSIBLE.

THE ACTIVE PORTS CONTAINS THE RING, SEALS, LATCHES, WEDGE AND GUIDES. THE PASSIVE PORTS CONTAINS ONLY THE RING AND GUIDES. THE CORE MODULE HAS TWO END PASSIVE PORTS AND EIGHT SIDE PASSIVE PORTS. THE POWER MODULE HAS TWO PASSIVE AND TWO ACTIVE BERTHING PORTS. EACH OF THE STATION MODULES HAS ONE ACTIVE PORT THAT BERTHS TO THE CORE MODULE AND ONE PASSIVE PORT.

3.3.1.4.1.5 GENERAL PURPOSE LABORATORY FURNISHINGS

THE GENERAL PURPOSE LABORATORY CONSTITUTES THOSE FACILITIES AND EQUIPMENT WITHIN THE CONFINES OF THE STATION THAT PROVIDE THE MEANS FOR CONDUCTING SCIENTIFIC EXPERIMENTATION. THESE PROVISIONS INCLUDE STANDARD EQUIPMENT ITEMS WHICH HAVE A GENERAL PURPOSE APPLICATION, AVAILABLE FLOOR SPACE AND STATION UTILITIES INTERFACE PROVISIONS FOR INVESTIGATOR FURNISHED EQUIPMENT.

TO FACILITATE CREW OPERATIONS AND EFFICIENT UTILIZATION OF EQUIPMENT, THE GPL CONSISTS OF SEVERAL DIFFERENT FUNCTIONAL AREAS WHICH ARE PLACED IN SUITABLE LOCATIONS THROUGHOUT THE STATION. FOR THE INITIAL STATION, THESE AREAS ARE AS FOLLOWS - 1) AIRLOCKS, 2) MEDICAL/BIOLOGICAL AREA, 3) PHYSICS AREA, 4) DATA ANALYSIS AREA, 5) OPTICAL SUPPLY AND MAINTENANCE AREA, 6) ELECTRICAL/ELECTRONICS MAINTENANCE AREA, 7) PHOTOGRAPHIC PROCESSING AREA, AND 8) MECHANICAL MAINTENANCE AREA.

3.3.1.4.2 WEIGHT, POWER, AND SIZE CHARACTERISTICS

TABLE 3.3.1.4.2-1 WEIGHT SUMMARY

MAJOR ASSEMBLY	WEIGHT (LBS)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
1.1 PRIMARY STRUCTURE	5742	1878	4700	4700	4700	4700	26420
1.2 SECONDARY STRUCTURE	3399	410	3218	3350	3446	3378	17201
1.3 ENVIRONMENTAL SHIELD	1119	582	746	735	746	746	4674
1.4 BERTHING	2430	800	490	490	490	490	5190
1.5 GPL FURNISHINGS	0	0	1006	3055	1318	176	5555
TOTAL	12690	3670	10160	12330	10700	9490	59040

TABLE 3.3.1.4.2-2 POWER SUMMARY

MAJOR ASSEMBLY	POWER (WATTS - 24 HOUR AVG)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
1.1 PRIMARY STRUCTURE	0	0	0	0	0	0	0
1.2 SECONDARY STRUCTURE	0	0	0	0	0	0	0
1.3 ENVIRONMENTAL SHIELD	0	0	0	0	0	0	0
1.4 BERTHING	0	0	0	0	0	0	0
1.5 GPL FURNISHINGS	0	0	**	**	**	**	**
TOTAL	0	0	0	0	0	0	0

**POWER REQUIRED FOR OPERATION OF GPL FURNISHINGS SHALL BE CHARGED TO EXPERIMENTS BUDGET.

TABLE 3.3.1.4.2-3 UNIT CHARACTERISTICS/LOCATIONS/QTY.

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES) H	W	D	CORE	PWR	SM-1	SM-2	SM-3	SM-4
1.1 PRIMARY STRUCTURE											
Sidewalls											
Core Module	---	2050	144 Dia. x 460L			1	---	---	---	---	---
Power Module	---	1287	80 Dia. x 406L			----	1	---	---	---	---
Station Module	---	3780	164 Dia. x 444L			---	---	1	1	1	1
Bulkheads											
Hatch Bulkheads	---	104	-	-	-	10	2	2	2	2	2
Airlock Bulkheads	---	571	144 Dia. x 10 thick			2	---	---	---	---	---
Inertia Bulkheads	---	258	144 Dia. 2.0 thick			4	---	---	---	---	---
Fittings											
Shuttle Trunnions	---	30	-	-	-	4	4	4	4	4	4
Manipulator Sockets	---	15	-	-	-	4	8	4	4	4	4
Airlock	---	---	144 Dia. x 60L			1	---	---	---	---	---
Attach	---	**583	-	-	-	x	x	x	x	x	x
**Total Weight											

TABLE 3.3.1.4.2-3 UNIT CHARACTERISTICS/LOCATIONS/QTY. (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES) H	W	D	CORE	PWR	SM-1	SM-2	SM-3	SM-4
1.2 SECONDARY STRUCTURE											
Partitions	---	**2070	Variable			---	---	x	x	x	x
Floors	---	**5400	Variable			---	---	x	x	x	x
Utility Distribution	---	**1683	Variable			x	x	x	x	x	x
Doors/Hatches											
Berthing Port	---	*136	70	46		10	1	2	2	2	2
Bulkhead (Airlock)	---	*126	70	46		2	---	---	---	---	---
EVA (Airlock)	---	* 90	44 Dia.			1	---	---	---	---	---
EVA (Power Module)	---	57	44 Dia.			---	1	---	---	---	---
Flexport	---	* 53	40 Dia.			---	---	1	1	1	1
RCS Access Dome	---	54	48 Dia.			4	---	---	---	---	---
RCS Door	---	75	48 Dia.			4	---	---	---	---	---
Attach.	---	*381	-	-	-	x	x	x	x	x	x
Windows											
Berthing Port	---	Incl.Above	14.75 Dia.			10	1	2	2	2	2
Bulkhead (Airlock)	---	Incl.Above	14.75 Dia.			2	---	---	---	---	---
EVA Hatch (A/L)	---	Incl.Above	14.75 Dia.			1	---	---	---	---	---
Station Module	---	48	14.75 Dia.			---	---	1	---	1	1
Flexport	---	Incl.Above	4.0 Dia.			---	---	1	1	1	1
Flexport											
Hardware	---	135	-	-	-	---	---	x	x	x	x
Tunnel	---	130	40 Dia. x 60 lgth			---	---	---	1	---	1
Storage	---	**503	-	-	-	x	---	x	x	x	x

*Includes Window **Total Weight

TABLE 3.3.1.4.2-3 UNIT CHARACTERISTICS/LOCATIONS/QTY. (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES)			CORE	PWR	SM-1	SM-2	SM-3	SM-4
			H	W	D						
1.2 SECONDARY (Cont'd)											
Cargo Handling											
Rails, Vehicle	---	**407	-	-	-	x	x	x	x	x	x
Cart	---	20		TBD		-	-	-	1	1	1
Attach.	---	**51	-	-	-	x	x	x	x	x	x
Brackets, Doublers, etc.	---	**1991	-	-	-	x	x	x	x	x	x
1.3 ENVIRONMENTAL SHIELD											
Thermal Shield	---	**2053	-	-	-	x	x	x	x	x	x
Berthing Port Cover	---	46	88 Dia.			4	-	-	-	-	-
Window Cover	---	11	20 Dia.			1	-	1	-	1	1
Micrometeoroid Shield	---	**2621	-	-	-	x	x	x	x	x	x
Radiation Protection	---	0	-	-	-	-	-	-	-	-	-
1.4 BERTHING											
Mating Ring/Latches											
Latches	---	3		TBD		-	24	12	12	12	12
Mating Ring		97	80 Dia.			10	4	2	2	2	2
Seals (2)	---	10	80 Dia.			-	2	1	1	1	1
Alignment Guide	---	8				-	8	4	4	4	4
Utility Liner	---	20	66	42	20	-	1	1	1	1	1
Utility Interface	---	40				10	2	2	2	2	2
1.5 GPL FURNISHINGS											
Airlock	---	1200	80 I.D x 150 lgt.			-	-	-	1	1	-
Medical/Biological											
Total Carbon Analyzer	25	20	10	15	15	-	-	-	-	-	1
Nitrogen Analyzer	0.9	3	2	4	8	-	-	-	-	-	1
Colorimeter	20	10	8	12	4	-	-	-	-	-	1
**Total Weight											

TABLE 3.3.1.4.2-3 UNIT CHARACTERISTICS/LOCATIONS/QTY. (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES)			CORE	PWR	SM-1	SM-2	SM-3	SM-4
			H	W	D						
1.5 GPL FURNISHINGS (Cont'd)											
Medical/Biological (Cont'd)											
Culture Chamber	---	1	1	3	6	---	---	---	---	---	1
Lyophilizer	---	10	18	8	16	---	---	---	---	---	1
Incubator	60	20	12	10	12	---	---	---	---	---	2
Work Bench	---	80	30	60	30	---	---	---	---	---	1
Mounts & Support	---	**12	-	-	-	---	---	---	---	---	x
Physics Area											
Portable Reflectometer	---	10	10	12	12	---	---	---	---	1	---
Samples & Retrieval Box	---	27	$\frac{1}{4}$	12	12	---	---	---	---	1	---
Mass Spectrometer	35	25	8	10	9	---	---	---	---	1	---
Work Bench	---	50	30	60	30	---	---	---	---	1	---
Mounts & Supports	---	**6	-	-	-	---	---	---	---	x	---
Data Analysis Area											
Control Console	---	100	72	36	24	---	---	1	---	---	---
Work Bench/Desk	---	120	36	76	24	---	---	1	---	---	---
Light Table	---	50	36	28	24	---	---	1	---	---	---
Film Viewer	---	90	48	36	24	---	---	1	---	---	---
X-Y Plotter	---	50	36	24	24	---	---	1	---	---	---
Tape Deck/Strip Chart	---	50	36	30	24	---	---	1	---	---	---
Storage Cabinet	---	100	72	30	18	---	---	1	---	---	---
Mounts & Supports	---	**30	-	-	-	---	---	x	---	---	---
Optical Supply/Maint.											
Zero 'G' Bench	---	120	36	60	30	---	---	---	1	---	---
IR Calibration Device	---	75	20 Dia. x 90 Lgth			---	---	---	1	---	---
Precision Fixture	---	50	24	12	24	---	---	---	1	---	---
Bench & Equipment	---	450	36	160	24	---	---	---	1	---	---
Floodlight	---	8	5 Dia. x 4 Lgth			---	---	---	1	---	---
Electronic Flash	---	2	2	2	3	---	---	---	1	---	---

TABLE 3.3.1.4.2-3 UNIT CHARACTERISTICS/LOCATIONS/QTY. (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES)			CORE	PWR	SM-1	SM-2	SM-3	SM-4
			H	W	D						
1.5 GPL FURNISHINGS (Cont'd)											
Optical Supply/Maint. (Cont'd)											
Camera											
Cine	---	5	5	3	6	---	---	---	3	---	---
Still 35 MM	---	3	4	3	6	---	---	---	3	---	---
Still 70 MM	---	6	5	4	4	---	---	---	1	---	---
Microscope	---	12	6	6	12	---	---	---	1	---	---
Time Lapse	---	5	5	3	6	---	---	---	1	---	---
Mounts & Supports	---	**38	-	-	-	---	---	---	x	---	---
Elect/Electronic											
Electron Work Station	---	120	60	36	36	---	---	---	1	---	---
Test Bench	---	100	60	60	30	---	---	---	1	---	---
Var. Voltage Source	---	100	48	36	24	---	---	---	1	---	---
Storage for Instr.	---	200	78	48	48	---	---	---	1	---	---
Mounts & Supports	---	**30	-	-	-	---	---	---	x	---	---
Photo Processing											
Bench, Processor	---	200	30	80	24	---	---	1	---	---	---
Light Table	---	120	36	48	18	---	---	1	---	---	---
Storage Cabinet	---	75	82	40	18	---	---	1	---	---	---
Mounts/Supports	---	**21	-	-	-	---	--	x	---	---	---
Mechanical Maintenance											
Work Bench	---	175	60	70	30	---	---	---	1	---	---
Lanr Flow Glove Box	---	200	24	36	24	---	---	---	1	---	---
Tool Kit	---	100	24	48	24	---	---	---	1	---	---
Mounts/Supports	---	**25	-	-	-	---	---	---	x	---	---

3.3.1.5 SUBSYSTEM INTERFACES

3.3.1.5.1 STRUCTURAL AND MECHANICAL/STRUCTURAL AND MECHANICAL

NOT APPLICABLE

3.3.1.5.2 STRUCTURAL AND MECHANICAL/ECLSS SUBSYSTEM INTERFACES

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.2.4.2-4.

STRUCTURES SHALL PROVIDE FOR THE DISTRIBUTION OF AIR SUPPLY AND RETURN DUCTS, AND REDUNDANT ROUTING OF FLUID AND GAS PLUMBING.

3.3.1.5.3 STRUCTURAL AND MECHANICAL/ELECTRICAL POWER SUBSYSTEM INTERFACES

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.3.4.2-3.

STRUCTURES SHALL PROVIDE REDUNDANT ELECTRICAL DISTRIBUTION RUNS FOR PRIMARY POWER AND OTHER CRITICAL DISTRIBUTION. THE REDUNDANT RUNS SHALL BE SEPARATED TO THE MAXIMUM EXTENT REASONABLE.

STRUCTURES SHALL MOUNT ACQUISITION AND RUNNING LIGHTS SUCH THAT THE EQUIPMENT CAN BE SERVICED IN A SHIRTSLEEVE ENVIRONMENT.

STRUCTURES SHALL PROVIDE INSTALLATIONS FOR LIGHTING FIXTURES SUCH THAT THE CREW AND HABITABILITY ILLUMINATION INTENSITY REQUIREMENTS ARE SATISFIED.

THE EPS SOLAR ARRAY PANEL NATURAL FREQUENCY SHALL BE LESS THAN 0.1 HZ OR GREATER THAN 2.0 HZ.

3.3.1.5.4 STRUCTURAL AND MECHANICAL/G AND C SUBSYSTEM INTERFACES

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.4.4.2-4.

AS A GOAL, THE FUNDAMENTAL BENDING/TORSIONAL NATURAL FREQUENCY MODE OF THE SPACE STATION STRUCTURAL CONFIGURATION SHALL BE GREATER THAN ONE HZ.

STRUCTURES SHALL PROVIDE CELESTIAL AND EARTH VIEWING WINDOWS.

STRUCTURES SHALL PROVIDE MOUNTING AND PRESSURE SHELL PENETRATIONS FOR FOUR HORIZON TRACKER SENSORS SUCH THAT SIMULTANEOUS VIEWING OF THE FOUR HORIZON QUADRANTS IS OBTAINED. STRUCTURES SHALL PROVIDE MOUNTING AND TWO PRESSURE SHELL PENETRATIONS FOR THE STAR TRACKERS WITH A FIELD-OF-VIEW OVERLAP BETWEEN THE STAR TRACKERS AND THE SEXTANT TELESCOPE. OPTICAL ALIGNMENT PATHS BETWEEN THE RAMS AND HORIZON AND STAR TRACKERS SHALL BE PROVIDED.

STRUCTURES SHALL PROVIDE MOUNTING FOR STRAPDOWN IMU AND PREPROCESSOR NEAR SEXTANT FOR PRECISION ALINGMENT.

STRUCTURES SHALL PROVIDE MOUNTING FOR CONTROL MOMENT GYROS NEAR THE RAMS FOR PRECISION STABILIZATION.

STRUCTURES SHALL PROVIDE ENVIRONMENTAL PROTECTION FOR ANY STANDBY REDUNDANT SENSORS. SUCH PROTECTION SHALL BE DESIGNED TO PROVIDE MEANS FOR PERIODIC INFLIGHT CHECKS OF STANDBY DEVICES.

3.3.1.5.5 STRUCTURAL AND MECHANICAL/REACTION CONTROL SUBSYSTEM INTERFACES

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.5.4.2-3.

STRUCTURES SHALL PROVIDE MOUNTING FOR RCS ENGINES AND ASSOCIATED EQUIPMENT SUCH THAT SERVICING CAN BE ACCOMPLISHED IN A SHIRTSLEEVE ENVIRONMENT.

3.3.1.5.6 STRUCTURAL AND MECHANICAL/INFORMATION SUBSYSTEM INTERFACES

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.6.4.2-3.

STRUCTURES SHALL PROVIDE FOR THE DISTRIBUTION AND ROUTING OF AUDIO/VIDEO, PAGING AND ENTERTAINMENT, TELEMETRY, AND DIGITAL DATA BUSSES.

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS
RACU MEMORY SIZE - 4 K (32 BIT) WORDS
RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND DATA STORAGE.

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

3.3.1.5.7 STRUCTURAL AND MECHANICAL/CREW HABITABILITY SUBSYSTEM INTERFACES

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.7.25.3.

STRUCTURES SHALL PROVIDE FOR MOUNTING OF MOBILITY AND RESTRAINT DEVICES THROUGHOUT THE SPACE STATION PER PARAGRAPH 3.3.7.7.

THE SPACE STATION INTERIOR SHALL BE DESIGNED IN ACCORDANCE WITH GOOD ARCHITECUTRAL AND DECORATOR PRACTICES IN ORDER TO PROVIDE COMFORTABLE, EFFICIENT AND ATTRACTIVE LIVING AND WORKING SPACES. THE INTERIOR ARRANGEMENTS SHALL INSURE CREW COMFORT, EFFICIENCY, AND PHYSIOLOGICAL AND PSYCHOLOGICAL WELL-BEING.

THE SPACE STATION INTERIOR SHALL BE PARTITIONED INTO BASIC FUNCTIONAL AREAS INCLUDING INDIVIDUAL CREW STATEROOMS, FOOD AND PREPARATION AND SERVING

AREAS, DINING AREAS, PERSONAL HYGIENE AREAS, EXERCISE AREA, MEDICAL TREATMENT AREA, WORK AREAS, STORAGE AREAS, ASILES, AND PASSAGEWAYS.

STRUCTURES SHALL INSTALL ALL EQUIPMENTS SUCH THAT THEY ARE CAPABLE OF USE FOR PUSH-OFF, AND SHALL BE CAPABLE OF REACTING TO CREW IMPACT LOADS (300 POUNDS LIMIT APPLIED IN ANY DIRECTION).

THE CEILING HEIGHT IN GENERAL MOBILITY AREAS ON THE MAIN DECK OF THE MODULES SHALL BE A MINIMUM OF 82 INCHES.

STRUCTURAL DESIGN SHALL BE SUCH THAT ACOUSTIC NOISE LEVELS SHALL BE MAINTAINED IN ACCORDANCE WITH THE CRITERIA SPECIFIED IN PARAGRAPH 3.3.7.17.

STRUCTURES SHALL PROVIDE INSTALLATION AND SHOCK-MOUNTING PROVISIONS FOR VIBRATION EMITTING EQUIPMENT AS SPECIFIED IN PARAGRAPH 3.3.7.17.

AS A GOAL, CREW/HABITABILITY SHALL PROVIDE 35 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

MODULAR SPACE STATION - INITIAL STATION SYSTEM
3.3.2 ENVIRONMENTAL CONTROL/LIFE SUPPORT

THIS SUBSYSTEM IS ONE OF THE SEVEN FUNCTIONAL GROUPINGS OF MAJOR SUBSYSTEMS THAT COMPROMISE THE SHUTTLE LAUNCH MODULAR SPACE STATION.

PREPARED W. E. Baker SYSTEM RQMTS/INTERFACES

APPROVAL D. Gaubert SUBSYSTEM PROJECT ENGR

APPROVAL R. W. Gastelf SUBSYSTEM PROJECT MGR

APPROVAL C. F. Jones PROJECT ENGINEERING MGR

3.3.2 ENVIRONMENTAL CONTROL LIFE SUPPORT (ECLSS)

3.3.2.1 PERFORMANCE REQUIREMENTS

3.3.2.1.1 NORMAL OPERATIONS

3.3.2.1.1.1 GASEOUS STORAGE

A. THE ECLSS SHALL PROVIDE HIGH PRESSURE GAS STORAGE CAPABILITY TO SUPPORT THE FUNCTIONS AND QUANTITIES INDICATED IN THE FOLLOWING TABLE.

FUNCTION/USE	VOLUME CU FT	FREQUENCY/ DURATION	GAS TYPE/QUANTITY IN LBS		
			OXYGEN	NITROGEN	HYDROGEN
EMERGENCY ECLSS					
CREW METABOLIC-1.84 LB/MAN/DAY	--	96 HRS	44.2	--	--
IVA - 8.0 LBS/MAN/HR	--	20 MAN-HRS	160	--	--
STATION LEAKAGE (O2 ONLY)	--	96 HRS			
SEALS - 2.33 LBS/DAY	--		9.32	--	--
VENTS - 0.15 LBS/DAY	--		0.60	--	--
STATION LEAKAGE (N2 ONLY)	--	120 DAYS			
SEALS - 7.67 LB/DAY			--	920	--
VENTS 0.5 LB/DAY			--	60	--
EVA SUPPORT	--				
2 MEN AT 1.6 LBS/RECHARGE		1/MONTH/ 120 DAYS	12.8	--	--
EMERGENCY EPS SUPPORT(1.75 KW AVG)	--	96 HRS	160		20
EMERGENCY RCS SUPPORT	--	8 KLB-SEC	22		2.8
REPRESSURIZATION (TO 10 PSIA)					
V2 CORE + 2 STATION MODULES	11,200	1/120 DAYS	195	380	--
PUMPDOWN LOSSES (N2 ONLY)					
AIRLOCKS					
EXPERIMENT	435	5/MONTH/ 120 DAYS	--	3.42	--
EVA/IVA	565	1/MONTH/ 120 DAYS	--	0.88	--
BERTHING PORTS	116	2/MONTH/ 120 DAYS	--	0.18	--
TOTALS			603.92	1364.48	22.8

B. CAPABILITY SHALL BE PROVIDED TO PUMP DOWN THE EXPER/EVA AIRLOCKS AND BERTHING PORTS TO A PRESSURE OF 0.1 PSIA IN 8 HOURS. VOLUMES TO BE ACCOMMODATED AND THE FREQUENCY OF USE ARE AS FOLLOWS -

EXPERIMENT AIRLOCKS (2)	-	435 CU FT EACH, 5 TIMES/MONTH/120 DAYS
EVA/IVA AIRLOCK	-	565 CU FT, 1 TIME/MONTH/120 DAYS
BERTHING PORTS	-	116 CU FT EACH, 2 USES/MONTH/120 DAYS

CAPABILITY SHALL ALSO BE PROVIDED TO REPRESSURIZE THE AIRLOCKS AND BERTHING PORTS IN A 20 MINUTE TIME PERIOD TO A PRESSURE OF 14.7 PSIA FROM THE NORMAL STATION ATMOSPHERE.

C. CAPABILITY TO REPRESSURIZE AN EVACUATED MODULE OR PRESSURE VOLUME TO A PRESSURE OF 10 PSIA FROM REPRESSURIZATION STORAGE SHALL BE PROVIDED. THE PRESSURE BETWEEN AFFECTED VOLUMES WILL THEN BE ALLOWED TO EQUALIZE AND BUILDUP TO THE NORMAL 14.7 PSIA. REPRESSURIZATION GAS STORAGE SHALL BE SIZED FOR ONE REPRESSURIZATION OF A TOTAL VOLUME OF 11,200 CU. FT. DURING ANY 120 DAY PERIOD WITHOUT RESUPPLY AS SPECIFIED IN THE PRECEEDING TABLE OF ITEM A.

3.3.2.1.1.2 CO2 MANAGEMENT

A. CO2 MANAGEMENT ASSEMBLY(S) SHALL BE CAPABLE OF PROCESSING 2.25 LB/MAN-DAY NOMINAL AND 3.0 LB/MAN-DAY MAXIMUM OF CREW PRODUCED CO2. THE ASSEMBLY SHALL BE CAPABLE OF ACCOMMODATING THE CO2 PRODUCED BY 6 EXTRA CREWMAN FOR 5 DAYS DURING PERIODS OF CREW OVERLAP.

B. STATION CO2 PARTIAL PRESSURE SHALL BE MAINTAINED WITHIN 3.0 MMHG (MAX.) NOMINAL. A MAXIMUM OF 7.6 MMHG IS ALLOWED FOR UP TO 14 DAYS FOR REDUCED CAPABILITY OPERATION, AND A 15.0 MMHG EMERGENCY MAXIMUM FOR 8 HOURS.

C. PROVISION FOR RECLAMATION OF O2 FROM CO2 SHALL BE PROVIDED.

D. PROVISION FOR GENERATION OF O2 AND H2 FROM WATER SHALL BE PROVIDED.

E. THE CO_2 REDUCTION AND O_2 AND H2 GENERATION PROVISIONS SHALL BE DESIGNED FOR CLOSED LOOP OPERATION TO MAINTAIN OXYGEN AND WATER BALANCE AND TO PROVIDE O2 AND H2 GASES FOR USE AS RCS PROPELLANTS. THE PROVISIONS SHALL ALSO BE DESIGNED TO PERMIT OPERATION ON A 14 HOUR WORK, 10 HOUR SLEEP LIGHT/DARK CYCLE. SUFFICIENT OXYGEN AND HYDROGEN SHALL BE PROVIDED TO MEET THE CONSUMPTION/USE/LOSS REQUIREMENTS SHOWN BELOW.

CONSUMPTION/USE/LOSS	GAS TYPE/RATE	
	OXYGEN	HYDROGEN
CREW METABOLIC (6-MEN AT 1.84 LB/MAN)	11.04 LB/DAY	--
STATION LEAKAGE		
SEALS	2.33 LB/DAY	--
VENTS	0.15 LB/DAY	--
RCS PROPELLANTS	6.64 LB/DAY	0.83 LB/DAY
EXPERIMENT USE	1.20 LB/DAY	--
PUMPDOWN LOSSES		
AIRLOCKS		
EXPERIMENT USE (5/MO/120 DAYS)	0.0087 LB/DAY	--
EVA USE (1/MO/120 DAYS)	0.0022 LB/DAY	--
BERTHING PORTS (2/MO/120 DAYS)	0.0005 LB/DAY	--
H_2 DEPOLARIZER	6.75 LB/DAY	0.84 LB/DAY
TOTALS	27.27 LB/DAY	* 1.67 LB/DAY

* DOES NOT INCLUDE 1.84 LB/DAY H_2 WHICH IS AVAILABLE FROM ELECTROLYSIS FOR SABATIER REACTION

F. CAPABILITY SHALL BE PROVIDED TO STORE CH_4 AND CO_2 FOR 12 HOURS. QUANTITIES TO BE STORED ARE AS FOLLOWS -

CH_4 - 1.83 LBS
CO_2 - 1.70 LBS

3.3.2.1.1.3 ATMOSPHERIC CONTROL

THE ATMOSPHERIC CONTROL ASSEMBLY SHALL MAINTAIN AN OXYGEN/NITROGEN MIXTURE AT A NORMAL OPERATING PRESSURE OF 14.7 PSIA IN ACCORDANCE WITH THE FOLLOWING REQUIREMENTS.

A. CIRCULATION - THE MSS ATMOSPHERE AIR VELOCITY SHALL BE MAINTAINED BETWEEN 15 FPM MINIMUM AND 100 FPM MAXIMUM.

B. TEMPERATURE - ATMOSPHERE TEMPERATURE SHALL BE MAINTAINABLE ON AN AREA BASIS AS FOLLOWS -

1. 60 TO 75 DEG F IN EXERCISE AREAS
2. 65 TO 80 DEG F IN PERSONAL HYGIENE AREAS
3. 65 TO 80 DEG F IN MEDICAL TREATMENT AREA
4. 65 TO 75 DEG F IN ALL OTHER AREAS

C. HUMIDITY - THE MSS ATMOSPHERE H20 PARTIAL PRESSURE SHALL BE MAINTAINED WITHIN 8 TO 12 MMHG. THE ATMOSPHERIC DEW POINT SHALL NOT EXCEED 57 DEG F MAXIMUM. NO CONDENSATION SHALL BE ALLOWED TO FORM ON INTERNAL SURFACES.

D. PRESSURE - THE MSS ATMOSPHERIC TOTAL PRESSURE SHALL BE MAINTAINED AT 14.7 PSIA NOMINAL. OXYGEN PARTIAL PRESSURE SHALL BE MAINTAINED BETWEEN 3.1 PSIA MINIMUM TO 3.5 PSIA MAXIMUM.

E. CONTAMINANT CONTROL - THE MSS ATMOSPHERE TRACE CONTAMINANTS SHALL BE MONITORED AND CONTROLLED TO 0.1 OF THE THRESHOLD LIMIT VALUE PER CONSTITUENT. TRACE CONTAMINANTS WHICH MAY BE ENCOUNTERED AND THEIR MAXIMAL ACCEPTABLE CONCENTRATION FOR CONTINUOUS EXPOSURE SHALL BE AS SPECIFIED IN DOCUMENTATION OF THRESHOLD LIMIT VALUES, REVISED EDITION, BY AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS. PROCESS FLOW RATES CONTAMINANT REMOVAL SUBASSEMBLY SHALL BE SIZED BY THE FOLLOWING CONTAMINANTS -

CHARCOAL	- MONOMETHYL HYDRAZINE
CATALYTIC OXIDIZER	- FORMALDEHYDE
AMMONIA SORBENT	- AMMONIA
ACID GAS SORBENT	- HYDROGEN FLUORIDE

THE CONCENTRATION OF BACTERIA IN THE ATMOSPHERE WITHIN THE PRESSURIZED COMPARTMENTS CONTAINING CREW QUARTERS, PROCESS LABORATORIES, OR EXPERIMENTAL FACILITIES SHALL BE MONITORED AND CONTROLLED. RAM IS INCLUDED.

THE ATMOSPHERE CONSTITUENTS, INCLUDING HARMFUL AIRBORNE TRACE CONTAMINANTS AND ODORS WILL BE MONITORED AND CONTROLLED IN EACH SEPARATE PRESSURE ISOLATABLE VOLUME.

F. ATMOSPHERIC CONTROL CONSIDERATIONS SHALL BE BASED ON A MAXIMUM OF SIX CREW MEMBERS IN ANY ONE MODULE AT A TIME.

3.3.2.1.1.4 THERMAL CONTROL

A. THE THERMAL CONTROL ASSEMBLY SHALL LIMIT THE TEMPERATURE OF INTERIOR WALLS OF PRESSURIZED VOLUMES TO A MINIMUM OF 57 DEG F AND A MAXIMUM OF 105 DEG F DURING MANNED OPERATIONS AND A MINIMUM OF 40 DEG F TO A MAXIMUM OF 135 DEG F DURING UNAMMNED OPERATIONS.

B. THE THERMAL CONTROL ASSEMBLY SHALL PREVENT FORMATION OF CONDENSATION ON INTERNAL SURFACES.

C. THE THERMAL CONTROL ASSEMBLY SHALL LIMIT THE HEAT LOAD GAIN TO THE SPACE STATION INTERNAL ENVIRONMENT FROM THE EXTERNAL ENVIRONMENT TO A MAXIMUM OF 1000 BTU/HR/MODULE (STATION AND CORE).

D. THE THERMAL CONTROL ASSEMBLY SHALL LIMIT THE HEAT LOAD LOSS FROM THE SPACE STATION INTERNAL ENVIRONMENT TO THE EXTERNAL ENVIRONMENT TO A MAXIMUM OF 2000 BTU/HR/MODULE (STATION AND CORE).

E. THE THERMAL CONTROL ASSEMBLY SHALL PROVIDE FOR TRANSFER AND REJECTION OF HEAT TO SPACE VIA INTERNAL COOLING LOOPS AND EXTERNAL RADIATORS.

F. INTERNAL COOLANT LOOP FLUIDS SHALL BE NON-TOXIC AND NON-FLAMMABLE.

G. THERMAL CONTROL DESIGN SHALL CONSIDER OPERATION OF VARIOUS EQUIPMENT IN A QUIESCENT MODE AND DEPRESSURIZED STATE AS WELL AS NORMAL MANNED OPERATIONS.

H. THE THERMAL CONTROL ASSEMBLY SHALL BE DESIGNED TO OPERATE NORMALLY IN A 240 NM, 55 DEG INCLINATION, X-POP, Z-LV FLIGHT MODE.

I. THE THERMAL CONTROL ASSEMBLY SHALL BE CAPABLE OF ACCOMMODATING A MAXIMUM HEAT LOAD OF 105,000 BTU/HR AND A MINIMUM OF 10,140 BTU/HR DURING NORMAL MANNED OPERATIONS.

J. THE THERMAL CONTROL ASSEMBLY SHALL ACCOMMODATE A MODULE AIR HEAT LOAD OF 3.5 KW.

K. THE THERMAL CONTROL ASSEMBLY SHALL ACCOMMODATE A HEAT LOAD OF 4.5 KW (40 TO 75 DEG F) VIA A SUITABLE HEAT EXHCANGER TO SUPPORT ATTACHED RAM OPERATIONS.

L. THERMAL CONTROL ASSEMBLY DESIGN SHALL BE BASED ON THE HEAT LOAD DISTRIBUTION SPECIFIED IN TABLE 3.3.2.1.1.4-1 AND SUMMARIZED IN TABLE 3.3.2.1.1.4-2.

TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION - CORE MODULE

HEAT SOURCE	MODULE MAXIMUM, CREW DAY HEAT LOAD BTU/HR				MSS TOTAL ** CREW DAY HEAT LOAD BTU/HR			
	LIGHT SIDE		DARK SIDE		LIGHT SIDE		DARK SIDE	
	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID
ECLSS								
PUMPDOWN UNIT	630		630		50		50	
CO2 SENSOR	5		5		5		5	
HUMID DUCT FAN	680		680		680		680	
VENT FANS	285		285		190		190	
SENSIBLE HX	680		680		340		340	
EPS								
FUEL CELLS-EQUIP	1920	14500	4730	39000	1920	14500	4730	39000
LIGHTING	4640		4640		4640		4640	
G-C								
IMU-PROCESSOR	50	345	50	345	50	345	50	345
HORIZ-STAR TRKR								
OPTICS		135		135		135		135
ELECTRONICS		165		165		165		165
OPTICAL REF PROC	10	75	10	75	10	75	10	75
ALIGN LINKS		190		190		190		190
SEXTANT-TELESCOPE	85	770	85	770	10	60	10	60
CMG PREPROCESSOR	50	440	50	440	50	440	50	440
RCS ELECTRONICS		85		85		10		10
ISS								
RACU	410		410		410		410	
LOCAL AND ALARM	10		10					
AUDIO/VIS UNIT	20		20		20		20	
TV CAMERA	10		10					
RAM	340	13260	1360	12240	340	1120	340	1120
POWER BOOM	180		180					

** DESIGN HEAT LOAD CONTRIBUTION TO MSS TOTAL

TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION - SM-1 MODULE

HEAT SOURCE	MODULE MAXIMUM, CREW DAY HEAT LOAD BTU/HR				MSS TOTAL ** CREW DAY HEAT LOAD BTU/HR			
	LIGHT SIDE		DARK SIDE		LIGHT SIDE		DARK SIDE	
	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID
ECLSS								
CO2 SENSOR	7		7		7		7	
VENT FANS	670		670		286		286	
SENSIBLE HX	680		680		680		680	
SPECIAL HX	96		96		96		96	
H2O PUMP PKG	289	2601	289	2601	289	2601	289	2601
FREON PUMP PKG		2230		2230		2230		2230
H2O RECLAMATION	279	1748	279	1748	182	873	182	873
PURITY MONITOR	154	1386	154	1386	77	693	77	693
FECAL/URINE COLL	51		51		51		51	
SINKS	256		256		20		20	
SHOWER	1200		1200		1200		1200	
FIRE DETECTION	34		34		34		34	
EPS								
ELECTROLYSIS	1160	6562	148	834	580	3281	74	417
LIGHTING								
GENERAL	1630		1630		1630		1630	
HYGIENE LIGHT	600		600		620		620	
METABOLIC (SENS)	900		900		600		600	
EXPERIMENTS	2200	3620	2200	3620	2200	3620	2200	3620
INSTRU STIMULI	365	765	365	765	365	765	365	765

TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION - SM-1 MODULE (CON'T)

HEAT SOURCE	MODULE MAXIMUM, CREW DAY HEAT LOAD BTU/HR				MSS TOTAL ** CREW DAY HEAT LOAD BTU/HR			
	LIGHT SIDE		DARK SIDE		LIGHT SIDE		DARK SIDE	
	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID
ISS								
DATA BUS CONTROL	5	81	5	81				
CENTRAL TIMING	5	97	5	97				
CENTRAL PROCESS	50	1225	50	1225	50	1225	50	1225
OPER CONTROL CON	45	865	45	865	45	865	45	865
CMDR CONTROL CON	22	463	22	463	22	463	22	463
PORT CONTROL CON	167		167		167		167	
LOCAL MON/ALARM	3		3					
K-BAND ANT ELECT	6	55	6	55				
S-BAND XPNDER	4	40	4	40	4	40	4	40
VHF XPNDER	290		290					
COMM RACK SUBASSY	12	312	12	312				
RECORDING SUBASSY	10	188	10	188				
AUDIO/VID UNITS	4	37	4	37	4	37	4	37
TV CAMERAS-MON	310		310		280		280	
RACU	102	103	102	103	102	103	102	103

TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION - SM-2 MODULE

HEAT SOURCE	MODULE MAXIMUM, CREW DAY HEAT LOAD BTU/HR				MSS TOTAL ** CREW DAY HEAT LOAD BTU/HR			
	LIGHT SIDE		DARK SIDE		LIGHT SIDE		DARK SIDE	
	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID
ECLSS								
CO2 REMOVAL	95		95		95		95	
CO2 REDUCTION-								
VENT ACCUM PUMP								
UNIT	410		410		410		410	
CONDENSER		170		170				
O2 GEN-V/C PUMP	660	3950			660	3950		
CO2 SENSOR	10		10		10		10	
VENT FANS	670		670		380		380	
SENSIBLE HX	680		680		550		550	
HUMIDITY HX								
CONDENSER		1300		1300		1300		1300
FAN	410		410		410		410	
PPO2 CONTROL	35		35		35		35	
CONTAM CONTROL	160	305	160	305	160	305	160	305
GAS MON-BACT DET	120	1100	120	1100	100	960	100	960
FIRE DETECTOR	35		35		35		35	
EPS								
AUTO-XFMR								
RECT/FILTER	100	440	80	390	100	440	80	390
CIRCUIT BREAKERS								
LIGHTING	1900		1900		1700		1700	
ISS								
LOCAL MON/ALARM	5		5		5		5	
MICROFILM PROJ	145		145		40		40	
AUDIO/VID UNIT	15		15		15		15	
RACU	100	105	100	105	100	105	100	105
TV CAMERA-COLOR	30		30		5		5	
TV CAMERA B-W	25		25		5		5	
METABOLIC	600		600		450		450	
EXPERIMENTS	190	2250	190	2250	190	2250	190	2250
INSTRU STIMULI	50	730	50	730	50	730	50	730

TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION - SM-3 MODULE

HEAT SOURCE	MODULE MAXIMUM, CREW DAY HEAT LOAD BTU/HR				MSS TOTAL ** CREW DAY HEAT LOAD BTU/HR			
	LIGHT SIDE		DARK SIDE		LIGHT SIDE		DARK SIDE	
	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID
ECLSS (BACKUP)								
CO2 REMOVAL	95		95					
CO2 RED-A/C PUMP	410	170	410	170				
O2 GEN - PUMP	660	3950						
CO2 SENSOR	10		10		10		10	
VENT FAN	670		670		420		420	
SENSIBLE HX	680		680		550		550	
HUMID CONTROL	410	1300	410	1300				
PPO2 CONTROL	35		35					
CONTAM CONTROL	160	305	160	305				
GAS MON-BACT DET	120	1100	120	1100				
TRASH PROCESSOR	255		255		150		150	
GALLEY SINK	360		360		20		20	
FIRE DETECTOR	35		35		35		35	
GALLEY								
FREEZER-REFRIG		980		980		980		980
OVEN-RESISTANCE	1400		1400		1100		1100	
OVEN-MICROWAVE	200		200		100		100	
RECONST UNIT	150		150		50		50	
EPS								
AUTO-XFMR								
RECT/FILTER	120	460	90	400	100	440	80	390
CIRCUIT BREAKERS								
LIGHTING	2550		2550		1900		1900	
METABOLIC	2400		2400		900		900	
EXPERIMENTS	400	5225	400	5225	400	5225	400	5225
INSTRU STIMULI	50	730	50	730	50	730	50	730

TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION - SM-4 MODULE

HEAT SOURCE	MODULE MAXIMUM, CREW DAY HEAT LOAD BTU/HR				MSS TOTAL ** CREW DAY HEAT LOAD BTU/HR			
	LIGHT SIDE		DARK SIDE		LIGHT SIDE		DARK SIDE	
	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID
ECLSS								
CO2 SENSOR	7		7		7		7	
VENT FANS	670		670		286		286	
SENSIBLE HX	680		680		680		680	
SPECIAL HX	96		96		14		14	
H2O PUMP PKG	289	2601	289	2601				
FREON PUMP PKG		2230		2230				
H2O RECLAMATION	279	1748	279	1748	182	873	182	873
PURITY MONITOR	154	1386	154	1386	77	693	77	693
FECAL/URINE COLL	51		51					
TRASH PROCESS	510		510					
SINKS	41		41		20		20	
FIRE DETECTION	34		34		34		34	
EPS								
ELECTROLYSIS	1160	6562	148	834	580	3281	74	417
LIGHTING								
GENERAL	1630		1630		1630		1630	
MEDICAL	150		150					
METABOLIC-SENS	900		900		600		600	
EXPERIMENTS	2200	3620	2200	3620				
INSTRU STIMULI	365	765	365	765	365	765	365	765

TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION - SM-4 MODULE (CON'T)

HEAT SOURCE	MODULE MAXIMUM, CREW DAY HEAT LOAD BTU/HR				MSS TOTAL ** CREW DAY HEAT LOAD BTU/HR			
	LIGHT SIDE		DARK SIDE		LIGHT SIDE		DARK SIDE	
	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID	AIR	LIQUID
ISS								
DATA BUS CONTROL	5	81	5	81	5	81	5	81
CENTRAL TIMING	5	97	5	97	5	97	5	97
CENTRAL PROCESS	50	1225	50	1225	50	1225	50	1225
OPER CONTROL CON	45	865	45	865	45	865	45	865
CMDR CONTROL CON	22	463	22	463	22	463	22	463
PORT CONTROL CON	167		167		167		167	
LOCAL MON/ALARM	3		3					
K-BAND ANT ELECT	6	55	6	55	6	55	6	55
S-BAND XPNDER	4	40	4	40				
VHF XPNDER	290		290		290		290	
COMM RACK SUBASSY	12	312	12	312	12	312	12	312
RECORDING SUBASSY	10	188	10	188	10	188	10	188
AUDIO/VID UNITS	4	37	4	37	4	37	4	37
TV CAMERAS-MON	266		266		266		266	
RACU	102	103	102	103	102	103	102	103

TABLE 3.3.2.1.1.4-2 HEAT LOAD DISTRIBUTION SUMMARY

HEAT SOURCE	MODULE MAXIMUM, CREW DAY HEAT LOAD BTU/HR ORBITAL AVERAGE			MSS TOTAL ** CREW DAY HEAT LOAD BTU/HR ORBITAL AVERAGE		
	AIR	LIQUID	TOTAL	AIR	LIQUID	TOTAL
CORE MODULE *	12065	39615	51680	10775	26690	37465
SM-1 MODULE	11206	20126	31332	9384	15670	25054
SM-2 MODULE	6185	8800	14985	5245	8660	13905
SM-3 MODULE	11400	11670	23070	6125	7375	13500
SM-4 MODULE	9857	20126	29983	5259	7902	13161
TOTAL	50713	100337	151050	36788	66297	103085

* PROVIDES COOLING FOR POWER BOOM
** DESIGN HEAT LOAD CONTRIBUTION TO MSS TOTAL

3.3.2.1.1.5 WATER MANAGEMENT

THE WATER MANAGEMENT ASSEMBLY SHALL HAVE THE FOLLOWING PERFORMANCE REQUIREMENTS -

A. QUANTITIES OF POTABLE WATER FOR FOOD AND DRINKING SHALL BE PROVIDED AS FOLLOWS -

FOOD - 1.44 LB/MAN-DAY
DRINK - 4.14 LB/MAN-DAY

B. QUANTITIES OF WATER FOR HOUSEKEEPING AND PERSONAL HYGIENE SHALL BE PROVIDED AS FOLLOWS -

WASHING - 4.0 LB/MAN-DAY
SHOWER - 16.6 LB/SHOWER TWICE PER DAY
HOUSEKEEPING - 0.4 LB/MAN-DAY
LAUNDRY - NOT REQUIRED

C. COLD WATER SHALL BE SUPPLIED AT 50 +/-5 DEG F AND HOT WATER AT 154 +/-4 DEG F FOR PURPOSES OF FOOD RECONSTITUTION.

D. POTABLE WATER SHALL BE PROVIDED FOR HYGIENIC FLUSHING OF URINALS AT 3.5 LB/MAN-DAY.

E. THE WATER SYSTEM SHALL BE DESIGNED FOR CLOSED LOOP OPERATION FOR RECLAMATION, STORAGE, AND REUSE, NOT INCLUDING FECAL WATER. CAPABILITY TO RECOVER POTABLE WATER AT A PROCESS RATE OF 161 LBS/DAY SHALL BE PROVIDED. CAPABILITY SHALL ALSO BE PROVIDED FOR AN ELECTROLYSIS WATER RESUPPLY RATE OF 11.6 LBS/DAY.

F. QUANTITIES OF WATER FOR EXPERIMENT USE SHALL BE PROVIDED AT A MAXIMUM RATE OF 35 LBS/DAY.

G. WATER POTABILITY STANDARDS SHALL BE AS SPECIFIED IN TABLE 3.3.2.1.2.5. THIS STANDARD SHALL APPLY TO THE PRODUCT WATER FROM URINE RECLAMATION)

H. POTABLE WATER STORAGE SHALL BE SUFFICIENT TO PROVIDE AN EMERGENCY RESERVE CAPACITY FOR A CREW OF SIX FOR 96 HOURS IN ADDITION TO NORMAL USAGE REQUIREMENTS AND SHALL PROVIDE A POSITIVE MEANS FOR MONITORING WATER PURITY. CAPABILITY TO RECOVER FROM A WATER SYSTEM CONTAMINATION FAILURE SHALL BE PROVIDED.

I. CAPABILITY TO SUPPLY 11.4 LBS OF WATER/MAN/EVENT FOR EVA SUPPORT SHALL BE PROVIDED. TOTAL QUANTITY SHALL BE BASED ON ONE 2-MAN EVA PER MONTH.

J. PROVISIONS FOR STORING VAPOR COMPRESSION VENT GASES FOR 12 HOURS SHALL BE PROVIDED.

TABLE 3.3.2.1.1.5 AEROSPACE POTABLE WATER SPECIFICATION

CHEMICAL REQUIREMENTS	MILLIGRAMS/LITER OR PARTS PER MILLION	SOURCE
TOTAL SOLIDS	1000.0	SSB
CADMIUM	0.05	SSB
CHROMIUM, HEXAVALENT	0.05	SSB
COPPER	3.0	SSB
LEAD	0.2	SSB
SILVER	0.5	SSB
IRON	1.0	AF
MANGANESE	0.1	AF
ZINC	15.0	AF
MERCURY	0.005	NASA
NICKEL	1.0	NR
CHEMICAL OXYGEN DEMAND	0.5	NR
SELENIUM	0.05	USPH
	UNITS	
COLOR	15.0	AF
TURBIDITY	25.0	AF
TASTE AND ODOR	ODOR NO. 3.0	AF
PH	6.0 - 8.0	NASA
MICRO-ORGANISMS	ESSENTIALLY NO COLIFORMS	USPH
PARTICULATES	LEVEL 3	NR MA0610-017

NOTE - SOURCE ABBREVIATIONS ARE EXPLAINED BELOW -
- SSB - SPACE SCIENCE BOARD
- AF - AIR FORCE POTABLE WATER STANDARD FOR 1967
- NASA - NASA PF-SPEC-1
- NR - NORTH AMERICAN ROCKWELL
- USPH - U. S. DEPT. OF PUBLIC HEALTH

3.3.2.1.1.6 WASTE MANAGEMENT

THE WASTE MANAGEMENT ASSEMBLY SHALL MEET THE FOLLOWING PERFORMANCE REQUIREMENTS. THE DATA IS BASED ON MALE CREW MEMBERS. SIMILAR DATA FOR FEMALE CREW MEMBERS HAS NOT BEEN ESTABLISHED, HOWEVER, DATA VALUES FOR FEMALES ARE EXPECTED TO BE SMALLER IN VALUE.

A. URINE WASTE SHALL BE COLLECTED AND PROCESSED. PROCESS RATES SHALL BE BASED ON 6 USES/MAN/DAY. QUANTITIES OF URINE WASTES TO BE PROCESSED SHALL BE AS FOLLOWS -

URINE WATER	- 3.45 LB/MAN-DAY NOMINAL
	- 4.48 LB/MAN-DAY MAXIMUM
URINE SOLIDS	- 0.13 LB/MAN-DAY

B. FECAL WASTES SHALL BE COLLECTED AND PROCESSED. FECAL WATER SHALL NOT BE RECLAIMED. PROCESS RATES SHALL BE BASED ON 1 USE/MAN/DAY. QUANTITIES OF FECAL WASTES TO BE PROCESSED SHALL BE AS FOLLOWS -

FECAL WATER	- 0.25 LB/MAN-DAY NOMINAL
	- 0.33 LB/MAN-DAY MAXIMUM
FECAL SOLIDS	- 0.13 LB/MAN-DAY

C. ONE TOILET CONSISTING OF SEPARATE FECAL AND URINE COLLECTION DEVICES AT THE SAME LOCATION SHALL BE PROVIDED. IN ADDITION, ONE WALL MOUNTED URINAL SHALL BE PROVIDED FOR ADDED CREW CONVENIENCE. COLLECTION DEVICES SHALL ACCOMMODATE A MIXED MALE/FEMALE CREW. THESE UTILITIES SHALL BE LOCATED IN EACH PERSONAL HYGIENE FACILITY OF EACH PRESSURE VOLUME.

D. FOOD WASTES SHALL BE COLLECTED AND PROCESSED.

E. TRASH MATERIAL SUCH AS PAPER, CLOTHING, FILM, FILM CONTAINERS, ETC. SHALL BE COLLECTED, PROCESSED, AND STORED FOR LOGISTICS RETURN. THE TYPES AND QUANTITIES OF WASTE MATERIALS TO BE PROCESSED PER SUBSYSTEM SHALL BE AS SPECIFIED IN TABLE 3.3.2.1.1.6. PROVISIONS FOR PROCESSING 15 LB/DAY WITH AN AVERAGE VOLUME OF 1 CU FT SHALL BE PROVIDED.

PROVISIONS FOR DRYING AND STERILIZATION OF TRASH MATERIAL SHALL BE PROVIDED. ALSO, REDUNDANT PROVISIONS ARE REQUIRED FOR DRYING AND STERILIZATION OF TRASH MATERIAL.

F. WASTE SOLIDS SHALL NOT BE DUMPED TO SPACE.

G. GASES AND WATER MAY BE VENTED TO SPACE, HOWEVER NON-PROPULSIVE DISCHARGE DEVICES SHALL BE USED. VENT PORTS SHALL BE LOCATED AS REMOTELY AS POSSIBLE FROM WINDOWS AND EXPERIMENT AIRLOCKS TO MINIMIZE EXTERIOR CONTAMINATION. VENT PORTS SHALL PROVIDE FOR DUMPING OF GASES AND WATER INTO THE STATION WAKE. DUMP SYSTEM DESIGN SHALL PROVIDE FOR PERIODIC DUMPING OF WASTE GASES AND WATER SIMULTANEOUSLY AND SHALL PROVIDE FOR A MINIMUM PERIOD OF 12 HOURS BETWEEN VENTINGS. VENTING OF DRY JOHN'S MAY BE ACCOMPLISHED ON A NON-PERIODIC BASIS PROVIDING VENT GASES ARE DISCHARGED INTO THE WAKE OF THE STATION.

H. MICROBIOLOGICALLY AND BACTERIOLOGICALLY CONTAMINATED WASTE MATERIALS SHALL BE DISINFECTED AS CLOSE AS POSSIBLE TO THEIR SOURCE PRIOR TO STORAGE, PROCESSING, OR DISPOSAL.

I. CAPABILITY FOR PROCESSING 67 LB/MONTH OF WASTE AND TRASH MATERIALS FROM EXPERIMENTS SHALL BE PROVIDED. THESE MATERIALS MAY CONTAIN BIOLOGICAL OR ANIMAL URINE AND/OR FECAL MATTER.

TABLE 3.3.2.1.1.6 TYPICAL WASTE MODEL

SOURCE	DESCRIPTION	BASIC RATE LB/MAN-DAY	6 MEN LB/DAY
CREW	URINE SOLIDS	0.13	0.78
	FECAL	0.38	2.28
FOOD MNGT	FOOD WASTE	0.40	2.40
	FOOD PACKAGING	1.18	7.08
	UTENSILS, SOAP, ETC	0.01	0.06
CREW RELATED	WIPES	0.20	1.20
	HAIR, NAILS, SKIN	0.05	0.30
	TOILET TISSUE	0.014	0.084
	MEDICAL SUPPLIES	0.02	0.12
	HOUSECLEANING SUPPLIES	0.02	0.12
	SOAP, HYGIENE	0.033	0.198
	DENTAL	----	
	HAIR CONTROL	----	
ECLSS PROCESS	FILTERS, CHARCOAL	----	
	WICKS, CARTRIDGES	0.033	0.198
	WATER TREATMENT	0.067	0.402
	USED CATALYSTS	0.033	0.198
	WASTE TREATMENT AND BAGS	----	
	CLOTHING, TOWELS, ETC	0.058	0.348
SUBSYSTEMS	TELETYPE PAPER	----	
	MICROFILM, MAGNETIC TAPE	----	
	SPARE PART PACKAGING	----	
EXPERIMENTS	PHOTO LAB	----	
	BIOSCIENCE LAB, ETC	----	
	SPACE PROCESSING-PHYSICS	----	
	CONTAM, WATER (NON-NORM)	----	

3.3.2.1.1.7 HYGIENE

HYGIENE FACILITIES SHALL BE PROVIDED TO MEET THE FOLLOWING REQUIREMENTS -

A. ONE SHOWER FACILITY SHALL BE PROVIDED WITH THE CAPABILITY FOR 2 SHOWERS/DAY AT 16.6 LBS OF WATER/SHOWER. THE FACILITY SHALL PROVIDE HOT AND COLD WATER FOR MIXING TO A TEMPERATURE OF 90 TO 110 DEG F FOR SHOWERING.

B. ONE GROOMING STATION WITHIN EACH PRESSURE VOLUME SHALL BE PROVIDED. EACH GROOMING STATION SHALL CONTAIN A SINK WITH HOT AND COLD WATER MIXING CAPABILITY, TEETH BRUSHING CUSPIDOR, AND SOAP DISPENSER FOR FACE AND HAND WASHING, BODY SPONGING, MOUTH WASHING AND GENERAL GROOMING.

C. STORAGE SPACE FOR HOUSEKEEPING PROVISIONS SHALL BE PROVIDED. THE SIZE AND LOCATION OF THE STORAGE FACILITIES ARE (TBD).

D. A SINK WITH HOT AND COLD WATER MIXING CAPABILITY SHALL BE PROVIDED IN THE PRIMARY GALLEY AND IN THE MEDICAL AREA.

E. SINK USAGE SHALL BE BASED ON 10 USES/MAN/DAY. CAPABILITY TO SUPPLY 4 LBS OF WATER/MAN/DAY FOR SINK USE SHALL BE PROVIDED.

3.3.2.1.1.8 SPECIAL LIFE SUPPORT

SPECIAL LIFE SUPPORT PROVISIONS AND CAPABILITY SHALL BE PROVIDED TO MEET THE FOLLOWING REQUIREMENTS -

A. O2 HIGH PRESSURE STORAGE CAPABLE OF SUPPLYING O2 FOR INTRA-VEHICULAR ACTIVITIES. IN ADDITION, IT SHALL PROVIDE O2 FOR RECHARGING PORTABLE LIFE SUPPORT EQUIPMENT FOR EVA.

B. THE ECLSS SHALL PROVIDE EVA/IVA SUPPORT AS FOLLOWS -

IVA SUPPORT

O2 NOMINAL MAX FLOW	-	8 LB/MAN-HR
O2 EMERGENCY FLOW	-	22 LB/MAN-HR FOR 30 MINUTES
O2 INLET TEMP	-	40 TO 64 DEG F
HEAT LOAD PEAK	-	2000 BTU/MAN-HR
SUIT PRESSURE	-	SOURCE REGULATE TO 110 PSIG
LCG WATER FLOW	-	240 LB/HR AT 43 DEG F
DESIGN CAPACITY	-	2 MEN AT 4 HRS EACH/RESUPPLY PERIOD IF REQUIRED

PLSS CHARGING

O2 PER RECHARGE	-	1.6 LBS
H2O PER RECHARGE	-	10.8 LBS
RECHARGE PRESSURE	-	1410 +/- 30 PSI
CHARGING FREQUENCY	-	2 UNITS/MONTH

C. AN EMERGENCY RESERVE OF WATER AND OXYGEN FOR 96 HOURS MINIMUM SHALL BE MAINTAINED ON BOARD THE SPACE STATION. THIS RESERVE SHALL BE ACCESS-

ABLE FROM EITHER PRESSURE VOLUME IN THE EVENT OF LOSS OF ONE VOLUME. THE WATER RESERVE SHALL BE MAINTAINED FROM THE NORMAL 120 DAY STORAGE CAPACITY.

D. EMERGENCY FIRE CONTROL AND DETECTION PROVISIONS SHALL BE PROVIDED. THESE PROVISIONS SHALL, AS A MINIMUM, CONTAIN AN OXYGEN FACE MASK AND O2 BOTTLE, AND A CO2 EXTINGUISHER FOR SMALL FIRE CONTROL. ATMOSPHERIC DUMP PROVISIONS SHALL BE PROVIDED FOR LARGE FIRE CONTROL.

3.3.2.1.2 EMERGENCY OPERATIONS

3.3.2.1.2.1 GASEOUS STORAGE

EMERGENCY GAS STORAGE REQUIREMENTS ARE INCLUDED WITH NORMAL OPERATIONS GAS STORAGE REQUIREMENTS AND ARE SPECIFIED IN PARAGRAPH 3.3.2.1.1.1.

3.3.2.1.2.2 CO2 MANAGEMENT

A. CO2 PARTIAL PRESSURE SHALL NOT EXCEED 15.0 MMHG FOR MORE THAN 8 HOURS.

3.3.2.1.2.3 ATMOSPHERIC CONTROL

A. CIRCULATION - SUFFICIENT TO MAINTAIN COMPOSITION, TEMPERATURE, AND CONTAMINATION CONTROL.

B. TEMPERATURE - MAINTAINABLE BETWEEN 45 AND 105 DEG F.

C. HUMIDITY - H2O PARTIAL PRESSURE MAINTAINABLE BETWEEN 8 TO 16 MMHG

D. PRESSURE - TOTAL PRESSURE SHALL BE MAINTAINED ABOVE 7.5 PSIA. O2 PARTIAL PRESSURE SHALL BE MAINTAINED BETWEEN 3.0 TO 3.5 PSIA.

E. CONTAMINANT CONTROL - TRACE CONTAMINANTS SHALL BE MAINTAINED WITHIN 0.5 OF THE THRESHOLD LIMIT VALUE PER CONSTITUENT. BACTERIA SHALL BE CONTROLLED TO 100 MICROBES PER CUBIC FOOT.

3.3.2.1.2.4 THERMAL CONTROL

CAPABILITY TO REJECT A HEAT LOAD OF 10,140 BTU/HR (2.95 KW THERMAL) SHALL BE PROVIDED (BASED ON 1.5 KW USABLE ELECTRICAL).

3.3.2.1.2.5 WATER MANAGEMENT

CAPABILITY TO PROVIDE 152 POUNDS OF POTABLE WATER FOR CREW CONSUMPTION SHALL BE PROVIDED.

3.3.2.1.2.6 WASTE MANAGEMENT

CAPABILITY FOR URINE AND FECAL WASTE COLLECTION AND PROCESSING EQUIVALENT TO NORMAL OPERATIONS REQUIREMENTS SHALL BE PROVIDED.

3.3.2.1.2.7 HYGIENE

NO SPECIFIC EMERGENCY REQUIREMENTS IDENTIFIED.

3.3.2.1.2.8 SPECIAL LIFE SUPPORT

CAPABILITY FOR EMERGENCY REMOVAL OF CO_2 FOR 96 HOURS SHALL BE PROVIDED. CO_2 PARTIAL PRESSURE SHALL BE MAINTAINED BELOW 7.6 MMHG.

3.3.2.1.3 BUILDUP OPERATIONS

3.3.2.1.3.1 GASEOUS STORAGE

HIGH PRESSURE STORAGE CAPABILITY SUFFICIENT TO REPRESSURIZE EACH MODULE AND/OR COMBINATION OF MODULES AT EACH STEP OF BUILDUP TO A PRESSURE OF 14.7 PSIA SHALL BE PROVIDED. IN ADDITION, LEAKAGE MAKEUP AND CREW CONSUMPTION GASEOUS REQUIREMENTS FOR A 5-DAY STAY TIME SHALL BE PROVIDED. THE QUANTITIES OF GASES REQUIRED ARE SHOWN IN THE FOLLOWING TABLE.

CONFIGURATION FOR LEAKAGE CONSIDERATION	INITIAL LEAK RATE LBS/DAY O2/N2	PRESS AT 30 DAY PSIA	REPRESS TO 14.7 PSIA QTY-LBS	5-DAY LEAKAGE LBS O2/N2	2-MAN CREW O2 5-DAYS LBS	GAS TOTAL LBS O2/N2
CORE	5.5	8.0	134	27	18.4	179.4
CORE, PWR	5.5	8.0	134	27	18.4	179.4
CORE, SM-1	6.0	11.2	145	30	18.4	200.4
CORE, SM-1, SM2	6.5	12.5	197	32	18.4	247.4
CORE, SM-1 SM-2, SM-3	7.0	13.0	193	35	18.4	246.4
CORE, SM-1, SM-2, SM-3, SM-4	7.5	13.0	196	37	18.4	251.4

3.3.2.1.3.2 CO2 MANAGEMENT

CO2 PARTIAL PRESSURE SHALL BE MAINTAINED WITHIN 10 MMHG UTILIZING ORBITER CO2 REMOVAL EQUIPMENT.

3.3.2.1.3.3 ATMOSPHERIC CONTROL

A. CIRCULATION - CAPABILITY SHALL BE PROVIDED FOR ATMOSPHERE CIRCULATION DURING PERIODS OF CREW OCCUPANCY AND FOR PERIODIC CIRCULATION DURING QUIESCENT OPERATIONS TO PROVIDE FOR CONTAMINANT MONITORING. AIR VELOCITY SHALL BE MAINTAINED BETWEEN 15 FPM MINIMUM AND 100 FPM MAXIMUM WHEN OCCUPIED BY THE CREW.

B. TEMPERATURE - CAPABILITY SHALL BE PROVIDED TO MAINTAIN THE ATMOSPHERE TEMPERATURE BETWEEN 40 AND 85 DEG F WHEN UNMANNED AND 65 TO 75 DEG F WHEN MANNED.

C. HUMIDITY - ORBITER EQUIPMENT SHALL BE USED TO MAINTAIN HUMIDITY CONTROL DURING PERIODS OF MANNED OPERATION.

D. PRESSURE - TOTAL PRESSURE SHALL BE MAINTAINED AT A NORMAL OPERATING PRESSURE OF 14.7 PSIA. O2 PARTIAL PRESSURE SHALL BE MAINTAINED BETWEEN 3.1 PSIA MINIMUM AND 3.5 PSIA MAXIMUM. THE TOTAL PRESSURE AND O2 PARTIAL PRESSURE SHALL BE MAINTAINED DURING PERIODS OF MANNED OPERATIONS FOR 5 DAYS MAXIMUM AT EACH BUILDUP STEP AND ALLOWED TO BLEED DOWN VIA NORMAL LEAKAGE DURING QUIESCENT PERIODS.

E. CONTAMINANT CONTROL - CAPABILITY SHALL BE PROVIDED FOR PERIODIC MONITORING FOR TOXIC CONTAMINATION AND AN EXPLOSIVE ATMOSPHERE. THE TYPES OF CONTAMINANTS TO BE MONITORED AND CONTROLLED AND THEIR ALLOWABLE CONCENTRATIONS ARE TO BE DETERMINED.

3.3.2.1.3.4 THERMAL CONTROL

A. CAPABILITY SHALL BE PROVIDED TO ACCOMMODATE THE FOLLOWING HEAT LOADS DURING QUIESCENT PERIODS OF OPERATION OF THE CORE/POWER MODULE(S) -

1. CONTINUOUS - 2574 BTU/HR (760 WATTS THERMAL)

2. INTERMITTENTLY - 4737 BTU/HR (1.38 KW) FOR 1/2 HR EACH DAY AND 4 1/2 HRS PRIOR TO SHUTTLE ORBITER BERTHING

B. CAPABILITY SHALL BE PROVIDED TO ACCOMMODATE THE FOLLOWING HEAT LOADS DURING MANNED PERIODS OF OPERATION OF THE CORE/POWER MODULE(S) -

1. CREW - 700 BTU/HR/MAN

2. EQUIPMENT - TBD

C. CAPABILITY SHALL BE PROVIDED TO UTILIZE THE SM-1 THERMAL CONTROL PROVISIONS TO ACCOMMODATE CREW AND EQUIPMENT HEAT LOADS AFTER SM-1 DELIVERY. SUBSEQUENT BUILDUP OPERATIONS WILL UTILIZE NORMAL OPERATIONS EQUIPMENT AS REQUIRED FOR THERMAL CONTROL.

3.3.2.1.3.5 WATER MANAGEMENT

CAPABILITY SHALL BE PROVIDED TO UTILIZE NORMAL OPERATIONS ECLSS ELECTROLY-

SIS WATER STORAGE TANKS AS A SUPPLEMENTARY SOURCE OF WATER FOR EPS USE. NO OTHER SPECIAL BUILDUP REQUIREMENTS HAVE BEEN IDENTIFIED. CREW WATER CONSUMPTION REQUIREMENTS SHALL BE MET USING ORBITER PROVISIONS.

3.3.2.1.3.6 WASTE MANAGEMENT

NO SPECIAL BUILDUP REQUIREMENTS HAVE BEEN IDENTIFIED. ORBITER PROVISIONS SHALL BE USED TO ACCOMMODATE CREW GENERATED WASTES.

3.3.2.1.3.7 HYGIENE

NO SPECIAL BUILDUP REQUIREMENTS HAVE BEEN IDENTIFIED.

3.3.2.1.3.8 SPECIAL LIFE SUPPORT

IVA SUIT CONNECT CAPABILITY SHALL BE AVAILABLE AT EACH PHASE OF BUILDUP.

3.3.2.1.4 SPECIAL REQUIREMENTS

3.3.2.1.4.1 FLUID SYSTEMS AND THEIR SERVICING EQUIPMENT SHALL BE DESIGNED TO PERMIT COMPLETE FLUSHING AND DRAINING. THE FOLLOWING CONDITONS SHALL BE SATISFIED AS A MINIMUM -

A. THE ASSEMBLY SHALL BE FREE AS POSSIBLE FROM DEAD-ENDED PIPING OR PASSAGES THROUGH WHICH FLUSHING FLUIDS CANNOT BE MADE TO FLOW.

B. DRAIN PORTS SHALL BE LOCATED AT THE LOW POINTS IN THE ASSEMBLY FOR GROUND CHECKOUT.

3.3.2.1.4.2 POSITIVE MEASURES SHALL BE TAKEN TO PREVENT THE INCORRECT INSTALLATION OF FLUID LINE COMPONENTS WHOSE FUNCTION IS DEPENDENT ON DIRECTION OF FLOW.

A. WHERE FEASIBLE, THE DESIGN OF THESE FLUID LINE COMPONENTS SHALL INCORPORATE END FITTINGS OR CONNECTORS WHOSE DIMENSIONS OR CONFIGURATIONS WILL NOT PERMIT INCORRECT INSTALLATION OR SERVICING.

B. THE DIRECTION OF FLOW SHALL BE CLEARLY INDICATED WITH PERMANENT MARKINGS ON THE EXTERIOR OF COMPONENTS AND PARTS EVERY SIX INCHES ON FLUID LINES.

C. SUBSYSTEM MEDIA SHALL BE IDENTIFIED BY AN ODIZING OR OTHER PERMANENT COLOR CODING ON THE EXTERIOR OF THE FLUID LINES/FITTINGS.

3.3.2.1.4.3 GROUND SERVICING AND TEST PORTS (NOT REQUIRED TO FUNCTION INFLIGHT) SHALL BE DESIGNED TO PRECLUDE LEAKAGE INFLIGHT IF CAPS ARE USED. THE MATERIAL SHALL BE COMPATIBLE WITH THE APPLICABLE SPACECRAFT SUBSYSTEM AND THE EXPECTED ENVIRONMENT.

3.3.2.2 SECONDARY PERFORMANCE CHARACTERISTICS

3.3.2.2.1 GASEOUS STORAGE

NO SPECIFIC SECONDARY PERFORMANCE CHARACTERISTICS IDENTIFIED.

3.3.2.2.2 CO2 MANAGEMENT

A. THE CO2 MANAGEMENT ASSEMBLY IS CAPABLE OF REMOVING 27 LBS OF CO2 PER DAY WITH BOTH H2 DEPOLARIZER UNITS OPERATING.

B. THE CO2 MANAGEMENT ASSEMBLY IS CAPABLE OF PROCESSING A MAXIMUM OF 27 LBS OF CO2 PER DAY WITH BOTH SABATIER UNITS OPERATING. TWO UNIT OPERATION REQUIRES 3.68 LBS OF H2 PER DAY AND PRODUCES 16.54 LBS OF H2O AND 7.34 LBS OF CH4 PER DAY, AND 6.8 LBS OF CO2 IS VENTED.

C. THE CO2 MANAGEMENT ASSEMBLY IS CAPABLE OF PRODUCING 56.24 LBS OF O2 PER DAY WITH BOTH ELECTROLYSIS UNITS OPERATING DURING SUNSIDE ONLY.

3.3.2.2.3 ATMOSPHERIC CONTROL

A. THE ATMOSPHERIC CONTROL ASSEMBLY IS CAPABLE OF PROCESSING 6.5 LBS OF HUMIDITY CONDENSATE PER HOUR WITH BOTH HUMIDITY UNITS OPERATING.

3.3.2.2.4 THERMAL CONTROL

A. THE THERMAL CONTROL ASSEMBLY IS CAPABLE OF REJECTING A MAXIMUM HEAT LOAD OF 118,842 BTU/HOUR (34.8 KW). (4.5 KW OVER THE 30.3 KW REQUIRED)

3.3.2.2.5 WATER MANAGEMENT

A. THE WATER MANAGEMENT ASSEMBLY IS CAPABLE OF PROCESSING 322 LBS OF WATER PER DAY WITH BOTH VAPOR COMPRESSION UNITS OPERATING.

3.3.2.2.6 WASTE MANAGEMENT

A. THE WASTE MANAGEMENT ASSEMBLY IS CAPABLE OF PROCESSING 30 LBS/DAY OF TRASH WITH TWO UNIT OPERATION.

B. THE WASTE MANAGEMENT ASSEMBLY IS CAPABLE OF PROCESSING 83 LBS/DAY OF URINE AND FLUSH WATER WITH BOTH UNITS OPERATING AT MAXIMUM CAPACITY.

3.3.2.2.7 HYGIENE

NO SPECIFIC SECONDARY PERFORMANCE CHARACTERISTICS IDENTIFIED.

3.3.2.2.8 SPECIAL LIFE SUPPORT

NO SPECIFIC SECONDARY PERFORMANCE CHARACTERISTICS IDENTIFIED.

3.3.2.3 EXPERIMENT PROVISIONS

3.3.2.3.1 GASEOUS STORAGE

A. OXYGEN/NITROGEN QUANTITIES

1. METABOLIC CONSUMPTION (O2) - 1.2 LB/DAY

2. LEAKAGE MAKEUP (O2/N2) - 1.0 LB/DAY/ATTACHED MODULE

3. PUMPDOWN (O2/N2)
   AIRLOCKS
   PRESS/DEPRESS FREQ - 5/MONTH
   VOLUME - 435 CU FT
   PUMPDOWN TIME - 8 HRS TO 0.1 PSIA
   REPRESS TIME - 20 MINUTES
   PUMPDOWN GAS RECEIVER - NORMAL STATION ATMOSPHERE
   PUMPDOWN REPRESS GAS - FROM STATION ATMOSPHERE

B. CO2 MANAGEMENT

THE STATION SHALL MAINTAIN THE ATMOSPHERE AT 3.0 MMHG NOMINAL CO2 PARTIAL PRESSURE. NON-METABOLIC, ANIMAL AND EXPERIMENT PRODUCED CO2 SHALL BE CONTROLLED BY THE EXPERIMENT. CO2 CONTROL FOR THE CREW SHALL BE PROVIDED FOR INTEGRAL, ATTACHED, AND DETACHED EXPERIMENTS WHEN ATTACHED TO THE STATION.

C. ATMOSPHERIC CONTROL

1. CIRCULATION - THE STATION SHALL PROVIDE AIR CIRCULATION FOR THE GPL BETWEEN 15 AND 100 FPM TO SUPPORT CREW COMFORT. THE STATION SHALL PROVIDE CO2 AND CONTAMINANT CONTROL OF THE ATMOSPHERE FOR THE GPL AND ATTACHED RAMS. AN INTERFACE SUPPLY AND RETURN DUCT SHALL PROVIDE 100 TO 400 CFM OF AIR TO CONTROL THE CO2, HUMIDITY, AND CONTAMINANT PRODUCTION OF 6 MEN.
2. TEMPERATURE CONTROL - THE STATION SHALL PROVIDE SELECTABLE TEMPERATURE CONTROL BETWEEN 65 AND 75 DEG F FOR THE GPL. ATTACHED RAMS SHALL PROVIDE SELECTABLE TEMPERATURE CONTROL BETWEEN 65 AND 75 DEG F. THE STATION ATMOSPHERE SHALL ACCOMMODATE THE HUMIDITY LOAD OF SIX CREWMEN MAXIMUM. ALL OTHER AIR THERMAL LOADS SHALL BE ACCOMMODATED BY THE MODULE.
3. PRESSURE CONTROL - THE STATION SHALL PROVIDE TOTAL PRESSURE CONTROL AND OXYGEN PARTIAL PRESSURE CONTROL FOR GPL EXPERIMENTS AND ATTACHED RAMS TO THE SAME CONDITION AS THE STATION ATMOSPHERE.

THE STATION AND EXPERIMENTS ATMOSPHERE SHALL BE CONTROLLED TO 14.7 PSIA NOMINAL (WITH VARIATION TO 10 PSIA ALLOWABLE) AND OXYGEN PARTIAL PRESSURE AT 3.1 PSIA. EXPERIMENT PRESSURE REQUIREMENTS DIFFERENT FROM THE STATION SHALL BE PROVIDED BY EXPERIMENTS.

4. HUMIDITY CONTROL - THE STATION SHALL PROVIDE ATMOSPHERE AT 8 TO 12 MMHG PARTIAL PRESSURE OF WATER FOR GPL EXPERIMENTS AND ATTACHED RAMS. HUMIDITY CONTROL TO A DIFFERENT LEVEL SHALL BE PROVIDED BY EXPERIMENTS. EXCESSIVE EXPERIMENT CAUSED HUMIDITY (GREATER THAN APPROX 0.1 LB/HR OF NON-HUMAN WATER TO THE ATMOSPHERE) SHALL BE REMOVED BY EXPERIMENT FACILITIES.

D. THERMAL CONTROL

1. GPL EXPERIMENTS - THE STATION SHALL PROVIDE ACTIVE TEMPERATURE CONTROL FOR GPL EXPERIMENTS SUFFICIENT TO ACCOMMODATE 4500 WATTS AVERAGE DISSIPATION.
2. ATTACHED RAMS - THE STATION SHALL PROVIDE A LIQUID INTERFACE HEAT EXCHANGER SIZED TO 4500 WATTS AVERAGE HEAT LOAD AVAILABLE AT EACH EXPERIMENT MODULE BERTHING PORT AT A COOLANT TEMPERATURE RANGE OF 40 TO 75 DEG F.

E. WATER MANAGEMENT

1. STORAGE AND/OR GENERATION CAPABILITY FOR SUPPLYING 35 LB/DAY MAXIMUM OF POTABLE WATER SHALL BE PROVIDED BY THE STATION ECLSS. THE WATER SHALL HAVE THE SAME POTABILITY AND PURITY REQUIREMENTS AS THE STATION. THIS CAPABILITY SHALL BE PROVIDED FOR GPL AND ATTACHED RAM EXPERIMENT USE EITHER INDIVIDUALLY OR COLLECTIVELY.
2. EXPERIMENT WATER REQUIREMENTS WITH A DIFFERENT PURITY REQUIREMENT SHALL BE CONSIDERED AN EXPERIMENT EXPENDABLE ITEM AND HANDLED AS A LOGISTICS SUPPLY MATERIAL.
3. EXPERIMENT WATER WHICH CANNOT BE ACCOMMODATED BY THE STATION POTABLE WATER RECLAMATION ASSEMBLY BECAUSE OF UNUSUAL CHEMICALS OR CONTAMINANTS SHALL BE CONSIDERED A WASTE PRODUCT AND TREATED AS A LOGISTICS RETURN MATERIAL. WATER MAKEUP FOR SUCH WASTE WATER SHALL BE TREATED AS AN EXPERIMENT LOGISTICS SUPPLY ITEM.

F. WASTE MANAGEMENT

1. THE STATION ECLSS SHALL PROVIDE CAPABILITY FOR PROCESSING EITHER INDIVIDUALLY OR COLLECTIVELY A TOTAL OF 67 LB/MONTH OF WASTE AND TRASH MATERIALS FROM GPL AND ATTACHED RAM EXPERIMENTS.
2. THE TYPES OF WASTE AND TRASH MATERIALS TO BE PROCESSED FROM EXPERIMENTS SHALL BE LIMITED TO THE STANDARDS OF NORMAL STATION WASTE

PRODUCTS AS SPECIFIED BELOW

(A) MANUFACTURING PROCESS WASTES
THIN FILMS, CASTINGS, CRYSTALS, ELECTROPHORESIS
(B) LABORATORY WASTES
CHEMICAL ANALYSIS, MICROBIOLOGICAL ANALYSIS, SYRINGES, SEPTUMS, NEEDLES
CLEANERS, AGAR, BROTH, DISHES, SWABS
METABOLIC WASTES, CARCASSES
SOILS, FERTILIZER
FISH, INSECTS
(C) PHOTOGRAPHIC
POLYESTER, MYLAR
(D) MAINTENANCE
SEALS, GASKETS, ADHESIVES, LUBRICANTS
(E) INSTRUMENTATION
SENSING ELEMENTS, CHEMICALS
(D) LOGISTICS
PACKING, CARTONS, CANS

G. HYGIENE

1. THE STATION SHALL SUPPORT THE HYGIENE REQUIREMENTS OF THE CREW FOR EXPERIMENTS. SPECIAL SHOWER AND WASHING REQUIREMENTS FOR BIOLOGY EXPERIMENTS SHALL BE PROVIDED BY EXPERIMENTS.
2. EXPERIMENTS SHALL PROVIDE FOR DISINFECTION AND GERMICIDAL CLEANING OF BIOLOGICAL WORK AREAS, EQUIPMENT, AND REUSABLE SUPPLIES.
3. ANY PROTECTIVE CLOTHING REQUIREMENTS SHALL BE PROVIDED BY EXPERIMENTS.

3.3.2.4 SUBSYSTEM DEFINITION

THE TECHNICAL DATA PRESENTED IN THESE PARAGRAPHS DOES NOT CONTAIN DESIGN-TO REQUIREMENTS, RATHER THE DATA REFLECTS A CONCISE DESCRIPTION OF THE TECHNICAL PARAMETERS THAT FORM THE CURRENT BASELINE SUBSYSTEM DEFINITION. THE SUMMATION OF THESE CHARACTERISTICS WITH THOSE OF THE OTHER SIX FUNCTIONAL SUBSYSTEMS FORM THE BASIS FOR CONFIGURATION LAYOUTS, WEIGHT STATEMENTS AND POWER PROFILES FOR THE MODULAR SPACE STATION SYSTEM.

THE ENVIRONMENTAL CONTROL LIFE SUPPORT SUBSYSTEM CONSISTS OF EIGHT MAJOR ASSEMBLIES AS DESCRIBED IN THE FOLLOWING PARAGRAPHS AND AS SHOWN IN THE FUNCTIONAL BLOCK DIAGRAM OF FIGURE 3.3.2.4-1.

3.3.2.4.1 MAJOR ASSEMBLIES

A. GASEOUS STORAGE ASSEMBLY

THE GASEOUS STORAGE ASSEMBLY CONTAINS TANKAGE FOR GASEOUS O2 AND N2 STORAGE TO SUPPORT REPRESSURIZATION. ONE 33 IN DIAMETER TANK FOR O2 AND THREE 31 IN DIAMETER TANKS FOR N2 ARE PROVIDED. IN ADDITION, THE ASSEMBLY CONTAINS ONE LARGE AND FOUR SMALL PUMPDOWN UNITS FOR EVACUATION OF THE BERTHING PORT AND AIRLOCK VOLUMES.

B. CO2 MANAGEMENT ASSEMBLY

THE CO2 MANAGEMENT ASSEMBLY CONTAINS H2 DEPOLARIZED UNITS AND SABATIER REACTORS FOR CO2 REMOVAL AND REDUCTION. THE ASSEMBLY ALSO CONTAINS CO2 SENSORS FOR MONITORING CO2 LEVELS. IN ADDITION, THE ASSEMBLY CONTAINS WATER ELECTROLYSIS UNITS, WATER ACCUMULATORS, AND FEED PUMPS.

C. ATMOSPHERIC CONTROL ASSEMBLY

THE ATMOSPHERIC CONTROL ASSEMBLY CONTAINS AIR CIRCULATION DUCTS AND FANS, SENSIBLE AND SPECIAL HEAT EXCHANGERS AND FANS FOR TEMPERATURE CONTROL, HUMIDITY CONTROL UNITS AND FANS, PRESSURE SENSORS, PARTIAL PRESSURE O2 CONTROLS. PRESSURE RELIEF SYSTEMS, AND A GAS PRESSURE REDUCTION UNIT FOR PRESSURE CONTROL. THE ASSEMBLY ALSO CONTAINS PLUMBING FOR O2 AND N2 GAS DISTRIBUTION IN THE CORE AND STATION MODULES. IN ADDITION, CONTAMINATION CONTROL UNITS, EXPLOSION DETECTORS, GAS MONITOR AND BACTERIA DETECTORS, CHARCOAL CANISTERS AND CATALYTIC OXIDIZER ARE PROVIDED FOR CONTAMINATION CONTROL.

D. THERMAL CONTROL ASSEMBLY

THE THERMAL CONTROL ASSEMBLY CONSISTS OF AN INTERNAL COOLANT LOOP AND A HEAT REJECTION LOOP. THE INTERNAL COOLANT LOOP CONTAINS TWO RAM HEAT EXCHANGERS, TWO WATER PUMP PACKAGES, COLDPLATES, AND ASSOCIATED TUBING AND VALVES. A BUILDUP WATER PUMP PACKAGE AND EMERGENCY WATER PUMP PACKAGE WITH ASSOCIATED TUBING AND VALVES ARE ALSO PROVIDED. THE HEAT REJECTION LOOP CONTAINS RADIATORS, FREON/H2O INTERCOOLERS, FREON PUMP PACKAGES, FREON RESERVOIRS, AND ASSOCIATED TUBING AND VALVES TO SUPPORT NORMAL, EMERGENCY, AND BUILDUP OPERATIONS.

E. WATER MANAGEMENT ASSEMBLY

THE WATER MANAGEMENT ASSEMBLY CONTAINS TWO WATER RECOVERY UNITS, TWO VENT ACCUMULATORS AND PUMPS, FOUR POTABLE WATER STORAGE TANKS, TWO PURITY MONITOR UNITS, AND ASSOCIATED PLUMBING FOR SUPPLY AND RETURN DISTRIBUTION OF WATER IN THE CORE AND STATION MODULES.

F. WASTE MANAGEMENT ASSEMBLY

THE WASTE MANAGEMENT ASSEMBLY CONTAINS TWO FECAL COLLECTION SUBASSEMBLIES TWO URINE COLLECTION SUBASSEMBLIES, AND TWO TRASH PROCESSING SUBASSEMBLIES.

G. HYGIENE ASSEMBLY

THE HYGIENE ASSEMBLY CONTAINS A SHOWER STALL AND EQUIPMENT FOR FULL BODY WASHING, TWO HYGIENE SINKS AND TWO GALLEY/LAB SINKS FOR PARTIAL BODY WASHING, AND TWO VACUUM CLEANERS FOR GENERAL HOUSEKEEPING.

H. SPECIAL LIFE SUPPORT ASSEMBLY

THE SPECIAL LIFE SUPPORT ASSEMBLY CONTAINS NINE FIRE EXTINGUISHER PACKAGES AND SIX FIRE DETECTORS FOR FIRE CONTROL, TWO SETS OF IVA CONNECTS FOR IVA SUPPORT, AND TWO LIOH SUBASSEMBLIES AND STORAGE CABINETS FOR EMERGENCY CO2 REMOVAL.

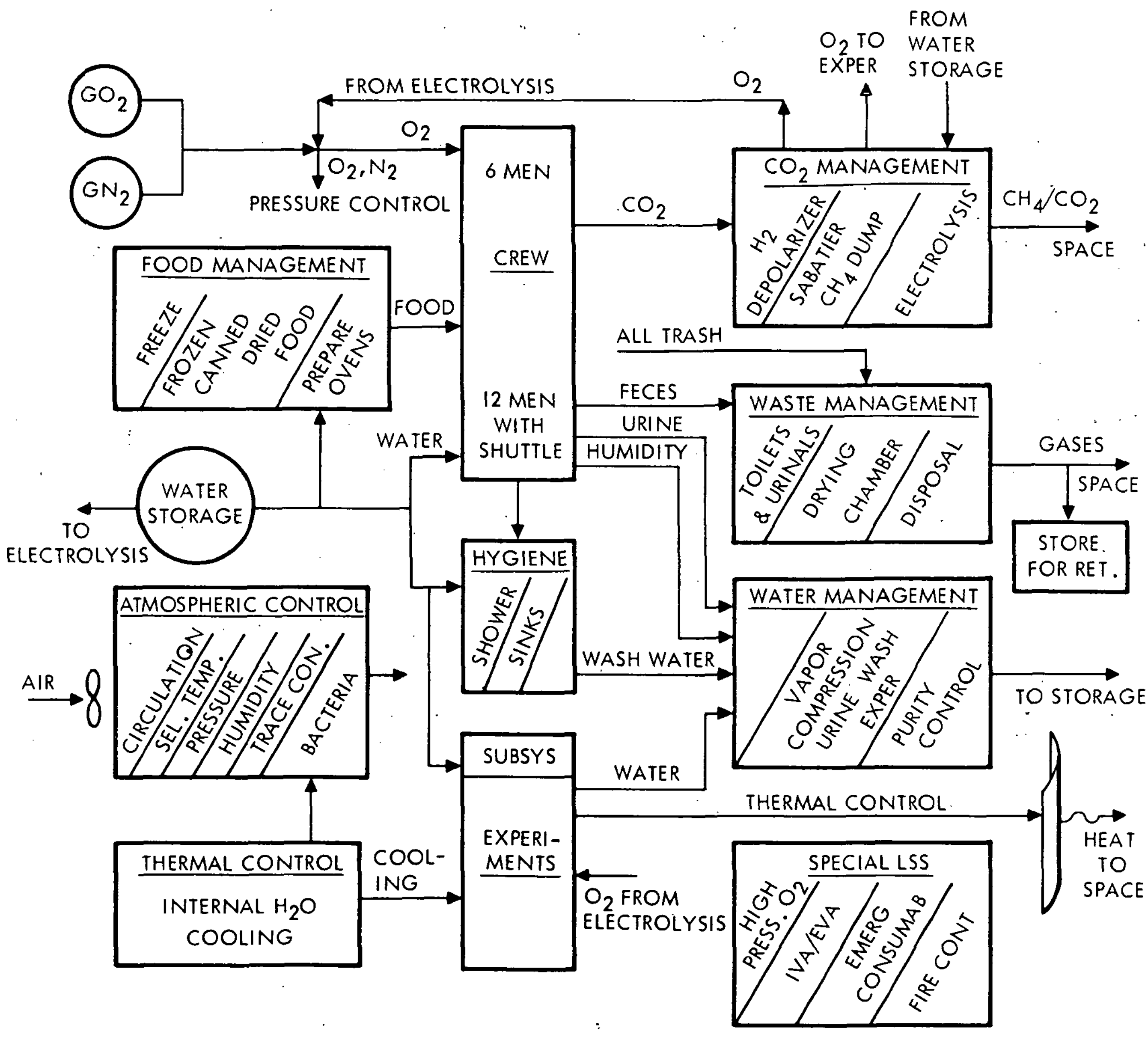


FIGURE 3.3.2.4-1 MAJOR ASSEMBLY FUNCTIONAL BLOCK DIAGRAM

3.3.2.4.2 WEIGHT, POWER AND UNIT/LOCATION CHARACTERISTICS

TABLE 3.3.2.4.2-1 WEIGHT CHARACTERISTICS

MAJOR ASSEMBLY	WEIGHT (LBS)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
2.0 ECLSS							
2.1 GASEOUS STORAGE	42	765		11	11		829
2.2 CO2 MANAGEMENT	4		4	741	741	4	1494
2.3 ATMOSPHERIC CONTROL	750	84	587	876	876	554	3727
2.4 THERMAL CONTROL	681		1969	1570	1570	1969	7759
2.5 WATER MANAGEMENT	20		638	23	23	638	1342
2.6 WA TE MANAGEMENT			86		79	163	328
2.7 HYGIENE			370	27	53	56	506
2.8 SPECIAL LIFE SUPPORT	122		36	62	62	36	318
TOTAL	1619	849	3690	3310	3415	3420	16303

NOTE ABOVE WEIGHTS INCLUDE ALLOCATION FOR MOUNTS AND SUPPORTS

TABLE 3.3.2.4.2-2 POWER CHARACTERISTICS - NORMAL OPERATIONS

MAJOR ASSEMBLY	POWER (WATTS - 24 HOUR AVG)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
2.0 ECLSS							
2.1 GASEOUS STORAGE	52						52
2.2 CO2 MANAGEMENT	2		2	3229	2	2	3237
2.3 ATMOSPHERIC CONTROL	415	5	251	866	271	247	2055
2.4 THERMAL CONTROL			1500				1500
2.5 WATER MANAGEMENT			535			535	1070
2.6 WASTE MANAGEMENT			15		19	5	39
2.7 HYGIENE			36	4	6		46
2.8 SPECIAL LIFE SUPPORT	20		10		10	10	60
TOTAL	489	5	2349	4109	308	799	8059

TABLE 3.3.2.4.2-3 POWER CHARACTERISTICS - EMERGENCY OPERATIONS

MAJOR ASSEMBLY	POWER (WATTS - 24 HOUR AVG)					
	CORE POWER	SM1	SM2	SM3	SM4	TOTAL
2.0 ECLSS						
2.1 GASEOUS STORAGE						0
2.2 CO2 MANAGEMENT						5
2.3 ATMOSPHERIC CONTROL						530
2.4 THERMAL CONTROL						500
2.5 WATER MANAGEMENT						0
2.6 WASTE MANAGEMENT						0
2.7 HYGIENE						0
2.8 SPECIAL LIFE SUPPORT						60
TOTAL						1095

TABLE 3.3.2.4.2-4 UNIT CHARACTERISTICS/LOCATIONS/QTY

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES) H	W	D	CORE	PWR	SM-1	SM-2	SM-3	SM-4
2.1 GASEOUS STORAGE											
O2 Supply	---	190	33 In. Dia.			---	1	---	---	---	---
Repress O2 Tank											
N2 Supply											
Repress N2 Tank	---	150	31 In. Dia.			---	3	---	---	---	---
Pumpdown											
Small Unit	184	10	10	10	13	2	---	---	1	1	---
Large Unit	220	20	12	12	15	1	---	---	---	---	---
Mounts and Supports	---	129				x	x	---	x	x	---
2.2 CO_2 MANAGEMENT											
CO_2 Removal											
CO_2 Removal Unit	27	157	24	24	16.5	---	---	---	1	1	---
CO_2 Reduction											
CO_2 Reduction Unit	68	42	16	19	16	---	---	---	1	1	---
Vent Gas Accumulator	---	8	22 In. Dia.			---	---	---	1	1	---
Accumulator Pump	110	19	10	10	13	---	---	---	1	1	---
Water Electrolysis											
Water Electrolysis Unit	4900	462	33	30	26	---	---	---	1	1	---
Water Accumulator (Dry)	---	5	15 In. Dia.			---	---	---	1	1	---
V/C Water Feed Pump	20	10	10	10	10	---	---	---	1	1	---
CO_2 Sensor	2	3	4	4	4	1	---	1	1	1	1
Mounts and Supports	---	73				x		x	x	x	x

TABLE 3.3.2.4.2-4 UNIT CHARACTERISTICS/LOCATIONS/QTY (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES) H	W	D	CORE	PWR	SM-1	SM-2	SM-3	SM-4
2.3 ATMOSPHERIC CONTROL											
Circulation											
Boom Ducting	---	44	9 In. Dia. x 33 ft			---	x	---	---	---	---
Ducting - Sensible	---	126	15 In. Dia. x 50 ft			x	---	---	---	---	---
Ducting - Humidity	---	339	15 In. Dia. x 80 ft			x	---	---	---	---	---
			9 In. Dia.x 110 ft			x	---	---	---	---	---
Ducting - Module	---	294	15 In. Dia.x 118 ft			---	---	x	x	x	x
			9 In. Dia. x 23 ft			---	---	x	x	x	x
Humidity Duct Fan	200	20	11 x 11 x 5			2	---	---	---	---	---
Ventilation Fans	28	10	14 x 14 x 12			3	---	7	7	7	7
Temperature Control											
Sensible HX & Fan Assy.	200	80	14 x 14 x 23			1	---	1	1	1	1
Special HX & Fan Assy.	28	30	12 x 12 x 12			---	---	2	---	---	1
Humidity Control											
Humidity Control Unit & Fan Assembly	120	124	24 x 24 x 50			---	---	---	1	1	---
Pressure Control											
Gas Pressure Reduction	5	22	---			---	1	---	---	---	---
Pressure Relief System	---	10	2 In. Dia. x 6 In.			2	1	1	1	1	1
Partial Press O_2 Control	10	6	10 x 10 x 8			---	---	---	1	1	---
Pressure Sensors	---	0.5	1 In. Dia. x 2 In.			1	1	1	1	1	1
Gas Distribution System											
O2/N2 Lines - Core	---	77	3/8 In.Dia.x320 ft			x	---	---	---	---	---
O2/N2 Lines - Module	---	25	3/8 In.Dia.x111 ft			---	---	x	x	x	x
Contamination Control											
Contamination Control Unit	155	135	30 x 30 x 30			---	---	---	1	1	---
Detectors - Explosion	35	4	Unit-9x4x19;Det-3x4x7			1	1	1	1	1	1
Detectors - Gas Monitor and Bacteria	63 to 363	68	40 x 24 x 24			---	---	---	1	1	---
Local Charcoal Canisters	---	6	8 In. Dia. x 24 In.			---	---	1	1	1	1
Local Charcoal Assy	---	10	8½ In. Dia x 25 In.			---	---	1	1	1	1
Mounts and Supports	---	178.5				x	x	x	x	x	x

TABLE 3.3.2.4.2-4 UNIT CHARACTERISTICS/LOCATIONS/QTY (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS: POWER	WEIGHT (LBS)	SIZE (INCHES) H x W x D	LOCATION/QUANTITY: CORE	PWR	SM-1	SM-2	SM-3	SM-4
2.4 THERMAL CONTROL									
Internal Coolant Loop									
RAM HX	---	25	14 x 14 x 18	2	---	---	---	---	---
Water Pump Pkg	846	35	15 x 15 x 30	---	---	1	---	---	1
Coldplates (Dry)									
Core	---	18	8 Sq. Ft.	x	---	---	---	---	---
Module	---	92	41 Sq. Ft.	---	---	x	x	x	x
Tubing and Valves (Dry)									
Core	---	213	1.5 In.Dia.x176 ft	x	---	---	---	---	---
			1.0 In.Dia.x 80 ft	x	---	---	---	---	---
Module (with intercooler)	---	324	1.5 In.Dia.x148 ft	---	---	x	---	---	x
			1.0 In.Dia.x306 ft	---	---	x	---	---	x
Module (without intercooler)	---	186	1.0 In.Dia.x306 ft	---	---	---	x	x	---
Water Pump Pkg (Buildup)	60	10	10 x 10 x 15	1	---	---	---	---	---
Water Pump Pkg (Emerg)	400	17	10 x 10 x 20	1	---	---	---	---	---
Tubing & Valves(B-Up & Emerg)	---	6	1 In. Dia. x 10 ft	x	---	---	---	---	---
Heat Rejection Loop									
Radiator	---	1170	1230 Sq. Ft.	---	---	x	x	x	x
Radiator (Build-up)	---	176	185 Sq. Ft.	x	---	---	---	---	---
Freon/H_2O Intercooler	---	100	36 x 18 x 24	---	---	1	---	---	1
Freon Pump Pkg	654	80	15 x 15 x 38	---	---	1	---	---	1
Freon Reservoir (Dry)	---	30	23 In. Dia.	---	---	1	---	---	1
Tubing & Valves (Dry)									
Core	---	58	1.5 In.Dia.x176ft	x	---	---	---	---	---
Module (with intercooler)	---	62	1.5 In.Dia.x148ft	---	---	x	---	---	x
			1.0 In.Dia.x 56ft	---	---	x	---	---	x
Module (without intercooler)	---	46	1.0 In.Dia.x204ft	---	---	---	x	x	---
Freon/H_2O Intercooler (B-Up Emerg)	---	50	24 x 18 x 18	1	---		---	---	
Freon Pump Pkg (Build-Up)	35	10	10 x 10 x 15	1	---	---	---	---	---
Freon Pump Pkg (Emerg)	100	30	10 x 10 x22	1	---	---	---	---	---
Tubing & Valves (B-Up & Emerg)	---	3	1.0 In.Dia.x 15ft	---	---	---	---	---	---
Mounts and Supports	---	344		x		x	x	x	x

TABLE 3.3.2.4.2-4 UNIT CHARACTERISTICS/LOCATIONS/QTY (cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS			LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES) H W D	CORE	PWR	SM-1	SM-2	SM-3	SM-4
2.5 WATER MANAGEMENT									
Water Reclamation									
Water Recovery Unit	570	495	36 x 32 x 55	---	---	1	---	---	1
Vent Accumulator (Dry)	---	5	12 In. Dia.	---	---	1	---	---	1
Vent Accumulator Pump	25	10	10 x 10 x 13	---	---	1	---	---	1
Water Storage									
Potable Water Tank (Dry)	---	20	22 In. Dia.	---	---	2	---	---	2
Plumbing (Dry)									
Core	---	19	$\frac{1}{4}$ In. Dia.x 256ft	x	---	---	---	---	---
Module	---	22	$\frac{1}{4}$ In. Dia.x 296ft	---	---	x	x	x	x
Purity Control									
Purity Monitor	450	12	10 x 20 x 18	---	---	1	---	---	1
Mounts and Supports	---	111		x	---	x	x	x	x
2.6 WASTE MANAGEMENT									
Fecal Collection	160	50	$15\frac{1}{2}$ x 30 x 26	---	---	1	---	---	1
Urine Collection	40	30	18 x 12 x 12	---	---	1	---	---	1
Trash Processing	150	75	34 x 30 x 24	---	---	---	---	1	1
Mounts and Supports	---	18		---	---	x	---	x	x
2.7 HYGIENE									
Full Body Washing									
Shower Stall	---	322	84 x 34 x 36	---	---	1	---	---	---
Shower Equip	350		84 x 26 x 36	---	---	1	---	---	---
Partial Body Washing									
Hygiene Sink	75	28	13 x 30 x $12\frac{1}{2}$	---	---	1	---	---	1
Galley/Lab Sink	75	26	13 x 19 x $12\frac{1}{2}$	---	---	---	---	1	1
Housekeeping									
Vacuum Cleaner	84	25	14 x 9 x 14	---	---	---	1	1	---
Mounts and Supports	---	26				x	x	x	x

TABLE 3.3.2.4.2-4 UNIT CHARACTERISTICS/LOCATIONS/QTY (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES) H	W	D	CORE	PWR	SM-1	SM-2	SM-3	SM-4
2.8 SPECIAL LIFE SUPPORT											
Fire Control											
Fire Extinguisher Pkg	---	14	28 x 10 x 8			1	---	2	2	2	2
Fire Detector	10	6	6 x 6 x 6			2	---	1	1	1	1
IVA Support											
IVA Connects	*400	45	3 x 14 x 3			2	---	---	---	---	---
Emergency CO_2 Removal											
LIOH Assembly	---	10	Fits in Duct			---	---	---	1	1	---
Storage Cabinet	---	15	24 x 24 x 24			---	---	---	1	1	---
Mounts and Supports	---	16				x		x	x	x	x

*Add watts for water flow through LCG

3.3.2.5 SUBSYSTEM INTERFACES

3.3.2.5.1 ECLSS/STRUCTURAL AND MECHANICAL INTERFACES

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.2.4.2-4.

STRUCTURES SHALL PROVIDE FOR THE DISTRIBUTION OF AIR SUPPLY AND RETURN DUCTS, AND REDUNDANT ROUTING OF FLUID AND GAS PLUMBING.

3.3.2.5.2 ECLSS/ECLSS INTERFACES

NOT APPLICABLE

3.3.2.5.3 ECLSS/EPS INTERFACES

ECLSS SHALL PROVIDE EQUIPMENT COOLING FOR HEAT LOADS AS SPECIFIED IN TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION.

EPS SHALL PROVIDE REDUNDANTLY DISTRIBUTED REGULATED 120/208 V, 400 HZ, AC AND 56 VDC (IF REQUIRED) ELECTRICAL POWER. THE QUALITY OF THE POWER SHALL BE PER MIL-STD-704 EXCEPT FOR THE DC LINE DROP WHICH SHALL BE 2.5 VOLTS MAXIMUM BETWEEN THE LOADS AND THE REGULATED BUS. WIRE PROTECTION SHALL BE PROVIDED FOR ALL LOADS CONNECTED TO THE EPS DISTRIBUTION BUSES. WHERE APPLICABLE, REDUNDANT DEVICES SHALL BE EMPLOYED. CRITICAL LIFE SUPPORT LOADS SHALL BE MAINTAINED DURING EMERGENCIES AFFECTING ELECTRICAL POWER FOR A MINIMUM OF 96 HOURS. EPS SHALL PROVIDE ELECTRICAL POWER (24 HOUR AVERAGE WATTS) AS SPECIFIED (AT THE LOAD BUSES) BELOW -

SUBSYSTEM	BUILDUP STEP 1	BUILDUP STEP 2	NORMAL OPERATIONS	EMERGENCY OPERATIONS
ECLSS	160	160	8059	1095

ECLSS SHALL PROVIDE 160 POUNDS OF GASEOUS O2 AT 300 PSI AND 20 POUNDS OF H2 AT 300 PSI FOR A MINIMUM DURATION OF 96 HOURS (FOR EPS EMERGENCY OPERATIONS).

ECLSS SHALL PROVIDE THE CAPABILITY TO SUPPLY POTABLE WATER TO THE EPS WATER STORAGE TANKS.

ECLSS SHALL PROVIDE THE CAPABILITY TO UTILIZE EPS WATER STORAGE AND EXCESS EPS WATER.

3.3.2.5.4 ECLSS/G-C INTERFACES

ECLSS SHALL PROVIDE EQUIPMENT COOLING FOR HEAT LOADS AS SPECIFIED IN TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION.

3.3.2.5.5 ECLSS/RCS INTERFACES

ECLSS SHALL PROVIDE EQUIPMENT COOLING FOR HEAT LOADS AS SPECIFIED IN TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION.

THE ECLSS SHALL SUPPLY TO THE RCS GASEOUS HYDROGEN AND OXYGEN AS FOLLOWS -

OXYGEN

DELIVERY PRESSURE	-	NOMINAL 300 PSIA
TEMPERATURE	-	NOMINAL 70 DEG F
DELIVERY RATE	-	NOMINAL 28.12 LB/DAY
EMERGENCY	-	AN EMERGENCY SOURCE SHALL PROVIDE 22 LBS TO TWO DIFFERENT LOCATIONS

HYDROGEN

DELIVERY PRESSURE	-	NOMINAL 300 PSIA
TEMPERATURE	-	NOMINAL 70 DEG F
DELIVERY RATE	-	NOMINAL 3.51 LB/DAY
EMERGENCY	-	AN EMERGENCY SOURCE SHALL PROVIDE 2.8 LBS TO TWO DIFFERENT LOCATIONS.

THE RCS SHALL PROVIDE GO2 AND GH2 STORAGE ACCOMMODATIONS FOR ECLSS PRODUCED GASES TO SUPPORT ECLSS OPERATIONS DURING ORBITAL DARK PERIODS.

3.3.2.5.6 ECLSS/ISS INTERFACES

ECLSS SHALL PROVIDE EQUIPMENT COOLING FOR HEAT LOADS AS SPECIFIED IN TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION.

THE ECLSS SHALL PROVIDE THE ISS WITH MEASUREMENTS PRECONDITIONED TO A 0 TO 5 VDC RANGE WITH A SOURCE IMPEDANCE OF LESS THAN 1000 OHMS.

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS

RACU MEMORY SIZE - 4 K (32 BIT) WORDS

RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND DATA STORAGE.

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

3.3.2.5.7 ECLSS/CREW HABITABILITY INTERFACES

ECLSS SHALL PROVIDE EQUIPMENT COOLING FOR HEAT LOADS AS SPECIFIED IN TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION.

AS A GOAL, CREW/HABITABILITY SHALL PROVIDE 110 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

MODULAR SPACE STATION - INITIAL STATION SYSTEM

3.3.3 ELECTRICAL POWER

THIS SUBSYSTEM IS ONE OF THE SEVEN FUNCTIONAL GROUPINGS OF MAJOR SUBSYSTEMS THAT COMPRISE THE SHUTTLE LAUNCH MODULAR SPACE STATION.

PREPARED	D. T. Haigh	SYSTEM RQMTS/INTERFACES
APPROVAL	D.A. Nussberger	SUBSYSTEM PROJECT ENGR
APPROVAL	R.W. Anttel	SUBSYSTEM PROJECT MGR
APPROVAL	R. F. Jones	PROJECT ENGINEERING MGR

3.3.3 ELECTRICAL POWER SUBSYSTEM

3.3.3.1 PERFORMANCE REQUIREMENTS

3.3.3.1.1 NORMAL OPERATIONS

THE ELECTRICAL POWER SUBSYSTEM SHALL PROVIDE ELECTRICAL POWER (AT THE LOAD BUSES) CAPABLE OF SUSTAINING THE FOLLOWING LOADS (WATTS) -

		14 HOUR CREW DAY		10 HOUR CREW NIGHT	
	24 HOUR AVERAGE	ORBIT LIGHT PERIOD	ORBIT DARK PERIOD	ORBIT LIGHT PERIOD	ORBIT DARK PERIOD
NORMAL	19,267	25,027	19,497	16,180	10,650
DEGRADED	13,425	16,576	11,044	14,060	8,530

3.3.3.1.1.1 PRIMARY POWER GENERATION

PRIMARY POWER SHALL BE SUPPLIED BY A 2 DEGREE OF FREEDOM SOLAR ARRAY. THE SOLAR ARRAY WILL BE CAPABLE OF USE IN AN ORBIT OF 55 DEGREES AT AN ALTITUDE BETWEEN 240 AND 270 NAUTICAL MILES WHEN IN SOLAR SUNLIGHT. THE SOLAR ARRAY SHALL HAVE AN OPERATIONAL LIFE OF 5 YEARS.

3.3.3.1.1.2 SECONDARY POWER GENERATION

THE ENERGY STORAGE FUEL CELLS WILL BE UTILIZED FOR SECONDARY POWER GENERATION (EMERGENCY/BUILDUP POWER SOURCE).

3.3.3.1.1.3 ENERGY STORAGE

THE CAPABILITY TO STORE SUFFICIENT ENERGY FROM SOLAR SUN PERIODS TO SUPPORT THE ABOVE ELECTRICAL LOADS DURING SOLAR ECLIPSE PERIODS OVER A 24 HOUR PERIOD SHALL BE PROVIDED. WATER ELECTROLYSIS SHALL BE UTILIZED TO STORE PRIMARY POWER IN THE FORM OF GASEOUS REACTANTS (H2 AND O2). FUEL CELLS SHALL BE UTILIZED TO CONVERT THE STORED ENERGY TO ELECTRICAL POWER.

3.3.3.1.1.4 POWER CONDITIONING

A. THE CAPABILITY TO CONVERT THE SOLAR ARRAY DC OUTPUT VOLTAGE TO THE PRIMARY BUS VOLTAGE (416/240 VAC, 400 HZ, 3 PHASE) SHALL BE PROVIDED.

B. THE CAPABILITY TO REGULATE AND CONVERT THE FUEL CELL DC OUTPUT VOLTAGE TO THE PRIMARY BUS VOLTAGE SHALL BE PROVIDED.

C. THE CAPABILITY TO CONVERT THE PRIMARY BUS VOLTAGE TO THE SECONDARY BUS VOLTAGE (120/208 VAC, 400 HZ, 3 PHASE) SHALL BE PROVIDED.

D. THE CAPABILITY TO CONVERT THE SECONDARY BUS VOLTAGE TO THE DC BUS VOLTAGE (56 VDC) SHALL BE PROVIDED.

3.3.3.1.1.5 DISTRIBUTION, CONTROL AND WIRING

THE CAPABILITY TO ELECTRICALLY INTERCONNECT THE EPS EQUIPMENT AND THE ELECTRICAL LOADS AS REQUIRED SHALL BE PROVIDED. CIRCUIT PROTECTION SHALL BE PROVIDED. THE QUALITY OF POWER DELIVERED SHALL BE PER MIL-STD-704 OR BETTER.

3.3.3.1.1.6 LIGHTING

A. INTERIOR LIGHTING

PROVIDE THE EQUIPMENT REQUIRED TO MEET CREW AND HABITABILITY SUBSYSTEM INTERIOR ILLUMINATION CRITERIA (REFER TO PARAGRAPH 3.3.7.21). PROVIDE PORTABLE FLOODLIGHTS TO ILLUMINATE BERTHING AIDES DURING FINAL ALIGNMENT FOR BERTHING.

B. EXTERIOR LIGHTING

RUNNING LIGHTS SHALL BE PROVIDED SUCH THAT A RENDEZVOUSING VEHICLE CAN VISUALLY DETERMINE THE MSS ORIENTATION AT 2000 FEET. SHIRTSLEEVE MAINTAINABLE ACQUISITION LIGHTS SHALL BE PROVIDED ON OPPOSITE SIDES OF THE ORIENTATION DRIVE AND POWER TRANSFER MECHANISM AND ON THE -X END OF THE MSS. SHIRTSLEEVE MAINTAINABLE RUNNING LIGHTS SHALL BE PROVIDED ON THE MSS AS FOLLOWS.

2 GREEN LIGHTS ON +Y AXIS CORE MODULE BERTHING PORTS OR END OF MODULES
2 AMBER LIGHTS ON +Z AXIS CORE MODULE BERTHING PORTS OR END OF MODULES
2 RED LIGHTS ON -Y AXIS CORE MODULE BERTHING PORTS OR END OF MODULES
2 WHITE LIGHTS ON -Z AXIS CORE MODULE BERTHING PORTS OR END OF MODULES

EXTERIOR ILLUMINATION SHALL BE A MINIMUM OF 2 FOOT-CANDLES ALONG EVA SURFACE PATHS (TBD) AND 7 FOOT-CANDLES AT EVA WORK STATION SURFACES (TBD).

3.3.3.1.2 EMERGENCY OPERATIONS

LOSS OF PRIMARY POWER GENERATION IS DEFINED AS AN EPS POWER EMERGENCY. THE ELECTRICAL POWER SUBSYSTEM SHALL PROVIDE AN AVERAGE OF 1750 WATTS (AT THE LOAD BUSES) FOR A MINIMUM OF 96 HOURS. HIGH PRESSURE EMERGENCY REACTANT STORAGE IS A FUNCTION OF THE ECLSS.

3.3.3.1.2.1 PRIMARY POWER GENERATION

NOT REQUIRED FOR EPS EMERGENCY OPERATIONS.

3.3.3.1.2.2 SECONDARY POWER GENERATION

THE FUEL CELLS NORMALLY UTILIZED AS A PORTION OF THE ENERGY STORAGE ASSEMBLY SHALL BE CAPABLE OF CONVERTING REACTANTS (H2 AND O2) INTO ELECTRICAL POWER (AND WATER) TO SUPPORT THE EMERGENCY ELECTRICAL LOADS.

3.3.3.1.2.3 ENERGY STORAGE

THE ENERGY STORAGE FUNCTION IS NOT REQUIRED DURING EMERGENCY EPS OPERATIONS.

3.3.3.1.2.4 POWER CONDITIONING

PORTIONS OF THE EQUIPMENT IN THE NORMAL OPERATIONAL CONFIGURATION SHALL BE UTILIZED TO PERFORM POWER CONDITIONING DURING EPS EMERGENCY OPERATIONS.

3.3.3.1.2.5 DISTRIBUTION, CONTROL, AND WIRING

PORTIONS OF THE EQUIPMENT IN THE NORMAL OPERATIONAL CONFIGURATION SHALL BE UTILIZED DURING EPS EMERGENCY OPERATIONS.

3.3.3.1.2.6 LIGHTING

DURING EPS EMERGENCY OPERATIONS FIXED LIGHTING WILL BE LIMITED IN USAGE TO 60 WATTS AVERAGE.

3.3.3.1.3 BUILDUP OPERATIONS

PROVIDE THE ELECTRICAL POWER LEVEL (AT THE LOAD BUSES) AS DESIGNATED FOR EACH BUILDUP STEP.

BUILDUP STEP	1	2	3	4	5	6	7
MODULE DELIVERED	CORE	POWER	SM 1	SM 2	SM 3	SM 4	CARGO
POWER LEVEL (WATTS)	355	355	3768	4103	4442	4871	15,140

3.3.3.1.3.1 PRIMARY POWER GENERATION

THE SOLAR ARRAY SHALL BE CAPABLE OF BEING DEPLOYED 25 PERCENT FOR BUILDUP STEPS 3 THROUGH 6. PORTIONS OF THE EQUIPMENT UTILIZED FOR NORMAL EPS OPERATIONS SHALL BE UTILIZED FOR BUILDUP STEP 3 AND ALL SUBSEQUENT BUILDUP STEPS. THE SOLAR ARRAY SHALL BE FOLDED UP FOR LAUNCH. PRIMARY POWER GENERATION WILL NOT BE UTILIZED FOR BUILDUP STEPS 1 AND 2.

3.3.3.1.3.2 SECONDARY POWER GENERATION

THE FUEL CELLS NORMALLY UTILIZED AS A PORTION OF THE ENERGY STORAGE ASSEMBLY SHALL BE CAPABLE OF CONVERTING REACTANTS (H2 AND O2) INTO ELECTRICAL POWER (AND WATER) TO SUPPORT THE BUILDUP ELECTRICAL LOADS FOR BUILDUP STEPS 1 AND 2.

3.3.3.1.3.3 ENERGY STORAGE

A. THE ENERGY STORAGE ASSEMBLY SHALL STORE THE EPS REACTANTS AND THE RCS PROPELLANTS FOR BUILDUP STEPS 1 AND 2 IN THE FORM OF HIGH PRESSURE GASES AS FOLLOWS -

	30 DAY REQUIREMENT INCLUDING CONTINGENCIES (BUILDUP STEP 1)	60 DAY REQUIREMENT INCLUDING CONTINGENCIES (BUILDUP STEPS 1 AND 2)
POUNDS OF H2	41.7	75.7 (TOTAL)
POUNDS OF O2	333.3	605.8 (TOTAL)

B. THE CAPABILITY TO STORE 643 POUNDS OF WATER (AS GENERATED BY THE FUEL CELLS) DURING BUILDUP STEPS 1 AND 2 SHALL BE PROVIDED.

C. THE CAPABILITY TO SUPPORT THE REACTION CONTROL SUBSYSTEM WITH GASES FROM THE EPS ACCUMULATORS DURING ALL BUILDUP STEPS SHALL BE PROVIDED.

D. THE CAPABILITY TO ELECTROLYZE SUFFICIENT ADDITIONAL H_2 AND O_2 FROM WATER TO SUPPORT RCS DURING BUILDUP STEPS 3 THROUGH 6 SHALL BE PROVIDED.

E. PORTIONS OF THE EQUIPMENT IN THE NORMAL CONFIGURATION SHALL BE UTILIZED TO PERFORM ENERGY STORAGE DURING BUILDUP STEP 3 AND ALL SUBSEQUENT BUILDUP STEPS.

F. THE CAPABILITY TO STORE 3500 WATT HOURS OF ENERGY FOR 60 DAYS WITH BATTERIES SHALL BE PROVIDED.

3.3.3.1.3.4 POWER CONDITIONING

A. THE CAPABILITY TO CONDITION THE FUEL CELL OUTPUT DC VOLTAGE TO 120 VAC 400 HZ, 1 PHASE VOLTAGE DURING LOW POWER OPERATIONS (LESS THAN 1 KW) FOR BUILDUP STEPS 1 AND 2 SHALL BE PROVIDED.

B. THE CAPABILITY TO CONDITION THE SHUTTLE SUPPLIED POWER FOR SPACE STATION USE FOR MANNED OPERATIONS DURING BUILDUP STEP 2 AND SUBSEQUENT BUILDUP STEPS SHALL BE PROVIDED.

C. PORTIONS OF THE EQUIPMENT IN THE NORMAL CONFIGURATION SHALL BE UTILIZED TO CONDITION POWER FOR BUILDUP STEP 3 AND SUBSEQUENT BUILDUP STEPS.

D. THE CAPABILITY TO CONTROL AND CONDITION THE BUILDUP BATTERY POWER SHALL BE PROVIDED. THE CAPABILITY TO ACTIVATE PRESELECTED ALTERNATE POWER SOURCES AUTOMATICALLY SHALL BE PROVIDED.

3.3.3.1.3.5 DISTRIBUTION, CONTROL AND WIRING

A. SINGLE PHASE 400 HZ AC POWER SHALL BE DISTRIBUTED TO PROVIDE POWER TO THE BUILDUP STEP 1 AND 2 LOADS.

B. PORTIONS OF THE EQUIPMENT IN THE NORMAL CONFIGURATION SHALL BE UTILIZED DURING BUILDUP STEP 3 AND SUBSEQUENT BUILDUP STEPS.

3.3.3.1.3.6 LIGHTING

AN ACQUISITION LIGHT SHALL BE PROVIDED ON THE +X END OF THE CORE MODULE TO BE UTILIZED DURING BUILDUP STEP 1. IN ADDITION, THE NORMAL EXTERIOR ACQUISITION AND RUNNING LIGHTS SHALL BE UTILIZED DURING BUILDUP.

3.3.3.2 SECONDARY PERFORMANCE CHARACTERISTICS

3.3.3.2.1 PRIMARY POWER GENERATION

THE SOLAR ARRAY HAS THE CAPABILITY TO SUPPORT AN ADDITIONAL 24 HOUR AVERAGE LOAD AT THE LOAD BUSES OF 8.2 KW AT THE BEGINNING OF SOLAR ARRAY LIFE. THIS SECONDARY PERFORMANCE CHARACTERISTIC DECREASES BY 1/3 AT THE END OF THE FIRST YEAR AND BY AN ADDITION 1/6 AT THE END OF EACH SUCCEEDING YEAR.

THE SOLAR ARRAY HAS THE CAPABILITY TO SUPPORT ELECTROLYSIS (OR OTHER LOADS) WITH SUFFICIENT ELECTRICAL POWER TO ELECTROLYZE WATER TO PRODUCE AN ADDITIONAL 7327 POUNDS OF REACTANT PER YEAR AT THE END OF SOLAR ARRAY LIFE DUE TO SEASONAL VARIATIONS IN THE SOLAR DARK TO LIGHT RATIOS. THIS EQUATES TO AN AVERAGE STORAGE CAPABILITY OF 24 KILOWATT HOURS OF ENERGY STORED AS REACTANTS PER DAY.

THE PRIMARY POWER GENERATION POWER TRANSFER MECHANISM (SOLAR ARRAY SLIP RINGS) HAS THE CAPABILITY TO TRANSFER AN ADDITIONAL 23 KILOWATTS OF PRIMARY POWER FROM THE SOLAR ARRAY.

3.3.3.2.2 SECONDARY POWER GENERATION

THE ENERGY STORAGE FUEL CELLS ARE CAPABLE OF GENERATING ADDITIONAL ELECTRICAL POWER FROM REACTANTS TO SUPPORT AN ADDITIONAL 3.9 KILOWATTS OF ELECTRICAL LOADS AT THE LOAD BUSES DURING 14 HOUR CREW WORK SUN ECLIPSE PERIODS AND 12.7 KILOWATTS OF ELECTRICAL LOADS AT THE LOAD BUSES DURING 10 HOUR CREW REST SUN ECLIPSE PERIODS. DURING SOLAR LIGHT PERIODS THE ENERGY STORAGE FUEL CELLS ARE CAPABLE OF GENERATING ADDITION ELECTRICAL POWER FROM REACTANTS TO SUPPORT AN ADDITIONAL 23.4 KILOWATTS OF ELECTRICAL LOADS AT THE LOAD BUSES.

IN ADDITION TO THE ABOVE CAPABILITIES, THE ENERGY STORAGE FUEL CELLS ARE CAPABLE OF GENERATING ELECTRICAL POWER FROM REACTANTS TO SUPPORT AN ADDITIONAL 10 KILOWATTS OF ELECTRICAL LOADS AT THE LOAD BUSES FOR DURATIONS OF FIVE MINUTES.

EPS HAS THE CAPABILITY TO PROVIDE 220 KW-HOURS OF POWER WHEN THE SHUTTLE DELIVERS A CARGO MODULE FROM THE EMERGENCY GASES STORED IN THE CARGO MODULE TO BE RETURNED TO EARTH. EPS HAS THE CAPABILITY TO CONVERT THESE GASES TO WATER (UTILIZED TO REDUCE THE WATER LOGISTICS REQUIREMENTS) AT RATES OF UP TO 22.8 POUNDS PER HOUR TO ENABLE RAPID TURN AROUND OF SHUTTLE FLIGHTS.

3.3.3.2.3 ENERGY STORAGE

THE ELECTROLYSIS CELLS USED IN ENERGY STORAGE HAVE THE CAPABILITY TO GENERATE AN ADDITIONAL 6.58 POUNDS OF REACTANT PER HOUR DURING 14 HOUR CREW WORK SUNLIGHT PERIODS AND 4.4 POUNDS OF REACTANT PER HOUR DURING 10 HOUR CREW REST SUNLIGHT PERIODS ON AN AVERAGE SOLAR DAY (DARK TO LIGHT RATIO OF 0.6). THIS 85 POUNDS OF REACTANT PER AVERAGE SOLAR DAY EQUATES TO 86 KILOWATTS HOURS PER DAY OF ELECTRICAL POWER AT THE LOAD BUSES.

THE OXYGEN AND HYDROGEN GAS ACCUMULATORS IN THE ENERGY STORAGE ASSEMBLY HAVE THE CAPABILITY TO STORE AN ADDITIONAL 53 POUNDS OF REACTANT (AT 400 PSIA). THIS EQUATES TO AN ADDITIONAL 64.5 KILOWATT HOURS OF ENERGY STORED.

THE WATER STORAGE TANKS IN THE ENERGY STORAGE ASSEMBLY HAVE THE CAPABILITY TO STORE AN ADDITIONAL 563 POUNDS OF WATER.

3.3.3.2.4 POWER CONDITIONING

THE INVERTERS UTILIZED IN POWER CONDITIONING ARE CAPABLE OF PROVIDING AN ADDITIONAL 30 KVA DURING THE 14 HR CREW WORK SOLAR LIGHT PERIOD.

THE SECONDARY BUS AUTOTRANSFORMERS ARE CAPABLE OF HANDLING AN ADDITIONAL 30 KVA IN THE CORE MODULE AND AN ADDITONAL 5 KVA IN EACH STATION MODULE.

THE POWER CONDITIONING ASSEMBLY HAS THE CAPABILITY TO PROVIDE VOLTAGE REGULATION OF AN ADDITIONAL 12 KVA.

3.3.3.2.5 DISTRIBUTION, CONTROL AND WIRING

THE PRIMARY FEEDERS HAVE THE CAPABILITY TO HANDLE AN ADDITIONAL 63 KVA.

3.3.3.2.6 LIGHTING

INSTALLED LIGHTING CAPABILITY PROVIDES 3128 WATTS IN ADDITION TO THE NORMAL 24 HR AVERAGE REQUIREMENT.

3.3.3.3 EXPERIMENT PROVISIONS

A. EPS SHALL PROVIDE ELECTRICAL POWER (AT THE LOAD BUSES) FOR EXPERIMENT USAGE AS FOLLOWS -

	24 HOUR AVERAGE (WATTS)
EPS NORMAL OPERATION	4500
EPS DEGRADED OPERATION	800
EPS EMERGENCY OPERATION	NONE
EPS BUILDUP OPERATION	NONE

B. THE CAPABILITY TO PROVIDE A SUSTAINED PEAK POWER (SUSTAINED FOR ONE HOUR OR FOR ONE HOUR ACCUMULATED TIME IN ANY ONE TWELVE HOUR TIME PERIOD) OF 7.0 KW (AT THE LOAD BUSES) TO THE EXPERIMENT PROVISIONS SHALL BE PROVIDED.

C. THE POWER SHALL BE PROVIDED IN THE FORM OF 120/208 VAC, 400 HZ, 3 PHASE, 4 WIRE.

3.3.3.4 SUBSYSTEM DEFINITION

THE TECHNICAL DATA PRESENTED IN THESE PARAGRAPHS DOES NOT CONTAIN DESIGN-TO REQUIREMENTS, RATHER THE DATA REFLECTS A CONCISE DESCRIPTION OF THE TECHNICAL PARAMETERS THAT FORM THE CURRENT BASELINE SUBSYSTEM DEFINITION. THE SUMMATION OF THESE CHARACTERISTICS WITH THOSE OF THE OTHER SIX FUNCTIONAL SUBSYSTEMS FORM THE BASIS FOR CONFIGURATION LAYOUTS, WEIGHT STATEMENTS AND POWER PROFILES FOR THE MODULAR SPACE STATION SYSTEM.

3.3.3.4.1 MAJOR ASSEMBLIES

THE ELECTRICAL POWER SUBSYSTEM CONSISTS OF SIX MAJOR ASSEMBLIES AS DESCRIBED IN THE FOLLOWING PARAGRAPHS AND AS SHOWN IN THE FUNCTIONAL BLOCK DIAGRAM SHOWN IN FIGURE 3.3.3.4.1-1.

A. PRIMARY POWER GENERATION

THE PRIMARY POWER GENERATION ASSEMBLY CONSISTS OF TWO 3500 SQUARE FOOT SOLAR ARRAYS AND THE ORIENTATION DRIVE AND POWER TRANSFER (ODAPT) MECHANISM.

B. SECONDARY POWER GENERATION

THE FUEL CELLS (PART OF THE ENERGY STORAGE ASSEMBLY) ARE UTILIZED TO PERFORM THIS FUNCTION.

C. ENERGY STORAGE

THE ENERGY STORAGE ASSEMBLY CONSISTS OF FOUR FUEL CELLS, TWO WATER STORAGE UNITS, FOUR ELECTROLYSIS UNITS, SEVEN HYDROGEN TANKS, SEVEN OXYGEN TANKS, AND THREE BATTERIES.

D. POWER CONDITIONING

THE POWER CONDITIONING ASSEMBLY CONSISTS OF TEN INVERTERS, FOUR REGULATORS, TWO SEQUENCERS, AND TWENTY-FOUR AUTOTRANSFORMERS AND RECTIFIER FILTERS.

E. DISTRIBUTION, CONTROL AND WIRING

THE DISTRIBUTION, CONTROL AND WIRING ASSEMBLY CONSISTS OF WIRING, FOUR EPS CONTROL UNIT, TWENTY-TWO FEEDERS (EIGHT FEEDER CRICUITS), TWENTY CONTACTORS, FOUR PRIMARY BUSES, AND TWELVE SECONDARY BUSES.

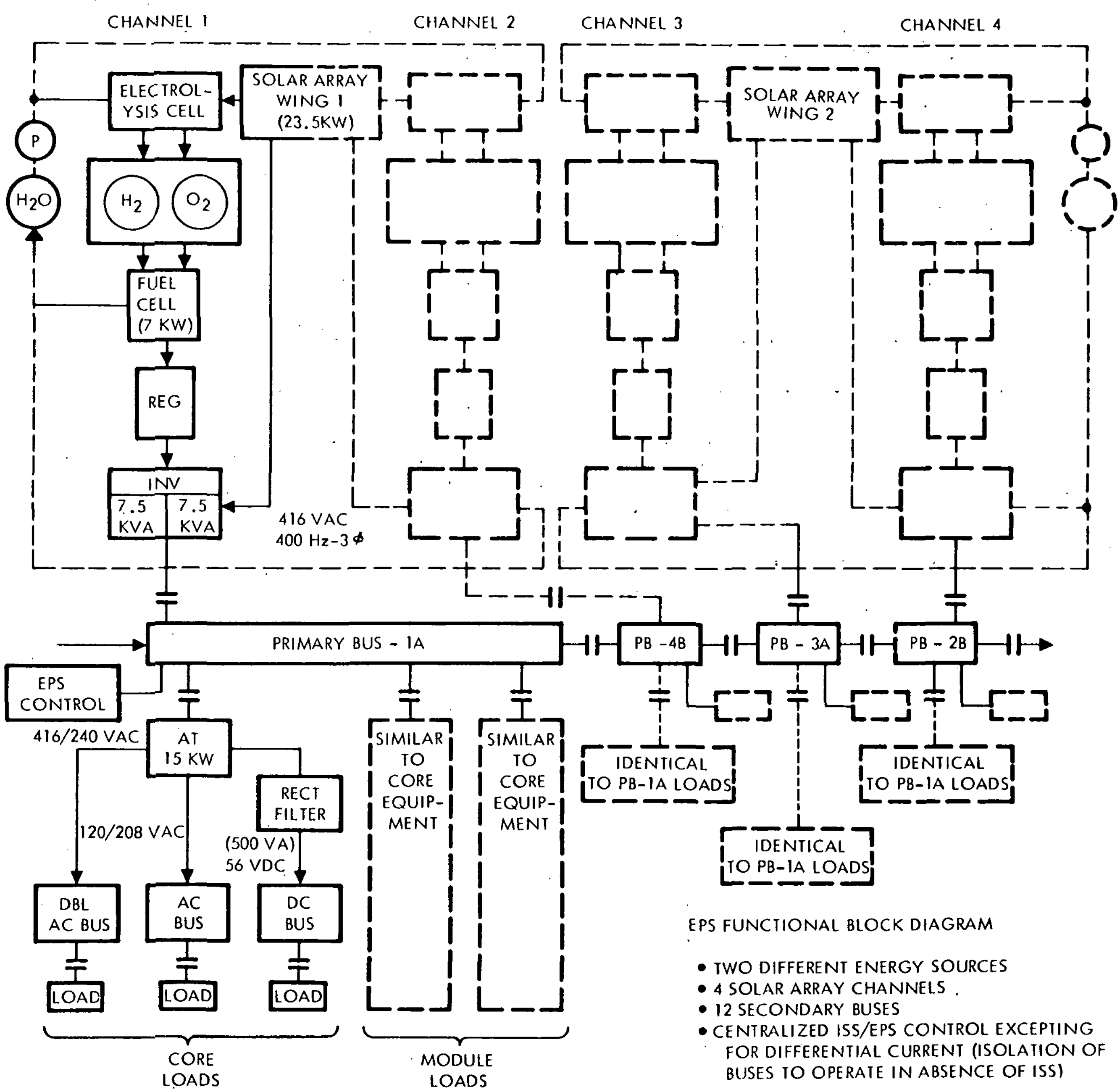


FIGURE 3.3.3.4.1-1 EPS FUNCTIONAL BLOCK DIAGRAM

F. LIGHTING

THE LIGHTING ASSEMBLY CONSISTS OF 254 INTERIOR LIGHTS, FOUR EXTERIOR ACQUISITION LIGHTS, AND SIXTEEN EXTERIOR RUNNING LIGHTS.

3.3.3.4.2 WEIGHT, POWER, AND UNIT/LOCATION CHARACTERISTICS

TABLE 3.3.3.4.2-1 EPS WEIGHT CHARACTERISTICS

MAJOR ASSEMBLY	WEIGHT (LBS)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
3.0 ELECTRICAL POWER							
3.1 PRIMARY POWER GENERATION		6676					6676
3.2 SECONDARY PWR GENERATION							0
3.3 ENERGY STORAGE	2449	985	766			766	4966
3.4 POWER CONDITIONING	379		16	16	16	16	443
3.5 DISTRIBUTION, CONTROL AND WIRING	776	115	834	383	383	834	3325
3.6 LIGHTING	186	24	146	146	146	146	794
TOTAL	1470	7800	1762	545	545	1762	16204

TABLE 3.3.3.4.2-2 EPS POWER CHARACTERISTICS

MAJOR ASSEMBLY	POWER (WATTS - 24 HOUR AVG)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
3.0 ELECTRICAL POWER							
3.6 LIGHTING	380	---	357	383	348	380	1848
TOTAL	380	0	357	383	348	380	1848

TABLE 3.3.3.4.2-3 UNIT CHARACTERISTICS/LOCATIONS/QTY

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER (W)	WEIGHT (LBS)	SIZE (INCHES)			CORE	PWR	SM-1	SM-2	SM-3	SM-4
			H	W	D						
3.1 PRIMARY POWER GENERATION											
Solar Array - Deployed		2160	945 x	644	x 30		2				
- Stowed			336 x	36	x 56						
Orientation Drive and Pwr Xfer		2100	88 Dia.		x 76		1				
3.2 SECONDARY POWER GENERATION (Utilizes Fuel Cells)											
3.3 ENERGY STORAGE											
Battery		10				2					
Battery		50				1					
Fuel Cell		202	13 x	13	x 55	4					
Electrolysis Unit		322	24 x	24	x 48			2			2
Water Storage Tank and Pump		40	26 Inch ID			2					
Hydrogen Tank		187	33 Inch ID			4	3				
Oxygen Tank		90	26 Inch ID			4	3				
3.4 POWER CONDITIONING											
Inverter		22.5	12 x	12	x 9	8					
Inverter		5				2					
Regulator		20				4					
Auto Xrms and Rect Filters											
- Core (A)		17	5 x	6	x 8	4					
- Modules (A)		7	5 x	5	x 5			2	2	2	2
Sequencer	5	3				2					

(A) Located within Sec. Bus Envelope

TABLE 3.3.3.4.2-3 UNIT CHARACTERISTICS/LOCATIONS/QTY (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER (W)	WEIGHT (LBS)	SIZE (INCHES) H	W	D	CORE	PWR	SM-1	SM-2	SM-3	SM-4
3.5 DISTR. CONTROL AND WIRING											
Wiring		2330				x	x	x	x	x	x
EPS Controls		40	12 x	12 x	9	4					
Feeders		4.5				8	8				
Feeders		2						2			2
Contactors		2	3 x	3 x	3	20					
Primary Bus		4				4					
Secondary Bus - Core		41	9 x	12 x	14	4					
Secondary Bus - Modules		31	9 x	12 x	15			2	2	2	2
3.6 LIGHTING											
Interior Lights	20	2.5				50	4	50	50	50	50
Recognition Lights	4.8	4				8		2	2	2	2
Acquisition Lights	22	6				2	2				

3.3.3.5 SUBSYSTEM INTERFACES

3.3.3.5.1 ELECTRICAL POWER/STRUCTURAL AND MECHANICAL SUBSYSTEM

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.3.4.2-3.

STRUCTURES SHALL PROVIDE REDUNDANT ELECTRICAL DISTRIBUTION RUNS FOR PRIMARY POWER AND OTHER CRITICAL DISTRIBUTION. THE REDUNDANT RUNS SHALL BE SEPARATED TO THE MAXIMUM EXTENT REASONABLE.

STRUCTURES SHALL MOUNT ACQUISITION AND RUNNING LIGHTS SUCH THAT THE EQUIPMENT CAN BE SERVICED IN A SHIRTSLEEVE ENVIRONMENT.

STRUCTURES SHALL PROVIDE INSTALLATIONS FOR LIGHTING FIXTURES SUCH THAT THE CREW AND HABITABILITY ILLUMINATION INTENSITY REQUIREMENTS ARE SATISFIED.

THE EPS SOLAR ARRAY PANEL NATURAL FREQUENCY SHALL BE LESS THAN 0.1 HZ OR GREATER THAN 2.0 HZ.

3.3.3.5.2 ELECTRICAL POWER/ENVIRONMENTAL CONTROL AND LIFE SUPPORT SUBSYSTEM

EPS SHALL PROVIDE REDUNDANTLY DISTRIBUTED REGULATED 120/208 V, 400 HZ, AC AND 56 VDC (IF REQUIRED) ELECTRICAL POWER. THE QUALITY OF THE POWER SHALL BE PER MIL-STD-704 EXCEPT FOR THE DC LINE DROP WHICH SHALL BE 2.5 VOLTS MAXIMUM BETWEEN THE LOADS AND THE REGULATED BUS. WIRE PROTECTION SHALL BE PROVIDED FOR ALL LOADS CONNECTED TO THE EPS DISTRIBUTION BUSES. WHERE APPLICABLE, REDUNDANT DEVICES SHALL BE EMPLOYED. CRITICAL LIFE SUPPORT LOADS SHALL BE MAINTAINED DURING EMERGENCIES AFFECTING ELECTRICAL POWER FOR A MINIMUM OF 96 HOURS. EPS SHALL PROVIDE ELECTRICAL POWER (24 HOUR AVERAGE WATTS) AS SPECIFIED (AT THE LOAD BUSES) BELOW -.

SUBSYSTEM	BUILDUP STEP 1	BUILDUP STEP 2	NORMAL OPERATIONS	EMERGENCY OPERATIONS
ECLSS	160	160	8059	1095

ECLSS SHALL PROVIDE 160 POUNDS OF GASEOUS O2 AT 300 PSI AND 20 POUNDS OF H2 AT 300 PSI FOR A MINIMUM DURATION OF 96 HOURS (FOR EPS EMERGENCY OPERATIONS).

ECLSS SHALL PROVIDE THE CAPABILITY TO SUPPLY POTABLE WATER TO THE EPS WATER STORAGE TANKS.

ECLSS SHALL PROVIDE THE CAPABILITY TO UTILIZE EPS WATER STORAGE AND EXCESS EPS WATER.

ECLSS SHALL PROVIDE EQUIPMENT COOLING FOR HEAT LOADS AS SPECIFIED IN TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION.

3.3.3.5.3 ELECTRICAL POWER/ELECTRICAL POWER SUBSYSTEM

DOES NOT APPLY

3.3.3.5.4 ELECTRICAL POWER/GUIDANCE AND CONTROL SUBSYSTEM

EPS SHALL PROVIDE REDUNDANTLY DISTRIBUTED REGULATED 120/208 V, 400 HZ, AC AND 56 VDC (IF REQUIRED) ELECTRICAL POWER. THE QUALITY OF THE POWER SHALL BE PER MIL-STD-704 EXCEPT FOR THE DC LINE DROP WHICH SHALL BE 2.5 VOLTS MAXIMUM BETWEEN THE LOADS AND THE REGULATED BUS. WIRE PROTECTION SHALL BE PROVIDED FOR ALL LOADS CONNECTED TO THE EPS DISTRIBUTION BUSES. WHERE APPLICABLE, REDUNDANT DEVICES SHALL BE EMPLOYED. CRITICAL LIFE SUPPORT LOADS SHALL BE MAINTAINED DURING EMERGENCIES AFFECTING ELECTRICAL POWER FOR A MINIMUM OF 96 HOURS. EPS SHALL PROVIDE ELECTRICAL POWER (24 HOUR AVERAGE WATTS) AS SPECIFIED (AT THE LOAD BUSES) BELOW -

SUBSYSTEM	BUILDUP STEP 1	BUILDUP STEP 2	NORMAL OPERATIONS	EMERGENCY OPERATIONS
G AND C	16	16	487	197

3.3.3.5.5 ELECTRICAL POWER/REACTION CONTROL SUBSYSTEM

EPS SHALL PROVIDE REDUNDANTLY DISTRIBUTED REGULATED 120/208 V, 400 HZ, AC AND 56 VDC (IF REQUIRED) ELECTRICAL POWER. THE QUALITY OF THE POWER SHALL BE PER MIL-STD-704 EXCEPT FOR THE DC LINE DROP WHICH SHALL BE 2.5 VOLTS MAXIMUM BETWEEN THE LOADS AND THE REGULATED BUS. WIRE PROTECTION SHALL BE PROVIDED FOR ALL LOADS CONNECTED TO THE EPS DISTRIBUTION BUSES. WHERE APPLICABLE, REDUNDANT DEVICES SHALL BE EMPLOYED. CRITICAL LIFE SUPPORT LOADS SHALL BE MAINTAINED DURING EMERGENCIES AFFECTING ELECTRICAL POWER FOR A MINIMUM OF 96 HOURS. EPS SHALL PROVIDE ELECTRICAL POWER (24 HOUR AVERAGE WATTS) AS SPECIFIED (AT THE LOAD BUSES) BELOW -

SUBSYSTEM	BUILDUP STEP 1	BUILDUP STEP 2	NORMAL OPERATIONS	EMERGENCY OPERATIONS
RCS	0	0	13	8

EPS AND RCS SHALL PROVIDE THE CAPABILITY TO EXCHANGE PROPELLANT GASES. EPS SHALL HAVE THE CAPABILITY TO STORE AND PROVIDE PROPELLANT GASES FOR RCS USE DURING BUILDUP

3.3.3.5.6 ELECTRICAL POWER/INFORMATION SUBSYSTEM

EPS SHALL PROVIDE REDUNDANTLY DISTRIBUTED REGULATED 120/208 V, 400 HZ, AC AND 56 VDC (IF REQUIRED) ELECTRICAL POWER. THE QUALITY OF THE POWER SHALL BE PER MIL-STD-704 EXCEPT FOR THE DC LINE DROP WHICH SHALL BE 2.5 VOLTS MAXIMUM BETWEEN THE LOADS AND THE REGULATED BUS. WIRE PROTECTION SHALL BE PROVIDED FOR ALL LOADS CONNECTED TO THE EPS DISTRIBUTION BUSES. WHERE APPLICABLE, REDUNDANT DEVICES SHALL BE EMPLOYED. CRITICAL LIFE SUPPORT LOADS SHALL BE MAINTAINED DURING EMERGENCIES AFFECTING ELECTRICAL POWER FOR A MINIMUM OF 96 HOURS. EPS SHALL PROVIDE ELECTRICAL POWER (24 HOUR AVERAGE WATTS) AS SPECIFIED (AT THE LOAD BUSES) BELOW -

SUBSYSTEM	BUILDUP STEP 1	BUILDUP STEP 2	NORMAL OPERATIONS	EMERGENCY OPERATIONS
ISS	30	30	3764	174

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS

RACU MEMORY SIZE - 4 K (32 BIT) WORDS

RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND DATA STORAGE.

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

THE ISS SHALL PROVIDE SUBSYSTEM ELECTRICAL LOAD CONTROL AND MANAGEMENT.

THE ISS SHALL PROVIDE SOLAR ARRAY AND FUEL CELL CONTROL AND MANAGEMENT.

THE ISS SHALL PROVIDE THE ENERGY STORAGE MANAGEMENT FUNCTION.

3.3.3.5.7 ELECTRICAL POWER/CREW AND HABITABILITY SUBSYSTEM

EPS SHALL PROVIDE REDUNDANTLY DISTRIBUTED REGULATED 120/208 V, 400 HZ, AC AND 56 VDC (IF REQUIRED) ELECTRICAL POWER. THE QUALITY OF THE POWER SHALL BE PER MIL-STD-704 EXCEPT FOR THE DC LINE DROP WHICH SHALL BE 2.5 VOLTS MAXIMUM BETWEEN THE LOADS AND THE REGULATED BUS. WIRE PROTECTION SHALL BE PROVIDED FOR ALL LOADS CONNECTED TO THE EPS DISTRIBUTION BUSES. WHERE APPLICABLE, REDUNDANT DEVICES SHALL BE EMPLOYED. CRITICAL LIFE SUPPORT LOADS SHALL BE MAINTAINED DURING EMERGENCIES AFFECTING ELECTRICAL POWER FOR A MINIMUM OF 96 HOURS. EPS SHALL PROVIDE ELECTRICAL POWER (24 HOUR AVERAGE WATTS) AS SPECIFIED (AT THE LOAD BUSES) BELOW -

SUBSYSTEM	BUILDUP STEP 1	BUILDUP STEP 2	NORMAL OPERATIONS	EMERGENCY OPERATIONS
C/H	0	0	496	0

EPS SHALL PROVIDE INTERIOR LIGHTING IN ACCORDANCE WITH CREW AND HABITABILITY REQUIREMENTS.

EPS SHALL PROVIDE EXTERIOR LIGHTING ALONG EVA SURFACE PATHS (TBD) AND AT EVA WORK STATION SURFACES (TBD) IN ACCORDANCE WITH CREW AND HABITABILITY REQUIREMENTS.

AS A GOAL, CREW/HABITABILITY SHALL PROVIDE 30 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

MODULAR SPACE STATION - INITIAL STATION SYSTEM

3.3.4 GUIDANCE AND CONTROL

THIS SUBSYSTEM IS ONE OF THE SEVEN FUNCTIONAL GROUPINGS OF MAJOR SUBSYSTEMS THAT COMPRISE THE SHUTTLE LAUNCH MODULAR SPACE STATION.

PREPARED L M Meyers SYSTEM RQMTS/INTERFACES

APPROVAL A Cormack SUBSYSTEM PROJECT ENGR

APPROVAL C W Roberts SUBSYSTEM PROJECT MGR

APPROVAL N J Jones PROJECT ENGINEERING MGR

3.3.4 GUIDANCE AND CONTROL

3.3.4.1 PERFORMANCE REQUIREMENTS

3.3.4.1.1 NORMAL OPERATIONS

A. DESIGN ENVELOPE

THE GUIDANCE AND CONTROL SUBSYSTEM SHALL BE DESIGNED AND SIZED TO SUPPORT INDEPENDENT SPACE STATION OPERATIONS FOR PERIODS UP TO 120 DAYS WITHOUT RESSUPPLY AND MAINTAIN AN ORBIT OF 55 DEGREES INCLINATION AT AN ALTITUDE OF 240 NM AND AN ATMOSPHERE EQUIVALENT TO A FEBRUARY 1982 TWO SIGMA MEAN JACCHIA ATMOSPHERE.

THE DESIGN-TO FLIGHT MODE IS X-POP WITH THE STATION +Z AXIS POINTING TOWARD NADIR AND THE + OR - Y AXIS DIRECTED ALONG THE VELOCITY VECTOR. THE STATION SHALL ALSO BE CAPABLE OF FLYING IN X-POP INERTIAL FLIGHT MODES. THE DESIGN CONFIGURATION FOR THE ROUTINE OPERATION PHASE CONSISTS OF THE STATION MODULES LOCATED IN THE X-Z PLANE AS SHOWN IN FIGURE 3.3.4.1-1.

THE STATION SHALL FLY PRINCIPAL AXES DURING PERIODS OF NON-EXPERIMENT POINTING WITHIN RADIATOR CAPABILITY. THE FLIGHT COORDINATE SYSTEM SHALL BE ORIENTED AS SHOWN IN FIGURE 3.3.4.1-1.

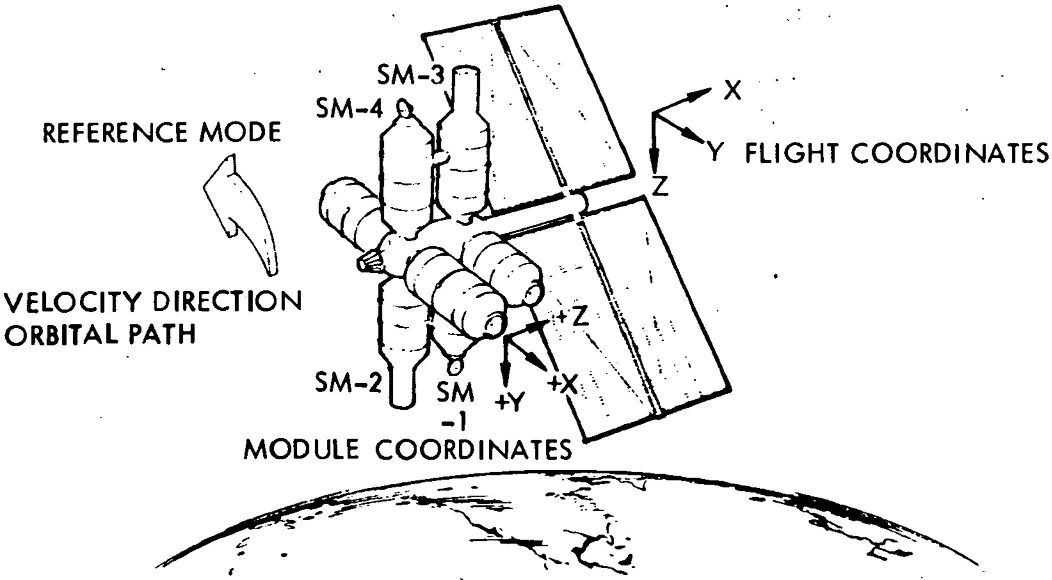


FIG 3.3.4.1-1 FLIGHT COORDINATE SYSTEM

B. OPERATE ENVELOPE

THE GUIDANCE AND CONTROL SUBSYSTEM SHALL BE CAPABLE OF SUPPORTING INDEPENDENT SPACE STATION OPERATIONS FOR PERIODS UP TO 120 DAYS WITHOUT RESUPPLY AND MAINTAIN AN ORBIT OF 55 DEGREES INCLINATION AT ALTITUDES BETWEEN 240 AND 270 NM AND AN ATMOSPHERE EQUIVALENT TO A FEBRUARY 1982 NOMINAL JACCHIA ATMOSPHERE. THE STATION SHALL BE CAPABLE OF OPERATING IN X-POP LEVEL AND INERTIAL FLIGHT MODES.

C. STABILIZATION FOR BERTHING

ATTITUDE HOLD OF +/- 1.0 DEG AND 3 AXIS ANGULAR RATES OF +/-0.05 DEG/SEC. AFTER RF LINK INITIATION, STABILIZATION WILL BE OBTAINED IN TBD MINUTES AND WILL BE CAPABLE OF BEING HELD IN ONE HOUR DURATIONS.

ON BERTHING WITH THE SHUTTLE, THE STATION STABILIZATION WILL BE INHIBITED TO ALLOW STABILIZATION AND CONTROL TO BE PROVIDED BY THE SHUTTLE FOR BOTH THE STATION AND THE SHUTTLE COMBINATION.

ALL FUNCTIONS OF THE ATTITUDE STABILIZATION SYSTEM FOR DOCKING SUPPORT SHALL BE CAPABLE OF OPERATION FOLLOWING ANY THREE FAILURES DURING NORMAL OPERATIONS.

WHILE THE SHUTTLE IS ATTACHED, THE SHUTTLE SHALL PROVIDE ALL NECESSARY STABILIZATION.

D. ROUTINE ORBITAL OPERATIONS

THE G/C SHALL BE CAPABLE OF PROVIDING MODULAR SPACE STATION STATE VECTOR AND ORIENTATION DATA TO THE ISS AS FOLLOWS-

ALTITUDE	+/-1500 FT., 1 SIGMA
IN-TRACK	+/-3800 FT., 1 SIGMA
CROSS-TRACK	+/-2200 FT., 1 SIGMA
ORBIT VELOCITY	+/- 3.5 FT/SEC

THE G/C SHALL BE CAPABLE OF AUTOMATICALLY AND SELECTIVELY CONTROLLING THE RCS THRUSTERS WITH ON-OFF SIGNALS TO VALVES AND IGNITOR OF ANY ENGINE OR ENGINE COMBO.

DESATURATION OF MOMENTUM EXCHANGE SHALL BE PERFORMED NO MORE THAN ONCE EVERY TWELVE HOURS IN NORMAL OPERATING MODES.

THE G/C SHALL BE CAPABLE OF PERFORMING REORIENTATION MANEUVERS WITH 3

AXIS REORIENTATION RATES OF LESS THAN .2 DEG/SEC.

THE G/C SHALL MAINTAIN A STABLE MODULAR SPACE STATION ATTITUDE IN EITHER OF THE FOLLOWING MODES-

1. EARTH REFERENCED ATTITUDE HOLD
2. INERTIAL ATTITUDE HOLD

THE G/C SHALL BE CAPABLE OF DETERMINING AND CONTROLLING THE REQUIRED ORBIT MAKEUP.

THE G/C SHALL BE CAPABLE OF PERFORMING ENERGY MANAGEMENT IN CONJUNCTION WITH THE ISS OF STATION DISTURBANCES.

E. STATION GUIDANCE AND NAVIGATION

THE G/C SHALL MEET THE POSITION DETERMINATION REQUIREMENTS WITHIN ONE SIGMA UNCERTAINTIES USING AUTOMATIC MEASUREMENTS.

THE G/C SHALL PROVIDE DATA TO THE ISS IN SUPPORT OF SHUTTLE DEPARTURE AND RENDEZVOUS INCLUDING RETROGRADE DELTA V REQUIREMENTS AND TRAJECTORY INFORMATION TO ENTRY INTERFACE.

3.3.4.1.2 EMERGENCY OPERATIONS

A. THE STATION SHALL BE ABLE TO STABILIZE FOR DOCKING/BERTHING WITHIN TBD HOURS AFTER LOSS OF PRESSURIZATION IN A PRESSURE VOLUME CAUSED BY ACCI-DENTAL PENETRATION OF AN OUTSIDE WALL WITH THE MAXIMUM DIMENSIONS OF THE HOLE BEING TWO INCHES.

B. MANEUVERING AND/OR STABILIZATION OF THE STATION MAY BE ACCOMPLISHED USING A HAND CONTROLLER AND (OUT-THE-WINDOW) VISUAL CUES.

3.3.4.1.3 BUILDUP OPERATIONS

A. PREMANNING

THE STATION SHALL BE IN A MINIMUM FUEL MODE.
THE GROUND WILL MAINTAIN THE STATION STATE VECTOR PRIOR TO MANNING.

B. INITIAL MANNED OPERATIONS

THE G/C SHALL BE CAPABLE OF INITIAL MANNING CHECKOUT UTILIZING ONLY MODULAR SPACE STATION ONBOARD CHECKOUT FACILITIES TO THE

IFRU LEVEL WITH NO SPECIAL CHECKOUT EQUIPMENT.

C. THE STATION SHALL FLY PRINCIPAL AXES DURING BUILDUP.

D. ALL FUNCTIONS OF THE ATTITUDE STABILIZATION SYSTEM FOR DOCKING SUPPORT SHALL BE CAPABLE OF OPERATION FOLLOWING ANY TWO FAILURES DURING BUILDUP.

3.3.4.2 SECONDARY PERFORMANCE CHARACTERISTICS

A. ROUTINE ORBITAL OPERATIONS.

SECONDARY PERFORMANCE CHARACTERISTICS FOR MODULAR SPACE STATION STATE VECTOR AND ORIENTATION DATA ARE AS FOLLOWS ASSUMING STADIAMETERIC MEASUREMENT SOFTWARE -

ALTITUDE	+/- 650 FT., 1 SIGMA
IN-TRACK	+/-3000 FT., 1 SIGMA
CROSS-TRACK	+/-1600 FT., 1 SIGMA
ORBIT VELOCITY	+/- 2.9 FPS, 1 SIGMA

MOMENTUM EXCHANGE SATURATION OCCURS AT 45-HOUR INTERVALS MINIMUM IN AN INERTIAL FLIGHT MODE. THIS INTERVAL COULD BE EXTENDED DEPENDING UPON STATION CONFIGURATION.

3.3.4.3 EXPERIMENT PROVISIONS

A. STABILITY

FOR EXPERIMENTS THE STATION G/C SHALL BE CAPABLE OF LIMITING ANGULAR RATES AROUND THE VEHICLE AXES TO +/-0.05 DEG/SEC CONTINUOUSLY, AND TO +/-0.01 DEG/SEC IN THE FINE POINTING MODE.

THE STATION SHALL BE CAPABLE OF HOLDING THE FINE POINTING MODE FOR PERIODS UP TO 30 MINUTES, WITH THE VEHICLE AXES HELD WITH RESPECT TO LOCAL VERTICAL WITHIN +/-0.1 DEGREES.

THE STATION SHALL FLY THE GEOMETRIC AXES AFTER INITIATING EXPERIMENT POINTING.

THE STATION SHALL BE CAPABLE OF DISSIPATING ANGULAR IMPULSES (RESULTING FROM EXPERIMENT TORQUES) OF 10,000 LB-FT-SEC IN PITCH OR YAW AND 2,500 LB-FT-SEC IN ROLL PER 24 HOUR PERIOD (AVERAGE OVER ONE RESUPPLY PERIOD). NO EXPERIMENT TORQUE SHALL EXCEED 100 LB-FT.

THE STATION SHALL BE CAPABLE OF MAINTAINING STATION AXIS WITHIN +/-0.25 DEGREES IN EARTH REFERENCED ATTITUDE HOLD WITH +Z AXIS AT NADIR ON A CONTINUOUS BASIS.

THE G/C SHALL BE CAPABLE OF PROVIDING MODULAR SPACE STATION STATE VECTOR AND ORIENTATION DATA TO THE ISS AS FOLLOWS-

ALTITUDE UNCERTAINTY	+/-1500 FT. (1 SIGMA)
IN-TRACK UNCERTAINTY	+/-3800 FT. (1 SIGMA)
CROSS TRACK	+/-2200 FT. (1 SIGMA)
ORBITAL VELOCITY	+/- 3.5 FPS (1 SIGMA)

B. ACCELERATIONS

OPERATIONAL ACCELERATIONS WILL BE MAINTAINED WITHIN THE FOLLOWING NOMINAL LIMITS -

CMG DESAT AND ORBIT MAKEUP	.00014 G	MAX FOR 140 SEC
DOCKING-BERTHING	.04 G	MAX FOR 0.3 SEC
6 HR CONTINUOUS	.0001 G	MAXIMUM
2 HR CONTINUOUS	.00001 G	MAXIMUM

3.3.4.4 SUBSYSTEM DEFINITION

THE TECHNICAL DATA DESCRIBED IN THIS SECTION ARE NOT DESIGN-TO REQUIREMENTS, RATHER THEY REFLECT A CONCISE DESCRIPTION OF THE TECHNICAL PARAMETERS THAT FORM THE CURRENT BASELINE SUBSYSTEM DEFINITION. THE SUMMATION OF THESE CHARACTERISTICS ALONG WITH THOSE OF THE OTHER SIX FUNCTIONAL SUBSYSTEMS FORM THE BASIS FOR CONFIGURATION LAYOUTS, WEIGHT STATEMENTS AND POWER PROFILES.

3.3.4.4.1 MAJOR ASSEMBLIES

A. INERTIAL REFERENCE ASSEMBLY

THE INERTIAL REFERENCE ASSEMBLY CONTAINS SIX STRAPDOWN GYROS FOR SENSING STATION INSTANTANEOUS ANGULAR RATES AND SIX ACCELEROMETERS FOR SENSING STATION INSTANTANEOUS LINEAR ACCELERATIONS. THESE SENSING ELEMENTS ARE ARRANGED IN A NON-ORTHOGONAL SKEW AXES ORIENTATION IN THE STRAPDOWN INERTIAL MEASUREMENT UNIT WHICH IS MOUNTED TO THE NAVIGATION BASE. THIS ORIENTATION ALLOWS THE INERTIAL REFERENCE PREPROCESSOR TO PROVIDE BODY ORIENTATION AND CHANGES IN VELOCITY TO THE ISS WITH THREE GYROS AND THREE ACCELEROMETERS FAILED.

THE PREPROCESSOR PROVIDES CHANGES IN STATION BODY AXES ORIENTATION AND CHANGES IN VELOCITY TO THE ISS FOR RELATING PRESENT STATION ORIENTATION AND LOCATION WITH THE REFERENCE FRAME BEING MAINTAINED BY THE ISS COMPUTER, AND FOR USE IN ATTITUDE CONTROL AND ORBIT MAINTENANCE.

B. OPTICAL REFERENCE ASSEMBLY

THE OPTICAL REFERENCE ASSEMBLY CONTAINS ONE HORIZON EDGE TRACKER AND ASSOCIATED ELECTRONICS AND TWO STAR TRACKERS FOR PROVIDING AUTOMATIC SENSING OF THE HORIZON AND STAR ANGLES. THE OUTPUTS FROM THESE SENSORS ARE UTILIZED BY THE OPTICAL REFERENCE PREPROCESSOR IN PROVIDING STAR AND HORIZON ANGLES AND PITCH, YAW AND ROLL ATTITUDE ERRORS TO THE ISS COMPUTER FOR USE IN MAINTAINING THE STATION STATE VECTOR AND THE DESIRED FLIGHT MODE.

THE TELESCOPE/SEXTANT UNIT IS MOUNTED TO THE NAVIGATION BASE TO RELATE MANUAL OPTICAL SIGHTINGS TO THE STATION ATTITUDE. THE TELESCOPE/SEXTANT UNIT PROVIDES A MEANS OF INITIALIZING THE AUTOMATIC NAVIGATION REFERENCE. IT ALSO PROVIDES DIRECT VISUAL OBSERVATION OF EARTH TARGETS IN SUPPORT OF EXPERIMENTS.

C. MOMENTUM EXCHANGE

THE CONTROL MOMENT GYRO ASSEMBLY CONTAINS THREE DOUBLE GIMBAL CONTROL MOMENT GYROS WHICH ARE ORIENTED IN RESPONSE TO COMMANDS FROM THE CMG PREPROCESSOR TO COMPENSATE FOR ANGULAR MOMENTUM CHANGES DUE TO PERIODIC DISTURBANCE TORQUES. BUILDUP OF RESIDUAL MOMENTUM FROM NON-PERIODIC TORQUES EVENTUALLY CAUSES CMG GIMBAL ANGLES TO REACH THEIR LIMIT, AND THE CMG PREPROCESSOR PROVIDES DATA TO THE ISS TO DETERMINE RCS TORQUE AND ON-TIME REQUIRED FOR CMG DESATURATION.

D. RCS ELECTRONICS ASSEMBLY

THE RCS ELECTRONICS ASSEMBLY CONTAINS THE RCS ELECTRONICS PREPROCESSOR WHICH PROVIDES RCS JET DRIVER SELECTION LOGIC TO THE JET DRIVER PACKAGES WHICH ARE ALSO PART OF THE RCS ELECTRONICS ASSEMBLY. THE RCS JET DRIVERS PROVIDE ON-OFF SIGNALS TO THE REACTION CONTROL SUBSYSTEM SOLENOID VALVES AND IGNITORS.

E. COMPUTATION ASSEMBLY

THOSE GUIDANCE AND CONTROL COMPUTATIONS NOT PERFORMED IN THE PRE-PROCESSORS DESCRIBED IN THE OTHER ASSEMBLIES ARE PERFORMED WITHIN THE ISS COMPUTER. THE COMPUTATION ASSEMBLY REPRESENTS THE SOFTWARE ASSOCIATED WITH THE GUIDANCE AND CONTROL COMPUTATIONS PERFORMED WITHIN THE ISS COMPUTER.

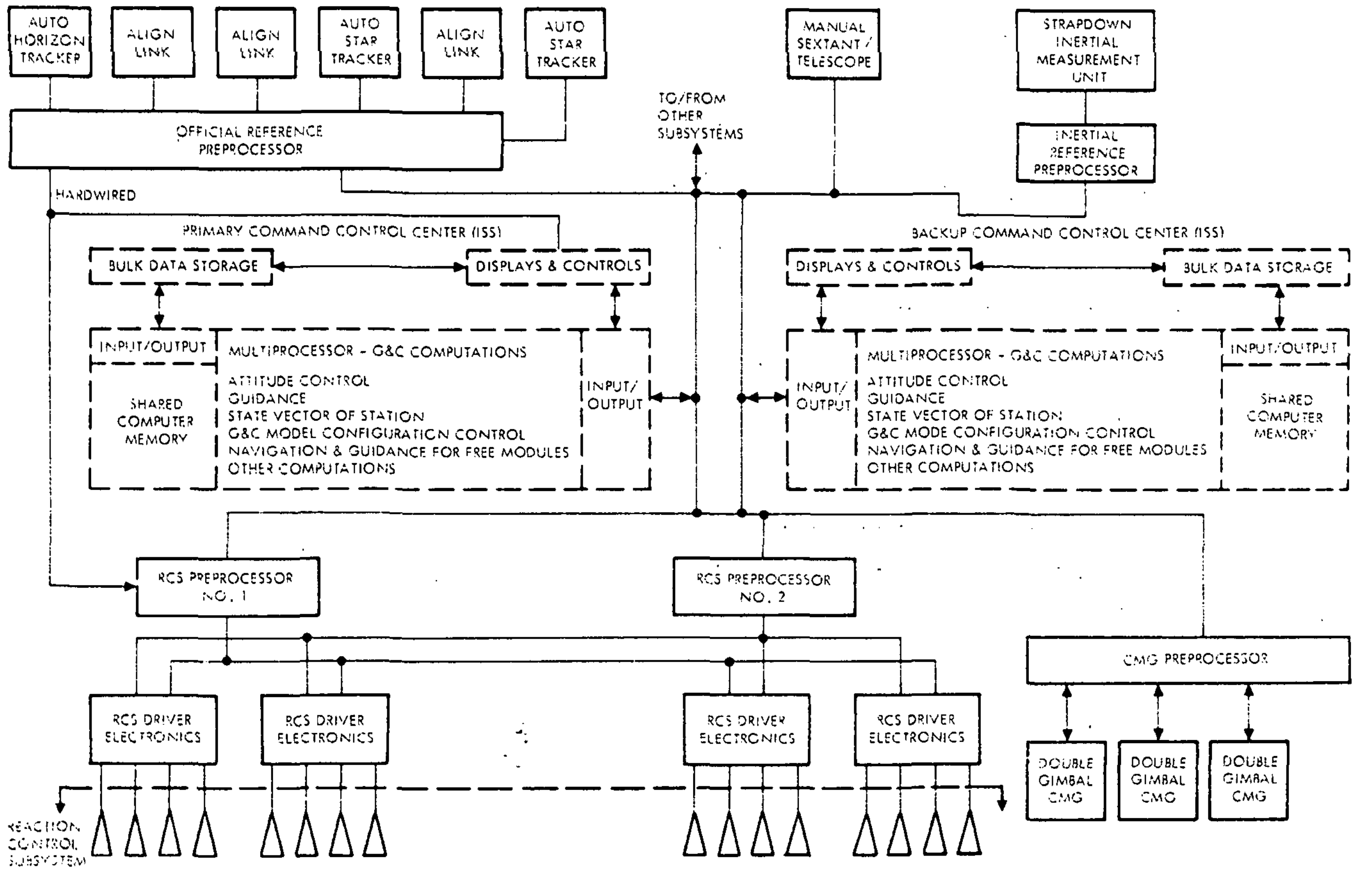


Figure 3.3.4.4.1-1. Guidance and Control Mechanization Diagram

3.3.4.4.2 WEIGHT, POWER, AND VOLUME CHARACTERISTICS

TABLE 3.3.4.4.2-1 WEIGHT SUMMARY

MAJOR ASSEMBLY	WEIGHT (LBS)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
4.1 INERTIAL REFERENCE	65	0	0	0	0	0	65
4.2 OPTICAL REFERENCE	346	0	0	0	0	0	346
4.3 RCS ELECTRONICS	75	0	0	0	0	0	75
4.4 MOMENTUM EXCHANGE	984	0	0	0	0	0	984
4.5 COMPUTATION	0	0	0	0	0	0	0
TOTAL	1470	0	0	0	0	0	1470

TABLE 3.3.4.4.2-2 POWER SUMMARY (NORMAL OPERATIONS)

MAJOR ASSEMBLY	POWER (WATTS - 24 HOUR AVG)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
4.1 INERTIAL REFERENCE	145	0	0	0	0	0	145
4.2 OPTICAL REFERENCE	195	0	0	0	0	0	195
4.3 RCS ELECTRONICS	3	0	0	0	0	0	3
4.4 MOMENTUM EXCHANGE	144	0	0	0	0	0	144
4.5 COMPUTATION	0	0	0	0	0	0	0
TOTAL	487	0	0	0	0	0	487

TABLE 3.3.4.4.2-3 POWER SUMMARY (EMERGENCY OPERATIONS)

MAJOR ASSEMBLY	POWER (WATTS - 24 HOUR AVG)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
4.1 INERTIAL REFERENCE	145	0	0	0	0	0	145
4.2 OPTICAL REFERENCE	0	0	0	0	0	0	0
4.3 RCS ELECTRONICS	60	0	0	0	0	0	60
4.4 MOMENTUM EXCHANGE	0	0	0	0	0	0	0
4.5 COMPUTATION	0	0	0	0	0	0	0
TOTAL	205	0	0	0	0	0	205

TABLE 3.3.4.4.2-4 UNIT CHARACTERISTICS/LOCATIONS/QTY

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES) H	W	D	CORE	PWR	SM-1	SM-2	SM-3	SM-4
4.1 INERTIAL REFERENCE											
Strapdown IMU	120	45	14 Dia. x 12 Lgth			1	---	---	---	---	---
IMU Preprocessor	25	14	5	5	10	1	---	---	---	---	---
Mounts/Supports (10%)	---	**6	-	-	-	x	---	---	---	---	---
4.2 OPTICAL REFERENCE											
Horizon Trkr. Optics	3	8	8 Dia. x 26.5 lgh.			4	---	---	---	---	---
Horizon Trkr. Elect.	22	11	6	9	8	1	---	---	---	---	---
Sext/Telescope	20	88	8	8	31	1	---	---	---	---	---
Star Tracker Optics	14	22	8 Dia. x 22.5 lgh.			2	---	---	---	---	---
Star Tracker Elect.	16	11	7	8	8	2	---	---	---	---	---
Optical Ref. Preproc.	25	14	5	5	10	1	---	---	---	---	---
Alignment Link	18.7	30	10	10	12	3	---	---	---	---	---
Supports (5%)	---	**45	-	-	-	x	---	---	---	---	---
4.3 RCS ELECTRONICS											
Jet Driver Elect.	*0.5	10	8	5	7	4	---	---	---	---	---
RCS Preprocessor	*0.5	14	5	5	10	2	---	---	---	---	---
Mounts/Supports (10%)	---	**7	-	-	-	x	---	---	---	---	---
4.4 MOMENTUM EXCHANGE											
Control Moment Gyro	39.7	258	35.5 Dia x 38 LH.			3	---	---	---	---	---
CMG Preprocessor	25	14	5	5	10	1	---	---	---	---	---
Mounts/Provisions	---	**196	-	-	-	x	---	---	---	---	---
4.5 COMPUTATION											

**Total Weight
* Jet Firing Average is negligible

3.3.4.5 SUBSYSTEM INTERFACES

3.3.4.5.1 G AND C/STRUCTURAL AND MECHANICAL SUBSYSTEM INTERFACES

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.4.4.2-4.

AS A GOAL, THE FUNDAMENTAL BENDING/TORSIONAL NATURAL FREQUENCY MODE OF THE SPACE STATION STRUCTURAL CONFIGURATION SHALL BE GREATER THAN ONE HZ.

STRUCTURES SHALL PROVIDE CELESTIAL AND EARTH VIEWING WINDOWS.

STRUCTURES SHALL PROVIDE MOUNTING AND PRESSURE SHELL PENETRATIONS FOR FOUR HORIZON TRACKER SENSORS SUCH THAT SIMULTANEOUS VIEWING OF THE FOUR HORIZON QUADRANTS IS OBTAINED. STRUCTURES SHALL PROVIDE MOUNTING AND TWO PRESSURE SHELL PENETRATIONS FOR THE STAR TRACKERS WITH A FIELD-OF-VIEW OVERLAP BETWEEN THE STAR TRACKERS AND THE SEXTANT TELESCOPE. OPTICAL ALIGNMENT PATHS BETWEEN THE RAMS AND HORIZON AND STAR TRACKERS SHALL BE PROVIDED.

STRUCTURES SHALL PROVIDE MOUNTING FOR STRAPDOWN IMU AND PREPROCESSOR NEAR SEXTANT FOR PRECISION ALINGMENT.

STRUCTURES SHALL PROVIDE MOUNTING FOR CONTROL MOMENT GYROS NEAR THE RAMS FOR PRECISION STABILIZATION.

STRUCTURES SHALL PROVIDE ENVIRONMENTAL PROTECTION FOR ANY STANDBY REDUNDANT SENSORS. SUCH PROTECTION SHALL BE DESIGNED TO PROVIDE MEANS FOR PERIODIC INFLIGHT CHECKS OF STANDBY DEVICES.

3.3.4.5.2 GUIDANCE AND CONTROL/ECLSS SUBSYSTEM INTERFACES

ECLSS SHALL PROVIDE EQUIPMENT COOLING FOR HEAT LOADS AS SPECIFIED IN TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION.

3.3.4.5.3 GUIDANCE AND CONTROL/ELECTRICAL POWER SUBSYSTEM INTERFACES

EPS SHALL PROVIDE REDUNDANTLY DISTRIBUTED REGULATED 120/208 V, 400 HZ, AC AND 56 VDC (IF REQUIRED) ELECTRICAL POWER. THE QUALITY OF THE POWER SHALL BE PER MIL-STD-704 EXCEPT FOR THE DC LINE DROP WHICH SHALL BE 2.5 VOLTS MAXIMUM BETWEEN THE LOADS AND THE REGULATED BUS. WIRE PROTECTION SHALL BE PROVIDED FOR ALL LOADS CONNECTED TO THE EPS DISTRIBUTION BUSES. WHERE APPLICABLE, REDUNDANT DEVICES SHALL BE EMPLOYED. CRITICAL LIFE SUPPORT LOADS SHALL BE MAINTAINED DURING EMERGENCIES AFFECTING ELECTRICAL POWER FOR

A MINIMUM OF 96 HOURS. EPS SHALL PROVIDE ELECTRICAL POWER (24 HOUR AVERAGE WATTS) AS SPECIFIED (AT THE LOAD BUSES) BELOW -

SUBSYSTEM	BUILDUP STEP 1	BUILDUP STEP 2	NORMAL OPERATIONS	EMERGENCY OPERATIONS
G AND C	160	160	487	197

3.3.4.5.4 G AND C/G AND C SUBSYSTEM INTERFACES

NOT APPLICABLE

3.3.4.5.5 GUIDANCE AND CONTROL/REACTION CONTROL SUBSYSTEM INTERFACES

THE G/C SHALL PROVIDE ON/OFF SIGNALS TO THE RCS SOLENOID VALVES AND IGNITORS.

THE RCS SHALL ACCEPT CONTROL SIGNALS FROM THE G-C RCS JET DRIVER ELECTRONICS.

3.3.4.5.6 GUIDANCE AND CONTROL/INFORMATION SUBSYSTEM INTERFACES

THE G/C SHALL PROVIDE THE FOLLOWING INFORMATION TO THE ISS IN SUPPORT OF EXPERIMENTS -

- CURRENT STATION ATTITUDE (INSTANTANEOUS KNOWLEDGE WITHIN 0.10 DEG) AND REFERENCE ATTITUDE ALIGNMENT
- POSITION VECTORS OF TARGETS OF OPPORTUNITY
- CURRENT STATION ESTIMATED STATE VECTOR
- EXPERIMENT TO G/C REFERENCE CALIBRATION DATA
- GUIDANCE TARGETING AND DELTA-V COMMANDS FOR RENDEZVOUS, REENTRY, DOCKING AND STATION KEEPING OF DETACHED RAMS

THE G/C SHALL PROVIDE THE FOLLOWING OPERATIONAL INFORMATION TO THE ISS -
- SUBSYSTEMS STATUS
- FLIGHT MODE STATUS
- ATTITUDE, ATTITUDE ERROR, RATE AND DELTA-V INFORMATION
- CMG GIMBAL ANGLES AND RATES

STATE VECTOR DATA WITHIN THE FOLLOWING LIMITS -

- ALTITUDE UNCERTAINITY +/- 1500 FT (1 SIGMA)
- IN-TRACK UNCERTAINTY +/- 3800 FT (1 SIGMA)
- CROSS TRACK +/- 2200 FT (1 SIGMA)
- ORBITAL VELOCITY +/- 3.5 FT/SEC

THE G/C SHALL PROVIDE THE ISS WITH MEASUREMENTS PRECONDITIONED TO A 0 TO 5 VDC RANGE WITH A SOURCE IMPEDANCE OF LESS THAN 1000 OHMS.

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS
RACU MEMORY SIZE - 4 K (32 BIT) WORDS
RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND DATA STORAGE.

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

THE FOLLOWING G/C COMPUTATIONS SHALL BE PERFORMED BY THE ISS.

- CMG DESATURATION REQUIREMENTS (TIME-TO-SATURATION PREDICTION)

- CURRENT STATION ATTITUDE AND RATE AND REFERENCE ATTITUDE ALIGMENT
- POSITION VECTOR OF TARGETS OF OPPORTUNITY (TRACKED BY CREW USING G/C SEXTANT/TELESCOPE
- SHUTTLE RETURN-TO-EARTH GUIDANCE PARAMETERS
- EXPERIMENT G/C REFERENCE CALIBRATION DATA
- GUIDANCE TARGETING AND DELTA-V COMMANDS FOR RENDEZVOUS, DEPLOYMENT AND STATION KEEPING OF DETACHED RAMS AND SHUTTLE VEHICLES.
- REACTION JET COMMANDS AND DELTA-V PREDICTIONS FOR STATION ORBIT MAINTENANCE
- G/C CONFIGURATION STATUS (REAL TIME)
- G/C OPERATION STATUS (MODE)
- REAL TIME FAILURE IDENTIFICATION AND MAINTENANCE/REPLACEMENT REQUIREMENTS
- ENERGY MANAGEMENT COMPUTATIONS ASSOCIATED WITH JET FIRINGS
- CONTROL MODELLING PARAMETER ESTIMATE AND ADAPTION
- STAR TRACKER POINTING COMMANDS
- STATE VECTOR PROPOGATION AND UPDATE FOR DETACHED RAMS AND STATION KEEPING AND COLLISION AVOIDANCE COMPUTATIONS.
- FPE GROUND TRACK AND POINTING ANGLE.

THE ISS SHALL PROVIDE THE FOLLOW DATA TO THE G/C IN SUPPORT OF COMPUTATION.

- VEHICLE CONFIGURATION AND SOLAR PANEL ATTITUDE
- SOLAR PANEL ORIENTATION COMMANDS
- SUN AND MOON EPHEMERIDES
- STAR CATALOGUE
- GROUND UPLINK DATA
- RANGE, RANGE RATE AND LOS
- SCHEDULED INITIATION OF STATION DELTA-V AND CMG DESATURATION
- REACTION JET ATTITUDE CONTROL INHIBITS AND JET FAILURE DATA
- CREW INTERFACE - MANUAL NAVIGATION SIGHTINGS, OPERATION MODE COMMANDS, CONFIGURATION COMMANDS, MAINTENANCE-IN-PROGRESS/ ACCOMPLISHED DATA
- SUBROUTINES AND BULK STORAGE DATA LOADS
- PERMANENT AND TEMPORARY DATA STORAGE
- EXPERIMENT REFERENCE ALIGNMENT
- MANEUVER SCHEDULE
- TIMING SIGNAL AT 1 KHZ RATE

3.3.4.5.7 G AND C/CREW AND HABITABILITY SUBSYSTEM INTERFACES

AS A GOAL, CREW/HABITAILITY SHALL PROVIDE 5 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

MODULAR SPACE STATION - INITIAL STATION SYSTEM
3.3.5 REACTION CONTROL

THIS SUBSYSTEM IS ONE OF THE SEVEN FUNCTIONAL GROUPINGS OF MAJOR SUBSYSTEMS THAT COMPRISE THE SHUTTLE LAUNCH MODULAR SPACE STATION.

PREPARED W. E. Baker SYSTEM RQMTS/INTERFACES
APPROVAL E. K. Meyer SUBSYSTEM PROJECT MGR
APPROVAL R.W. Antell SUBSYSTEM PROJECT MGR
APPROVAL R. Jones PROJECT ENGINEERING MGR

3.3.5 REACTION CONTROL

3.3.5.1 PERFORMANCE REQUIREMENTS

3.3.5.1.1 NORMAL OPERATIONS

THE REACTION CONTROL SUBSYSTEM SHALL PROVIDE THE CONTROL FORCES AND TORQUES NECESSARY TO (A) MAINTAIN SPACE STATION STABILIZATION AND CONTROL, (B) CONTROL THE SPACE STATION DURING BERTHING OPERATIONS, (C) MAINTAIN SPACE STATION ORBIT, (D) DESATURATE THE G-C CONTROL MOMENT GYROS, AND (E) PERFORM SPACE STATION MANEUVERS. IN ADDITION, THE RCS SHALL PROVIDE GASEOUS O2 AND H2 STORAGE CAPABILITY.

A. DESIGN ENVELOPE

THE REACTION CONTROL SUBSYSTEM SHALL BE DESIGNED AND SIZED TO SUPPORT INDEPENDENT SPACE STATION OPERATIONS FOR PERIODS UP TO 120 DAYS WITHOUT RESUPPLY AND TO MAINTAIN AN ORBIT OF 55 DEGREES INCLINATION AT AN ALTITUDE OF 240 NMI WITH AN ATMOSPHERE EQUIVALENT TO THE FEBRUARY 1982 TWO SIGMA JACCHIA MEAN ATMOSPHERE. THE DESIGN TO FLIGHT MODE SHALL BE X-POP LOCAL LEVEL WITH THE STATION +Z AXIS POINTED TOWARD NADIR. THE DESIGN CONFIGURATION FOR THE ROUTINE OPERATIONS PHASE SHALL BE AS SHOWN IN FIGURE 3.3.5.1.1 THE STATION SHALL BE CAPABLE OF FLYING AN X-POP FLIGHT MODE WITH EITHER THE + OR -Y AXIS ALONG THE VELOCITY VECTOR. THE STATION SHALL ALSO BE CAPABLE OF FLYING AN INERTIAL FLIGHT MODE.

B. OPERATE ENVELOPE

THE REACTION CONTROL SUBSYSTEM SHALL BE CAPABLE OF 120 DAY OPERATION WITHOUT RESUPPLY AT AN ORBITAL ALTITUDE OF 270 NMI AND AN INCLINATION OF 55 DEGREES IN AN X-POP, Z-IV FLIGHT MODE WITH AN ATMOSPHERE EQUIVALENT TO THE 1982 THROUGH 1987 JACCHIA NOMINAL ATMOSPHERE. THE STATION SHALL ALSO BE CAPABLE OF OPERATING IN AN X-POP LOCAL LEVEL AND Y-POP INERTIAL FLIGHT MODES.

C. STABILIZATION FOR BERTHING

THE ATTITUDE STABILIZATION SYSTEM FOR BERTHING SUPPORT SHALL BE CAPABLE OF OPERATION FOLLOWING ANY THREE FAILURES DURING NORMAL OPERATIONS.

ON BERTHING WITH THE SHUTTLE ORBITER, STATION STABILIZATION WILL BE INHIBITED TO ALLOW STABILIZATION AND CONTROL TO BE PROVIDED BY THE SHUTTLE ORBITER FOR BOTH THE STATION AND SHUTTLE ORBITER COMBINATION. WHILE THE SHUTTLE ORBITER IS ATTACHED, THE SHUTTLE ORBITER SHALL PROVIDE ALL NECESSARY STABILIZATION.

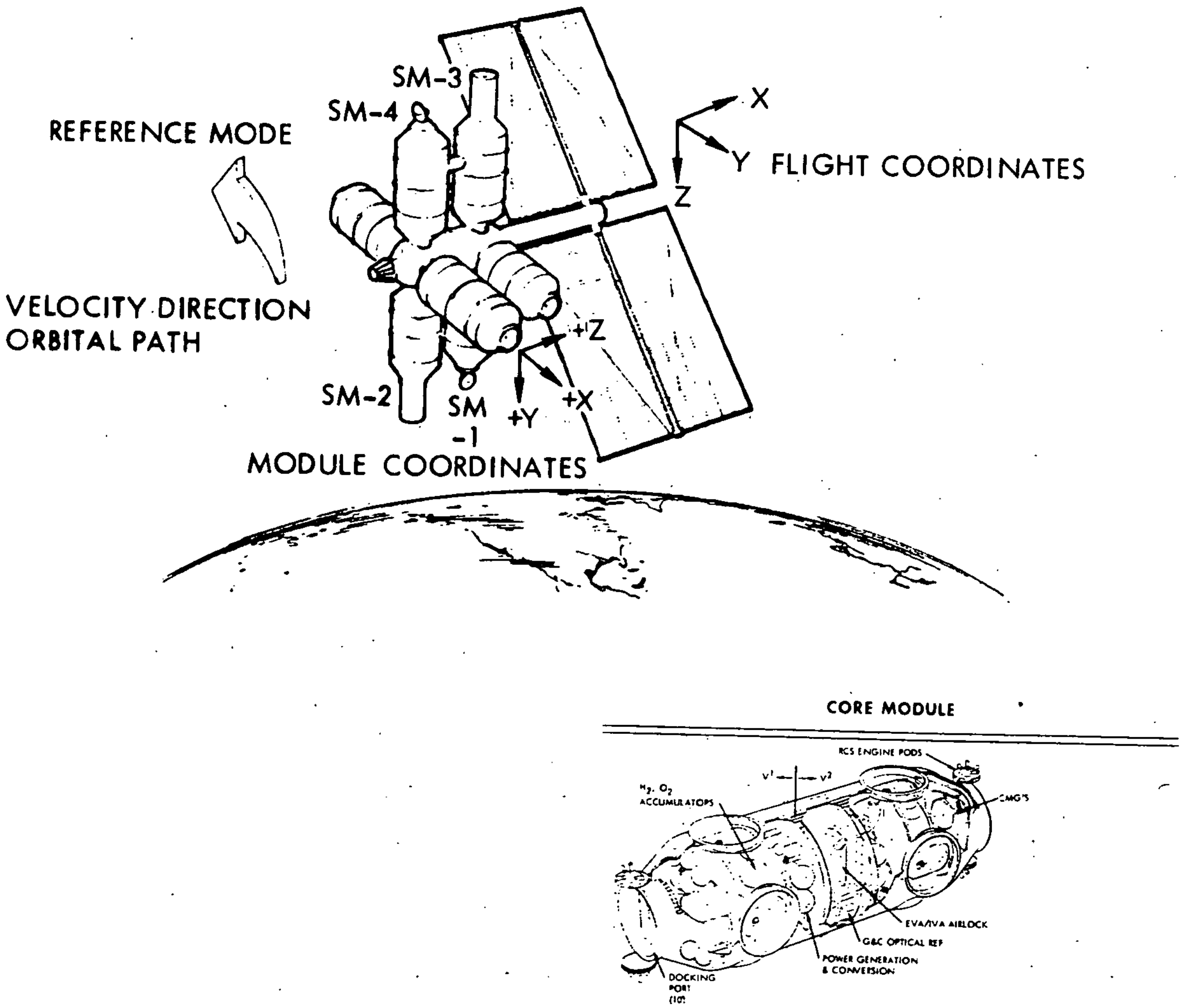


FIGURE 3.3.5.1.1 STATION CONFIGURATION

D. ROUTINE ORBITAL OPERATIONS

THE RCS THRUSTERS SHALL BE AUTOMATICALLY AND SELECTIVELY CONTROLLED BY THE G-C WITH ON-OFF SIGNALS TO THE VALVES AND IGNITOR OF ANY ENGINE OR ENGINE COMBINATION.

THE RCS IN CONJUNCTION WITH THE G-C SHALL BE CAPABLE OF PERFORMING REORIENTATION MANEUVERS WITH 3-AXIS REORIENTATION RATES OF LESS THAN 0.2 DEG/SEC.

THE RCS IN CONJUNCTION WITH THE G-C SHALL MAINTAIN A STABLE MODULAR SPACE STATION ATTITUDE IN EITHER THE EARTH REFERENCED ATTITUDE HOLD OR THE INERTIAL ATTITUDE HOLD MODES.

IN A BACKUP MODE, MANEUVERING AND/OR STABILIZATION OF THE STATION MAY BE ACCOMPLISHED USING A HAND CONTROLLER AND (OUT THE WINDOW) VISUAL CUES.

O2 AND H2 GASES SHALL BE USED AS THE PRIMARY PROPELLANTS FOR RCS JET ENGINES DURING ROUTINE ORBITAL OPERATIONS.

E. IMPULSE REQUIREMENTS

THE 120 DAY IMPULSE REQUIREMENTS AND THEIR SUPPORT FUNCTION ALLOCATIONS FOR SIZING PURPOSES SHALL BE AS FOLLOWS -

SUPPORT FUNCTION	IMPULSE
ORBIT MAKEUP AND CMG DESATURATION	166,000 LB SEC
MANEUVERS	48,000 LB SEC
ATTACHED ORBITER	28,000 LB SEC
CONTINGENCY	48,000 LB SEC
TOTAL	290,000 LB SEC

F. PROPELLANT STORAGE

THE RCS SHALL PROVIDE REDUNDANT PAIRS OF ACCUMULATORS FOR THE STORAGE OF GASEOUS O2 AND H2 SUPPLIED BY THE ECLSS ELECTROLYSIS UNITS AT A NOMINAL OPERATING PRESSURE OF 300 PSIA. THE ACCUMULATORS SHALL BE SIZED FOR A TOTAL STORAGE CAPACITY FOR 12 HOURS OPERATION (1200 LB SEC IMPULSE) AND FOR ECLSS OPERATIONS DURING ORBITAL DARK PERIODS.

6. ENGINES

THE RCS SHALL PROVIDE FOUR QUADS WITH FOUR ENGINES PER QUAD ON THE Z-AXIS OF THE CORE MODULE.

EACH RCS ENGINE SHALL PROVIDE A THRUST OF 10 LBS AND A SPECIFIC IMPULSE OF 320 SEC WHILE OPERATING ON AN OXIDIZER TO FUEL RATIO OF 8 TO 1. THE ENGINES SHALL BE CAPABLE OF OPERATING WITH FUEL SUPPLIED AT A NOMINAL TEMPERATURE OF 70 DEG F. FIRING DURATION SHALL BE 60 SECONDS PER 2 THRUSTORS EVERY 12 HOURS.

THE RCS QUADS SHALL BE DESIGNED FOR SHIRTSLEEVE MAINTENANCE.

3.3.5.1.2 EMERGENCY OPERATIONS

CAPABILITY SHALL BE PROVIDED TO INTERCHANGE GASEOUS O2 AND H2 BETWEEN THE RCS AND EPS FOR EMERGENCY OR CONTINGENCY OPERATIONS.

THE RCS SHALL BE CAPABLE OF USING GASEOUS O2 AND H2 SUPPLIED FROM ECLSS HIGH PRESSURE (3000 PSIA) EMERGENCY STORAGE FOR AN EMERGENCY BERTHING OPERATION WITH THE SHUTTLE ORBITER REQUIRING AN 8000 LB SEC IMPULSE.

3.3.5.1.3 BUILDUP OPERATIONS

A. PREMANNING

THE STATION SHALL BE IN A MINIMUM FUEL MODE. FUEL SHALL BE PROVIDED FROM EPS STORAGE OF HIGH PRESSURE OXYGEN AND HYDROGEN IN THE CORE MODULE AND POWER BOOM DURING BUILDUP ASSEMBLY OF THESE TWO MODULES. EPS ELECTROLYSIS SUPPLIED GASES SHALL BE USED DURING SUBSEQUENT BUILD-UP STEPS.

THE GROUND WILL MAINTAIN THE STATION STATE VECTOR PRIOR TO MANNING.

THE REACTION CONTROL SUBSYSTEM SHALL BE CAPABLE OF PROVIDING CONTROL TORQUES FOR STATION STABILIZATION AND ATTITUDE HOLD FOR BERTHING DURING THE PREMANNING PHASE IN CONJUNCTION WITH THE G-C SUBSYSTEM. THE STATION SHALL FLY PRINCIPAL AXES DURING BUILDUP OR PERIODS OF NON-EXPERIMENT POINTING WITHIN RADIATOR CAPABILITY.

STABILIZATION FOR BERTHING SHALL BE INITIATED BY RF LINK TO AN ATTITUDE HOLD OF +/- 1.0 DEG AND 3-AXIS ANGULAR RATES OF +/-0.05 DEG/SEC. AFTER RF LINK INITIATION, STABILIZATION WILL BE OBTAINED AND HELD IN ONE HOUR DURATIONS.

B. INITIAL MANNED OPERATIONS

THE REACTION CONTROL SUBSYSTEM SHALL BE CAPABLE OF INITIAL MANNING CHECKOUT UTILIZING ONLY MODULAR SPACE STATION ONBOARD CHECKOUT

3.3.5.2 SECONDARY PERFORMANCE CHARACTERISTICS

PROVIDE EPS FUEL CELL REACTANT STORAGE AS REQUIRED.

HIGH PRESSURE O2 IN POWER BOOM (190 LBS) UTILIZED FOR STATION CONTROL AFTER EPS ELECTRICAL FAILURE. 130 LBS O2 REQUIRED TO PERFORM STATION CONTROL FUNCTION.

MAXIMUM ECLSS ELECTROLYSIS OUTPUT IS 37 LBS OF WATER PER DAY WHICH IS EQUIVALENT TO 11,840 LB-SEC OF IMPULSE.

3.3.5.3 EXPERIMENT PROVISIONS

A. STABILITY

FOR EXPERIMENTS, THE STATION RCS IN CONJUNCTION WITH THE G-C SHALL BE

CAPABLE OF LIMITING ANGULAR RATES AROUND THE VEHICLE AXES TO +/-0.05 DEG/SEC CONTINUOUSLY, AND TO +/-0.01 DEG/SEC IN THE FINE POINTING MODE.

THE STATION SHALL BE CAPABLE OF HOLDING THE FINE POINTING MODE FOR PERIODS UP TO 30 MINUTES, WITH THE VEHICLE AXES HELD WITH RESPECT TO LOCAL VERTICAL WITHIN +/-0.1 DEGREES.

THE STATION SHALL FLY THE GEOMETRIC AXES AFTER INITIATING EXPERIMENT POINTING.

THE STATION SHALL BE CAPABLE OF DISSIPATING ANGULAR IMPULSES (RESULTING FROM EXPERIMENT TORQUES) OF 10,000 LB-FT-SEC IN PITCH OR YAW AND 2,500 LB-FT-SEC IN ROLL PER 24 HOUR PERIOD (AVERAGE OVER ONE RESUPPLY PERIOD). NO EXPERIMENT TORQUE SHALL EXCEED 100 LB-FT.

THE STATION SHALL BE CAPABLE OF MAINTAINING STATION AXES WITHIN +/-0.25 DEGREES IN EARTH REFERENCED ATTITUDE HOLD WITH +Z AXIS AT NADIR ON A CONTINUOUS BASIS EXCEPT IN THE INERTIAL FLIGHT MODE.

B. ACCELERATIONS

OPERATIONAL ACCELERATIONS WILL BE MAINTAINED WITHIN THE FOLLOWING NOMINAL LIMITS-

CMG DESAT AND ORBIT MAKEUP	.00014 G MAX FOR 140 SEC
DOCKING-BERTHING	.04 G MAX FOR 0.3 SEC
6 HR CONTINUOUS	.0001 G MAXIMUM
2 HR CONTINUOUS	.00001 G MAXIMUM

3.3.5.4 SUBSYSTEM DEFINITION

3.3.5.4.1 MAJOR ASSEMBLIES

A. PROPELLANT ACCUMULATORS

EIGHT PROPELLANT GAS ACCUMULATORS ARE PROVIDED FOR STORAGE OF THE GASEOUS OXYGEN AND HYDROGEN PROPELLANTS WHICH ARE OBTAINED FROM THE WATER ELECTROLYSIS SYSTEM SUPPLIED BY ECLSS.

B. PROPELLANT FEED CONTROLS

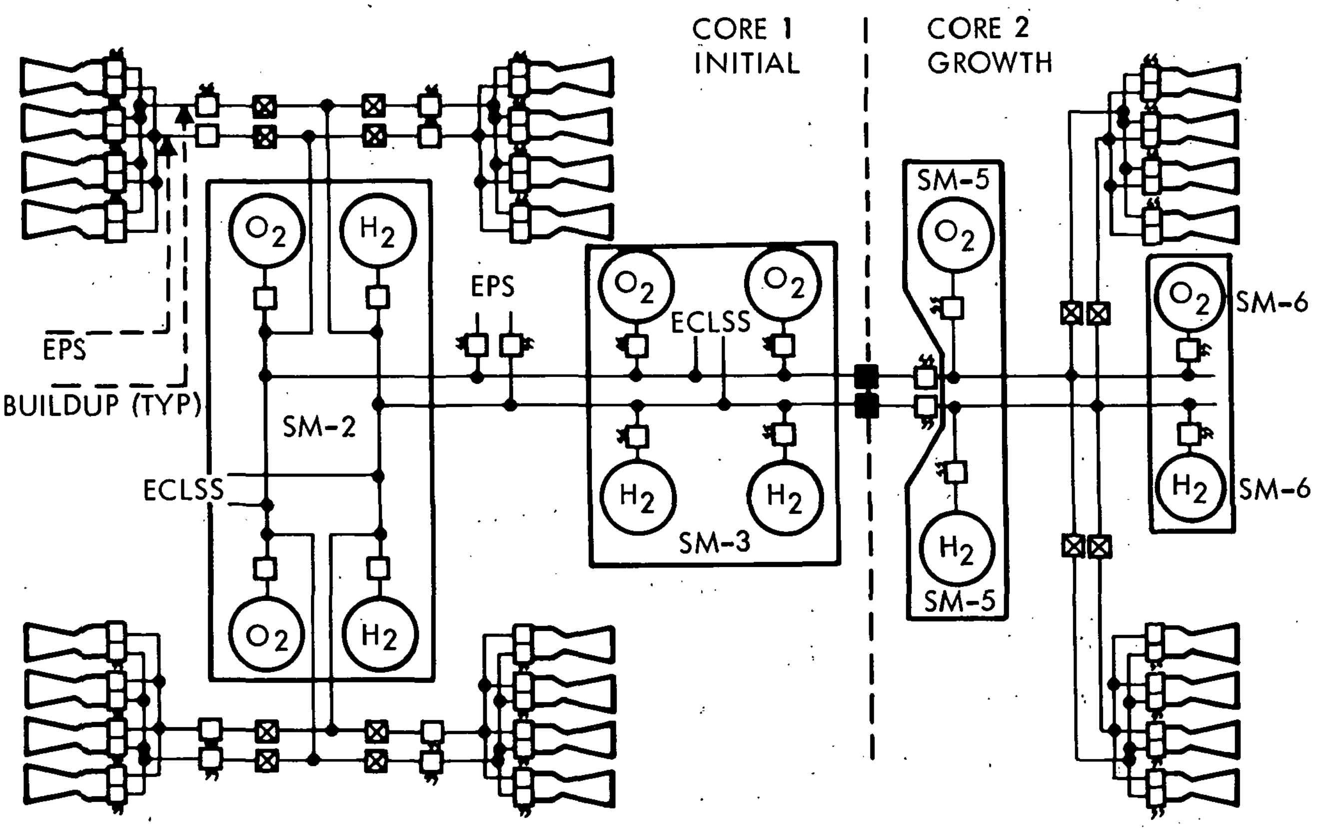
THE OXYGEN AND HYDROGEN FEED CONTROL ASSEMBLIES ARE LOCATED IN THE LINES BETWEEN THE PROPELLANT ACCUMULATORS AND THE ENGINE QUADS. THEY CONSIST OF PROPELLANT GAS PRESSURE REGULATORS, VALVES, AND FILTERS.

C. ENGINES

THE ENGINE QUADS CONSIST OF FOUR ENGINES AND IGNITOR CIRCUITS. THE IGNITOR CIRCUITS ARE PART OF THE GUIDANCE AND CONTROL SUBSYSTEM. MOUNTS ARE PROVIDED TO ATTACH THE ENGINES TO STRUCTURE.

REACTION CONTROL FUNCTIONAL DIAGRAM

THE RCS FUNCTIONS AND INTERFACES WITH OTHER SUBSYSTEMS ARE IDENTIFIED IN THE DIAGRAM BELOW



3.3.5.4.2 WEIGHT, POWER, AND UNIT/LOCATION CHARACTERISTICS

TABLE 3.3.5.4.2-1 WEIGHT SUMMARY

MAJOR ASSEMBLY	WEIGHT (LBS)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
5.0 REACTION CONTROL							
5.1 PROPELLANT ACCUMULATORS				88	88		176
5.2 PROPELLANT FEED CONTROLS	60			65	65		190
5.3 ENGINES	120						120
TOTAL	180			153	153		486

TABLE 3.3.5.4.2-2 POWER SUMMARY

MAJOR ASSEMBLY	POWER (WATTS - 24 HOUR AVG)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
5.0 REACTION CONTROL							
5.1 PROPELLANT ACCUMULATORS							
5.2 PROPELLANT FEED CONTROLS							
5.3 ENGINES	13						13
TOTAL	13						13

TABLE 3.3.5.4.2-3 UNIT CHARACTERISTICS/LOCATIONS/QTY

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES) H	W	D	CORE	PWR	SM-1	SM-2	SM-3	SM-4
5.1 PROPELLANT ACCUMULATORS											
H2 Accumulator	---	22	16 In. Dia.			---	---	---	2	2	---
02 Accumulator	---	18	13 In. Dia.			---	---	---	2	2	---
Mounts and Supports	---	16				---	---	---	x	x	---
5.2 PROPELLANT FEED CONTROL											
Valves and Regulators	---	50				x	---	---	x	x	---
Plumbing	---	20				x	---	---	x	x	---
Mounts and Supports	---	20				x	---	---	x	x	---
5.3 ENGINES											
Engines	115	24.5	20	36	20	4	---	---	---	---	---
Mounts	---	22				x	---	---	---	---	---

3.3.5.5 SUBSYSTEM INTERFACES

3.3.5.5.1 RCS/STRUCTURAL AND MECHANICAL INTERFACES

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.5.4.2-3.

STRUCTURES SHALL PROVIDE MOUNTING FOR RCS ENGINES AND ASSOCIATED EQUIPMENT SUCH THAT SERVICING CAN BE ACCOMPLISHED IN A SHIRTSLEEVE ENVIRONMENT.

3.3.5.5.2 RCS/ECLSS INTERFACES

ECLSS SHALL PROVIDE EQUIPMENT COOLING FOR HEAT LOADS AS SPECIFIED IN TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION.

THE ECLSS SHALL SUPPLY TO THE RCS GASEOUS HYDROGEN AND OXYGEN AS FOLLOWS -

OXYGEN

DELIVERY PRESSURE	-	NOMINAL 300 PSIA
TEMPERATURE	-	NOMINAL 70 DEG F
DELIVERY RATE	-	NOMINAL 28.12 LB/DAY
EMERGENCY	-	AN EMERGENCY SOURCE SHALL PROVIDE 22 LBS TO TWO DIFFERENT LOCATIONS

HYDROGEN

DELIVERY PRESSURE	-	NOMINAL 300 PSIA
TEMPERATURE	-	NOMINAL 70 DEG F
DELIVERY RATE	-	NOMINAL 3.51 LB/DAY
EMERGENCY	-	AN EMERGENCY SOURCE SHALL PROVIDE 2.8 LBS TO TWO DIFFERENT LOCATIONS.

THE RCS SHALL PROVIDE GO2 AND GH2 STORAGE ACCOMMODATIONS FOR ECLSS PRODUCED GASES TO SUPPORT ECLSS OPERATIONS DURING ORBITAL DARK PERIODS.

3.3.5.5.3 RCS/EPS INTERFACES

EPS SHALL PROVIDE REDUNDANTLY DISTRIBUTED REGULATED 120/208 V, 400 HZ, AC AND 56 VDC (IF REQUIRED) ELECTRICAL POWER. THE QUALITY OF THE POWER SHALL BE PER MIL-STD-704 EXCEPT FOR THE DC LINE DROP WHICH SHALL BE 2.5 VOLTS MAXIMUM BETWEEN THE LOADS AND THE REGULATED BUS. WIRE PROTECTION SHALL BE PROVIDED FOR ALL LOADS CONNECTED TO THE EPS DISTRIBUTION BUSES. WHERE APPLICABLE, REDUNDANT DEVICES SHALL BE EMPLOYED. CRITICAL LIFE SUPPORT

LOADS SHALL BE MAINTAINED DURING EMERGENCIES AFFECTING ELECTRICAL POWER FOR A MINIMUM OF 96 HOURS. EPS SHALL PROVIDE ELECTRICAL POWER (24 HOUR AVERAGE WATTS) AS SPECIFIED (AT THE LOAD BUSES) BELOW -

SUBSYSTEM	BUILDUP STEP 1	BUILDUP STEP 2	NORMAL OPERATIONS	EMERGENCY OPERATIONS
RCS	0	0	13	8

EPS AND RCS SHALL PROVIDE THE CAPABILITY TO EXCHANGE PROPELLANT GASES.

EPS SHALL HAVE THE CAPABILITY TO STORE AND PROVIDE PROPELLANT GASES FOR RCS USE DURING BUILDUP

3.3.5.5.4 RCS/G-C INTERFACES

THE G/C SHALL PROVIDE ON/OFF SIGNALS TO THE RCS SOLENOID VALVES AND IGNITORS.

THE RCS SHALL ACCEPT CONTROL SIGNALS FROM THE G-C RCS JET DRIVER ELECTRONICS.

3.3.5.5.5 RCS/RCS INTERFACES

NOT APPLICABLE

3.3.5.5.6 RCS/ISS INTERFACES

RCS SHALL PROVIDE STATUS DATA FOR ALL PROPELLANT VALVES AND ENGINES TO DETERMINE THEIR OPEN-CLOSED OR ON-OFF CONDITIONS.

RCS SHALL PROVIDE PROPELLANT LINE, PROPELLANT ACCUMULATOR, AND ENGINE PACKAGE TEMPERATURE AND PRESSURE MEASUREMENTS TO THE ISS TO FACILITATE THE CONTROL AND MONITORING OF THE RCS.

RCS SHALL PRECONDITION ALL MEASUREMENTS TO A 0 TO 5 VDC RANGE WITH A SOURCE IMPEDANCE OF LESS THAN 1000 OHMS.

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS

RACU MEMORY SIZE - 4 K (32 BIT) WORDS

RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND DATA STORAGE.

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

3.3.5.5.7 RCS/CREW HABITABILITY INTERFACES

AS A GOAL, CREW/HABITABILITY SHALL PROVIDE 5 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

MODULAR SPACE STATION - INITIAL STATION SYSTEM
3.3.6 INFORMATION

THIS SUBSYSTEM IS ONE OF THE SEVEN FUNCTIONAL GROUPINGS OF MAJOR SUBSYSTEMS THAT COMPRISE THE SHUTTLE LAUNCH MODULAR SPACE STATION

PREPARED	D W Earle	SYSTEM RQMTS/INTERFACES
APPROVAL	C R Gerber	SUBSYSTEM PROJECT ENGR
APPROVAL	C W Roberts	SUBSYSTEM PROJECT MGR
APPROVAL	R L Jones	PROJECT ENGINEERING MGR

3.3.6 INFORMATION SUBSYSTEM REQUIREMENTS

3.3.6.1 ISS PERFORMANCE REQUIREMENTS

3.3.6.1.1 NORMAL OPERATIONS

3.3.6.1.1.1 DATA PROCESSING ASSEMBLY

DATA PROCESSING SHALL COSIST OF ACQUISITION, PROCESSING, DISTRIBUTION, AND STORAGE OF INFORMATION AND PROVIDE THE CENTRAL TIMING GENERATION AND DISTRIBUTION FUNCTION.

A. ACQUISITION AND DISTRIBUTION

THE DIGITAL DATA DISTRIBUTION NETWORK SHALL LINK ALL DATA SOURCES IN THE MSS TO THEIR DISTINATION. ANALOG DATA SHALL BE CONVERTED TO DIGITAL PRIOR TO DISTRIBUTION. THE DIGITAL DATA DISTRIBUTION NETWORK SHALL INTERFACE WITH EXTERNAL COMMUNICATIONS TO PROVIDE DIGITAL RECEPTION AND TRANSMISSION CAPABILITY TO AND FROM THE MSS. CENTRAL TIMING DISTRIBUTION SHALL BE PROVIDED TO ALL SUBSYSTEMS AND EXPERIMENTS. THE DIGITAL DATA NETWORK SIZING AND DATA RATES MUST BE COMPATIBLE WITH THE INFORMATION MANAGEMENT REQUIREMENTS STATED IN TABLE 3.3.6.1.1-1.

B. PROCESSING

THE PROCESSING PORTION OF THE INFORMATION SUBSYSTEM SHALL PREFORM THE COMPUTATION, CONTROL, COMPACTION, AND MEMORY FUNCTIONS REQUIRED IN PERFORMING THE MSS INFORMATION MANAGEMENT FUNCTIONS. TABLE 3.3.6.1.1-1 CONTAINS THE PARAMETRIC DATA REQUIRED TO SIZE THE DATA PROCESSING, MEMORY, AND INFORMATION STORAGE, AND TO ESTABLISH THE DPA MECHANIZATION CONCEPT. THE CENTRAL TIMING SOURCE SHALL BE PROVIDED AS PART OF THE DPA AND SHALL HAVE A BASE FREQUENCY OF 10 MHZ AND A STABILITY FACTOR OF 2 PARTS IN 10(8).

C. STORAGE

THE REQUIREMENTS FOR OPERATING, MASS, AND ARCHIVE MEMROY ARE DELINEATED IN TABLE 3.3.6.1.1-1.

TABLE 3.3.6.1.1-1 DPA HARDWARE REQUIREMENTS SUMMARY

	HARDWARE X 10(3)				
SUBSYSTEM OR FUNCTION	COMPUT. RATE EOPS	DATA BUS RATE BPS	MEMORY (32 BIT WORDS) OPNS	MASS	ARCHIVE
G AND C	22.7	78.1	2.1	21.5	43.0
ECLSS	29.8	90.0	4.3	23.7	47.4
EPS	133.6	75.6	12.2	57.8	115.6
RCS	34.4	10.8	1.1	5.4	10.8
STRUCTURES	3.3	4.4	0.2	4.1	8.2
CREW/HAB	19.9	12.4	1.0	8.7	17.4
ISS	78.3	75.4	14.1	66.1	132.2
TOTAL SUBSYSTEM	322.0	346.7	35.0	187.3	374.6
OPNS MGMT	10.9	-	13.3	53.0	106.0
ORCO MGMT	208.0	-	9.4	55.8	111.6
REMOT PROC MGMT	7.9	-	0.7	0.7	1.4
CENTRAL EXEC	82.3	51.9	8.8	44.5	89.0
STA. OPNS TOTAL	631.1	398.6	67.2	341.3	682.6*

* INCREASE TO 4.2 X 10(6) TO INCLUDE DATA BASE STORAGE REQUIREMENTS.

EOPS = EQUIVALENT OPERATION PER SECOND

3.3.6.1.1.2 COMMAND/CONTROL AND MONITORING

THE COMMAND/CONTROL AND INFORMATION DISPLAY FUNCTIONS OF THE MSS SHALL BE AUTOMATED TO THE MAXIMUM EXTENT POSSIBLE. CAPABILITY SHALL BE PROVIDED FOR THE CREW TO OVERRIDE THE AUTOMATED FUNCTIONS. ALTERNATE OR BACKUP DISPLAY AND CONTROL METHODS SHALL BE PROVIDED TO PERFORM FUNCTIONS WHICH ARE TIME CRITICAL OR THE CREW OR EQUIPMENT SAFETY ARE IN JEOPARDY. DISPLAY AND CONTROL DEVICES SHALL BE PROVIDED TO PERFORM FLIGHT MANAGEMENT, SPACE STATION OPERATIONS MANAGEMENT, PLANNING AND SCHEDULING MANAGEMENT, AND EXPERIMENT MANAGEMENT.

A. FLIGHT MANAGEMENT

THERE SHALL BE CAPABILITY IN THE PRIMARY CONTROL CENTER FOR OVER-ALL COGNIZANCE OR RELATIVE POSITIONS AND RATES OF ALL VEHICLES WITHIN THE STATION SPHERE OF INFLUENCE. SUFFICIENT DISPLAYS AND CONTROLS SHALL BE PROVIDED FOR CREW FLIGHT CONTROL OF THE SPACE STATION AND DETACHED MODULES. CONCURRENT ACTIVE FLIGHT CONTROL CAPABILITY FROM THIS POSITION SHALL NOT BE REQUIRED. BACKUP CAPABILITY SHALL BE PROVIDED.

B. OPERATIONS MANAGEMENT

OPERATIONS MANAGEMENT SHALL BE CONTROLLED FROM A SINGLE POSITION. THE OPERATIONS MANAGEMENT FUNCTION MAY BE PERFORMED AT MORE THAN ONE POSITION IN THE STATION. BACKUP CONTROL CAPABILITY SHALL BE PROVIDED. THERE SHALL BE SUFFICIENT INFORMATION PROVIDED TO PERFORM THE FOLLOWING OPERATIONS MANAGEMENT FUNCTIONS BUT NOT NECESSARILY SIMULTANEOUSLY AT THE SAME POSITION.

1. SUBSYSTEM MANAGEMENT - INFORMATION FOR SUBSYSTEM (INCLUDING DOCKED MODULES) STATUS AND SURVEILLANCE SHALL BE PROVIDED TO A SINGLE POSITION. STATION AND EXPERIMENT SUBSYSTEM REMOTE DISPLAY AND CONTROL CAPABILITY SHALL BE PROVIDED.
2. MAINTENANCE - INFORMATION SHALL BE AVAILABLE FOR CO-ORINDATION OF SPACE STATION CHECKOUT AND MAINTENANCE. DISPLAYS, CONTROLS, AND INTERCOMMUNICATIONS SHALL BE PROVIDED AT THIS POSITION FOR DETERMINATION OF THE DEGREE OF SUCCESS OF ANY MAINTENANCE.
3. EMERGENCY MANAGEMENT - CRITERIA AND INFORMATION SHALL BE PRESENTED TO THE COMMANDER/DUTY OFFICER TO ENABLE ANALYSIS - EVALUATION OF THE NATURE AND MAGNITUDE OF ANY IMPORTANT PROBLEM. THE DATA PROCESSING FUNCTION SHALL PERFORM DETECTION AND SHALL PREPARE CAUTION AND WARNING INFORMATION FOR PRESENTATION TO THE COMMANDER/DUTY OFFICER BY THE DISPLAY AND CONTROL FUNCTION.
4. PERSONNEL MANAGEMENT - PERSONNEL ACTIVITY AND AVAILABILITY INFORMATION SHALL BE AVAILABLE. A LIST OF TASKS WITH PRIORITIES AND PERSONNEL REQUIREMENTS SHALL ALSO BE AVAILABLE AT THIS POSITION.
5. EXTRA VEHICULAR ACTIVITY - VISIBILITY OF, AND COMMUNICATIONS WITH PERSONNEL ENGAGED IN EVA SHALL BE PROVIDED.
6. VISITOR MANAGEMENT - INFORMATION FOR ACCOMMODATION OF VISITORS TO THE SPACE STATION WITH MINIMUM DISRUPTION OF STATION OPERATIONS SHALL BE AVAILABLE.
7. INVENTORY MANAGEMENT - SUFFICIENT INFORMATION TO DECIDE ON INVENTORY ITEM UTILIZATION SHALL BE AVAILABLE. INVENTORY TREND DATA FOR CRITICAL CONSUMABLES SHALL BE AVAILABLE.

C. PLANNING AND SCHEDULING MANAGEMENT

THERE SHALL BE SUFFICIENT INFORMATION AVAILABLE AT A SINGLE POSITION TO PLAN/SCHEDULE THE MAINTENANCE, LOGISTICS/INVENTORY, AND PERSONNEL ACTIVITIES FOR THE SPACE STATION. THE INFORMATION DISPLAY SHALL BE FLEXIBLE ENOUGH FOR CREW PERSONNEL TO DECIDE WHICH OF SEVERAL PLANS/ SCHEDULES TO IMPLEMENT. BACKUP CAPABILITY SHALL BE PROVIDED.

D. EXPERIMENT MANAGEMENT

THERE SHALL BE SUFFICIENT DISPLAYS AND CONTROLS PROVIDED AT A SINGLE POSITION TO MANAGE AND EVALUATE EXPERIMENT OPERATIONS. THE DISPLAY AND CONTROLS FOR SPACE STATION SUPPORT OF EXPERIMENT OPERATIONS SHALL BE PROVIDED AT THIS POSITION. DISPLAY AND CONTROL FUNCTIONS UNIQUE TO THE INDIVIDUAL EXPERIMENTS SHALL BE LOCATED IN THE AREA OF THE EXPERIMENT.

E. AUDIO/VIDEO CONTROL

1. LOCAL CONTROL (ON, OFF, AND VOLUME) OF ENTERTAINMENT FUNCTION SHALL BE PROVIDED. IN THE CASE OF AN EMERGENCY SITUATION THE MONITOR AND ALARM FUNCTION SHALL GENERATE AN AUDIO ALARM SIGNAL TO ALL ENTERTAINMENT OUTPUTS IN PARALLEL AND BYPASSING THE LOCAL CONTROLS. PROVISION SHALL BE MADE ON PRIMARY AND EXPERIMENT COMMAND AND CONTROL LOCATIONS FOR CONTROL OF ENTERTAINMENT MUSIC AND PAGING. ACTIVATION OF PAGING SHALL DISCONNECT THE MUSIC (IF ON) AND CONNECT THE MICRO-PHONE, THROUGH A SUITABLE AMPLIFIER, TO ALL ENTERTAINMENT OUTPUTS.

2. EACH COMMAND/CONTROL CENTER AND THE COMMANDER'S STATEROOM SHALL HAVE PROVISIONS SO THAT THE COMMANDING OFFICER CAN OBTAIN OVERRIDE TELEPHONE ACCESS TO CERTAIN CRITICAL AREAS. MANUAL ACTIVATION SHALL AUTOMATICALLY GENERATE THE CORRECT PHONE NUMBER CODE AND SHALL AUTOMATICALLY TERMINATE CONVERSATIONS IN PROGRESS.

3. ALL AREAS SUPPORTING BIOMEDICINE EXPERIMENTS, UTILIZING CCTV FOR PATIENT OR TEST SUBJECT MONITORING, SHALL HAVE THE CAPABILITY OF EXPERIMENTAL CCTV CHANNEL SELECTION AND MONITORING.

F. DIGITAL DATA

ACCESS TO AND DISPLAY OF INFORMATION ON THE DIGITAL DATA NETWORK SHALL BE PROVIDED AT EACH PROCESSOR LOCATION AND AT EACH CONTROL CENTER.

3.3.6.1.1.3 EXTERNAL COMMUNICATION

THE INITIAL SPACE STATION MUST PROVIDE COMMUNICATIONS WITH GROUND NETWORKS AND OTHER COOPERATING SPACECRAFT, BUT NOT NECESSARILY SIMULTANEOUSLY. NEARLY CONTINUOUS DUPLEX VOICE COMMUNICATIONS WITH THE GROUND MUST BE PROVIDED BEGINNING WITH INITIAL MANNED FLIGHT. INTERRUPTIONS IN DATA COMMUNICATIONS AS LONG AS FIVE HOURS WITH THE GROUND NETWORK ARE ACCEPTABLE FOR THE INITIAL SPACE STATION.

SYSTEM AND MISSION STATUS WILL NOT NECESSARILY BE TRANSMITTED TO THE GROUND ON A REAL-TIME BASIS, BUT REAL-TIME CAPABILITY SHOULD EXIST.

THE FIRST MODULE TO BE ORBITED SHALL PROVIDE THE FOLLOWING COMMUNICATIONS - CONTROL, TELEMETRY, METRIC TRACKING, AND WHEN MANNED, DUPLEX VOICE LINKS. (ON-ORBIT MODULE TO TRANSPOND PRN RANGING SIGNAL FROM GROUND OR SHUTTLE SO THAT THE GROUND OR SHUTTLE CAN PERFORM THE METRIC TRACKING FUNCTION.)

COMMUNICATION SUBSYSTEM STATUS DATA SHALL BE PROVIDED TO THE DATA MANAGEMENT SYSTEM FOR SUPPORT OF A PERIODIC CHECKOUT AND FAULT ISOLATION TO A LEVEL CONSISTENT WITH SAFETY AND WITH THE IN-ORBIT MAINTENANCE AND REPAIR APPROACH SELECTED.

THE CAPABILITY FOR VOICE CONFERENCE SHALL BE PROVIDED BETWEEN THE ORBITER, THE GROUND NETWORK, AND THE STATION DURING PERIODS OF ORBITER-STATION LINE-OF-SIGHT COMMUNICATIONS CAPABILITY AND BETWEEN THE EVA VIA THE STATION, STATION (OR MANNED DM), AND GROUND NETWORK DURING PERIODS OF EVA (LOCAL TO THE STATION OR DM).

FOR EACH MANNED STATE OF CLUSTER BUILDUP AND OPERATIONS, SPACE STATION-GROUND AND SPACE STATION-SHUTTLE DUPLEX VOICE COMMUNICATION CAPABILITY SHALL BE AVAILABLE FROM ANY PRESSURIZED VOLUME THE CREW MIGHT RETREAT TO WHEN AN EMERGENCY CONDITION EXISTS.

SPACE STATION ATTITUDE CONSTRAINTS FROM NORMAL ATTITUDE FLIGHT MODES SHOULD NOT BE REQUIRED TO MAINTAIN ACCEPTABLE CIRCUIT PERFORMANCE MARGINS FOR THE COMMUNICATIONS SUBSYSTEM'S VOICE, TRACKING DATA, COMPUTER DATA, AND CONTROL DATA CHANNELS.

A CAPABILITY FOR RF AND HARDLINE COMMUNICATIONS WITH EVA CREWMAN WILL BE PROVIDED.

DIRECTIVE ANTENNAS SHALL EMPLOY AUTOMATIC ACQUISITION AND AUTOMATIC STEER-

ING TECHNIQUES.

SPACE STATION-GROUND, SPACE STATION-ORBITER, AND INTERNAL COMMUNICATION DUPLEX VOICE COMMUNICATIONS CAPABILITY SHALL BE AVAILABLE FROM VOLUMES (OR AREAS) WHERE IVA IS, OR MAY BE, REQUIRED.

EXTERNAL COMMUNICATIONS SHALL INTERFACE WITH THE DIGITAL DATA DISTRIBUTION NETWORK TO PROVIDE FOR DIGITAL RECEPTION AND TRANSMISSION BETWEEN THE DPA AND EXTERNAL SOURCES.

THE MODULAR SPACE STATION COMMUNICATIONS SUBSYSTEM SHALL BE DESIGNED TO PROVIDE COMMUNICATIONS WITH NASA'S EARTH ORBITAL GROUND NETWORK (WITH OR WITHOUT SATELLITES) AND OTHER COOPERATING SPACECRAFT. COMMUNICATION AND TRACKING CAPABILITY BETWEEN ELEMENTS SHALL BE DESIGNED IN ACCORDANCE WITH THE FOLLOWING TABLES.

A CAPABILITY FOR CONDUCTING PRIVATE VOICE COMMUNICATIONS BETWEEN THE SPACE STATION AND GROUND SHALL BE PROVIDED (PRIVATE TO THE EXTENT OF A PRIVATE PHONE IN A HOUSE I. E.,PRIVATE, BUT NOT SECURE).

TABLE 3.3.6.1.1-2 EXTERNAL COMMUNICATION

DATA TYPE	DATA RATE (BASEBAND)	QUALITY	T/R	NO. CHNLS	CHANNEL
VOICE	300 TO 4K HZ	54 DB HZ	T R	3	FULL DUPLEX
MUSIC	30 TO 10K HZ	58 DB HZ	R	1	SIMPLEX-TIME SHARED
TV B/W DRAM	2.9 MHZ	*5 DB HZ	R	2	SIMPLEX-SIMUL
TV B/W GND	2.9 MHZ	*5 DB HZ	T R	1	HALF DUPLEX-TIME SH
TV COLOR GND	4.5 MHZ	*7 DB HZ	T	1	SIMPLEX-TIME SHARED
EXP TM GND	2.0 MBPS	10(-5) BER	T	1	SIMPLEX-TIME SHARED
EXP TM DRAM	0.05 MBPS	10(-5) BER	R	2	SIMPLEX-SIMUL
SYSTEM TM LO	0.05 MBPS	10(-5) BER	T	1	SIMPLEX-TIME SHARED
SYSTEM TM HI	0.50 MBPS	10(-5) BER	T	1	SIMPLEX-TIME SHARED
SYSTEM TM EVA	200 BPS	10(-5) BER	R	1	SIMPLEX-TIME SHARED
COMPUTER DATA	0.50 MBPS	10(-6) BER	T R	1	FULL DUPLEX
TEXT/GRAPHIC					
DIGITAL	1000 BPS	10(-5) BER	R	1	SIMPLEX-TIME SHARED
FACSIMILE	0.5 MHZ	60 DB HZ	T	1	SIMPLEX
RANGING PRN	0.5 MBPS	10(-5) BER	T R	4	FULL DUPLEX
COMMAND (GND)	1000 BPS	10(-6) BER	R	1	SIMPLEX SIMUL
CONTROL DRAM)	10 KBPS	10(-6) BER	T	2	SIMPLEX SIMUL

T/R = TRANSMIT/RECEIVE
FULL DUPLEX = 2 WAY-SIMULTANEOUSLY SIMPLEX = ONE WAY
HALF DUPLEX = 2 WAY-SERIALLY SIMUL = SIMULTANEOUSLY

TABLE 3.3.6.1.1-3 COMMUNICATION FROM MSS TO PROGRAM ELEMENTS

FROM STATION TO-		COMMUNICATION LINKS						
		VOICE	TELEVISION	EXP TLM	SYSTEM TLM	COMPUTER DATA	CONTROL	TEXT GRAPHICS
ORBITER	DURING ORBIT	T			T*			
	DURING HARD DOCK	T/H			H*			
	WHEN MSS MODULE IS ORBITER PAYLOAD.	H			H			
GROUND NETWORK (GROUND STA/TDRS)		T	T	T	T	T		T
DETACHED MODULE (DRAM)		T/M				T	T	
EXTRA VEHICULAR ACTIVITY (EVA LOCAL)		T H						

T = TRANSMIT H = HARDLINE M= MANNED

* = DURING BUILDUP PHASE PREMANNING ONLY.

TABLE 3.3.6.1.1-4 COMMUNICATION TO MSS FROM PROGRAM ELEMENTS

TO STATION FROM -		COMMUNICATION LINKS: VOICE	TELEVISION	EXP TLM	SYSTEM TLM	COMPUTER DATA	CONTROL	TEXT GRAPHICS
ORBITER	DURING ORBIT	R					R*	
ORBITER	DURING HARD DOCK	R H			H			
ORBITER	WHEN MSS MODULE IS ORBITER PAYLOAD	H				H	H	
GROUND NETWORK (GROUND STA/TDRS)		R	R			R	R D	R
DETACHED MODULE (DRAM)		R M	R	R	R	R		
EXTRA VEHICULAR ACTIVITY (EVA LOCAL)		R H			R			

R = RECEIVE H = HARDLINE D = DEVEL PHASE ONLY M = MANNED

* DURING BUILDUP PHASE PREMANNING ONLY.

TRANSMIT/RECEIVE MODES

TRANSMIT/RECEIVE MODES SHALL BE AVAILABLE IN ALL POSSIBLE MODE COMBINATIONS WITHIN SPECIFIED BANDWITHS. THE MODES ITEMIZED BELOW REFLECT MINIMUM REQUIREMENTS.

A. PRIMARY MODES REQUIRED FROM SPACE STATION TO GROUND NETWORK.

SLANT RANGE TO GND NET = 1100 N.M. LOS OR VIA TDRS

	DIFFERENT COMBINATIONS								
MODE	1	2	3	4	5	6	7	8	9
VOICE	X	X	X	X	X	X	X	X	X
FACSIMILE		X					X		
SYSTEM TELEMETRY			X					X	
RANGING (PRN)				X					
EXPERIMENT TELEMETRY					X				*X
TV B AND W OR COLOR						X	X	X	X
*LIMIT 50 KBPS									

B. PRIMARY MODES REQUIRED FROM THE GROUND NETWORK TO THE SPACE STATION.

SLANT RANGE FROM GOUND NET = 1100 N.M. OR VIA TDRS

	DIFFERENT COMBINATIONS							
MODE	1	2	3	4	5	6	7	8
* VOICE	X	X	X	X	X	X	X	X
CONTROL		X				X		X
COMPUTER DATA			X				X	X
TEXT/GRAPHICS				X				
RANGING (PRN)					X	X	X	

* INCLUDES MUSIC

C. PRIMARY MODES REQUIRED FROM STATION TO THE SPACE SHUTTLE.

RANGE TO 1100 N.M.

	DIFFERENT COMBIN.					
MODE	1	2	3	4	5	6
VOICE	X	X	X			
DATA		X	X	X	X	
RANGING (PRN)			X	X		X

D. PRIMARY MODES REQUIRED FROM SPACE SHUTTLE TO THE SPACE STATION.

RANGE TO 1100 N.M.

	DIFFERENT COMBIN.					
MODE	1	2	3	4	5	6
VOICE	X	X	X			
* CONTROL				X	X	
DATA		X	X	X	X	
TRACKING (PRN)			X	X		X

* DURING UNMANNED INITIAL BUILDUP ONLY

E. PRIMARY MODES REQUIRED FROM STATION TO THE DETACHED MODULE.

RANGE TO 450 N.M.

	DIFFERENT COMBIN.				
MODE	1	2	3	4	5
(IF MANNED) VOICE	X	X	X		
EXP AND OPNS CONTROL		X	X	X	
RANGING (PRN)			X	X	X

F. PRIMARY MODES REQUIRED FROM DETACHED MODULE TO THE STATION.

RANGE TO 450 N.M.

	DIFFERENT COMBIN.				
MODE	1	2	3	4	5
(IF MANNED) VOICE	X	X	X		
EXP AND OPNS DATA		X	X	X	
RANGING (PRN)			X		
TV B AND W				X	

TRACKING

THE MSS SHALL BE CAPABLE OF TRACKING THE ORBITER, DETACHED MODULES AND ANY COOPERATIVE TARGET WITHIN ITS SPHERE OF INFLUENCE. THE MSS SHALL BE COOPERATIVE TARGET (TRANSPOND) WHEN THE ORBITER OR GROUND NETWORK IS TRACKING THE MSS. THE TRACKING AND TRANSPONDING FUNCTIONS SHALL BE CONDUCTED SIMULTANEOUSLY. THE TRACKING OF MULTIPLE TARGETS SIMULTANEOUSLY IS NOT REQUIRED. THE POSITION AND RANGE RATE UNCERTAINTY (WITH REFERENCE TO THE MSS) AND THE AREA OF COVERAGE ARE AS FOLLOWS.

RANGE	POS UNCERTAINTY WITH REF TO MSS	RANGE RATE UNCERT WITH REF TO MSS	AREA OF COVERAGE
450 TO 20 NM	+/-500 FT	0.5 FT/SEC	RADIAL IN ORBITAL PLANE
20 NM TO 1000 FT	+/-500 FT	0.5 FT/SEC	SPHERICAL

3.3.6.1.1.4 INTERNAL COMMUNICATION

THE ASSEMBLED CLUSTER OF MODULES SHALL PROVIDE MULTIPLE DUPLEX VOICE, CAUTION AND WARNING SIGNALS AND VIDEO LINKS THROUGHOUT THE SPACE STATION.

INTERNAL COMM (FULL DUPLEX VOICE, CAUTION AND WARNING SIGNALS, PUBLIC ADDRESS, AND CLOSED CIRCUIT VIDEO) SHALL BE AVAILABLE IN ALL HABITABLE AREAS OF THE SPACE STATION AND ALL ACTIVE DOCKING PORTS. INTERNAL COMMUNICATIONS SHALL NOT BE INTERRUPTED NOR DEGRADED WITHIN THE REMAINING PRESSURIZED VOLUME DUE TO A MALFUNCTION OF A SINGLE OR A GROUP OF SPACE STATION MODULES.

THE NORMAL OPERATIONAL INTERNAL COMMUNICATION REQUIREMENTS ARE LISTED IN TABLE 3.3.6.1.1-5.

TABLE 3.3.6.1.1-5 INTERNAL COMMUNICATIONS

DATA TYPE	DATA RATE	QUALITY	NO. CHNLS
VOICE - PRIVATE/CONFERENCE TELEPHONE	300 TO 4K HZ	40 DB	3
MSUIC - ENTERTAINMENT AND PAGING	30 TO 10K HZ	54 DB	1
CCTV - B AND W OR COLOR	4.5 MHZ	39 DB	3
RECORD/PLAYBACK - AUDIO/VIDEO REALTIME	30 TO 4.5M HZ	DNA	ALL

ENTERTAINMENT (TV AND MUSIC) AND PAGING (VOICE)

ENTERTAINMENT AND PAGING SHALL BE PROVIDED IN ALL HABITABLE MODULES. THE CAPABILITY TO PLAYBACK PRERECORDED MUSIC AND VIDEO SIGNAL SHALL BE PROVIDED. DISCRETIONARY STATION WIDE OVERRIDE PAGING CAPABILITY SHALL BE PROVIDED. UTILIZATION CONTROL SHALL BE FROM THE CONTROL CENTERS. PAGING AND ALARM SIGNALS SHALL NOT BE CONTROLLED BY LOCAL CONTROL, JUST BY THE CENTRAL OR COMMANDERS CONTROL AREAS. THE CAPABILITY TO RECORD VIDEO AND MUSIC FROM THE EXTERNAL COMMUNICATIONS SHALL BE PROVIDED.

AUDIO VIDEO

A. VOICE INTERCOMMUNICATIONS SHALL BE PROVIDED IN ALL HABITABLE AREAS. PRIMARY CONTROL OF INTERCOMMUNICATION SHALL BE FROM THE CONTROL AREAS. HARDLINE EVA/IVA COMMUNICATIONS SHALL BE PROVIDED.

B. PRIVATE VOICE (TELEPHONE TYPE) SHALL BE THE PRIMARY VOICE COMMUNICATION MEDIA WITHIN THE SPACE STATION. CAPABILITY OF ACCESSING ANY OTHER TELEPHONE IN THE SPACE STATION SHALL BE PROVIDED. CAPABILITY FOR CONFERENCE CALLS INTERNAL AND EXTERNAL TO THE SPACE STATION SHALL BE PROVIDED. CAPABILITY TO DIAL TELEPHONE STATIONS EXTERNAL TO THE SPACE STATION SHALL BE PROVIDED. CAPABILITY TO RECORD AND PLAYBACK CONVERSATIONS SHALL BE PROVIDED.

C. CAPABILITY SHALL BE PROVIDED TO INTERCONNECT AUDIO AND VIDEO CHANNELS OF THE INTERNAL COMMUNICATION NETWORK WITH THE EXTERNAL COMMUNICATION NETWORK. VIDEO NETWORKS INCLUDED COLOR CHANNEL BANDWIDTHS.

D. THE SPACE STATION TELEVISION REQUIREMENT IS DEFINED IN THE TABLE. THE TELEVISION MONITOR AND CAMERA UNITS WILL CONTAIN APPROPRIATE LOCAL ADJUSTMENT CONTROLS INCLUDING CHANNEL SELECTION.

FUNCTION	CAMERAS	MONITORS
ONBOARD ENTERTAINMENT VIDEO		CREW QUARTERS
VIDEO TRANSMITTED TO GROUND	COLOR OR B/W	
VIDEO DOCKING AID	DOCKING/BERTHING PORTS AND EVA AIRLOCKS B/W	CONTROL CENTER
ON-BOARD EXPERIMENT CCTV	GPL AND EXPR AIRLOCK COLOR AND B/W	GPL AND CONTROL CENTER
ONBOARD OPERATIONS CCTV	PORTABLE, B/W	CONTROL CENTER

3.3.6.1.1.5 SOFTWARE

THE SOFTWARE SHALL CONSIST OF SUPERVISORY APPLICATION, SUPPORT, AND DATA BASE TYPES OF PROGRAMS. WORKING IN CONCERT, THIS SOFTWARE SHALL BE CAPABLE OF SUPPORTING SIMULTANEOUSLY REAL-TIME CONTINUOUS FUNCTIONS, INTERACTIVE FUNCTIONS, AND BATCH FUNCTIONS. ALL SOFTWARE REQUIRED REPETITIOUSLY OVER SHORT TERM PERIODS SHALL RESIDE IN MASS MEMORY AND TRANSFERRED TO OPERATING MEMORY UPON REQUEST. SOFTWARE REQUIRED CONTINUOUSLY AND FOR CRITICAL FUNCTIONS SHALL RESIDE IN OPERATING MEMORY AT ALL TIMES. MSS COMPUTER SOFTWARE SHALL BE MODULAR AND COMPATIBLE.

A. SUPERVISORY PROGRAMS

THE SUPERVISORY PROGRAM SOFTWARE MODULES PROVIDE THE PROCESSING AND CONTROL REQUIRED TO COORDINATE AND SUPERVISE THE OPERATIONS OF THE APPLICATION, SUPPORT, AND DATA BASE PROGRAMS. THE SUPERVISORY MODULES ARE GROUPED INTO THE FOLLOWING CLASSES OF SOFTWARE PROGRAMS.

GROUP 1	I/O SCHEDULING AND CONTROL
GROUP 2	TIMING CONTROL
GROUP 3	PROGRAM INTERACTION CONTROL
GROUP 4	INTERRUP (EXTERNAL AND INTERNAL) PROCESSING
GROUP 5	MULTI-PROCESSOR/MULTI-PROGRAM CONTROL
GROUP 6	TASK SCHEDULER CONTROL
GROUP 7	RESOURCE ALLOCATION CONTROL

B. APPLICATION PROGRAMS

THE APPLICATIONS PROGRAM SOFTWARE MODULES PROVIDE THE PROCESSING AND CONTROL REQUIRED TO CONDUCT OPERATIONS. THE APPLICATIONS MODULES ARE GROUPED INTO THE FOLLOWING CLASSES OF SOFTWARE PROGRAMS.

GROUP 1	FLIGHT OPERATIONS
GROUP 2	ON-BOARD CHECKOUT OPERATIONS
GROUP 3	SYSTEM/SUBSYSTEM OPERATIONS
GROUP 4	EXPERIMENT DATA MANAGEMENT
GROUP 5	OPERATIONS DATA MANAGEMENT
GROUP 6	LOGISTICS MANAGEMENT

C. SUPPORT PROGRAMS

THE SUPPORT PROGRAM SOFTWARE MODULES PROVIDE THE OFF-LINE AND CALLABLE PROCESSING REQUIREMENTS IN SUPPORT OF SUPERVISORY, APPLICATION, AND DATA BASE PROGRAMS. THE SUPPORT MODULES ARE GROUPED INTO THE FOLLOWING PARTIAL

LISTING OF SOFTWARE PROGRAMS.

GROUP 1	DIAGNOSTICS AND FAULT ISOLATION AIDS
GROUP 2	FLIGHT HARDWARE TEST SUPPORT
GROUP 3	COMPLIERS/ASSEMBLERS
GROUP 4	TAPE LIBRARY - MAINTENANCE AND LOADING
GROUP 5	COMPUTATION PROGRAMS
GROUP 6	DATA MANAGEMENT (REPORTS, REDUCTION, COMPRESSION, ETC.)
GROUP 7	DATA BASE TAPE LIBRARY I/O ROUTINES

D. DATA BASE PROGRAMS

THE DATA BASE SOFTWARE MODULES PROVIDES THE MSS OPERATING OFF-LINE DATA BANK IN ARCHIVE/TAPE MEMORY. A PARTIAL LISTING OF TYPICAL DATA BASE PROGRAMS ARE AS FOLLOWS.

GROUP 1	MISSION PLANNING
GROUP 2	FLIGHT HARDWARE CONFIGURATION RECORDS
GROUP 3	EXPERIMENT REFERENCE DATA
GROUP 4	EXPERIMENT CONFIGURATION RECORDS
GROUP 5	EXPERIMENT SENSOR PATTERNS
GROUP 6	FLIGHT LOG
GROUP 7	OPERATION DATA (SATELLITE EPHEMERIDES, MSFN COORDINATES)
GROUP 8	MAINTENANCE SUPPORT INFORMATION
GROUP 9	COMPUTATIONAL, CONVERSION AND PHYSICAL CONSTANTS

TEST, TRAINING, SIMULATION, AND VERIFICATION SOFTWARE PROGRAMS ARE NOT COVERED AS PART OF THE FLIGHT SOFTWARE REQUIREMENTS

3.3.6.1.2 EMERGENCY OPERATIONS

3.3.6.1.2.1 DATA PROCESSING

NO SPECIFIC EMERGENCY REQUIREMENTS IDENTIFIED.

3.3.6.1.2.2 COMMAND/CONTROL AND MONITORING

CAPABILITY SHALL BE PROVIDED TO PERMIT MANUAL CONTROL OF THE MSS ATTITUDE STABILIZATION SYSTEM THROUGH THE RCS CONTROL ELECTRONICS. THIS EMERGENCY CAPABILITY SHALL BE PROVIDED IN BOTH PRESSURE VOLUMES.

3.3.6.1.2.3 EXTERNAL COMMUNICATION

NO SPECIFIC EMERGENCY REQUIREMENTS IDENTIFIED.

3.3.6.1.2.4 INTERNAL COMMUNICATION

NO SPECIFIC EMERGENCY REQUIREMENTS IDENTIFIED.

3.3.6.1.2.5 SOFTWARE

NO SPECIFIC EMERGENCY REQUIREMENTS IDENTIFIED.

3.3.6.1.3 BUILDUP OPERATIONS

3.3.6.1.3.1 DATA PROCESSING

REDUNDANT BUILDUP DATA PROCESSING ASSEMBLIES SHALL BE PROVIDED TO PERFORM THE DATA PROCESSING FUNCTIONS REQUIRED DURING THE BUILDUP PHASE UNTIL SUFFICIENT MODULES CONTAINING THE NORMAL DPA EQUIPMENT ARE ON-ORBIT TO PERFORM THE DPA FUNCTION. THIS ASSEMBLY SHALL PROVIDE THE TIMING, CONTROL, AND DATA ACQUISITION FUNCTIONS REQUIRED FOR MSS HEALTH STATUS DURING BUILDUP. THE PROCESSOR SHALL BE CAPABLE OF ACQUIRING UP TO 60 MEASUREMENTS AND ISSUING UP TO 64 ON-OFF COMMANDS. THE BUILDUP DPA SHALL INTERFACE WITH THE BUILDUP COMMUNICATIONS ASSEMBLY AT 5KBPS TELEMETRY DATA RATE.

3.3.6.1.3.2 COMMAND/CONTROL AND MONITORING

NO SPECIFIC BUILDUP REQUIREMENTS IDENTIFIED.

3.3.6.1.3.3 EXTERNAL COMMUNICATION

BUILDUP COMMUNICATIONS SHALL BE PROVIDED TO PERFORM THE FOLLOWING FUNCTIONS DURING MSS SEQUENTIAL BUILDUP PHASE.

ANTENNAS - SPHERICAL COVERAGE VHF ANTENNA

TRANSPONDERS - DUAL-REDUNDANT WAKE-UP RECEIVER/COMMAND DECODERS - VHF. MINIMUM POWER RECEIVER TO ACTIVATE TELEMETRY LINK FOR MSS RESPONSE AND COMMAND/CONTROL COMMUNICATIONS BETWEEN THE MSS AND THE SHUTTLE AND/OR GROUND ELEMENTS.

3.3.6.1.3.4 INTERNAL COMMUNICATION

HARDWARE INTERCOM SHALL BE PROVIDED BETWEEN SHUTTLE AND MSS DURING BUILDUP.

3.3.6.1.3.5 SOFTWARE

SPECIFIC SOFTWARE WILL BE DEVELOPED TO PERFORM THE STATION KEEPING FUNCTION UTILIZING THE NORMAL DPA DURING EACH STEP OF THE BUILDUP SEQUENCE UNTIL THE STATION IS OPERATIONAL.

3.3.6.2 ISS SECONDARY PERFORMANCE CHARCTERISTICS

3.3.6.2.1 DATA PROCESSING

CENTRAL TIMING - 10 MHZ BASE TIMING FREQUENCY HAS A STABILITY FACTOR OF 5 PARTS PER 10(9) AVERAGE.

DIGITAL DATA BUS IS CAPABLE OF HANDLING DATA RATES UP TO 10 MBPS. THIS CAPABILITY PERMIT GROWTH IN THE INFORMATION MANAGEMENT SYSTEM (RACU, DATA BUS CONTROL UNITS AND COMPUTER CAPABILITY EXPANSION).

THE OVERALL DPA IMPLEMENTED FOR THE INITIAL STATION HAS A PROCESSING RATE OF 2.0 X 10(6) OPERATIONS PER SECOND, EXPANDABLE TO 4.0 X 10(6) OPERATIONS PER SECOND, AN OPERATING MEMORY CAPACITY OF 144 X 10(3) WORDS, EXPANDABLE TO 216 X 10(3) WORDS, A MASS MEMORY CAPACITY OF 704 X 10(3) WORDS, EXPANDABLE TO 1056 X 10(3) WORDS, AN ARCHIVE MEMORY CONSISTING OF TAPE CARTRIDGES THAT CAN EXPAND INDEFINITELY. IN ADDITION, THE ABOUT 50 PERCENT OF THE INITIAL IMPLEMENTATION IS DESIGN MARGIN, ANY UNUSED MARGIN CAPABILITY WOULD BE AVAILABLE FOR EXPERIMENT SUPPORT PROVISION.

3.3.6.2.2 COMMAND/CONTROL AND MONITORING

THE INITIAL STATION IMPLEMENTS TWO OPERATIONS CONSOLES, TWO COMMANDERS CONSOLES AND TWO PORTABLE CONSOLES. ADDITIONAL CONSOLES OF ANY TYPE CAN BE INSTALLED WHERE VOLUME AND DATA BUS CONNECTIONS ARE AVAILABLE. ALL CONSOLES PROVIDE ACCESS TO THE DATA PROCESSING ASSEMBLY FOR COMPUTATION AND DATA FILE ACCESS. ALL CONSOLES MAY BE ACTIVE CONCURRENTLY.

3.3.6.2.3 EXTERNAL COMMUNICATION

K-BAND WILL MAKE A 100 MHZ BANDWIDTH AVAILABLE FOR HIGHER DATA TRANSMISSION RATES IN THE FUTURE. CAPABILITY TO TRANSMIT 5 MBPS DATA TO THE GROUND WILL EXIST.

ALL RF COMMUNICATION CAPABILITIES ARE TWO-WAY, THUS CAPABILITY EXISTS TO RECEIVE FACSIMILE, AND TELEVISION (COLOR OR B AND W) FROM THE GROUND NETWORK. TOTAL DATA CAPABILITY, STATION TO GROUND AT 5.0 X 10(6) BITS PER SECOND, OR ONE NTSC. COLOR TELEVISION SIGNAL, IS LIMITED ONLY BY AVAILABILITY OF TDRS WIDE-BAND CHANNEL. UP TO 20 HOURS OF TELEVISION, OR UP TO 36 X 10(10) BITS PER DAY CAN BE TRANSMITTED. TWO DIRECTIVE K-BAND TERMINALS ARE PROVIDED FOR LINK TO THE TDRS, THESE LINKS MAY ALSO SUPPORT DETACHED RAM, UP TO TWO CONCURRENTLY FOR ABOUT 22 HOURS PER DAY. THE VHF VOICE CAPABILITY CAN BE INCREASED, MODULARLY FROM THREE TO UP TO TWENTY CHANNELS (LIMITED BY TDRS).

3.3.6.2.4 INTERNAL COMMUNICATION

NINE (9) OF TWELVE (12) VOICE CHANNELS AND THREE (3) OF SIX (6) COLOR TV CHANNELS ARE IDENTIFIED AS SECONDARY PERFORMANCE CHARACTERISTICS.

ADDITIONAL AUDIO VIDEO TERMINALS MAY BE INSTALLED, AS WELL AS ADDITIONAL TV CAMERAS AND MONITORS, ADDITIONAL VIDEO, DIGITAL AND VOICE RECORDERS MAY BE INSTALLED.

3.3.6.2.5 SOFTWARE

NO SPECIFIC SECONDARY PERFORMANCE CHARACTERISTICS IDENTIFIED.

3.3.6.3 ISS EXPERIMENT PROVISIONS

3.3.6.3.1 DATA PROCESSING

THE DATA PROCESSING ASSEMBLY WILL PROVIDE THE FOLLOWING CAPABILITY TO SUPPORT EXPERIMENTS.

COMPUTER SPEED	1,045 X 10(3) OPERATION/SEC
*OPERATING MEMEORY	64 X 10(3) 32 BIT WORDS
*MASS MEMEORY	22 X 10(3) 32 BIT WORDS
ARCHIVE MEMORY	AS REQUIRED - TAPE CARTRIDGES
DATA BUS RATE	2,000 X 10(3) BITS PER SEC

* OPERATING AND MASS MEMORY MAY BE EXPANDED IN MODULAR INCREMENTS OF 16K 32 BIT WORDS AND 64K 32 BIT WORD RESPECTIVELY.

3.3.6.3.2 COMMAND/CONTROL AND MONITORING

ONE OF THE TWO OPERATION CONTROL CONSOLE WILL BE AVAILABLE FOR EXPERIMENTS.

3.3.6.3.3 EXTERNAL COMMUNICATION

THE EXTERNAL COMMUNICATIONS ASSEMBLY WILL PROVIDE THE FOLLOWING CAPABILITY TO SUPPORT EXPERIMENTS.

DATA TYPE	NO CHANNELS	
	S-BAND	K-BAND
VOICE - FULL DUPLEX	3	3
EXP. TLM - DRAM TO MSS	2	1
EXP. CONTROL/COMPUTER DATA - MSS TO DRAM	2	1
EXP. TLM - MSS TO GROUND	1	1
TV - B AND W - DRAM TO MSS	2	1
TV - B AND W OR COLOR - MSS TO GROUND	1	1
TEXT/GRAPHICS - DIGITAL - GROUND TO MSS	1	1
- FACSIMILE - DUPLEX	1	1
RANGING - DRAM/MSS -	LOS*	LOS*
DATA COMM DISTANCE	LOS*	LOS*
TV COMM DISTANCE	450 NM	LOS*

* LOS = LINE OF SIGHT (APPROX 2800 NM).

3.3.6.3.4 INTERNAL COMMUNICATION

THE INTERNAL COMMUNICATIONS ASSEMBLY WILL PROVIDE THE FOLLOWING CAPABILITY TO SUPPORT EXPERIMENTS.

DATA TYPE	CHNLS/STATIONS
VOICE - PRIVATE/CONFERENCE - TELEPHONE	3 CHNLS
VOICE - PUBLIC ADDRESS	2 STATIONS
CCTV - B AND W OR COLOR	3 CHNLS
RECORD/PLAYBACK - AUDIO/VIDEO - REAL TIME	2 STATIONS

3.3.6.3.5 SOFTWARE

SPECIFIC SOFTWARE WILL BE DEVELOPED FOR EACH INDIVIDUAL EXPERIMENT.

3.3.6.4 SUBSYSTEM DEFINITION

THE TECHNICAL DATA PRESENTED IN THIS SECTION DOES NOT CONTAIN DESIGN-TO REQUIREMENS. THIS DATA REFLECTS THE CONCISE DESCRIPTION OF THE TECHNICAL PARAMETERS THAT FORM THE CURRENT BASELINE SUBSYSTEM DEFINITION. THE SUMMATION OF THESE CHARACTERISTICS, WITH THOSE OF THE OTHER SIX FUNCTIONAL SUBSYSTEMS, FORM THE BASIS FOR CONFIGURATION LAYOUT, WEIGHT STATEMENTS, AND POWER PROFLIES FOR THE MODULAR SPACE STATION SYSTEM.

THE INFORMATION SUBSYSTEM CONSISTS OF FOUR MAJOR HARDWARE ASSEMBLIES AND ONE SOFTWARE SECTION WHICH INTERFACES WITH DPA. THE INTERFACING OF THESE MAJOR HARDWARE ASSEMBLIES IS DEPICTED IN FIGURE 3.3.6.4-1 ISS BLOCK DIAGRAM.

3.3.6.4.1 MAJOR ASSEMBLIES

3.3.6.4.1.1 DATA PROCESSING

THE DATA PROCESSING ASSEMBLY FUNCTIONAL BLOCK DAIGRAM DEPICTED IN FIGURE 3.3.6.4.1-1 SHOWS THE LOCATION OF THE MAJOR DPA SUBASSEMBLIES IN THE INITIAL MSS MODULES, AND THERE INTERNAL INTERFACING VIA THE DIGITAL DATA BUS.

3.3.6.4.1.2 COMMAND/CONTROL AND MONITORING

THE COMMAND/CONTROL AND MONITORING ASSEMBLY FUNCTIONAL BLOCK DIAGRAM DEPICTED IN FIGURE 3.3.6.1.1-2 SHOWS THE LOCATION OF THE C/C AND M MAJOR SUBASSEMBLIES AND THERE INTERFACING VIA THE DIGITAL DATA, AUDIO/VIDEO, AND ENTERAINMENT/PAGING DATA BUSSES.

3.3.6.4.1.3 EXTERNAL COMMUNCATIONS

THE EXTERNAL COMMUNICATION ASSEMBLY BLOCK DIAGRAM DEPICTED IN FIGURE 3.3.6.4.1-3 SHOWS THE LOCATION OF THE EXTERNAL COMMUNICATION SUBASSEMBLIES IN THE MSS AND INTERNAL INTERFACING WITH ALL OF THE INTERNAL COMMUNICATION BUSSES AND THE VHF, S-BAND, AND K-BAND EXTERNAL COMMUNICATION LINKS.

3.3.6.4.1.4 INTERNAL COMMUNICATIONS

THE INTERNAL COMMUNICATIONS ASSEMBLY FUNCTIONAL BLOCK DIAGRAM DEPICTED IN FIGURE 3.3.6.4.1-4 SHOWS THE LOCATION OF THE SUBASSEMBLIES IN THE MSS AND INTERNAL INTERFACING VIA ALL OF THE INTERNAL COMMUNICATION BUSSES.

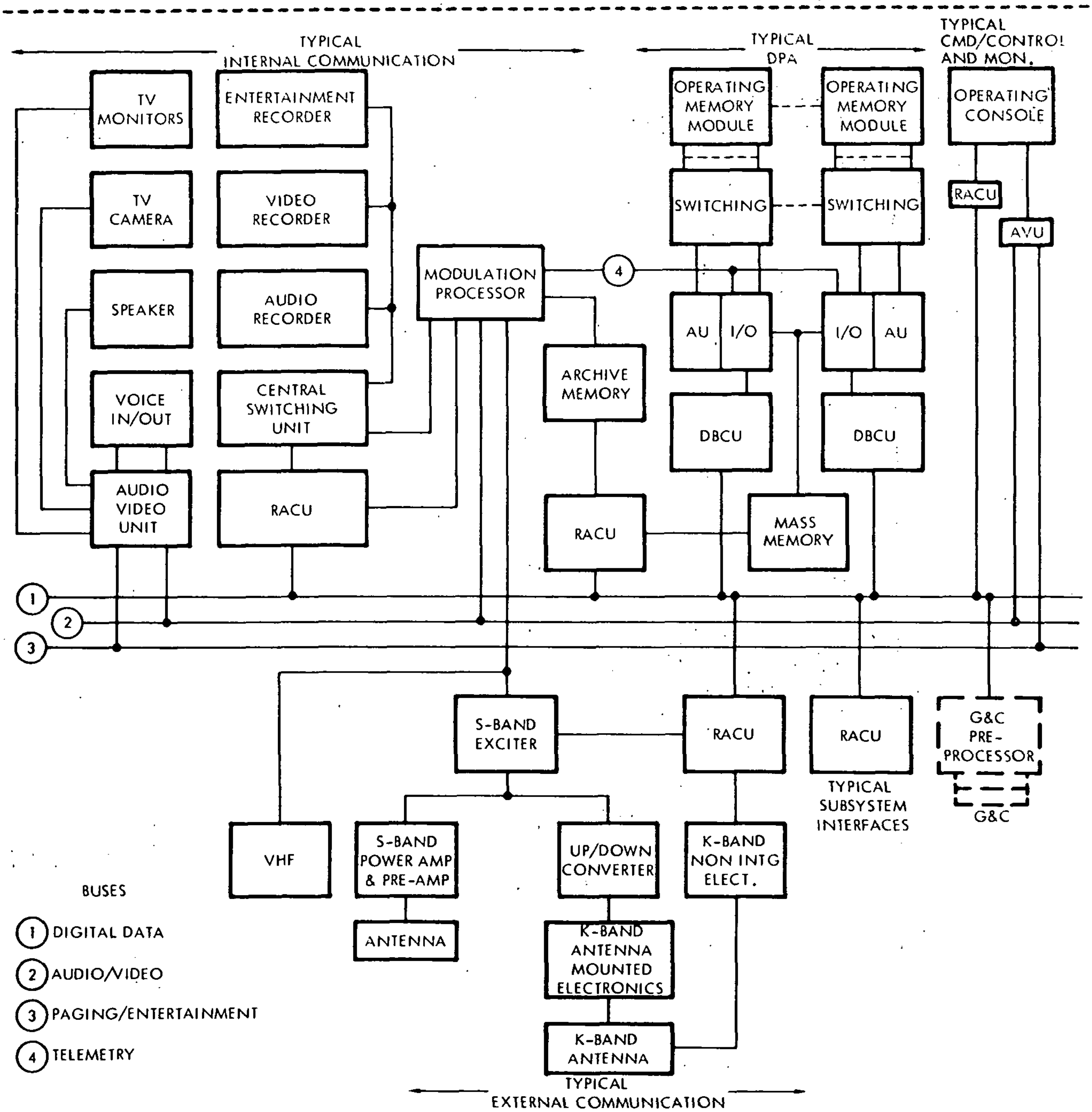


FIGURE 3.3.6.4-1 ISS BLOCK DIAGRAM

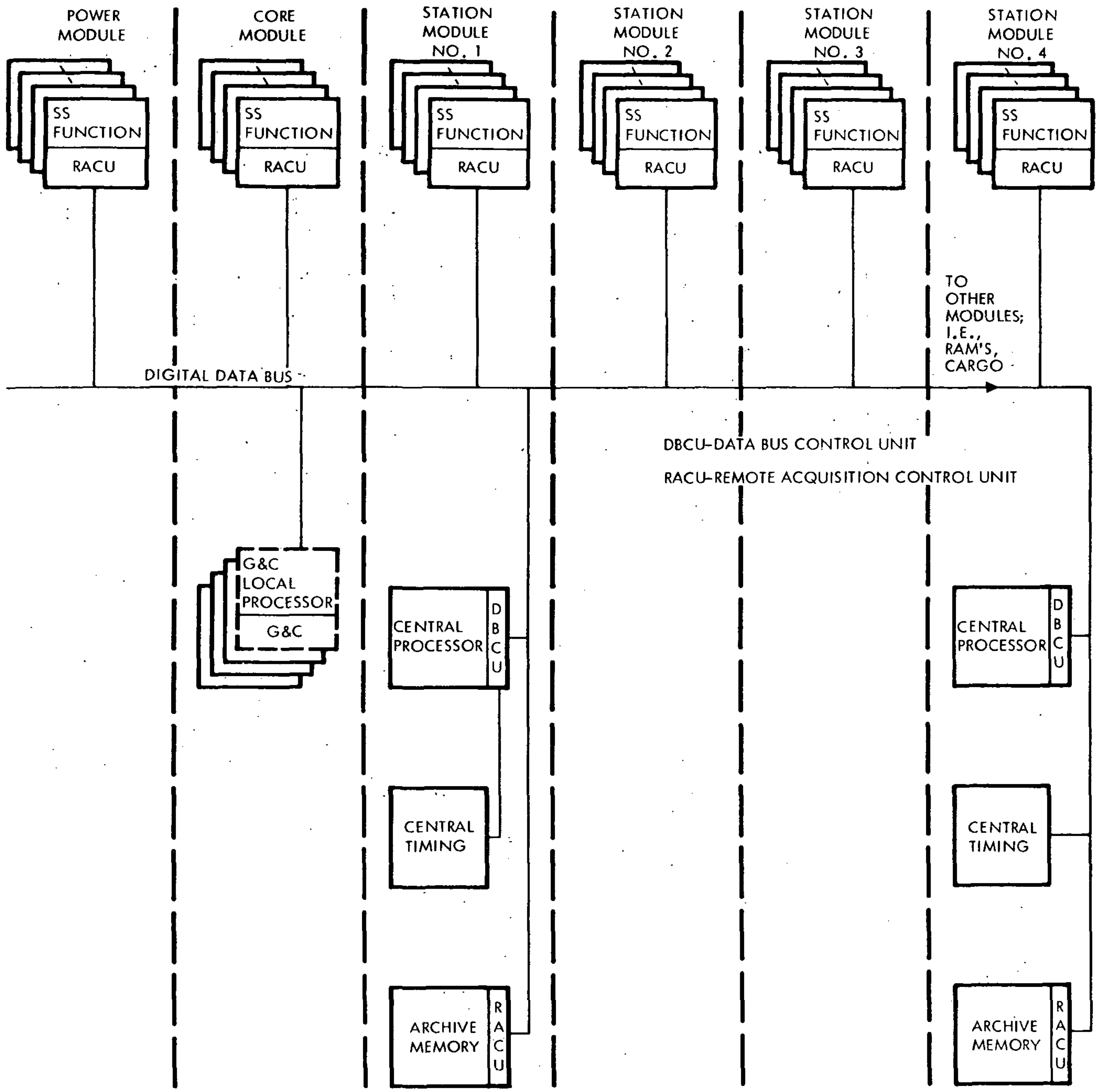


FIGURE 3.3.6.4.1-1 DATA PROCESSING ASSEMBLY BLOCK DIAGRAM

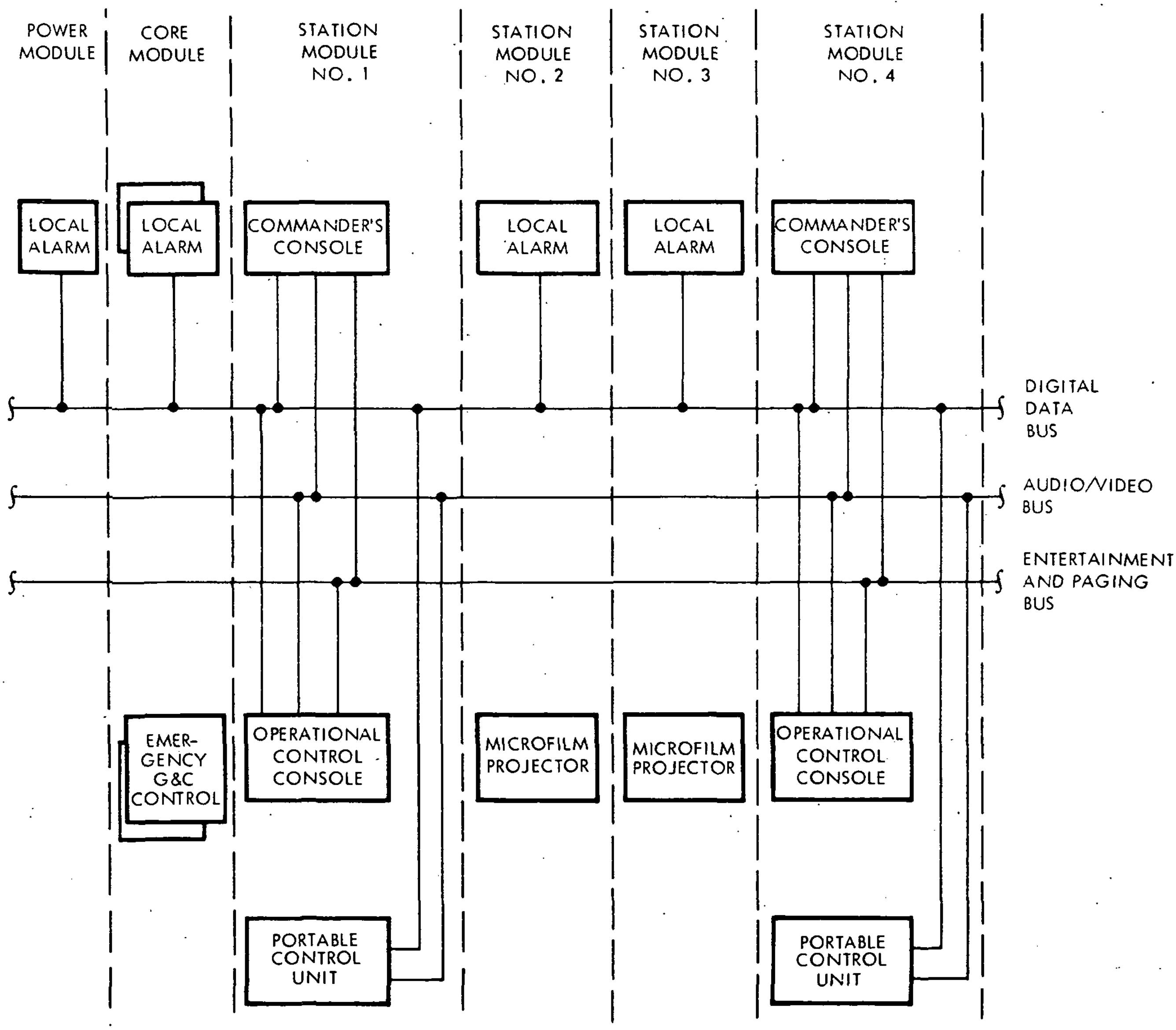


FIGURE 3.3.6.4.1-2 CMD/CONTROL AND MONTIORING BLOCK DIAGRAM

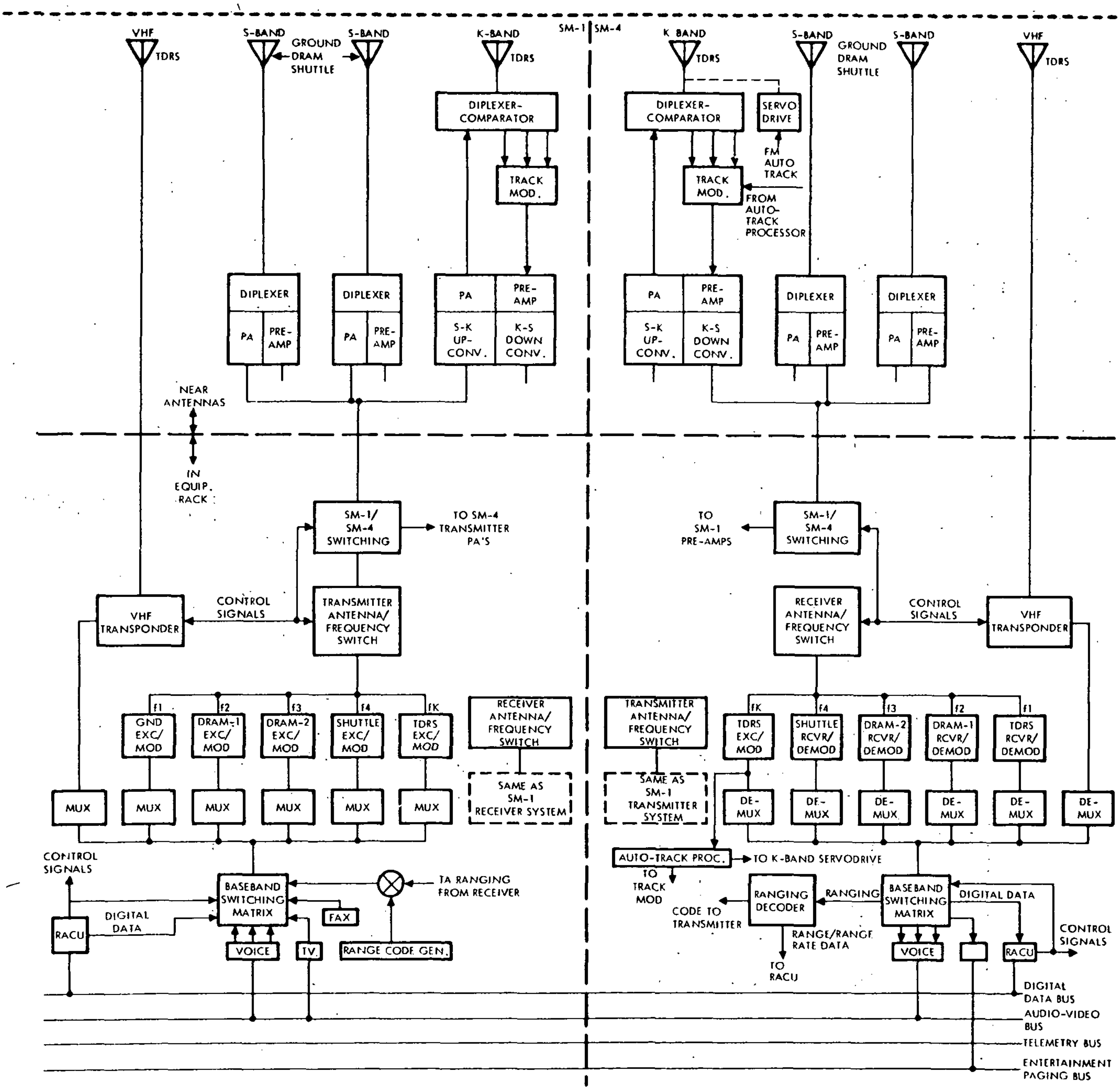


FIGURE 3.3.6.4.1-3 EXTERNAL COMMUNICATION ASSEMBLY BLOCK DIAGRAM

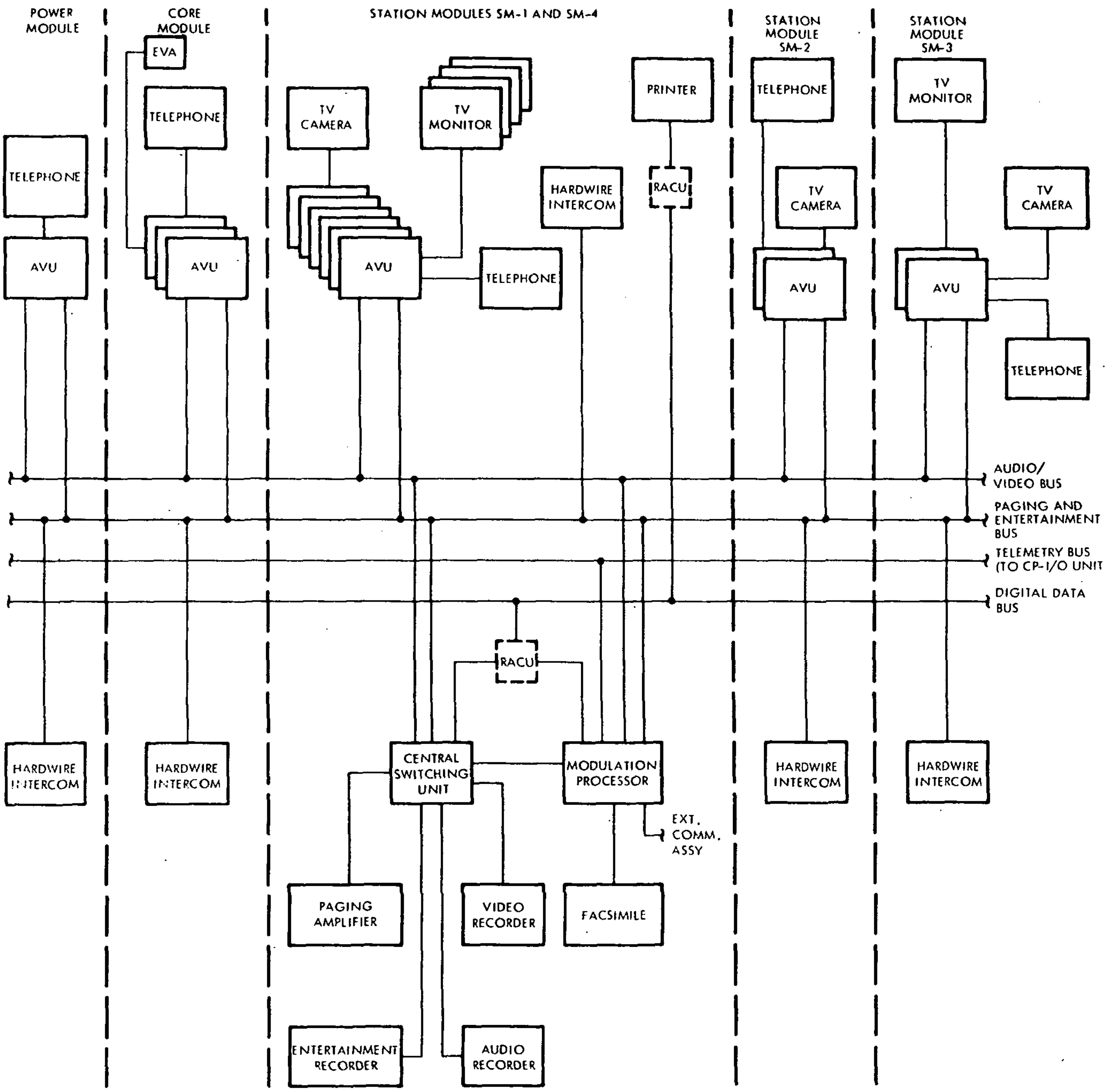


FIGURE 3.3.6.4.1-4 INTERNAL COMMUNICATION ASSEMBLY BLOCK DIAGRAM

3.3.6.4.2 WEIGHT, POWER, AND SIZE CHARACTERISTICS

TABLE 3.3.6.4.2-1 ISS WEIGHT CHARACTERISTICS

MAJOR ASSEMBLY	WEIGHT (LBS)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
6.0 ISS							
6.1 DATA PROCESSING	171	91	692	64	64	692	1774
6.2 CMD/CNTRL AND MONITORING	59	4	478	40	40	478	1099
6.3 EXTERNAL COMM.	193	0	849	0	0	749	1791
6.4 INTERNAL COMM.	39	21	641	30	57	641	1429
6.5 SOFTWARE	0	0	80	0	0	80	160
TOTAL	462	116	2740	134	161	2640	6253

TABLE 3.3.6.4.2-2 POWER CHARACTERISTICS

MAJOR ASSEMBLY	POWER (WATTS - 24 HOUR AVE)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
6.0 ISS							
6.1 DATA PROCESSING	360	135	554	180	180	609	2018
6.2 CMD/CNTRL AND MONITORING	6	1	442	12	12	475	948
6.3 EXTERNAL COMM.	0	0	98	0	0	175	273
6.4 INTERNAL COMM.	6	2	135	4	80	298	525
6.5 SOFTWARE	0	0	0	0	0	0	0
TOTAL	372	138	1229	196	272	1557	3764

TABLE 3.3.6.4.2-3 UNIT CHARACTERISTICS/LOCATIONS/QTY

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES)			CORE	PWR	SM-1	SM-2	SM-3	SM-4
			H	W	D						
6.1 DATA PROCESSING											
Data Bus Control	25	15	(a)					1			1
Central Timing	30	18	(a)					1			1
Central Processor	495	554	(b)					1			1
RACU	*15	5	5	5	4	24	9	12	12	12	12
Buildup Data Processor	50	40	13	14	10	1	1				
6.2 COMMAND/CONTROL & MONITORING											
Operational Control Console	431	331	48	50	31			1			1
Commander's Control Console	257	67	23	27	18			1			1
Emergency G and C Control	4	25	6	6	9	2					
Portable Control Unit	240	57	15	16	20			1			1
Local Monitor/Alarm	5	3	4.5	10	3	2	1		1	1	
Microfilm Projector	50	35	11	9	14				1	1	
6.3 EXTERNAL COMMUNICATIONS											
KU-Band Antenna	50	630	60 Inch Dia.		96			1			1
KU Ant. Mounted Electronics	220	80	15	12	10			1			1
KU Non-Integrated Electronics	30	20	10	10	8			1			1
S-Band Antenna	---	1	6 Inch Dia.		8	2		2			2
S-Band Transponder	150	30	12	16	5	(c)2		2			(c)0
VHF Antenna	---	1	4	4	2	2		2			2
VHF Transponder	85	20	12	6	5	(c)2		2			(c)0
Buildup Communications	85	34	5	16	14	2					

*Additional 10 Watts Included with each RACU to distribute instrumentation/stimuli power.

TABLE 3.3.6.4.2-3 UNIT CHARACTERISTICS/LOCATIONS/QTY (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES)			CORE	PWR	SM-1	SM-2	SM-3	SM-4
			H	W	D						
6.4 INTERNAL COMMUNICATIONS											
Communications Rack	466	291	24	38	17			1			1
Recording Unit	85	135	32	18	17			1			1
Audio/Video Unit	6	9	6	6	2	3	1	6	2	2	6
Hardwire Intercomm	0	10	6	6	2	1	1	1	1	1	1
TV Camera - Color	50	5	8	6	12			1			1
TV Camera - Band-W	40	4	7	5	12			1			1
TV Monitor - Color	225	25	9	9	14			4		1	4
6.5 SOFTWARE											
Computer Programs	0	65	30	19	15			1			1
Microfilm	0	15	6	5	10			1			1
Printer/Facsimile Paper (consumable)	0	60	16	16	12			1			1

(c) Transfer from Core Module to SM-4 during buildup.
(b) Mounted in operations control console.
(a) Mounted in mass memory rack.

3.3.6.5 ISS SUBSYSTEM INTERFACES

3.3.6.5.1 INFORMATION/STRUCTURAL AND MECHANICAL

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS

RACU MEMORY SIZE - 4 K (32 BIT) WORDS

RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND STORAGE.

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.6.4.2-3.
STRUCTURES SHALL PROVIDE FOR THE DISTRIBUTION AND ROUTING OF AUDIO/VIDEO, PAGING AND ENTERTAINMENT, TELEMETRY, AND DIGITAL DATA BUSSES.

3.3.6.5.2 INFORMATION/ENVIRONMENTAL CONTROL AND LIFE SUPPORT

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS

RACU MEMORY SIZE - 4 K (32 BIT) WORDS

RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND STORAGE.

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

ECLSS SHALL PROVIDE EQUIPMENT COOLING FOR HEAT LOADS AS SPECIFIED IN TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION.

3.3.6.5.3 INFORMATION/ELECTRICAL POWER

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS

RACU MEMORY SIZE - 4 K (32 BIT) WORDS

RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND STORAGE.

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

THE ISS SHALL PROVIDE SUBSYSTEM ELECTRICAL LOAD CONTROL AND MANAGEMENT.

THE ISS SHALL PROVIDE SOLAR ARRAY AND FUEL CELL CONTROL AND MANAGEMENT.

THE ISS SHALL PROVIDE THE ENERGY STORAGE MANAGEMENT FUNCTION.

EPS SHALL PROVIDE REDUNDANTLY DISTRIBUTED REGULATED 120/208 V, 400 HZ, AC AND 56 VDC (IF REQUIRED) ELECTRICAL POWER. THE QUALITY OF THE POWER SHALL BE PER MIL-STD-704 EXCEPT FOR THE DC LINE DROP WHICH SHALL BE 2.5 VOLTS MAXIMUM BETWEEN THE LOADS AND THE REGULATED BUS. WIRE PROTECTION SHALL BE PROVIDED FOR ALL LOADS CONNECTED TO THE EPS DISTRIBUTION BUSES. WHERE APPLICABLE, REDUNDANT DEVICES SHALL BE EMPLOYED. CRITICAL LIFE SUPPORT LOADS SHALL BE MAINTAINED DURING EMERGENCIES AFFECTING ELECTRICAL POWER FOR A MINIMUM OF 96 HOURS. EPS SHALL PROVIDE ELECTRICAL POWER (24 HOUR AVERAGE WATTS) AS SPECIFIED (AT THE LOAD BUSES) BELOW -

SUBSYSTEM	BUILDUP STEP 1	BUILDUP STEP 2	NORMAL OPERATIONS	EMERGENCY OPERATIONS
ISS	30	30	3764	174

3.3.6.5.4 INFORMATION/GUIDANCE AND CONTROL

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS

RACU MEMORY SIZE - 4 K (32 BIT) WORDS

RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	9
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND STORAGE.

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

THE FOLLOWING G/C COMPUTATIONS SHALL BE PERFORMED BY THE ISS.

- CMG DESATURATION REQUIREMENTS (TIME-TO-SATURATION PREDICTION)
- CURRENT STATION ATTITUDE AND RATE AND REFERENCE ATTITUDE ALIGNMENT
- POSITION VECTOR OF TARGETS OF OPPORTUNITY (TRACKED BY CREW USING G/C SEXTANT/TELESCOPE
- SHUTTLE RETURN-TO-EARTH GUIDANCE PARAMETERS
- EXPERIMENT G/C REFERENCE CALIBRATION DATA
- GUIDANCE TARGETING AND DELTA-V COMMANDS FOR RENDEZVOUS, DEPLOYMENT AND STATION KEEPING OF DETACHED RAMS AND SHUTTLE VEHICLES.
- REACTION JET COMMANDS AND DELTA-V PREDICTIONS FOR STATION ORBIT MAINTENANCE
- G/C CONFIGURATION STATUS (REAL TIME)
- G/C OPERATION STATUS (MODE)
- REAL TIME FAILURE IDENTIFICATION AND MAINTENANCE/REPLACEMENT REQUIREMENTS
- ENERGY MANAGEMENT COMPUTATIONS ASSOCIATED WITH JET FIRINGS
- CONTROL MODELLING PARAMETER ESTIMATE AND ADAPTION
- STAR TRACKER POINTING COMMANDS
- STATE VECTOR PROPOGATION AND UPDATE FOR DRAMS AND STATION KEEPING AND COLLISION AVOIDANCE COMPUTATIONS.
- FPE GROUND TRACK AND POINTING ANGLE.

THE ISS SHALL PROVIDE THE FOLLOWING DATA TO THE G/C IN SUPPORT OF COMPUTATION.

- VEHICLE CONFIGURATION AND SOLAR PANEL ATTITUDE
- SOLAR PANEL ORIENTATION COMMANDS
- SUN AND MOON EPHEMERIDES
- STAR CATALOGUE
- GROUND UPLINK DATA
- RANGE, RANGE RATE AND LOS
- SCHEDULED INITIATION OF STATION DELTA-V AND CMG DESATURATION
- REACTION JET ATTITUDE CONTROL INHIBITS AND JET FAILURE DATA

- CREW INTERFACE - MANUAL NAVIGATION SIGHTINGS, OPERATION MODE COMMANDS, CONFIGURATION COMMANDS, MAINTENANCE-IN-PROGRESS/ ACCOMPLISHED DATA
- SUBROUTINES AND BULK STORAGE DATA LOADS
- PERMANENT AND TEMPORARY DATA STORAGE
- EXPERIMENT REFERENCE ALIGNMENT
- MANEUVER SCHEDULE
- TIMING SIGNAL AT 1 KHZ RATE

THE G/C SHALL PROVIDE THE FOLLOWING INFORMATION TO THE ISS IN SUPPORT OF EXPERIMENTS -

- CURRENT STATION ATTITUDE (INSTANTANEOUS KNOWLEDGE WITHIN 0.10 DEG) AND REFERENCE ATTITUDE ALIGNMENT
- POSITION VECTORS OF TARGETS OF OPPORTUNITY
- CURRENT STATION ESTIMATED STATE VECTOR
- EXPERIMENT TO G/C REFERENCE CALIBRATION DATA
- GUIDANCE TARGETING AND DELTA-V COMMANDS FOR RENDEZVOUS, REENTRY, DOCKING AND STATION KEEPING OF DETACHED RAMS

THE G/C SHALL PROVIDE THE FOLLOWING OPERATIONAL INFORMATION TO THE ISS -

- SUBSYSTEMS STATUS
- FLIGHT MODE STATUS
- ATTITUDE, ATTITUDE ERROR, RATE AND DELTA-V INFORMATION
- CMG GIMBAL ANGLES AND RATES

ORIENTATION DATA WITHIN THE FOLLOWING LIMITS -

- ALTITUDE UNCERTAINITY +/- 1500 FT (1 SIGMA)
- IN-TRACK UNCERTAINTY +/- 3*00 FT (1 SIGMA)
- CROSS TRACK +/- 2200 FT (1 SIGMA)
- ORBITAL VELOCITY +/- 3.5 FT/SEC

THE G/C SHALL PROVIDE THE ISS WITH MEASUREMENTS PRECONDITIONED TO A 0 TO 5 VDC RANGE WITH A SOURCE IMPEDANCE OF LESS THAN 1000 OHMS.

3.3.6.5.5 INFORMATION/REACTION CONTROL

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS

RACU MEMORY SIZE - 4 K (32 BIT) WORDS

RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND DATA STORAGE.

RCS SHALL PROVIDE STATUS DATA FOR ALL PROPELLANT VALVES AND ENGINES TO DETERMINE THEIR OPEN-CLOSED OR ON-OFF CONDITIONS.

RCS SHALL PROVIDE PROPELLANT LINE, PROPELLANT ACCUMULATOR, AND ENGINE PACKAGE TEMPERATURE AND PRESSURE MEASUREMENTS TO THE ISS TO FACILITATE THE CONTROL AND MONITORING OF THE RCS.

RCS SHALL PRECONDITION ALL MEASUREMENTS TO A 0 TO 5 VDC RANGE WITH A SOURCE IMPEDANCE OF LESS THAN 1000 OHMS.

3.3.6.5.6 INFORMATION/INFORMATION

DOES NOT APPLY

3.3.6.5.7 INFORMATION/CREW HABITABILITY

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS

RACU MEMORY SIZE - 4 K (32 BIT) WORDS

RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND DATA STORAGE.

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

THE ISS SHALL PROVIDE THE FOLLOWING INFORMATION TO CREW HABITABILITY.

- ALARMS AND DISPLAYS

  AUDIO AND VISUAL ALARMS SHALL BE PROVIDED IN ALL HABITABLE AREAS. VISUAL ALARMS SHALL BE USED PRIMARILY TO ALERT THE CREW TO THE PRESENCE OF DANGEROUS OR POTENTIALLY DANGEROUS SITUATIONS. ISS ACCESS DISPLAYS SHALL BE PROVIDED WITHIN THE COMMANDERS STATE-ROOM.

- COMMUNICATIONS

  TWO-WAY INTERCOMMUNICATIONS SHALL BE PROVIDED BETWEEN EACH OF THE INDIVIDUAL CREW STATEROOMS, PRIMARY GALLEY, BACKUP GALLEY, DINING AREA, RECREATION AREA, PERSONAL HYGIENE AREAS, CREW EXERCISE AREA, MEDICAL TREATMENT AREA, CREW WORK STATIONS, INTER-VOLUME AIRLOCK, AND EXPERIMENT AREAS.

  TWO-WAY HARDLINE AND RF COMMUNICATIONS CAPABILITY SHALL BE PRO-VIDED BETWEEN THE PRIMARY AND BACKUP CONTROL STATIONS AND CREWMEN PERFORMING EVA IN PRESSURE SUITS. TWO-WAY HARDLINE COMMUNICATIONS CAPABILITY SHALL BE PROVIDED BETWEEN THE PRIMARY AND BACKUP CONTROL STATIONS AND CREWMEN PERFORMING IVA. THE CAPABILITY FOR PRIVATE COMMUNICATIONS WITH THE GROUND SHALL BE PROVIDED WITHIN EACH OF THE INDIVIDUAL CREW STATEROOMS UNDER STATION OPERATOR CONTROL. THE CAPABILITY TO RECEIVE SELECTABLE ENTERTAINMENT TYPE AUDIO AND VIDEO COMMUNICATIONS (MUSIC AND TV) SHALL BE PROVIDED SIMULTANEOUS WITHIN EACH OF THE INDIVIDUAL CREW STATEROOMS.

  THE CAPABILITY TO RECEIVE SELECTABLE ENTERTAINMENT TYPE AUDIO COMMUNICATIONS (MUSIC) SHALL BE PROVIDED WITHIN THE GALLEY, PRIMARY DINING AREA AND RECREATION AREA.

  THE CAPABILITY TO BROADCAST (TIME DELAYED) SELECTABLE EARTH RADIO AND TELEVISION PROGRAMS SHALL BE PROVIDED WITHIN THE RECREATION AREA.

- INVENTORY CONTROL

  THE CAPABILITY FOR INVENTORY CONTROL OF FOOD SUPPLIES AND MENU PLANNING SHALL BE PROVIDED FOR THE PRIMARY AND BACKUP GALLEYS. THE CAPABILITY FOR INVENTORY CONTROL OF CREW CLOTHING AND BEDDING SHALL BE PROVIDED.

AS A GOAL, CREW/HABITABILITY SHALL PROVIDE 15 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

MODULAR SPACE STATION - INITIAL STATION SYSTEM
3.3.7 CREW AND HABITABILITY

THIS SUBSYSTEM IS ONE OF THE SEVEN FUNCTIONAL GROUPINGS OF MAJOR SUBSYSTEMS THAT COMPROMISE THE SHUTTLE LAUNCH MODULAR SPACE STATION.

PREPARED	W.E. Baker	SYSTEM RQMTS/INTERFACES
APPROVAL	C.L. Buckman	SUBSYSTEM PROJECT ENGR
APPROVAL	M.R. Schall	SUBSYSTEM PROJECT MGR
APPROVAL	[illegible]	PROJECT ENGINEERING MGR

3.3.7 CREW HABITABILITY SUBSYSTEM

3.3.7.1 LIFE SUPPORT CRITERIA

GENERAL

1. THE SPACE STATION INTERIOR SHALL BE DESIGNED IN ACCORDANCE WITH GOOD ARCHITECTURAL AND DECORATOR PRACTICES IN ORDER TO PROVIDE COMFORTABLE, EFFICIENT AND ATTRACTIVE LIVING AND WORK SPACES. THE INTERIOR ARRANGEMENT SHALL INSURE CREW COMFORT, EFFICIENCY, AND PSYCHOLOGICAL AND PHYSIOLOGICAL WELL-BEING. AS A GOAL THE ARRANGEMENT OF ALL EQUIPMENT WITHIN A GIVEN AREA SHALL BE IN AN UPRIGHT (EARTH-LIKE) ORIENTATION.

2. THE SPACE STATION INTERIOR SHALL BE PARTITIONED INTO BASIC FUNCTIONAL AREAS INCLUDING -

INDIVIDUAL CREW STATEROOMS
FOOD PREPARATION, PRESERVATION AND SERVING AREAS
DINING AREA
RECREATION AREA
PERSONAL HYGIENE AREAS
EXERCISE AREA
MEDICAL TREATMENT AREA
WORK, OPERATION AND EXPERIMENT AREAS
STORAGE AREAS
AISLES, PASSAGEWAYS AND FLEXPORTS

3. THE CEILING HEIGHT IN ALL GENERAL MOBILITY AREAS ABOVE DECK SHALL BE A MINIMUM OF 82 INCHES. BELOW DECK, THE MINIMUM HEIGHT FOR GENERAL MOBILITY AREAS SHALL BE 62 INCHES WITH NO PROTRUSIONS.

4. ALL EQUIPMENT INSTALLATIONS WITHIN THE SPACE STATION SHALL BE CAPABLE OF USE FOR PUSH-OFF, AND SHALL BE CAPABLE OF REACTING TO CREW IMPACT LOADS (300 POUNDS LIMIT APPLIED IN ANY DIRECTION).

5. ALL EQUIPMENT INSTALLED WITHIN THE SPACE STATION SHALL BE SUCH THAT ACCESS TO THE PRESSURE HULL CAN BE ACHIEVED FOR INSPECTION AND/OR REPAIR. THE ACCESS PROVISIONS SHALL BE SUCH THAT A SUITED/PRESSURIZED CREWMAN CAN GAIN ACCESS TO THE PRESSURE HULL.

6. MOBILITY SPACE

MOBILITY SPACE REQUIREMENTS SHALL BE AS SPECIFIED IN THE FOLLOWING TABLE

FUNCTIONAL AREA	NOMINAL SPACE INCHES
GENERAL STATEROOMS	36 X 54
CMDR'S/EXEC STATEROOMS	48 X 60
PRIMARY GALLEY	38 X 60
BACKUP GALLEY	30 X 36
PRIMARY DINING AREA	30
RECREATION AREA	30
PERSONAL HYGIENE FACILITIES	30
CREW EXERCISE AREA	30
MEDICAL TREATMENT AREA (AROUND EXAM TABLE)	24 BOTH ENDS 36 BOTH SIDES
CREW WORK STATIONS	
CONSOLES - CREW STANDING	24 WIDE 22 DEEP
- CREW SEATED	28 WIDE 32 DEEP
TABLES AND BENCHES	30 X 36
SPACE BEHIND CONSOLES	28
AISLES AND PASSAGEWAYS	
CREWMAN ONLY	32
EQUIPMENT	60

7. ACCESS

TO BE DETERMINED

8. WALL TO WALL AREA AND STORAGE VOLUMES

FUNCTIONAL AREA	NO REQD V2	NO REQD V1	MIN SQ FT/FAC	STORAGE CUFT/FAC	SHAPE FACTOR
GENERAL STATEROOM	2	2	50	30	1-1,8.5-6, HEIGHT SHALL ALLOW CREW MEMBERS TO MANEUVER ERECT BETWEEN STATEROOM FACILITIES
CMDRS STATEROOM/OFFICE BACKUP CONTROL	0	1	90	55	
EXEC STATEROOM	1	0	90		
PERSONAL HYGIENE					
WITH SHOWER	0	1	54	} 30	
WITHOUT SHOWER	1	0	38		
PRIMARY CONTROL CTR 2	1	0	50	50	
PRIMARY CONTROL CTR 1	0	1	50	TBD	
PRIMARY GALLEY	0	1	85	TBD	
BACKUP GALLEY	1	0	15	TBD	MIN LENGTH-TO-WIDTH 3-5 MIN WIDTH-TO-LENGTH 1-3
DINING/RECREATION	0	1	160	TBD	MIN LENGTH-TO-WIDTH 3-5 MIN WIDTH-TO-LENGTH 1-3
PRIME CREW CARE/EXER	1	0	190	140-190	
BACKUP MED CARE/EXER	0	1	51	2	
EVA/IVA AIRLOCK	1		35	C	44 IN DIA X 60 IN LENGTH

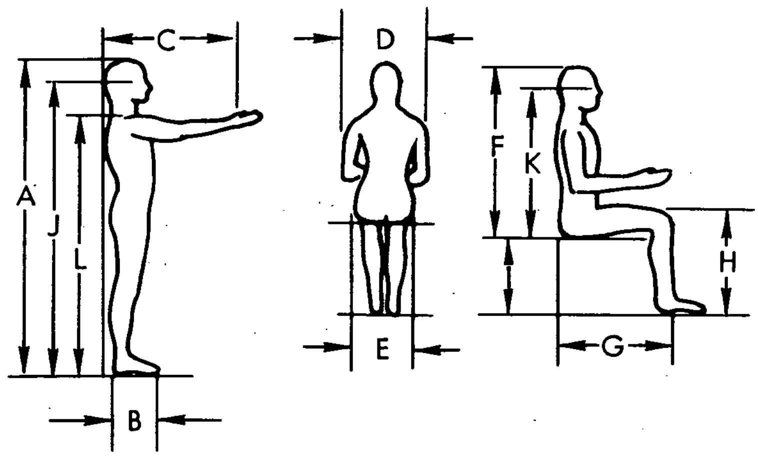
FUNCTIONAL AREA	NO REQD V2	NO REQD V1	MIN SQ FT/FAC	STORAGE CUFT/FAC	SHAPE FACTOR
GPL (PHYSICS)	0	1	34		
GPL (BIOMED/BIOLOG)	0	1	34		
GPL (MECH, ELECT, OPTICAL MAINT)	1	0	232	490	
GPL (PHOTO LAB)	0	1	33	TBD	
GPL (DATA ANALYSIS)	0	1	95	TBD	
EXPMT CPS (ZENITH A/L)	0	1	100	TBD	
EXPMT CPS (NADIR A/L)	1	0	168	TBD	
EXPMT AIRLOCKS	1	1	60		80 IN DIA X 150 IN LENGTH ONE EARTH ORIENTED ONE ZENITH ORIENTED

NOTES
(1) WHERE TWO VOLUME SIZES APPEAR IN THE STORAGE COLUMN, THE FIRST REPRESENTS THE VOLUME REQUIRED IN THE IMMEDIATE AREA, THE SECOND IS THE TOTAL VOLUME REQUIRED FOR THE FACILITY ON THE SPACE STATION.
(2) CONVENIENT ACCESS TO PERSONAL HYGIENE AREAS IS REQUIRED. PRIVACY IS A PRIME CONSIDERATION WITH CAPABILITIES TO ACCOMMODATE MALE AND FEMALE CREW MEMBERS (NOT NECESSARILY AT THE SAME TIME).

A. CREW DIMENSIONAL CRITERIA

MALE CREW MEMBERS

PERTINENT CREWMAN DIMENSIONS, FOR A 5TH AND 95TH PERCENTILE CREW MEMBER, PRESENTED IN FIGURE 3.3.7.1-2 SHALL BE USED FOR DEVELOPING SPACE STATION INTERIOR ARRANGEMENTS. THESE STANDARD ANTHROPOMETRIC DIMENSIONS ARE FOR A MALE WEARING LIGHTWEIGHT CLOTHING. STANDING HEIGHT, EYE HEIGHT (STANDING), SHOULDER HEIGHT AND KNEE HEIGHT (SITTING), SHALL BE INCREASED BY 1.0 INCH BY THE ADDITION OF SHOES.

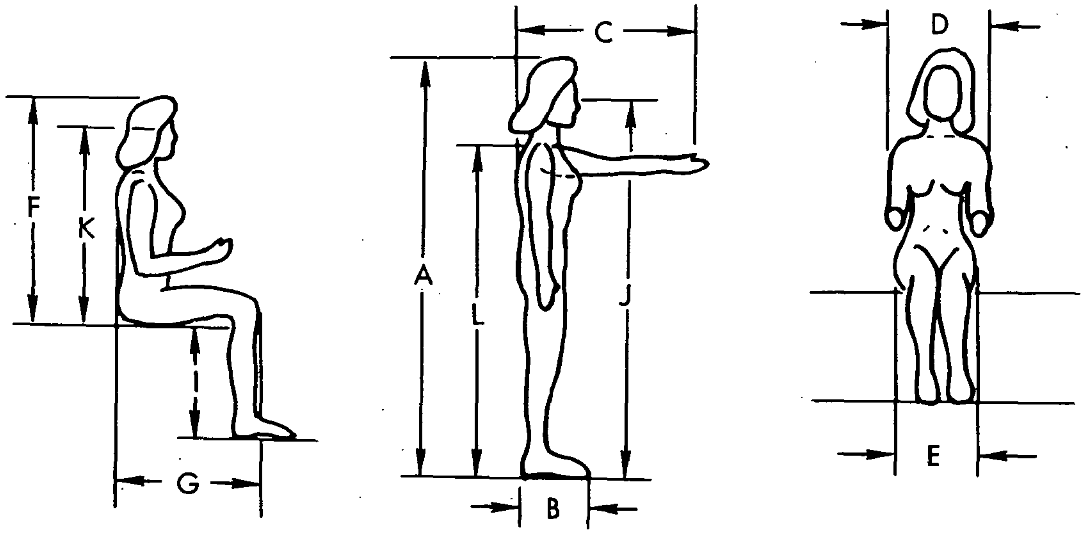


DIMENSION	PERCENTILE (INCHES) 5	95	DIMENSION	PERCENTILE (INCHES) 5	95
A-STANDING HEIGHT	65.2	73.1	H-KNEE HEIGHT(SITTING)	20.1	23.3
B-FOOT LENGTH	9.9	11.4	I-POPLITEAL HEIGHT	15.7	18.2
C-FUNCTIONAL REACH (THUMBTIP)	29.4	35.0	J-EYE HEIGHT(STANDING)	60.8	68.6
			K-EYE HEIGHT(SITTING)	29.4	33.5
D-SHOULDER BREADTH	16.5	19.4	L-SHOULDER HEIGHT (STANDING)	52.8	60.2
E-HIP BREADTH (SITTING)	12.7	15.4			
F-SITTING HEIGHT	33.8	38.0	M-WEIGHT (POUNDS)	132.5	200.8
G-BUTTOCK-KNEE LENGTH	21.9	25.4			

FIGURE 3.3.7.1-2 PERTINENT MALE CREWMAN DIMENSIONS (BASED ON WADC SURVEY, 1954)

FEMALE CREW MEMBERS

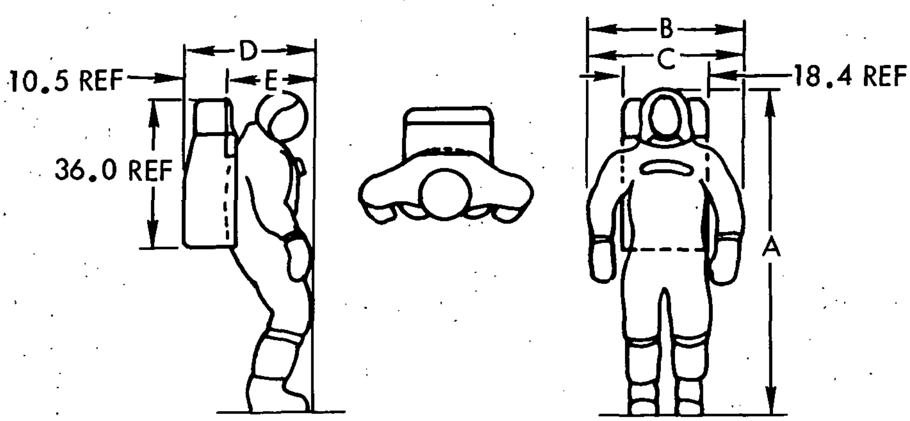
PERTINENT FEMALE CREW MEMBER DIMENSIONS, FOR A 5TH AND 95TH PERCENTILE CREW MEMBER, PRESENTED IN FIG 3.3.7.1-3 SHALL ALSO BE USED FOR DEVELOPING SPACE STATION INTERIOR ARRANGEMENTS. THESE STANDARD ANTHROPOMETRIC DIMENSIONS ARE FOR A FEMALE WEARING LIGHTWEIGHT CLOTHING. STANDING HEIGHT, EYE HEIGHT (STANDING), SHOULDER HEIGHTS, STANDING AND SITTING SHALL BE INCREASED BY ONE INCH BY THE ADDITION OF SHOES.



DIMENSION	PERCENTILE (INCHES) 5	95	DIMENSION	PERCENTILE (INCHES) 5	95
A-STANDING HEIGHT	61.7	68.9	H-KNEE HEIGHT(SITTING)	18.7	21.5
B-FOOT LENGTH	8.7	10.2	I-POPLITEAL HEIGHT	14.7	17.5
C-FUNCTIONAL REACH (THUMBTIP)	29.7	34.1	J-EYE HEIGHT(STANDING)	57.0	63.8
			K-EYE HEIGHT(SITTING)	27.7	31.0
D-SHOULDER BREADTH	14.9	17.6	L-SHOULDER HEIGHT (STANDING)	48.2	55.4
E-HIP BREADTH (SITTING)	13.5	16.9			
F-SITTING HEIGHT	32.4	36.0	M-WEIGHT (POUNDS)	102.0	148.2
G-BUTTOCK-KNEE LENGTH	21.1	24.2			

FIGURE 3.3.7.1-3 PERTINENT FEMALE CREW MEMBER DIMENSIONS (BASED ON WADC TECH REPORT 56-30, 1958)

RELEVANT ENVELOPE DIMENSIONS FOR A SUITED PRESSURIZED MALE CREW MEMBER WEARING A PORTABLE LIFE SUPPORT SYSTEM (BACKPACK) ARE PRESENTED IN FIGURE 3.3.7.1-4. THE MAXIMUM ANTERIOR-POSTERIOR DIMENSIONS FOR A SUITED/PRESSURIZED MODE UTILIZING AN UMBILICAL LIFE SUPPORT SYSTEM IN LIEU OF A PORTABLE BACKPACK ARE ALSO SHOWN. THESE DIMENSIONS SHALL BE EMPLOYED FOR DESIGN PURPOSES WHERE SUITED/PRESSURIZED TRANSIT OR ACCESS IS EITHER REQUIRED OR ANTICIPATED.



DIMENSION	PERCENTILE (INCHES)	
	5	95
A-HEIGHT	67.5	75.5
B-MAX BREADTH AT ELBOWS (ARMS RELAXED)	*	29.4
C-MAX BREADTH AT ELBOWS (ARMS AT SIDE)	*	26.4
D-MAX DEPTH WITH PORTABLE LIFE SUPPORT SYSTEM (PLSS) AND BACKUP OXYGEN (OPS)	26.0	28.4
E-MAX DEPTH WITHOUT PLSS/OPS	15.5	17.9
WEIGHT (POUNDS), WITH PLSS/OPS	316.0	385.3
WEIGHT (POUNDS), WITHOUT PLSS/OPS	190.3	259.6

* INDICATES DATA NOT AVAILABLE.
FOR DIMENSIONS D AND E 2 INCHES HAVE BEEN ADDED TO MAXIMUM CHEST OF SUITED/PRESSURIZED CREWMAN FOR PLSS CONTROL BOX TO OBTAIN ENVELOPE DIMENSIONS.
MEASUREMENTS MADE ON A7L PGA, PRESSURIZED TO 3.75 PSIG.

FIGURE 3.3.7.1-4 SUITED/PRESSURIZED MALE CREW MEMBER ENVELOPE DIMENSIONS

B. METABOLIC CRITERIA

1. THE FOLLOWING SPECIFIES METABOLIC CRITERIA FOR LIGHT ACTIVITY IN A SHIRTSLEEVE, 14.7 PSIA (20.9 PERCENT OXYGEN, 79.1 PERCENT NITROGEN) ENVIRONMENT, AND SHALL BE USED FOR DESIGN PURPOSES.
METABOLIC LOAD (NOMINAL) - 11,900 BTU/MAN/DAY, EQUIVALENT TO 3,000 KCAL/MAN/DAY
OXYGEN CONSUMPTION (NOMINAL) - 1.84 LBS/MAN/DAY
CARBON DIOXIDE PRODUCTION (NOMINAL) - 2.25 LBS/MAN/DAY
WATER BALANCE (NOMINAL) - 7.10 LBS/MAN/DAY.

2. AVERAGE METABOLIC RATES FOR VARIOUS ACTIVITIES ARE LISTED BELOW -

SLEEPING	280 BTU/HR
EATING	450 BTU/HR
WORKING (LIGHT ACTIVITY)	600 BTU/HR
EXERCISE (MODERATE TO HEAVY)	1,600 BTU HR
RECREATION (RELAXATION)	400 BTU/HR
PERSONAL HYGIENE ACTIVITIES	465 BTU/HR
EVA/IVA (SUITED/PRESSURIZED)	1,200 BTU HR

C. WATER CRITERIA

1. SUFFICIENT POTABLE WATER SHALL BE PROVIDED FOR THE CREW TO MAINTAIN WATER BALANCE. POTABLE WATER REQUIREMENTS IN POUNDS/MAN/DAY, BASED ON A METABOLIC LOAD OF 11,900 BTU/MAN/DAY, ARE AS FOLLOWS -

HUMAN WATER BALANCE	CABIN PRESSURE	
	14.7 PSIA	10.0 PSIA
WATER GAIN		
WATER OF OXIDATION (FROM FOOD)	0.78	0.78
BEVERAGES PLUS WATER IN FOOD	6.32	6.47
TOTALS	7.10	7.25
WATER LOSS		
INSENSIBLE (LUNGS + LATENT)	2.44	2.69
SENSIBLE (PERSPIRATION)	1.06	0.96
URINE	3.45	3.45
WATER IN FECES	0.15	0.15
TOTALS	7.10	7.25

2. SUFFICIENT WATER SHALL BE PROVIDED FOR WASHING AND CLEANING TO SATISFY THE FOLLOWING REQUIREMENTS -

CREW WASH WATER - 4.0 POUNDS/MAN/DAY
CREW SHOWER WATER (BASED ON TWO SHOWERS/MAN/WEEK AT 16.6 POUNDS OF WATER/SHOWER) - 4.9 POUNDS/MAN/DAY
HOUSEKEEPING - 0.4 POUNDS/MAN/DAY
LAUNDRY - NOT REQUIRED

3. HOT WATER (155 DEGREES F +/- 5 DEGREES F) AND COLD WATER (50 DEGREES F +/- 5 DEGREES F) SHALL BE PROVIDED IN SUFFICIENT QUANTITIES FOR CREW USAGE IN BOTH PERSONNEL HYGIENE AREAS AND FOOD PREPARATION AREAS.

4. THE CAPABILITY SHALL BE PROVIDED FOR MIXING HOT AND COLD WATER IN A SUITABLE RATIO, SO AS TO PROVIDE WATER AT A TEMPERATURE COMFORTABLE FOR CREW WASHING AND SHOWERING.

D. FOOD MANAGEMENT CRITERIA

FOOD SHALL BE PROVIDED FOR CREW CONSUMPTION IN ACCORDANCE WITH THE FOLLOWING REQUIREMENTS -

1. THE SPACE STATION FOOD MANAGEMENT SHALL PROVIDE THE CREW WITH NUTRITIOUS FOOD HAVING A HIGH DEGREE OF ACCEPTABILITY, AND SHALL PROVIDE A REASONABLE MENU SELECTION FOR THE INDIVIDUAL CREWMAN.

2. THREE PRIMARY MEALS SHALL BE SERVED OR SHALL BE AVAILABLE FOR EACH 24-HOUR PERIOD, AND PROVISIONS SHALL BE MADE FOR BETWEEN-MEAL SNACKS.

3. DAILY CALORIC REQUIREMENTS SHALL BE AS FOLLOWS -
NORMAL DIET - 3,000 KCAL/MAN
CONTINGENCY DIET (SHORT DURATION) - 2,600 KCAL/MAN (MINIMUM)

4. FOOD MANAGEMENT PREPARATION, PRESERVATION AND STORAGE
THE BASIC PRIMARY GALLEY SHALL INCLUDE A SINK FOR HAND WASHING; A RECONSTITUTION DEVICE (SUPPLYING METERED HOT AND COLD WATER AT TEMPERATURES OF 155 DEG F +/- 5 DEG AND 50 DEG F +/- 5 DEG, RESPECTIVELY, FOR PREPARATION OF DRIED AND FREEZE DRIED FOODS); A FOOD PREPARATION OVEN(S) CAPABLE OF HEATING 5 LBS OF FOOD FROM 0 TO 160 DEG F IN 30 MINUTES; STORAGE FOR FROZEN FOOD, AT TEMPERATURES BETWEEN -10DEG. F. AND +5 DEG.F.; CHILLED FOOD STORAGE CAPABLE OF MAINTAINING TEMPERATURES BETWEEN +35 DEG.F. AND +45 DEG.F.; TRASH DISPOSAL/COMPACTION EQUIPMENT; FOOD PREPARATION, SERVING AND EATING UTENSILS; FOOD TRAY STORAGE, AND A PORTABLE (VACUUM) CLEANING DEVICE.

THE BACKUP GALLEY, LOCATED IN SM-2, SHALL INCLUDE PROVISIONS FOR STORAGE AND PREPARATION OF DRIED/FREEZE-DRIED AND THERMO-STABILIZED FOODS. THESE PROVISIONS SHALL INCLUDE A RECONSTITUTION DEVICE (SUPPLYING METERED HOT AND COLD WATER AT TEMPERATURES OF 155 +/-5 DEG F AND 50 +/-5 DEG F RESPECTIVELY, FOR RECONSTITUTING DRIED/FREEZE DRIED FOODS); FOOD WARMING TRAYS (SKYLAB-TYPE) FOR WARMING THERMO-STABLIZED FOODS. SUFFICIENT VOLUME FOR STORING 290 LBS OF DRIED/FREEZE-DRIED FOOD; 130 LBS OF THERMO-STABILIZED FOOD; AND APPROXIMATELY 55 LBS OF UTENSILS. A FOOD SPILLAGE UNIT OR PORTABLE VACUUM CLEANER SHALL ALSO BE PROVIDED.

THE PRIMARY GALLEY STORAGE AREAS SHALL BE SIZED TO ACCOMMODATE THE FOLLOWING LISTS OF FOOD TYPES, WEIGHTS AND VOLUMES FOR A CREW OF 6 MEN FOR 120 DAYS WITHOUT RESUPPLY-

*DRIED AND FREEZE DRIED FOODS	1170 LBS.	56.0 $FT.^3$
FROZEN FOODS	780 LBS.	37.5 $FT.^3$
*THERMO-STABILIZED FOOD	520 LBS.	25.0 $FT.^3$
FRESH FOODS	130 LBS.	6.5 $FT.^3$
TOTAL	2600 LBS.	125.0 $FT.^3$

*CAN BE STORED AT AMBIENT ROOM TEMPERATURES.

REFRIGERATOR STORAGE REQUIREMENTS SHALL INCLUDE THE FOLLOWING CONSIDERATIONS -

3 CU FT FOR SCIENTIFIC EXPERIMENT STORAGE
6.5 CU FT FOR FRESH FOOD
5 CU FT FOR OPENED BULK FOODS (THERMO-STABILIZED)

5. THE FOOD SUPPLY CHARACTERISTICS TO SUPPORT THE ABOVE SHALL BE AS FOLLOWS -

TOTAL FOOD SUPPLY (DRY)	1.68 LBS/MAN/DAY
NOMINAL FOOD INTAKE (DRY	1.50 LBS/MAN/DAY
DRIED FOODS (ALL TYPES)	1.04 LBS/MAN/DAY
DRY PORTION OF WET FOODS (FROZEN, CANNED, FRESH)	0.64 LBS/MAN/DAY
FOOD NOT INGESTED	0.18 LB/MAN/DAY
WATER IN WET FOODS	0.96 LB/MAN/DAY
PACKAGING MATERIAL	
DRIED FOODS	0.73 LB/MAN/DAY
WET FOODS	0.45 LB/MAN/DAY

6. PREPARATION CAPABILITY SHALL BE PROVIDED FOR INDIVIDUALLY AND BULK PACKAGED FOODS.

E. ATMOSPHERE

1. THE CABIN ATMOSPHERE SHALL CONSIST OF AN OXYGEN NITROGEN MIXTURE AT A NORMAL OPERATING PRESSURE OF 14.7 PSIA, BUT CAPABLE OF OPERATING AT SELECTED PRESSURES BETWEEN 10 PSIA AND 14.7 PSIA. THE ATMOSPHERIC TOTAL PRESSURE SO PROVIDED WILL MAINTAIN THE PARTIAL PRESSURE OF OXYGEN IN THE ALVEOLAR SPACES OF THE LUNGS BETWEEN THE LIMITS OF 100 MMHG TO 120 MMHG. THE VARIOUS OXYGEN/NITROGEN MIXTURES NECESSARY TO PROVIDE A PARTIAL PRESSURE OF OXYGEN OF 3.08 PSI AND AN ALVEOLAR PARTIAL PRESSURE OF OXYGEN OF 100 MMHG, FOR CABIN ATMOSPHERES RANGING FROM 14.7 TO 10.0 PSIA, ARE AS FOLLOWS -

OXYGEN (PERCENT BY VOL)	NITROGEN (PERCENT BY VOL)	CABIN PRESSURE (PSIA)
20.9	79.1	14.7
21.0	79.0	14.65
22.0	78.0	14.0
23.0	77.0	13.4
24.0	76.0	12.8
25.0	75.0	12.3
26.0	74.0	11.8
27.0	73.0	11.4
28.0	72.0	11.0
29.0	71.0	10.6
30.0	70.0	10.25
30.9	69.1	10.0

2. CARBON DIOXIDE TENSIONS ON THE SPACE STATION SHALL BE MAINTAINED BELOW 3.0 MMHG IN ALL HABITABLE AREAS.

3. THE ATMOSPHERE CONSTITUENTS, INCLUDING HARMFUL AIRBORNE TRACE CONTAMINANTS SHALL BE MONITORED AND CONTROLLED IN EACH PRESSURIZED COMPARTMENT OF THE SPACE STATION.

4. IN THE EVENT OF SPACE STATION PRESSURE HULL DAMAGE RESULTING IN PRESSURE DECAY IN A PRESSURE VOLUME, THE DURATION OF ACCEPTABLE CREW PERFORMANCE SHALL BE CONSIDERED TO BE THAT PERIOD OF TIME UNTIL A PARTIAL PRESSURE OF OXYGEN OF 1.9 PSI IS REACHED.

5. EVA/IVA SUPPORT

THE FOLLOWING EVA/IVA SUPPORT SHALL BE REQUIRED

IVA SUPPORT

O2 NOMINAL MAX FLOW - 8 LB/MAN-HR
O2 EMERGENCY FLOW - 22 LB/MAN-HR FOR 30 MINUTES
O2 INLET TEMP - 40 TO 64 DEG F
HEAT LOAD PEAK - 2000 BTU/MAN-HR
SUIT PRESSURE - SOURCE REGULATE TO 110 PSIG
LCG WATER FLOW - 240 LB/HR AT 48 DEG F

PLSS CHARGING

O2 PER RECHARGE	-	1.6 LBS
H2O PER RECHARGE	-	10.8 LBS
RECHARGE PRESSURE	-	1410 +/-30 PSI
CHARGING FREQUENCY	-	2 UNITS PER MONTH

6. TEMPERATURE

(1) TEMPERATURE SETTINGS WILL BE ADJUSTABLE OVER THE FOLLOWING MINIMAL RANGES WITHIN HABITABLE AREAS -

STATEROOMS	65 TO 75 DEG F
PRIMARY GALLEY	65 TO 75 DEG F
RECREATION AREAS	65 TO 75 DEG F
PERSONAL HYGIENE	65 TO 80 DEG F
EXERCISE AREA	60 TO 75 DEG F
MEDICAL TREATMENT	65 TO 80 DEG F
LABS, MAINT/REPAIR	65 TO 75 DEG F
OPERATIONAL AREAS	65 TO 75 DEG F
DINING AREA	65 TO 75 DEG F

(2) THE TEMPERATURE OF INTERIOR EXPOSED SURFACES WITH WHICH A CREW MEMBER MAY COME IN CONTACT SHALL NOT BE LESS THAN 57 DEG F NOR MORE THAN 105 DEG F.

F. HUMIDITY

1. THE WATER VAPOR PARTIAL PRESSURE SHALL BE MAINTAINED BETWEEN 9 TO 12 MMHG, AND NO CONDENSATION SHALL FORM ON INTERNAL SURFACES.

G. AIR VELOCITY

1. THE AIR VELOCITY SHALL BE MAINTAINED BETWEEN 15 FEET PER MINUTE (MINIMUM) AND 100 FEET PER MINUTE (MAXIMUM), WITH 40 FEET PER MINUTE AS THE NOMINAL VENTILATION FLOW RATE. THE CAPABILITY SHALL BE PROVIDED TO ADJUST THE FLOW RATE FOR CREW COMFORT.

H. ODOR CONTROL

1. PROVISIONS FOR ODOR CONTROL SHALL BE PROVIDED WITHIN EACH PRESSURIZED COMPARTMENT OF THE SPACE STATION.

2. SPECIAL CONSIDERATIONS FOR ODOR CONTROL SHALL BE GIVEN TO THE FOLLOWING AREAS -

FOOD PREPARATION AREAS
PERSONAL HYGIENE AREAS
EXERCISE AREA
MEDICAL TREATMENT AREA

I. CONTAMINATION CONTROL

1. MICROBIOLOGICALLY AND BACTERIOLOGICALLY CONTAMINATED WASTE MATERIAL SHALL BE DISINFECTED AS CLOSE AS POSSIBLE TO ITS SOURCE PRIOR TO STORAGE, PROCESSING OR DISPOSAL.

2. THE CONCENTRATION OF BACTERIA WITHIN THE ATMOSPHERE, WITHIN EACH OF THE PRESSURIZED COMPARTMENTS CONTAINING CREW QUARTERS, PROCESS LABORATORIES OR EXPERIMENTAL FACILITIES, SHALL BE MONITORED AND CONTROLLED BY APPROPRIATE MEANS.

3.3.7.2 CREW APPAREL AND LINENS

CREW APPAREL SHALL INCLUDE THOSE GARMENTS CUSTOMARILY WORN BY THE CREW IN A SHIRTSLEEVE MODE OF OPERATION. THEY SHALL PROVIDE FOR GENERAL COMFORT, WARMTH AND PERSPIRATION ABSORPTION. ARTICLES OF CLOTHING REQUIRED, UNIT WEIGHTS, USAGE RATES, AND QUANTITIES REQUIRED FOR EACH CREW MEMBER FOR A 120 DAY SPACE STATION RESIDENCY ARE SHOWN IN TABLE 3.3.7.2-1. ALL CLOTHING EXCEPT UNDERWEAR ARE CONSIDERED FOR BOTH MALE AND FEMALE. THESE EXCEPTIONS ARE INCLUDED BELOW.

TABLE 3.3.7.2-1 CREW MEMBER CLOTHING REQUIREMENTS

ITEM	UNIT WEIGHT LBS	USAGE RATES (DAYS)		QUANTITY/CREW MEMBER FOR 120 DAYS NOMINAL USE
		NOM	MAX	
SHIRT (SHORT SLEEVE)	0.27	3	6	40
TROUSERS	0.77	6	12	20
JACKET	0.83	AS REQ'D		1
UNDERWEAR (UPPER) MALE	0.17	2	3	60
UNDERWEAR (LOWER) MALE	0.17	2	3	60
UNDERWEAR (UPPER) FEMALE	0.13	1	2	120
UNDERWEAR (LOWER) FEMALE	0.09	1	2	120
SOCKS	0.04	2	3	60
SHOES	0.55	NOT APPLICABLE		2

LINEN REQUIREMENTS FOR THE CREW FOR A 120 DAY MISSION ARE SHOWN IN TABLE 3.3.7.2-2.

TABLE 3.3.7.2-2 CREW LINEN REQUIREMENTS

ITEM	UNIT WEIGHT LBS	USAGE RATES (DAYS)		QUANTITY/CREW FOR 120 DAYS NOMINAL USE
		NOM	MAX	
SHEETS	0.37	6	10	20
BLANKETS	1.00	NOT APPLICABLE		1
TOWELS	0.75	3	6	40
WASHCLOTHS	0.08	3	6	40

3.3.7.3 CREW PERSONAL EFFECTS

CREW PERSONAL EFFECTS SHALL INCLUDE TOILET ARTICLES, GROOMING EQUIPMENT, CLEANSERS, AND ITEMS OF PERSONAL EQUIPMENT OF THE INDIVIDUAL CREWMAN'S CHOICE AND SHALL BE IN ACCORDANCE WITH THE FOLLOWING -

ITEM	WEIGHT (LBS)
TOILET ARTICLES (TOOTHBRUSH, TOOTHPASTE, ETC.)	4.0
GROOMING EQUIPMENT (SHAVING EQUIPMENT, COMBS, HAIR AND NAIL TRIMMING, ETC.)	6.5
CLEANSERS (SOAP, ANTISEPTICS, DEODORANTS, SHAMPOO, ETC.)	7.5
PERSONAL EQUIPMENT (ITEMS OF CREW'S CHOICE), INCLUDES PERSONAL CREW MEDICAL SUPPLIES PER INDIVIDUAL CREW MEDICAL HISTORY.	8.0

3.3.7.4 EMERGENCY PERSONAL EQUIPMENT

EMERGENCY PERSONAL EQUIPMENT SHALL CONSIST OF AN EMERGENCY OXYGEN FULL FACE MASK, WHICH SHALL PROVIDE FOR EMERGENCY BREATHING IN THE EVENT OF SMOKE OR TOXIC GASES. THREE OXYGEN MASKS SHALL BE PROVIDED IN EACH MODULE. AN INTEGRAL OXYGEN BOTTLE ON EACH MASK SHALL PROVIDE A MINIMUM 5-MINUTE OXYGEN SUPPLY.

3.3.7.5 MISCELLANEOUS PERSONAL EQUIPMENT

PERSONAL RADIATION DOSIMETERS SHALL BE PROVIDED FOR EACH CREWMAN. THEY SHALL BE WORN AT ALL TIMES (IN POCKETS ON CREW GARMENTS), AND SHALL BE CAPABLE OF MEASURING ACCUMULATED RADIATION DOSAGE.

3.3.7.6 EVA/IVA PRESSURE GARMENT ASSEMBLIES

A TOTAL OF 4 CONSTANT VOLUME PRESSURE GARMENT ASSEMBLIES (PGA) AND THEIR SUPPORT EQUIPMENT SHALL BE PROVIDED, EVENLY DISTRIBUTED BETWEEN THE MAJOR PRESSURE VOLUMES.

A. EACH PGA SHALL PROVIDE A MOBILE LIFE SUPPORT CHAMBER FOR A CREWMAN, AND SHALL CONTAIN A 100 PERCENT OXYGEN ENVIRONMENT AT AN OPERATING PRESSURE OF 8.0 +/-0.5 PSIG. THE PGA ENVIRONMENT SHALL BE SUPPLIED BY EITHER OF THE FOLLOWING, DEPENDENT UPON THE MODE OF OPERATION.

1. EVA - A SELF-CONTAINED PORTABLE LIFE SUPPORT SYSTEM (PLSS)

WITH AN ATTACHED OXYGEN PURGE SYSTEM (OPS) (EMERGENCY OXYGEN SUPPLY).

2. IVA- THROUGH AN UMBILICAL SYSTEM FROM THE SPACE STATION ECLSS, CONNECTING TO A PRESSURE CONTROL UNIT (PCU) WORN ON THE PGA. THE CAPABILITY TO USE THE PLSS/OPS FOR IVA OPERATIONS SHALL ALSO BE PROVIDED.

B. WHEN AN UMBILICAL SYSTEM IS UTILIZED, THESE UMBILICALS SHALL SUPPLY OXYGEN AND LIQUID COOLING CAPABILITY, AND SHALL PROVIDE FOR TWO-WAY VOICE COMMUNICATIONS, TRANSMISSION OF BIOINSTRUMENTATION SIGNALS FROM THE CREWMAN, AND TRANSMISSION OF ELECTRICAL POWER AND CAUTION/WARNING SIGNALS TO THE CREWMAN. UMBILICALS FOR IVA USAGE SHALL BE PROVIDED TO PERMIT A MAXIMUM OF 2 SUITED PRESSURIZED CREWMEN TO REACH ANY LOCATION IN ANY MODULE OF THE OTHER PRESSURE VOLUME.

C. IN ADDITION TO THE PLSS/OPS OR UMBILICALS/PCU FOR LIFE SUPPORT, THE FOLLOWING EQUIPMENT SHALL BE REQUIRED FOR USE WITH EACH PGA.

1. LIQUID COOLING GARMENT (LCG) - SHALL BE WORN AS AN UNDERGARMENT FOR THE PGA, TO PROVIDE FOR GENERAL COMFORT, PERSPIRATION ABSORPTION AND THERMAL TRANSFER BETWEEN THE CREWMAN'S BODY AND THE GARMENT'S COOLING MEDIA.

2. FECAL CONTAINMENT EQUIPMENT (FCE) - SHALL BE WORN AS AN UNDERGARMENT FOR THE LCG, TO PERMIT DEFECATION DURING A SUITED MODE.

3. URINE COLLECTION AND TRANSFER EQUIPMENT (UCTE) - SHALL BE WORN OVER THE LCG WHILE A CREWMAN IS IN THE PGA, TO PROVIDE FOR THE COLLECTION AND INTERMEDIATE STORAGE OF URINE. SUBSEQUENT TRANSFER OF URINE FROM THE UCTE TO THE SPACE STATION WASTE MANAGEMENT ASSEMBLY SHALL BE REQUIRED, UTILIZING A UCTE CLAMP AND A UCTE TRANSFER ADAPTER.

4. BIOINSTRUMENTATION ASSEMBLY - SHALL BE WORN WITH THE LCG, TO PROVIDE THE CAPABILITY FOR PHYSIOLOGICAL MONITORING OF A CREWMAN.

5. PERSONAL COMMUNICATIONS EQUIPMENT - SHALL BE WORN WITH THE PGA TO PROVIDE DUAL EARPHONES AND DUAL MICROPHONES FOR CREW VOICE COMMUNICATIONS CAPABILITY.

6. EXTRAVEHICULAR (EV) GLOVES - SHALL BE WORN FOR EVA IN LIEU OF THE INTRAVEHICULAR (IV) GLOVES NORMALLY PROVIDED FOR THE PGA.

3.3.7.7 CREW MOBILITY AIDS

CREW MOBILITY AIDS IN THE FORM OF HANDHOLDS, GUIDERAILS AND OTHER DEVICES

SHALL BE PROVIDED TO FACILITATE CREW LOCOMOTION, STABILIZATION/BRACING IN A ZERO-G ENVIRONMENT. THEY SHALL BE CAPABLE OF USE IN EITHER A SHIRTSLEEVE OR SUITED/PRESSURIZED MODE OF OPERATION. CREW MOBILITY AIDS SHALL BE PROVIDED IN ACCORDANCE WITH THE FOLLOWING CRITERIA:

A. HANDHOLDS AND GUIDERAILS SHALL BE A MINIMUM OF 1.0 INCH DIAMETER, WITH A 2.0 INCH CLEARANCE TO ADJOINING STRUCTURE OR SURFACE, TO PERMIT USE WITH A GLOVED HAND (SUITED/PRESSURIZED OPERATIONS).

B. SPACING OF MOBILITY AIDS SHALL BE SUCH THAT EITHER THESE DEVICES, VEHICLE STRUCTURE, OR EQUIPMENT/ACCOMMODATIONS SHALL ALWAYS BE WITHIN REACH OF A CREW MEMBER.

C. MOBILITY AIDS SHALL BE MOUNTED ON EQUIPMENT OR ACCOMMODATIONS WHERE APPROPRIATE, AS WELL AS ON VEHICLE STRUCTURE.

D. DESIGN OF VEHICLE STRUCTURE, EQUIPMENT AND ACCOMMODATIONS SHALL CONSIDER FEATURES WHICH INHERENTLY PROVIDE A MOBILITY AID CAPABILITY.

E. HANDHOLDS SHALL BE EITHER THE RIGID, FLEXIBLE OR RECESSED TYPE, AS APPROPRIATE TO A SPECIFIC LOCATION.

F. MOBILITY ASSISTS SHALL BE LOCATED BETWEEN 36 AND 40 INCHES ABOVE THE FLOOR, AND SHALL BE PROVIDED ON BOTH SIDES OF AISLES AND PASSAGEWAYS.

G. HANDHOLDS SHALL BE APPROPRIATELY LOCATED WITH RESPECT TO CREW MOBILITY REQUIREMENTS.

3.3.7.8 CREW RESTRAINT DEVICES

CREW RESTRAINT DEVICES, SUCH AS TETHERS/TETHER ATTACH FITTINGS, HARNESSES, BELTS AND STRAPS, VARIOUS FOOT RESTRAINT DEVICES, AND ARTICULATED OR EXTENSIBLE MECHANICAL DEVICES SHALL BE PROVIDED FOR BRACING AND STABILIZATION, OR PREVENTING INADVERTENT DRIFT OF A CREWMAN, IN THE ZERO-G ENVIRONMENT. FOR A SHIRTSLEEVE MODE OF OPERATION, A SUITABLE DEVICE SHALL BE PROVIDED FOR EACH BUNK AND CHAIR-SEATING DEVICE, AND FOR EACH CREW WORK STATION AND PERSONAL ACTIVITY FUNCTION, TO MAINTAIN A RELATIVELY FIXED RELATIONSHIP OF THE CREWMAN WITH RESPECT TO THE WORK STATION OR PERSONAL ACTIVITY EQUIPMENT. SUITABLE DEVICES, COMPATIBLE WITH THE PGA, SHALL BE PROVIDED FOR A SUITED/PRESSURIZED MODE OF OPERATION. CREW RESTRAINT DEVICES SHALL BE RELEGATED TO THE LOWER BODY, LEGS AND FEET, TO PERMIT FREEDOM OF MOVEMENT OF THE UPPER TORSO, ARMS AND HANDS. THESE DEVICES SHALL BE EASILY OPERABLE, NOT RESTRICTIVE OF REQUIRED CREW MOTIONS, AND SHALL POSSESS A HIGH DEGREE OF CREW ACCEPTABILITY.

3.3.7.9 EQUIPMENT RESTRAINT DEVICES

RESTRAINT DEVICES SHALL BE PROVIDED FOR RETENTION OF ALL ITEMS OF LOOSE EQUIPMENT (E.G., EQUIPMENT NOT STOWED IN STORAGE FACILITIES). SMALL ITEMS SHALL BE RETAINED BY TETHERS, VELCRO PATCHES, MECHANICAL OR BUNGEE (ELASTIC) DEVICES. A POSITIVE RETENTION/RESTRAINT METHOD, SUCH AS TETHERS OR DETACHABLE MECHANICAL DEVICES, SHALL BE REQUIRED FOR LARGE ITEMS OF EQUIPMENT DURING CREW HANDLING (E.G., CARGO AND EQUIPMENT TRANSFER).

3.3.7.10 TOOLS

A SET OF TOOLS SHALL BE PROVIDED FOR MAINTENANCE AND REPAIR OF SPACE STATION AND EXPERIMENT SUPPORT EQUIPMENT.

3.3.7.11 EMERGENCY GENERAL CREW EQUIPMENT

EMERGENCY GENERAL CREW EQUIPMENT SHALL CONSIST OF PORTABLE LIGHTS AND A MEDICAL ACCESSORIES (FIRST AID) KIT. THEY SHALL SATISFY THE FOLLOWING PERFORMANCE REQUIREMENTS.

A. PORTABLE LIGHTS

A TOTAL OF ONE PORTABLE LIGHT PER MODULE EXCEPT THE POWER BOOM SHALL BE PROVIDED FOR EMERGENCY MAINTENANCE OR INSPECTION IN THE EVENT OF POWER FAILURE. PORTABLE LIGHTS SHALL BE HAND CARRIED FROM THE CORE OR OTHER STATION MODULES IF REQUIRED IN THE POWER BOOM. EACH PORTABLE LIGHT SHALL BE CAPABLE OF PROVIDING FLOODLIGHT TYPE DIRECT ILLUMINATION OF 100 FOOTCANDLES AT A DISTANCE OF 10 FEET, AND NOT LESS THAN 50 FOOTCANDLES AT THIS SAME DISTANCE AFTER 3 HOURS OF CONTINUOUS OPERATION. EACH PORTABLE LIGHT SHALL HAVE A CARRYING HANDLE AND ACTUATION DEVICE COMPATIBLE FOR USE WITH A GLOVED HAND (SUITED/PRESSURIZED OPERATIONS). CAPABILITY TO RECHARGE PORTABLE LIGHT BATTERIES SHALL BE PROVIDED.

B. MEDICAL ACCESSORIES KIT

A MEDICAL ACCESSORIES (FIRST AID) KIT SHALL BE PROVIDED IN EACH MODULE EXCEPT IN THE MODULE CONTAINING THE MEDICAL TREATMENT AREA AND IN THE POWER MODULE. A FIRST AID KIT SHALL BE HAND CARRIED FROM THE CORE OR OTHER STATION MODULES WHEN ENTRY TO THE POWER MODULE IS NECESSARY. THE FIRST AID KITS SHALL BE CAPABLE OF PROVIDING FOR MEDICAL EMERGENCIES. THE KITS SHALL INCLUDE SUCH ITEMS AS ORAL DRUGS, INJECTABLE DRUGS DRESSINGS, BANDAGES, AND TOPICAL AGENTS.

3.3.7.12 RADIATION MEASUREMENT DEVICES

IN ADDITION TO THE PERSONAL RADIATION DOSIMETERS PROVIDED AS PERSONAL EQUIPMENT AND WORN BY THE CREWMEN, SUITABLE DEVICES SHALL BE PROVIDED AT SELECTED LOCATIONS WITHIN EACH HABITABLE MODULE, TO MEASURE AMBIENT RADIATION LEVELS AS WELL AS CUMULATIVE RADIATION DOSAGE.

3.3.7.13 CREW FURNISHINGS

TABLE 3.3.7.13-1 CREW FURNISHING DIMENSION CRITERIA

ITEM	NOMINAL DIMENSION		
	WIDTH	DEPTH/LENGTH	HEIGHT
SLEEPING RESTRAINTS/BUNKS			
PRIMARY	30	78	
AUXILIARY	28	78	
SEATING RESTRAINTS/CHAIRS (*)	17	17	17
WORK SURFACES/TABLES/DESKS			
GENERAL STATEROOMS	30	20	28
COMMANDER'S STATEROOM	36	24	28
EXECUTIVE STATEROOM	36	24	28
PRIMARY GALLEY	42	24	36
BACKUP GALLEY	42	24	36
DINING/RECREATION	30	48	28
LAB/MAINT WORK SURFACES	30	24	28
CREW CARE	41	24	28
KNEE SPACE FOR WORK SURFACES/ TABLES/DESKS	22	22	25

(*) SEAT BACK TO SEATING SURFACE ANGLE - 95 TO 105 DEGREES

TABLE 3.3.7.13-2 CREW FURNISHINGS QUANTITIES/LOCATIONS

LOCATION	NUMBER AND TYPE OF FURNISHING				
	SLEEPING RESTRAINT/BUNK		SEATING RESTRAINT/CHAIR	WORK SURFACE/ TABLE/DESK	
	FIXED	AUX		FIXED	AUX
STATEROOMS					
CREW (4)	1	1	1	1	
COMMANDER	1	1	4	1	1
EXECUTIVE	1	1	4	1	1
DINING			8	2	
RECREATION			2	1	
DATA ANALYSIS			1		
CONTROL CENTER					
PRIMARY			1		
SECONDARY			1		
PHOTO PROCESS			1		
BIOMED/PHYSICS			2		

3.3.7.14 RECREATION

A. PASSIVE ENTERTAINMENT ACTIVITIES SHALL BE PROVIDED IN THE FORM OF MUSIC (E.G., INTERCOM, TAPE DECK), TELEVISION (EITHER TRANSMITTED FROM GROUND OR CLOSED-CIRCUIT), AND MOVIES (PROJECTOR AND STOWABLE MOTION PICTURE SCREEN).

B. A SPECIAL TABLE AND STORAGE SHALL BE PROVIDED FOR PASSIVE RECREATION. TWO ADDITIONAL SEATS/RESTRAINTS SHALL ALSO BE PROVIDED FOR USE AT THE PASSIVE RECREATION TABLE. DINING TABLES AND CHAIRS/RESTRAINTS MAY ALSO BE USED IN CONJUNCTION WITH PASSIVE RECREATION.

C. AT LEAST ONE OBSERVATION WINDOW SHALL BE PROVIDED FOR RECREATIONAL EARTH OR CELESTIAL VIEWING (MAY BE LOCATED IN DINING AREA). A CAPTIVE-TYPE LIGHT-TIGHT COVER SHALL BE PROVIDED TO CLOSE-OFF THE WINDOW WHEN DESIRED.

3.3.7.15 EXERCISE

THE FOLLOWING SHALL BE PROVIDED TO ACCOMMODATE CREW PHYSICAL CONDITIONING REQUIREMENTS IN A SHIRTSLEEVE ZERO-G ENVIRONMENT.

A. A BICYCLE ERGOMETER SHALL BE PROVIDED, AND SHALL BE CAPABLE OF USE BY A CREWMAN FOR EXERCISE PURPOSES.

B. ISOTONIC EXERCISE EQUIPMENT (E.G., BUNGEE CORD EXERCISE APPARATUS) SHALL BE PROVIDED FOR CREWMAN USE, TO MAINTAIN MUSCLE TONE AND FOR GENERAL CREW PHYSICAL CONDITIONING.

3.3.7.16 MEDICAL CARE

A. EMERGENCY BIOMEDICAL EQUIPMENT WILL BE PROVIDED AND LOCATED IN EACH HABITABLE MODULE AND WILL BE READILY ACCESSIBLE TO THE CREW.

C. THE FOLLOWING EQUIPMENT SHALL BE PROVIDED FOR MEDICAL AND DENTAL CARE OF THE CREW -

1. LOWER BODY NEGATIVE PRESSURE DEVICES
2. MASS MEASUREMENT DEVICE
3. MOBILE X-RAY UNIT
4. EXAMINATION TABLE (DETAILS- TO BE DETERMINED)
5. SURGICAL INSTRUMENTS (DETAILS- TO BE DETERMINED)
6. STERILIZER

7. STOWAGE CABINETS
8. MISCELLANEOUS PORTABLE DIAGNOSTIC EQUIPMENT (DETAILS - TO BE DETERMINED)

3.3.7.17 ACOUSTIC NOISE

A. ACOUSTIC NOISE LEVELS SHALL BE MAINTAINED SUCH THAT NO ADVERSE PSYCHOPHYSIOLOGICAL EFFECTS WILL BE PRODUCED.

B. NOISE LEVELS SHALL NOT CAUSE DISCOMFORT TO CREWMEN, NOR INTERFERE WITH COMMUNICATION BETWEEN CREWMEN AT NORMAL VOICE LEVELS UP TO DISTANCES OF 18 FEET.

C. CONTINUOUS NOISE LEVELS SHALL NOT EXCEED 50 DECIBELS IN THE SPEECH INTERFERENCE LEVEL (SIL) RANGE (600 TO 4800 HERTZ), 70 DECIBELS AT FREQUENCIES BELOW SIL, NOR 60 DECIBELS AT FREQUENCIES ABOVE SIL.

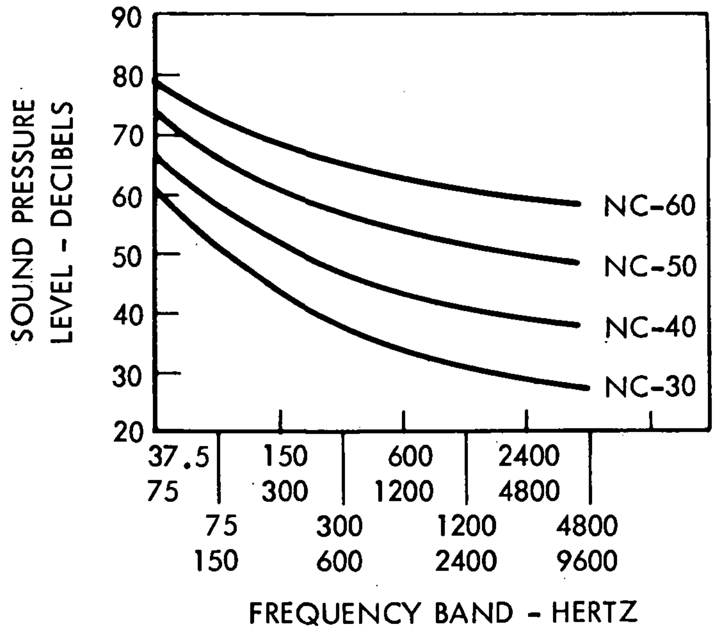
D. THE MAXIMUM ACOUSTIC NOISE LEVELS FOR VARIOUS FREQUENCIES, IN RELATION TO SPACE STATION FUNCTIONAL AREAS, SHALL BE IN ACCORDANCE WITH THE VALUES SPECIFIED BY FIGURE 3.3.7.17.

E. VIBRATION

1. VIBRATION EMITTING EQUIPMENT SHALL NOT BE LOCATED IN CREW LIVING AREAS, AND WHERE REQUIRED IN CREW WORK AREAS, SHALL BE SHOCK-MOUNTED, INSULATED OR OTHERWISE DAMPENED SO AS NOT TO ADVERSELY AFFECT CREW PERFORMANCE.

2. ACCEPTABLE VIBRATION LEVELS (FREQUENCIES AND AMPLITUDES) TBD.

3. WHERE NECESSARY, SEATING AND RESTRAINT DEVICES SHALL INCORPORATE PROVISIONS TO ABSORB PERCEPTIBLE VIBRATIONS.



NC CURVE	APPLICATION
NC-30	SLEEP/REST AREAS
NC-40	CONTROL AREAS WHERE COMMUNICATIONS ARE CRITICAL: AREAS WHERE SOME CONCENTRATION AND RELAXED COMMUNICATION MAY BE DESIRABLE (RADIO AND TELEVISION LISTENING)
NC-50	AREAS WHERE GOOD COMMUNICATION CONDITIONS ARE NOT ESSENTIAL (SOME DISTRACTION TO EXTERNAL NOISE CAN BE PERMITTED): INTERNAL NOISE GENERATION DUE TO OTHER ACTIVITIES MAY BE PRESENT: GENERAL WORK/LIVING AREAS
NC-60	MAINTENANCE AREAS (SHORT STAY TIME)

FIGURE 3.3.7.17 ACOUSTIC NOISE LEVELS

3.3.7.18 COMMUNICATIONS

1. TWO-WAY INTERCOMMUNICATIONS SHALL BE PROVIDED WITHIN EACH OF THE INDIVIDUAL CREW STATEROOMS, PRIMARY GALLEY, BACKUP GALLEY, DINING AREA, RECREATION AREA, PERSONAL HYGIENE AREAS, CREW EXERCISE AREA, MEDICAL TREATMENT AREA, CREW WORK STATIONS, INTERVOLUME AIRLOCK, EXPERIMENT AREAS.

2. TWO-WAY HARDLINE AND RF COMMUNICATIONS SHALL BE PROVIDED BETWEEN THE PRIMARY OR BACKUP CONTROL STATIONS, AIRLOCK, AND BIOMED CONSOLE AND CREWMEN PERFORMING IVA/EVA IN PRESSURE SUITS.

3. THE CAPABILITY FOR PRIVATE COMMUNICATIONS WITH THE GROUND SHALL BE PROVIDED WITHIN EACH OF THE INDIVIDUAL CREW STATEROOMS.

4. THE CAPABILITY TO RECEIVE SELECTABLE ENTERTAINMENT TYPE AUDIO AND VIDEO COMMUNICATIONS (MUSIC AND TELEVISION) SHALL BE PROVIDED SIMULTANEOUSLY WITHIN EACH OF THE INDIVIDUAL CREW STATEROOMS.

5. THE CAPABILITY TO RECEIVE SELECTABLE ENTERTAINMENT TYPE AUDIO COMMUNICATIONS (MUSIC) SHALL BE PROVIDED WITHIN THE GALLEY, PRIMARY DINING AREA AND RECREATION AREA.

6. THE CAPABILITY TO BROADCAST (TIME DELAYED) SELECTABLE EARTH RADIO AND TELEVISION PROGRAMS SHALL BE PROVIDED WITHIN THE RECREATION AREA.

7. CHANNEL SELECTABLE CCTV SHALL BE AVAILABLE FOR PATIENT OR TEST SUBJECT MONITORING IN ALL AREAS SUPPORTING MEDICAL CARE AND MEDICAL AND BEHAVIORAL TESTS/EXPERIMENTS.

3.3.7.19 ALARMS AND DISPLAYS

1. AUDIO AND VISUAL ALARM(S) SHALL BE PROVIDED IN ALL HABITABLE AREAS. THE AUDIO ALARMS SHALL BE BOTH TONE AND VOICE WITH THE VOICE ALARM DEFINING THE CREW ACTION TO BE TAKEN (E.G., PRE-PROGRAMMED CREW ACTIONS). THE VISUAL ALARM(S) SHALL BE OF THE FLASHING LIGHT TYPE AND SHALL BE USED PRIMARILY TO ALERT THE CREW TO THE PRESENCE OF A DANGEROUS OR POTENTIALLY DANGEROUS SITUATION.

2. ISS ACCESS DISPLAYS SHALL BE PROVIDED WITHIN THE COMMANDER'S AND EXECUTIVE STATEROOMS. THE NATURE OF THE DISPLAYS AND THE INFORMATION TO BE DISPLAYED IS TO BE DETERMINED.

3.3.7.20 PERSONAL HYGIENE CRITERIA

1. THE PERSONAL HYGIENE FACILITIES SHALL BE DIVIDED EQUALLY BETWEEN THE TWO PRESSURE VOLUMES AND SHALL BE LOCATED CONVENIENTLY WITH RESPECT TO STATEROOMS AND WORK AREAS.

2. EQUIPMENT AND PROVISIONS NECESSARY FOR CREW PERSONAL HYGIENE AND GROOMING FUNCTIONS SHALL BE PROVIDED AND SHALL HAVE A HIGH DEGREE OF CREW PHYSIOLOGICAL AND PSYCHOLOGICAL ACCEPTABILITY. THERE SHALL BE A MINIMUM OF ONE PERSONAL HYGIENE FACILITY IN EACH PRESSURE ISOLATABLE VOLUME WITH THE FOLLOWING CAPABILITIES.

(A) ONE GROOMING STATION WITH SINK, HOT AND COLD WATER MIXING CAPABILITY, TEETH BRUSHING CUSPIDOR, SOAP DISPENSER, FACE AND HANDS WASHING, BODY SPONGING, ETC.
(B) ONE URINAL (STANDUP)
(C) ONE TOILET WITH URINAL (FEMALE ADAPTION CONSIDERATIONS)
(D) ONE SHOWER (INCLUDED IN ONLY ONE OF THE TWO INITIAL STATION PERSONAL HYGIENE AREAS)

3. EQUIPMENT SHALL BE ARRANGED TO MAXIMIZE PERSONAL PRIVACY AND TO MINIMIZE INTERFERENCE BETWEEN MALE/FEMALE CREW MEMBERS USING ADJACENT EQUIPMENT. SCREENS/DOORS SHALL BE PROVIDED IN FRONT OF THE TOILETS AND SHOWER DRESSING AREAS FOR PERSONAL PRIVACY.

3.3.7.21 ILLUMINATION CRITERIA

FIXTURES, CONTROLS, AND WIRING SHALL BE PROVIDED TO SATISFY AS A MINIMUM, THE LIGHTING REQUIREMENTS (FOOT CANDLES) AS SPECIFIED IN TABLE 3.3.7.21-1.

TABLE 3.3.7.21-1 ILLUMINATION REQUIREMENTS (FOOT CANDLES)

AREA	OVERHEAD DIR. DIFFUSED	SUPPLEMENTARY LOCAL	EMERG	LOW LEVEL
CREW STATEROOMS	30	DESK 30-50 BUNK 30-50	5	0.5
CMDR'S/EXEC STATERMS	30	DESK 30-50 BUNK 30-50	5	0.5
PRIMARY GALLEY	50	WORK COUNTER 50-70	5	0.5
BACKUP GALLEY	10	WORK COUNTER 10-30	5	0.5
PRIMARY DINING	VAR TO 30(2)	EATING SURFACE 30-50	5	0.5
RECREATION	VAR TO 30(2)	30-50	5	0.5
PERSONAL HYGIENE	30		5	0.5
LAVATORIES		30-50	5	0.5
TOILETS		30	5	0.5
SHOWERS		30	5	0.5
EXERCISE	30	-	5	0.5
MEDICAL	SELECTABLE 50 AND 150	WORK COUNTER 50-70 DIFFUSED 500-1000(3)	100 DIFFUSED 500(1)	0.5
WORK STATIONS				
MAINTENANCE/REPAIR	30-50	WORK COUNTERS 50-70	10	0.5
EXPERIMENT	30-50	WORK COUNTERS 50-70	10	0.5
AISLES, PASSAGEWAYS	30			0.5

NOTES

(1) AUXILIARY DIFFUSED ILLUMINATION OF 500 FOOT CANDLES WILL BE PROVIDED, AUTOMATICALLY ACTUATED IN EVENT OF POWER FAILURE.

(2) VARIABLE LIGHTING TO 30 FOOT CANDLES MAY BE DESIGNED WITH 0.5 FOOT CANDLE LOW LIMIT TO PROVIDE NIGHT LIGHT.

(3) DIFFUSED 500 TO 1000 FOOT CANDLE LAMP SHALL BE LOCATED ABOVE THE EXAMINATION AND TREATMENT BENCH AND BE DIRECTIONALLY ADJUSTABLE FOR USE IN MEDICAL AND DENTAL AREA.

EXTERIOR ILLUMINATION FOR EVA OPERATIONS WILL BE A MINIMUM OF 2 FOOT-CANDLES ALONG EVA SURFACE PATHS AND 7 FOOTCANDLES AT WORK STATION SURFACES.

ILLUMINATION FIXTURE TYPES AND LOCATION REQUIREMENTS PER FUNCTIONAL AREA ARE INDICATED IN TABLE 3.3.7.21-2.

TABLE 3.3.7.21-2 ILLUMINATION FIXTURE MOUNTINGS

FUNCTIONAL AREA	ILLUMINATION FIXTURE LOCATIONS AND TYPES		
	SUPPLEMENTARY	GENERAL	EMERG
A GENERAL STATEROOM	BUNK DESK	OVERHEAD DIRECT/ DIFFUSED	EMERG ILLUM
B CMDR/EXEC STATEROOMS	BUNK DESK/TABLE	ILLUMINATION REQ'D FOR ALL FUNCTIONAL AREAS	REQ'D ALL FUNCT
C PRIMARY GALLEY	WORK COUNTERS GALLEY EQUIPMENT	- PLUS - LO-LEVEL NITE LITE	AREAS
D BACKUP GALLEY	WORK COUNTER	TYPE ILLUMINATION	
E DINING AREA	TABLE/SURFACE	AT 18 TO 24 INCHES	
F RECREATION AREA	TABLE/SURFACE	ABOVE FLOOR REQ'D	
G PERSONAL HYGIENE AREA	LAVATORY/GROOMING TOILET, SHOWERS	FOR FUNCTIONAL AREAS	
H CREW EXERCISE AREA	(NONE)		
I MEDICAL TREATMENT AREA	EXAMINATION CHAIR WORK COUNTER		
J CREW WORK STATIONS			
CONTROL FUNCTIONS	CONSOLES		
MAINTENANCE/REPAIR	WORK COUNTERS		
EXPERIMENT AREAS	WORK COUNTERS		
K STORAGE AREAS	(NONE)		
L AISLES, PASSAGEWAYS	(NONE)		

3.3.7.22 WINDOW CRITERIA

A. WINDOWS SHALL BE PROVIDED AT THE TWO CONTROL CENTERS, LOCATED TO PROVIDE THE CREWMAN SEATED AT THE CONTROL CENTER, VISION OF AN APPROACHING SHUTTLE OR FREE-FLYING MODULE.

B. A WINDOW SHALL BE LOCATED IN EACH PRESSURE HATCH OF EACH BERTHING PORT.

C. A WINDOW SHALL BE LOCATED IN THE DINING/RECREATION AREA TO PROVIDE THE CREWMAN EARTH AND CELESTIAL VIEWING.

D. A WINDOW SHALL BE LOCATED IN THE EXTERNAL (EVA) HATCH OF THE IVA/EVA AIRLOCK. IN ADDITION THE INTERNAL (IVA) HATCH OF THE IVA/EVA AIRLOCK SHALL ALSO INCLUDE A WINDOW.

E. A WINDOW SHALL BE LOCATED IN THE EXPERIMENTS AIRLOCK EXTERNAL HATCH (EVA) AND ALSO IN EACH INTERNAL HATCH.

F. ALL OF THE ABOVE WINDOWS SHALL HAVE A 14 INCH DIAMETER CLEAR AREA IN ACCORDANCE WITH THE NASA, MSC WINDOW DESIGN.

G. A 4 INCH DIAMETER WINDOW SHALL BE LOCATED IN EACH PRESSURE HATCH OF ALL FLEXPORTS.

ALL OF THE WINDOW REQUIREMENTS SHALL SATISFY THE REQUIREMENT OF THE NASA, GUIDELINES AND CONSTRAINT DOCUMENT. MSC03696 REVISION 7.

3.3.7.23 SECONDARY PERFORMANCE CHARACTERISTICS

THE PASSIVE RECREATION SPECIAL TABLE LOCATED IN THE DINING AREA MAY BE USED AS A DINING SURFACE FOR TWO CREW MEMBERS.

3.3.7.24 EXPERIMENT PROVISIONS

A. ALL ITEMS FOR CREW CONDITIONING AND CREW QUALIFICATION SHALL BE PROVIDED. IN ADDITION, A SIGNIFICANT PORTION OF THE DIAGNOSTIC AND TEST EQUIPMENT SHALL BE PROVIDED.

B. STORAGE AND REFRIGERATION OF MEDICINES SHALL BE PROVIDED.

C. SURGICAL INSTRUMENTS SHALL BE AVAILABLE FOR USE BY THE MEDICAL DOCTOR FOR MINOR OPERATIONS ON CREWMEN.

D. THE MAINTENANCE AREA AND EQUIPMENT FOR THE EXPERIMENT OPERATIONS SHALL BE UTILIZED FOR ALL SPACE STATION MAINTENANCE.

3.3.7.25 SUBSYSTEM DEFINITION

THE TECHNICAL DATA PRESENTED IN THESE PARAGRAPHS DOES NOT CONTAIN DESIGN-TO REQUIREMENTS, RATHER THE DATA REFLECTS A CONCISE DESCRIPTION OF THE TECHNICAL PARAMETERS THAT FORM THE CURRENT BASELINE SUBSYSTEM DEFINITION. THE SUMMATION OF THESE CHARACTERISTICS WITH THOSE OF THE OTHER SIX FUNCTIONAL SUBSYSTEMS FORM THE BASIS FOR CONFIGURATION LAYOUTS, WEIGHT STATEMENTS AND POWER PROFILES FOR THE MODULAR SPACE STATION SYSTEM.

3.3.7.25.1 MAJOR ASSEMBLIES

A. PERSONAL EQUIPMENT ASSEMBLY

THE PERSONAL EQUIPMENT ASSEMBLY CONTAINS CLOTHING/LINENS, GROOMING AIDS, AND PERSONAL DOSIMETERS FOR THE CREW MEMBERS. PROVISIONS FOR STORING THE PERSONAL EQUIPMENT ARE PROVIDED IN SM-1 AND SM-4 MODULES. CAPACITY FOR SIX CREW MEMBERS FOR 120 DAY STAY TIME IS PROVIDED.

B. GENERAL/EMERGENCY EQUIPMENT ASSEMBLY

THIS ASSEMBLY CONTAINS EQUIPMENT FOR GENERAL AND EMERGENCY USE BY THE CREW MEMBERS. THE EQUIPMENT CONSISTS OF A TOOL SET, PORTABLE LIGHTS, RADIATION DETECTION DEVICES, EMERGENCY O2 MASKS, PGA AND SUPPORT, IVA UMBILICALS, PLSS/OPS, MOBILITY AIDS AND RESTRAINTS, AND FIRST AIDS KITS.

C. FURNISHINGS ASSEMBLY

THIS ASSEMBLY CONTAINS THE FURNISHINGS USED BY THE CREW MEMBERS WHICH CAN BE EASILY INSTALLED/REMOVED AND ARE NOT BUILT IN AS PERMANENT FIXTURES. THE FURNISHINGS CONSIST OF SLEEPING RESTRAINTS/BUNKS (FIXED AND STOWABE), SEATING RESTRAINTS/CHAIRS, WORK SURFACES/DESKS, WORK SURFACES/TABLES, DINING SURFACE/TABLE, AND SPECIAL SURFACE/TABLE.

D. RECREATION/EXERCISE/CREW CARE ASSEMBLY

THIS ASSEMBLY CONTAINS THE EQUIPMENT NECESSARY TO SUPPORT CREW MEMBER RECREATION, EXERCISE, AND MEDICAL CARE. IT CONSISTS OF PASSIVE RECREATION DEVICES, ERGOMETER/ISOTONIC EQUIPMENT, MEDICAL/DENTAL DIAGNOSTIC EQUIPMENT, A PORTABLE X-RAY, MISCELLANEOUS MEDICAL SUPPLIES, PHARMACEUTICAL AGENTS/DRUGS, EXAMINATION/TREATMENT BENCH, STERILIZER, LOWER BODY NEGATIVE PRESSURE DEVICE, MASS MEASUREMENT DEVICE, MEDICAL LIGHT, DISTILLED WATER CABINET, PRIMARY AND BACKUP SUPPLY CABINETS, SINK AND

DISPOSAL CABINETRY, ANALYTICAL EQUIPMENT STORAGE WITH COUNTER, ANALYTICAL EQUIPMENT STORAGE CABINET, PRIMARY AND BACKUP PHARMACEUTICALS AND EQUIPMENT STORAGE CABINETS, AND A SUPPLY CABINET.

E. FOOD MANAGEMENT ASSEMBLY

THIS ASSEMBLY CONTAINS THE FOOD SUPPLIES AND ASSOCIATED STORAGE, PREPARATION, SERVING AND CLEANUP, INVENTORY CONTROL, AND UTENSILS FOR SIX CREW MEMBERS FOR 120 DAY STAY TIME. IT CONSISTS OF FOOD, A FREEZER AND REFRIGERATOR, A RESISTANCE AND MICROWAVE OVEN, TWO RECONSTITUTION DEVICES, TWO FOOD SPILLAGE UNITS, AN INVENTORY CONTROL UNIT, UTENSILS, AND THREE SKYLAB TYPE FOOD WARMER TRAYS.

3.3.7.25.2 WEIGHT, POWER, AND UNIT/LOCATION CHARACTERISTICS

TABLE 3.3.7.25-1 WEIGHT SUMMARY

MAJOR ASSEMBLY	WEIGHT (LBS)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
7.0 CREW HABITABILITY							
7.1 PERSONAL EQUIPMENT							
7.2 GENERAL/EMERGENCY EQUIP	733	125	145	145	145	145	1438
7.3 FURNISHINGS			220		160	206	586
7.4 RECREATION/EXER/CREW CARE			138		210	639	987
7.5 FOOD MANAGEMENT				88	756		844
TOTAL	733	125	503	233	1271	990	3855

TABLE 3.3.7.25-2 POWER SUMMARY

MAJOR ASSEMBLY	POWER (WATTS - 24 HOUR AVG)						
	CORE	POWER	SM1	SM2	SM3	SM4	TOTAL
7.0 CREW HABITABILITY							
7.1 PERSONAL EQUIPMENT							0
7.2 GENERAL/EMERGENCY EQUIP							0
7.3 FURNISHINGS							0
7.4 RECREATION/EXER/CREW CARE						10 (1)	(1) 10
7.5 FOOD MANAGEMENT				62	424		486
TOTAL				62	424	10	496

(1) WORST DAY - DAILY 24 HR AVERAGE - 112.8 WATTS

TABLE 3.3.7.25-3 UNIT CHARACTERISTICS/LOCATIONS/QTY

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES)			CORE	PWR	SM-1	SM-2	SM-3	SM-4
			H	W	D						
7.1 PERSONAL EQUIPMENT											
Clothing/Linens	---	*555				---	---	x	---	---	x
Grooming Aids	---	*156				---	---	x	---	---	x
Personal Dosimeters	---	*0.1				---	---	x	---	---	x
7.2 GENERAL/EMERGENCY EQUIP											
Tools (1 Set)	---	150				1	---	---	---	---	---
Portable Lights	---	5				1	---	1	1	1	1
Radiation Detection	---	10				1	---	---	---	---	---
Emergency O_2 Masks	---	2.5				3	---	3	3	3	3
PGA and Support	---	55				---	---	2	---	---	2
IVA Umbilicals	---	100				4	---	---	---	---	---
PLSS/OPS	---	122				---	---	2	---	---	2
Mobility Aids & Restraints	---	120				1	1	1	1	1	1
First Aid Kits	---	5				1	---	1	1	1	1
Mounts and Supports	---	70.5				x	x	x	x	x	x
7.3 FURNISHINGS											
Sleeping Restraints/Bunks	---										
Fixed	---	20				---	---	3	---	---	3
Stowed (Emerg Overlap)	---	10		28	76	---	---	3	---	---	3
Seating Restraints/Chairs	---	10				---	---	8	---	8	7
Work Surfaces/Desks	---	10	30	18	36	---	---	3	---	---	3
Work Surfaces/Tables	---	6	30	36	40	---	---	1	---	---	1
Dining Surface/Table	---	30	30	36	60	---	---	---	---	2	---
Special Surface/Table	---	6	30	36	60	---	---	---	---	2	---
Mounts and Supports	---	32				---	---	x	---	x	x

* 6 Men - 120 Days
50% In. SM 1, 50% In. SM 4

TABLE 3.3.7.25-3 UNIT CHARACTERISTICS/LOCATIONS/QTY (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES) H	W	D	CORE	PWR	SM-1	SM-2	SM-3	SM-4
7.4 RECREATION/EXERCISE/CREW CARE											
Passive Recreation Devices	---	200				---	---	---	---	1	---
Ergometer/Isotonic Equipment	---	50				---	---	---	---	---	1
Medical/Dental Diagnostic Equip	16	90				---	---	---	---	---	1
Portable X-Ray	300	45				---	---	---	---	---	1
Miscellaneous Medical Supplies	---	60				---	---	1	---	---	1
Pharmaceutical Agents/Drugs	---	50				---	---	1	---	---	1
Exam/Treatment Bench	---	50	28	24	72	---	---	1	---	---	1
Sterilizer	1500	30				---	---	---	---	---	1
Lower Body Negative Press Dev.	250	80				---	---	---	---	---	1
Mass Measure Device	250	50				---	---	---	---	---	1
Medical Light (1000W)	1000	25				---	---	1	---	---	1
Distilled H_2O Cabinet	---	11.3	30	24	24	---	---	---	---	---	1
Supply Cabinet											
Primary	---	30.4	28	60	24	---	---	---	---	---	1
Backup	---	23	28	60	18	---	---	1	---	---	
Sink and Disposal Cabinetry	---	10.2	30	42	24	---	---	---	---	---	1
Analytical Equip Storage with Counter	---	23.9	30	60	24	---	---	---	---	---	1
Analytical Equip Storage Cab.	---	30	72	34	16	---	---	---	---	---	1
Pharmaceuticals & Equipment Storage Cabinet											
Primary	---	54.3	60	64	24	---	---	---	---	---	1
Backup	---	27	60	36	18	---	---	1	---	---	
Supply Cabinet	---	24	72	20	24	---	---	---	---	---	1
Mounts & Supports	---	57.9				---	---	x	---	x	x

TABLE 3.3.7.25-3 UNIT CHARACTERISTICS/LOCATIONS/QTY (Cont'd)

ASSEMBLY/SUBASSEMBLY	UNIT CHARACTERISTICS					LOCATION/QUANTITY					
	POWER	WEIGHT (LBS)	SIZE (INCHES)			CORE	PWR	SM-1	SM-2	SM-3	SM-4
			H	W	D						
7.5 FOOD MANAGEMENT											
Supply	---	2600				---	---	---	*x	*x	---
Storage	---										
Freezer	230	300	60	60	48	---	---	---	---	1	---
Refrigerator	100	165	36	58	24	---	---	---	---	1	---
Preparation											
Resistance Oven	1000	80	24	24	12	---	---	---	---	1	---
Microwave Oven	1450	75	20	24	18	---	---	---	---	1	---
Reconstitution Device	300	27	12	8	13	---	---	---	1	1	---
Serving and Cleanup											
Food Spillage Unit	100	25	14	9	14	---	---	---	1	1	---
Inventory Control	---	40	12	12	18	---	---	---	---	1	---
Utensils	---	226	16	18	18	---	---	---	*x	*x	---
Skylab Food Warmer Tray	328	8	16	13	4.5	---	---	---	3	---	---
Mounts and Supports	---	56				---	---	---	x	x	---

* 75% IN SM-3
25% IN SM-2
6-Men-120 Days

3.3.7.26 SUBSYSTEM INTERFACES

3.3.7.26.1 CREW HABITABILITY/STRUCTURAL AND MECHANICAL INTERFACES

AS A GOAL, CREW/HABITABILITY SHALL PROVIDE 35 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

STRUCTURES SHALL PROVIDE INSTALLATION AND MOUNTING PROVISIONS FOR EQUIPMENT QUANTITIES AND LOCATIONS AS SPECIFIED IN TABLE 3.3.7.25.3.

STRUCTURES SHALL PROVIDE FOR MOUNTING OF MOBILITY AND RESTRAINT DEVICES THROUGHOUT THE SPACE STATION PER PARAGRAPH 3.3.7.7.

THE SPACE STATION INTERIOR SHALL BE DESIGNED IN ACCORDANCE WITH GOOD ARCHITECUTRAL AND DECORATOR PRACTICES IN ORDER TO PROVIDE COMFORTABLE, EFFICIENT AND ATTRACTIVE LIVING AND WORKING SPACES. THE INTERIOR ARRANGEMENTS SHALL INSURE CREW COMFORT, EFFICIENCY, AND PHYSIOLOGICAL AND PSYCHOLOGICAL WELL-BEING.

THE SPACE STATION INTERIOR SHALL BE PARTITIONED INTO BASIC FUNCTIONAL AREAS INCLUDING INDIVIDUAL CREW STATEROOMS, FOOD AND PREPARATION AND SERVING AREAS, DINING AREAS, PERSONAL HYGIENE AREAS, EXERCISE AREA, MEDICAL TREATMENT AREA, WORK AREAS, STORAGE AREAS, ASILES, AND PASSAGEWAYS.

STRUCTURES SHALL INSTALL ALL EQUIPMENTS SUCH THAT THEY ARE CAPABLE OF USE FOR PUSH-OFF, AND SHALL BE CAPABLE OF REACTING TO CREW IMPACT LOADS (300 POUNDS LIMIT APPLIED IN ANY DIRECTION).

THE CEILING HEIGHT IN GENERAL MOBILITY AREAS ON THE MAIN DECK OF THE MODULES SHALL BE A MINIMUM OF 82 INCHES.

STRUCTURAL DESIGN SHALL BE SUCH THAT ACOUSTIC NOISE LEVELS SHALL BE MAINTAINED IN ACCORDANCE WITH THE CRITERIA SPECIFIED IN PARAGRAPH 3.3.7.17.

STRUCTURES SHALL PROVIDE INSTALLATION AND SHOCK-MOUNTING PROVISIONS FOR VIBRATION EMITTING EQUIPMENT AS SPECIFIED IN PARAGRAPH 3.3.7.17.

3.3.7.26.2 CREW HABITABILITY/ECLSS INTERFACES

AS A GOAL, CREW/HABITABILITY SHALL PROVIDE 110 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

ECLSS SHALL PROVIDE EQUIPMENT COOLING FOR HEAT LOADS AS SPECIFIED IN TABLE 3.3.2.1.1.4-1 HEAT LOAD DISTRIBUTION.

3.3.7.26.3 CREW HABITABILITY/EPS INTERFACES

AS A GOAL, CREW/HABITABILITY SHALL PROVIDE 30 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

EPS SHALL PROVIDE REDUNDANTLY DISTRIBUTED REGULATED 120/208 V, 400 HZ, AC AND 56 VDC (IF REQUIRED) ELECTRICAL POWER. THE QUALITY OF THE POWER SHALL BE PER MIL-STD-704 EXCEPT FOR THE DC LINE DROP WHICH SHALL BE 2.5 VOLTS MAXIMUM BETWEEN THE LOADS AND THE REGULATED BUS. WIRE PROTECTION SHALL BE PROVIDED FOR ALL LOADS CONNECTED TO THE EPS DISTRIBUTION BUSES. WHERE APPLICABLE, REDUNDANT DEVICES SHALL BE EMPLOYED. CRITICAL LIFE SUPPORT LOADS SHALL BE MAINTAINED DURING EMERGENCIES AFFECTING ELECTRICAL POWER FOR A MINIMUM OF 96 HOURS. EPS SHALL PROVIDE ELECTRICAL POWER (24 HOUR AVERAGE WATTS) AS SPECIFIED (AT THE LOAD BUSES) BELOW -

SUBSYSTEM	BUILDUP STEP 1	BUILDUP STEP 2	NORMAL OPERATIONS	EMERGENCY OPERATIONS
C/H	0	0	496	0

EPS SHALL PROVIDE INTERIOR LIGHTING IN ACCORDANCE WITH CREW AND HABITABILITY REQUIREMENTS.

EPS SHALL PROVIDE EXTERIOR LIGHTING ALONG EVA SURFACE PATHS (TBD) AND AT EVA WORK STATION SURFACES (TBD) IN ACCORDANCE WITH CREW AND HABITABILITY REQUIREMENTS.

3.3.7.26.4 CREW HABITABILITY/G-C INTERFACES

AS A GOAL, CREW/HABITAILITY SHALL PROVIDE 5 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

3.3.7.26.5 CREW HABITABILITY/RCS INTERFACES

AS A GOAL, CREW/HABITABILITY SHALL PROVIDE 5 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

3.3.7.26.6 CREW HABITABILITY/ISS INTERFACES

AS A GOAL, CREW/HABITABILITY SHALL PROVIDE 15 MAN HOURS/MONTH AVERAGE FOR THE PERFORMANCE OF SCHEDULED AND UNSCHEDULED MAINTENANCE.

THE ISS SHALL PROVIDE A STANDARD BI-DIRECTIONAL COMMUNICATION DIGITAL DATA LINK WITH ALL SUBSYSTEM WHICH SHALL INTERFACE WITH THE SUBSYSTEM THROUGH

STANDARD REMOTE ACQUISITION CONTROL UNIT (RACU). THE RACU INPUT/OUTPUT INTERFACE CHARACTERISTICS WITH THE SUBSYSTEMS ARE AS FOLLOWS.

DATA BUS RATE - UP TO 10 MBPS

RACU MEMORY SIZE - 4 K (32 BIT) WORDS

RACU INPUT/OUTPUT LOGIC LEVELS - LOGIC '1' 3.6 + OR - 1.2 VDC
LOGIC '0' 0.2 + OR - 0.02 VDC

INPUT TO RACU FROM SUBSYSTEMS

	ANALOG	DIGITAL/DISCRETE
QUANTITY	100/28	28/100
INPUT RANGE VDC)	0 TO 5	SEE LOGIC LEVEL
INPUT TYPE	SINGLE ENDED	SINGLE ENDED
INPUT IMPEDANCE	1 MEGOHM	1 MEGOHM
SOURCE IMPEDANCE	1 K OHM	1 K OHM

OUTPUT FROM RACU TO SUBSYSTEM

	DIGITAL(PARALLEL)	DIGITAL(SERIAL)
QUANTITY	24	8
OUTPUT TYPE	ON/OFF PARALLEL	ON/OFF SERIAL

THE ISS SHALL PROVIDE TIMING SIGNALS TO THE SUBSYSTEM.

THE ISS SHALL PROVIDE CENTRALIZED SUBSYSTEM OPERATIONAL COMMAND/CONTROL AND MONITORING BASED ON SUBSYSTEM DATA EVALUATION.

THE ISS SHALL PROVIDE MANUAL CONTROL CAPABILITY WHICH CAN OVERRIDE THE AUTOMATED COMMANDS

THE ISS SHALL PROVIDE SUBSYSTEM DATA ACQUISITION, COMMAND GENERATION AND DISTRIBUTION, INTERNAL DATA DISSEMINATION, EXTERNAL DATA COMMUNICATION, DATA PROCESSING, AND DATA STORAGE.

THE ISS SHALL MAINTAIN A SUBSYSTEM LOGISTICS INVENTORY.

THE ISS SHALL PROVIDE THE FOLLOWING INFORMATION TO CREW HABITABILITY.

- ALARMS AND DISPLAYS

AUDIO AND VISUAL ALARMS SHALL BE PROVIDED IN ALL HABITABLE AREAS. VISUAL ALARMS SHALL BE USED PRIMARILY TO ALERT THE CREW TO THE PRESENCE OF DANGEROUS OR POTENTIALLY DANGEROUS SITUATIONS. ISS ACCESS DISPLAYS SHALL BE PROVIDED WITHIN THE COMMANDERS STATE-ROOM.

- COMMUNICATIONS

TWO-WAY INTERCOMMUNICATIONS SHALL BE PROVIDED BETWEEN EACH OF THE INDIVIDUAL CREW STATEROOMS, PRIMARY GALLEY, BACKUP GALLEY, DINING AREA, RECREATION AREA, PERSONAL HYGIENE AREAS, CREW EXERCISE AREA, MEDICAL TREATMENT AREA, CREW WORK STATIONS, INTER-VOLUME AIRLOCK, AND EXPERIMENT AREAS.

TWO-WAY HARDLINE AND RF COMMUNICATIONS CAPABILITY SHALL BE PRO-VIDED BETWEEN THE PRIMARY AND BACKUP CONTROL STATIONS AND CREWMEN PERFORMING EVA IN PRESSURE SUITS. TWO-WAY HARDLINE COMMUNICATIONS CAPABILITY SHALL BE PROVIDED BETWEEN THE PRIMARY AND BACKUP CONTROL STATIONS AND CREWMEN PERFORMING IVA. THE CAPABILITY FOR PRIVATE COMMUNICATIONS WITH THE GROUND SHALL BE PROVIDED WITHIN EACH OF THE INDIVIDUAL CREW STATEROOMS UNDER STATION OPERATOR CONTROL. THE CAPABILITY TO RECEIVE SELECTABLE ENTERTAINMENT TYPE AUDIO AND VIDEO COMMUNICATIONS (MUSIC AND TV) SHALL BE PROVIDED SIMULTANEOUS WITHIN EACH OF THE INDIVIDUAL CREW STATEROOMS.

THE CAPABILITY TO RECEIVE SELECTABLE ENTERTAINMENT TYPE AUDIO COMMUNICATIONS (MUSIC) SHALL BE PROVIDED WITHIN THE GALLEY, PRIMARY DINING AREA AND RECREATION AREA.

THE CAPABILITY TO BROADCAST (TIME DELAYED) SELECTABLE EARTH RADIO AND TELEVISION PROGRAMS SHALL BE PROVIDED WITHIN THE RECREATION AREA.

- INVENTORY CONTROL

THE CAPABILITY FOR INVENTORY CONTROL OF FOOD SUPPLIES AND MENU PLANNING SHALL BE PROVIDED FOR THE PRIMARY AND BACKUP GALLEYS. THE CAPABILITY FOR INVENTORY CONTROL OF CREW CLOTHING AND BEDDING SHALL BE PROVIDED.

3.3.7.26.7 CREW HABITABILITY/CREW HABITABILITY INTERFACES

NOT APPLICABLE

4.0 QUALITY ASSURANCE

A FUNDAMENTAL REQUIREMENT IN ACCOMPLISHING QUALITY ASSURANCE IS TO ESTABLISH A PLAN WHICH WILL ASSURE DELIVERY OF A QUALITY PRODUCT ON COMPLETION OF THE TEST PROGRAM. QUALITY ASSURANCE DETAILED REQUIREMENTS, MANAGEMENT APPROACH, AND QUALITY PROGRAM PLAN DESCRITPION FOR PHASE C/D ARE CONTAINED IN SD71-225, MSS PROGRAM MASTER PLAN. QUALITY ASSURANCE IS PROVIDED THROUGHOUT THE TEST PROGRAM AS SHOWN IN FIGURE 4.0-1 BY UTILIZING THE DATA BASE PERFORMANCE DATA THROUGHOUT DDEVELOPMENT TEST, DESIGN PROOF TEST, QUALIFICATION TEST, ACCEPTANCE TEST. PRELAUNCH TEST AND MISSION OPERATIONS. BY ACCESS TO THE DATA BASE, EACH DETAILED OPERATION WILL BE ASURED OF ANALYSIS, EVALUATION AND IMPLEMENTATION OF QUALITY ASSURANCE. IN ADDITION TO UTILIZING THE TEST DATA BASE, QUALITY ASSURANCE WILL BE APPLIED IN ALL PHASES OF MANUFACTURING, DEVELOPMENT TEST, SYSTEMS INSTALLATION AND CHECK-OUT.

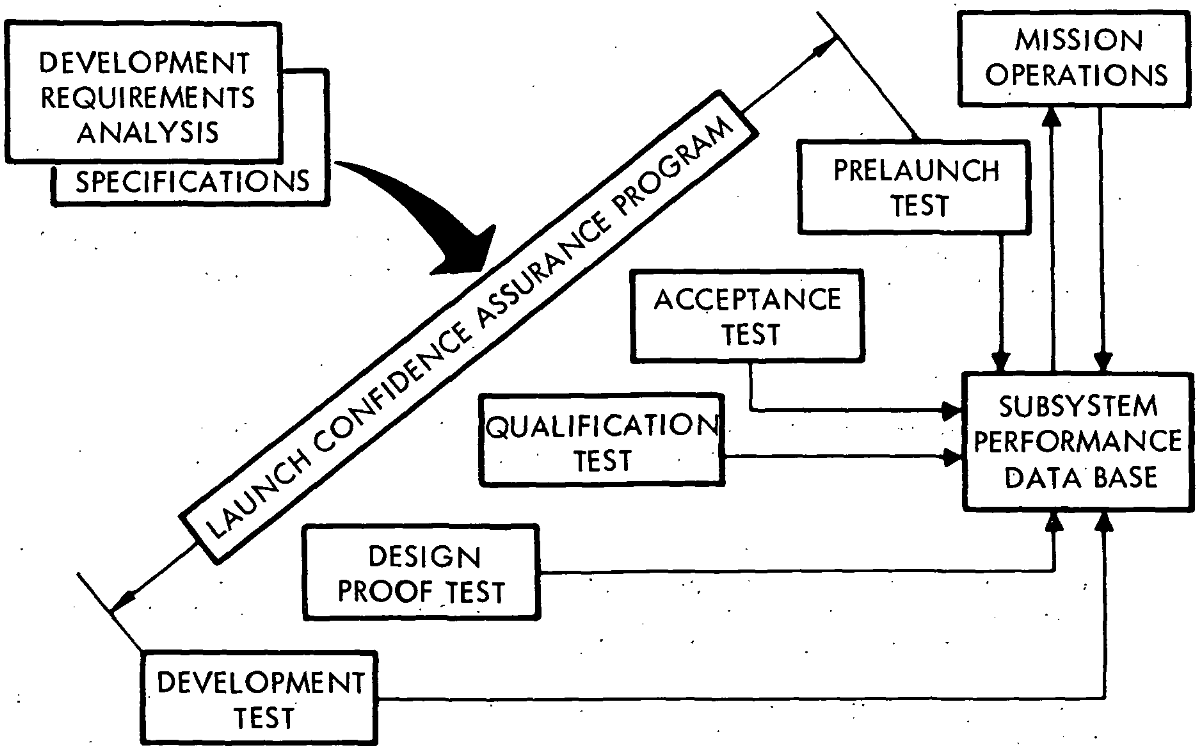


FIG 4.0-1 QUALITY ASSURANCE INTEGRATED PROGRAM

4.2.1.1 ANALYSIS

ANALYSIS SHALL BE REQUIRED TO VERIFY SYSTEM, EQUIPMENT DESIGN AND PERFORMANCE REQUIREMENTS. THE ANALYSIS SHALL INCLUDE VERIFICATION BY SIMILARITY, BY DESIGN CORRELATION, BY DATA EXTRAPOLATION AND BY COMPUTER SIMULATION. THE ANALYTICAL RESULTS MAY INDICATE THAT - (A) BECAUSE OF THE CONFIDENCE IN THE EXISTING DATA, TESTS NEED NOT BE PERFORMED, OR (B) BECAUSE OF INSUFFICIENT DATA OR MARGINAL RESULTS ADDITIONAL ANALYSIS SHOULD BE PERFORMED, OR (C) BECAUSE OF INCONCLUSIVE DATA OR MARGINAL RESULTS, SPECIFICALLY DEFINED LIMITED TESTS SHALL BE NECESSARY TO COMPLETE VERIFICATION. THESE ANALYSES IDENTIFY POSSIBLE HARDWARE WEAROUT CHARACTERISTICS AND MINIMIZE THE SCOPE OF TESTING REQUIRED AND YET FULFILL THE NECESSARY ELEMENTS TO SUPPORT FLIGHT WORTHINESS.

4.2.1.2 TESTING

THE TEST PHILOSOPHY WILL CONSIST OF A SET OF GROUND RULES AND CRITERIA DEVISED TO -

ASSIST IN FORMULATING DESIGN REQUIREMENTS AS WELL AS TEST, CHECKOUT AND OPERATIONAL REQUIREMENTS.

EVALUATE TEST REQUIREMENTS.

DEVELOP TEST LOGIC, AND A TEST PROGRAM TO MEET THE PROGRAM OBJECTIVES OF LOW COST, FLEXIBILITY, RELIABILITY, LONG LIFE AND SAFETY.

A. DEVELOPMENTAL TESTING

ALL DEVELOPMENT REQUIREMENTS RESULTING FROM NEW DESIGNS WILL BE SATISFIED BY EITHER ANALYSIS, DEVELOPMENT TESTS, OR A COMBINATION OF BOTH.

DEPTH OF DEVELOPMENT TESTING, IN PART, WILL BE DETERMINED BY AN ANALYSIS OF POSSIBLE FAILURE MODES (FMEA) AND THE CAUSE OF THESE FAILURES (FMEC). THE INITIAL DETERMINATION WILL BE MADE BASED ON THE CRITICALITY OF THE SUBSYSTEM.

STRUCTURAL TESTING WILL VERIFY A SATISFACTORY DESIGN MARGIN FOR OPERATIONAL LIMITS.

TESTING OF CANDIDATE MATERIALS WILL BE BASED UPON THE REQUIREMENTS OF LONG LIFE EXPOSURE TO THE EXTERNAL SPACE ENVIRONMENTS, INTERNAL

4.1 GENERAL QUALITY ASSURANCE

THE SHUTTLE LAUNCH MODULAR SPACE STATION PROGRAM SHALL HAVE A QUALITY ASSURANCE PROGRAM IN CONSONANCE WITH NHB5300.4 (1B) TO VERIFY THAT THE EQUIPMENT IS CAPABLE OF PERFORMING THE SHUTTLE LAUNCH MODULAR SPACE STATION MISSION. EACH COMPONENT OF EVERY PROGRAM ELEMENT WILL BE ANALYZED FOR QUALIFICATION REQUIREMENTS. A QUALIFICATION MATRIX WILL BE ESTABLISHED FROM THESE REQUIREMENTS.

4.2 TEST

4.2.1 PHASE I TEST/VERIFICATION

PHASE I TEST/VERIFICATION REQUIRES THAT AN OPTIMAL COMBINATION OF ANALYSIS OR TESTING BE PERFORMED TO VERIFY THAT THE EQUIPMENT IS CAPABLE OF PERFORMING THE SPACE MISSION. THE VERIFICATION PROGRAM FOR ALL EQUIPMENT SHALL BE ESTABLISHED ACCORDING TO ITS QUALIFICATION ANALYSIS.

METHODS	TEST TYPES
1. ANALYSIS	A. DEVELOPMENT
(A) SIMILARITY	B. ACCEPTANCE
(B) DESIGN CORRELATION	C. QUALIFICATION
(C) MATHEMATICAL	D. INTEGRATED SYSTEMS
(D) COMPUTER PROGRAM	E. MAJOR GROUND
	F. PRELAUNCH CHECKOUT
	G. IN ORBIT VERIFICATION
	H. POST FLIGHT

2. TEST DOCUMENTATION

   ALL TEST SEQUENCES SHALL EMPLOY A CENTRAL DATA BANK FOR SOURCE DATA (TOLERANCES, PROCEDURES, AND HISTORICAL RECORDS). THIS SAME DATA BANK WILL PROVIDE THE DOCUMENTATION REQUIRED TO ESTABLISH QUALIFICATION STATUS.

SPACE STATION ENVIRONMENT, AND WILL BE AN EXTENSION OF PRESENT SPACE MATERIALS TESTING PROGRAMS.

DEVELOPMENT TESTING OF SELECTED NEW MATERIALS, COMPONENTS, BREADBOARDS AND PROTOTYPE HARDWARE SHALL BE PERFORMED TO EVALUATE DESIGN AND MATERIALS COMPATIBILITY AND TO EVALUATE CAPABILITY OF THE DESIGN TO WITHSTAND EXPOSURE TO SHUTTLE LAUNCH MODULAR SPACE STATION ENVIRONMENTS.

B. ACCEPTANCE TESTING

ACCEPTANCE TESTING OF SELECTED FLIGHT OR TEST HARDWARE SHALL BE PERFORMED IN SUPPORT OF THE SHUTTLE LAUNCH MODULAR SPACE STATION PROGRAM AND ACCEPTANCE OF PRODUCTION HARDWARE. ACCEPTANCE TESTS SHALL BE CONDUCTED PRIOR TO TEST OR C/O TO ASSURE THAT NO MANUFACTURING DEFECTS NOT READILY DETECTED BY NORMAL INSPECTION TECHNIQUES SHALL BE PRESENT IN THE FLIGHT OR TEST HARDWARE. THE ACCEPTANCE TESTS ALSO PROVIDE FAILURE AND OPERATIONAL DATA TO ASSIST IN THE CORRECTION AND ELIMINATION OF THE CAUSES OF FAILURE. ACCEPTANCE TESTS SHALL BE INTEGRATED WITH THE MANUFACTURING TESTS AND SHUTTLE LAUNCH SPACE STATION CHECKOUT AS PART OF A TOTAL PROGRAM TO PROVIDE ASSURANCE THAT EACH CONTRACT END ITEM SHALL BE CAPABLE OF FULFILLING REQUIRED END USE.

(1) ACCEPTANCE TEST CRITERIA

THE FOLLOWING CRITERIA SHALL APPLY TO SHUTTLE LAUNCH MODULAR SPACE STATION COMPONENT ACCEPTANCE TESTING AND SHALL INCLUDE FUNCTIONAL TESTS, ENVIRONMENTAL EXPOSURE AS REQUIRED, AND INSPECTION TECHNIQUES DESIGNED TO DETECT MANUFACTURING DEFECTS AND HANDLING DAMAGE, TO PROVIDE ASSURANCE THAT NO MAL-FUNCTION EXISTS PRIOR TO SHIPPING SO THAT HARDWARE CONFORMS TO THE PERFORMANCE SPECIFICATION AND OTHER PERFORMANCE CRITERIA, AND TO ASSURE PROPER EQUIPMENT CALIBRATIONS OR ALIGNMENTS. THE DEGREE, DURATION, AND NUMBER OF TESTS SHALL BE SUFFICIENT TO PROVIDE ASSURANCE THAT EACH HARDWARE ITEM POSSESSES THE REQUIRED QUALITY AND PERFORMANCE WITHOUT DEGRADATION TO THE HARDWARE. ACCEPTANCE TESTS SHALL INCLUDE, BUT ARE NOT LIMITED TO (A) SUCH TESTS, CHECKS, AND INSPECTIONS AS VISUAL EXAMINATION, FUNCTIONAL CHECKS AND MEASUREMENTS, (B) NON-DESTRUCTIVE TESTS SUCH AS X-RAY, INFRARED, ULTRASONICS, AND PENETRANT AND RADIOGRAPHIC INSPECTION, (C) VIBRATION AND THERMAL ENVIRONMENTAL TESTS, AND (D) CALIBRATION OR ALIGNMENT. ACCEPTANCE TEST ENVIRONMENTAL LEVELS SHALL NOT EXCEED FLIGHT ENVIRONMENTAL LEVELS EXCEPT

UNDER SPECIFIC CONDITIONS DEFINED IN THE ENVIRONMENTAL TEST REQUIREMENTS.

C. QUALIFICATION TESTING

SPECIAL QUALIFICATION TESTS THAT HAVE BEEN IDENTIFIED FROM THE QUALIFICATION MATRIX SHALL VERIFY THE CAPABILITY OF EACH SUBSYSTEM TO MEET ITS REQUIREMENTS.

1. QUALIFICATION TEST CRITERIA

QUALIFICATION TESTING CRITERIA OF SHUTTLE LAUNCH MODULAR SPACE STATION AS ESTABLISHED BY CRITICALITY SHALL BE AS FOLLOWS -

(A) CATEGORY A EQUIPMENT

TEST TO THE SPECIFIED-GROUND AND IN-ORBIT OPERATIONS ENVIRONMENTAL DESIGN LIMIT EXTREMES.

(B) CATEGORY B EQUIPMENT

TEST TO THE SPECIFIED-GROUND AND IN-ORBIT OPERATIONS DESIGN LIMIT EXTREME.

2. QUALIFICATION TESTING WILL BE ACCOMPLISHED ON THE HIGHEST PRACTICAL LEVEL OF ASSEMBLY.

3. QUALIFICATION OF SUBSYSTEMS NOT OPERATING DURING LAUNCH WILL INCLUDE FUNCTIONAL TESTS AFTER BEING SUBJECTED TO THE SIMULATED LAUNCH ENVIRONMENT (MUST SURVIVE THE LAUNCH ENVIRONMENT, THEN FUNCTION PROPERLY).

4. QUALIFICATION OF IFRU'S TO A SIMULATED LAUNCH ENVIRONMENT WILL CONSIDER THE SHUTTLE LAUNCH ENVIRONMENTS.

D. INTEGRATED SYSTEMS TEST (PHASE II)

INTEGRATED SYSTEMS TEST WILL SIMULATE ALL MISSION PHASES AND ASSURE THAT NO ELECTROMAGNETIC INTERFERENCE PROBLEMS EXIST. WHEREVER POSSIBLE, ALTERNATE/REDUNDANT PATH CHECKOUT CAPABILITY WILL BE UTILIZED WITHOUT DISTURBING THE FLIGHT CONFIGURATION.

E. MAJOR GROUND TEST

MAJOR GROUND TESTS OF SELECTED EQUIPMENT SHALL BE PERFORMED TO EVALUATE SYSTEM INTEGRATION AND OPERATIONAL DEVELOPMENT FOR THE STRUCTURAL, DYNAMIC RESPONSE, FUNCTIONAL SYSTEM INTERFACE AND PHYSICAL SYSTEM INTERFACE IN RELATION TO THE FLIGHT AND LAUNCH ACTION, TIME/CYCLE LIMITS, AND ENVIRONMENTS. MAJOR GROUND TEST VERIFICATION SHALL BE FOR VIBRO-ACOUSTIC, PROPULSION, THERMAL VACUUM, STATIC STRUCTURAL AND ENVIRONMENTAL CONTROL SUBSYSTEM TESTS. UPON EVALUATION OF THE TEST DATA AND CORRELATION WITH THE SHUTTLE LAUNCH MODULAR SPACE STATION REQUIREMENTS, MAJOR GROUND TESTS SHALL BE ESTABLISHED FOR THE SPACE STATION INCLUDING APPROPRIATE ENVIRONMENTAL LEVELS, DURATIONS SHUTTLE LAUNCH MODULAR SPACE STATION INCLUDING APPROPRIATE ENVIRONMENTAL LEVELS, DURATIONS, AND TEST HARDWARE QUANTITIES.

1. DEVELOPMENT TESTS

BREADBOARD AND DEVELOPMENTAL EMI TEST DATA SHALL BE OBTAINED TO DETERMINE CORRECTIVE ACTION NECESSARY TO ASSURE ELECTROMAGNETIC COMPATIBILITY OF THE INTEGRATED SUBSYSTEM CONFIGURATION.

2. EQUIPMENT/COMPONENT TEST

THE SPACE STATION COMMUNICATION SUBSYSTEM RF EQUIPMENT SPECTRUM SIGNATURES SHALL BE ACQUIRED AND DOCUMENTED. TESTS SHALL INCLUDE TRANSMITTERS AND THE DETERMINATION OF SUSCEPTIBILITY CHARACTERISTICS OF EACH MAJOR SPACE STATION RECEIVER.

F. PRELAUNCH CHECKOUT

PRELAUNCH CHECKOUT SHALL BE PERFORMED TO DEMONSTRATE THAT ALL SUBSYSTEMS ARE IN A STATE OF OPERATIONAL READINESS AND ARE WITHIN OPERATIONAL LIMITS.

G. IN ORBIT VERIFICATION

ALL MEASUREMENTS STORED IN THE DATA BANK FROM IN ORBIT FLIGHT WILL BE AVAILABLE FOR ANALYSIS TO DETERMINE THE CAUSE OF FAILURE AND VALIDATE IN FLIGHT REPLACEABLE UNITS ACCEPTANCE OR COMPONENT TEST PROVISIONS.

H. POST FLIGHT

ALL IN FLIGHT REPLACEABLE UNITS WHICH HAVE BEEN RETURNED WILL BE AVAILABLE FOR ANALYSIS TO DETERMINE BEST MODES OF OPERATION AND PART MALFUNCTION AND WEAR.

5.0 PREPARATION AND DELIVERY

THREE BASIC MODULE CONFIGURATIONS ARE EMPLOYED IN THE MSS PROGRAM, CORE MODULE, STATION MODULE AND POWER MODULE. EACH BASIC MODULE CONFIGURATION PRESENTS SPECIFIC REQUIREMENTS FOR PREPARATION AND DELIVERY AS OUTLINED BELOW.

5.1 CORE MODULE

5.1.1 TRIAL ASSEMBLY AND CHECKOUT

THE CORE MODULE FINAL ASSEMBLY AND CHECKOUT OPERATIONS ARE CONDUCTED AT THE MANUFACTURING SITE WITH THE LONGITUDINAL AXIS IN THE VERTICAL POSITION AND THE FLOORS (BULKHEADS) IN A TRANSVERSE ORIENTATION FOR COMPATIBILITY WITH THE 1 G ENVIRONMENT.

5.1.2 PREPARATION FOR DELIVERY

5.1.2.1 FLUID LINES AND ACCUMULATORS

ALL FLUID LINES AND ACCUMULATORS WILL BE DRAINED AND PURGED WITH DRY NITROGEN. DEADFACE VALVES AT EACH OF THE 10 DOCKING PORTS WILL BE CLOSED. EACH LINE WILL BE FILLED WITH DRY NITROGEN TO A POSITIVE GAUGE PRESSURE.

5.1.2.2 ELECTRICAL CABLES, BUSSES AND CONTROL PANELS.

PLACE ALL SWITCHES IN OFF OR NORMAL POSITION. PLACE DEADFACE SWITCHES AT EACH OF THE 10 DOCKING/BERTHING PORTS IN THE CLOSED POSITION. REMOVE BATTERIES FOR SEPARATE SHIPMENT.

5.1.2.3 INSTALL SHIPPING SUPPORTS

INSTALL SHIPPING SUPPORTS AS REQUIRED FOR EACH ITEM OF EQUIPMENT. SHIPPING SUPPORTS WILL PROVIDE FOR EQUIPMENT STABILITY WITH THE MODULE LONGITUDINAL AXIS PARALLEL TO THE GROUND PLANE UNDER NORMAL GROUND AND AIR TRANSPORT LOAD CONDITIONS.

5.1.2.4 INSTALL SHIPPING COVERS

RETRACT RCS QUADS, INSTALL SHIPPING COVERS ON ALL OPTICAL DEVICES OR PORTS, INSTALL SHIPPING COVERS ON EACH OF 10 DOCKING/BERTHING PORTS.

5.1.2.5 INSTALL MODULE ON TRANSPORTER

POSITION CORE MODULE ON TRANSPORTER AND SECURE FOR SHIPMENT.

5.2 STATION MODULE

5.2.1 FINAL ASSEMBLY AND CHECKOUT

THE STATION MODULE FINAL ASSEMBLY AND CHECKOUT OPERATIONS ARE CONDUCTED AT THE MANUFACTURING SITE WITH THE LONGITUDINAL AXIS IN THE HORIZONTAL POSITION AND THE FLOORS PARALLEL TO THE GROUND PLANE FOR COMPATIBLITY WITH 1G ENVIRONMENT.

5.2.2 PREPARATION FOR DELIVERY

5.2.2.1 FLUID LINES AND ACCUMULATORS

ALL FLUID LINES AND ACCUMULATORS WILL BE DRAINED AND PURGED WITH DRY NITROGEN. DEADFACE VALVES AT EACH OF THE TWO DOCKING/BERTHING PORTS WILL BE CLOSED. EACH LINE WILL BE FILLED WITH DRY NITROGEN TO A POSITIVE GAUGE PRESSURE.

5.2.2.2 ELECTRICAL CABLES, BUSSES AND CONTROL PANEL

PLACE ALL SWITCHES IN OFF OR NORMAL POSITION. PLACE DEADFACE SWITCHES AT EACH DOCKING/BERTHING PORT IN THE CLOSED POSITION.

5.2.2.3 INSTALL SHIPPING SUPPORTS

INSTALL SHIPPING SUPPORTS AS REQUIRED. SHIPPING SUPPORTS WILL PROVIDE FOR EQUIPMENT STABILITY WITH THE MODULE FLOORS PARALLEL TO THE GROUND PLANE UNDER NORMAL GROUND AND AIR TRANSPORT LOAD CONDITIONS.

5.2.2.4 INSTALL SHIPPING COVERS

INSTALL SHIPPING COVERS ON ALL PORTS, WINDOWS, AND DOCKING/BERTHING PORTS.

5.2.2.5 INSTALL MODULE ON TRANSPORTER

POSITION STATION MODULE ON TRANSPORTER AND SECURE FOR SHIPMENT.

5.3 POWER MODULE

5.3.1 FINAL ASSEMBLY AND CHECKOUT

THE POWER MODULE FINAL ASSEMBLY AND CHECKOUT OPERATIONS ARE CONDUCTED AT THE MANUFACTURING SITE WITH THE LONGITUDINAL AXIS IN THE VERTICAL POSITION AND THE BULKHEADS IN A TRANSVERSE ORIENTATION FOR COMPATIBILITY WITH THE 1G ENVIRONMENT.

5.3.2 PREPARATION FOR DELIVERY

5.3.2.1 FLUID LINES AND ACCUMULATORS

ALL FLUID LINES AND ACCUMULATORS WILL BE DRAINED AND PURGED WITH DRY NITROGEN. DEADFACE VALVES AT THE DOCKING/BERTHING PORT WILL BE CLOSED. EACH LINE WILL BE FILLED WITH DRY NITROGEN TO A POSITIVE GAUGE PRESSURE.

5.3.2.2 ELECTRICAL CABLES, BUSSES AND CONTROL PANELS

ALL SWITCHES WILL BE PLACED IN THE OFF OR NORMAL POSITIONS. DEADFACE SWITCHES AT THE DOCKING/BERTHING PORT WILL BE PLACED IN THE CLOSED POSITION.

5.3.2.3 INSTALL SHIPPING SUPPORTS

INSTALL SHIPPING SUPPORTS AS REQUIRED FOR EACH ITEM OF EQUIPMENT. SHIPPING SUPPORTS WILL PROVIDE FOR EQUIPMENT STABILITY WITH THE MODULE LONGITUDINAL AXIS PARALLEL TO THE GROUND PLANE UNDER NORMAL GROUND AND AIR TRANSPORT LOADS.

5.3.2.4 INSTALL SHIPPING COVERS

INSTALL SHIPPING COVERS ON ALL PORTS, HATCHES AND THE BERTHING PORT.

5.3.2.5 INSTALL MODULE ON TRANSPORTER

POSITION POWER MODULE ON TRANSPORTER AND SECURE FOR SHIPMENT.

6.0 NOTES

NOT APPLICABLE AT THIS TIME

10.1 NATURAL ENVIRONMENT MODEL

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THIS MODEL DESCRIBES THE NATURAL ENVIRONMENTAL CRITERIA EFFECTING SPACE STATION DESIGN BASED ON THE FOLLOWING FUNDAMENTAL DESIGN REQUIREMENTS.

1. CAPABLE OF OPERATION IN ORBITS FROM 240 TO 270 NM WITH INCLINATION OF 55.0 DEGREES.
2. A MINIMUM OPERATIONAL LIFE OF TEN YEARS.
3. OPERATIONAL USE IN THE 1981 - 1991 APPROXIMATE TIME PERIOD
4. LAUNCH FROM KENNEDY SPACE CENTER IN A SHUTTLE VEHICLE.

FOR CONVENIENCE, THE NATURAL ENVIRONMENTS EXPECTED DURING SPACE STATION OPERATIONS ARE PRESENTED IN CHRONOLOGICAL SEQUENCE AS FOLLOWS- (1.0) GROUND OPERATIONS, AND (2.0) ORBITAL OPERATIONS.

1.0 GROUND ENVIRONMENT

1.1	TEMPERATURE (AIR)	-15F TO +115F
1.2	PRESSURE	1050 MB. (15.2 PSIA) MAXIMUM TO 900 MB. (13.1 PSIA) MINIMUM
1.3	HUMIDITY	0 TO 100 PERCENT RELATIVE HUMIDITY
1.4	SUNSHINE	SOLAR RADIATION OF 360 BTU/SQ-FT/HR FOR SIX HOURS PER DAY
1.5	RAIN	UP TO 0.6 INCH PER HOUR FOR 12 HOURS; 2.5 INCHES PER HOUR FOR ONE HOUR
1.6	SAND AND DUST	AS ENCOUNTERED IN OCEAN BEACH AREAS, EQUIVALENT TO 140-MESH SILICA FLOUR WITH PARTICLE VELOCITY UP TO 500 FT/MIN AND A DENSITY OF 0.25 GM/CU-FT.
1.7	FUNGUS	AS EXPERIENCED IN FLORIDA CLIMATE. MATERIALS WILL NOT BE USED WHICH WILL SUPPORT OR BE DAMAGED BY FUNGI.

1.8 SALT SPRAY	SALT ATMOSPHERE AS ENCOUNTERED IN COASTAL AREAS, THE EFFECT OF WHICH IS SIMULATED BY EXPOSURE TO A 5% SALT SOLUTION BY WEIGHT FOR 48 HOURS.
1.9 OZONE	FIVE YEARS EXPOSURE, INCLUDING 120 HOURS AT 0.5 PPM, SIX MONTHS AT 0.25 PPM, AND THE REMAINDER AT 0.05 PPM.
1.10 GROUND WINDS	THE MODULES WILL BE EXPOSED TO THE ATMOSPHERE DURING GROUND HANDLING OPERATIONS. THE WIND SPEEDS FOR STRUCTURAL LOADING CONSIDERATIONS ARE TO BE DETERMINED.
1.11 LIGHTNING	THE FOLLOWING CONDITION APPLIES TO SPACE STATION ONLY WHILE MATED TO THE LAUNCH VEHICLE AT KSC- A LIGHTNING CURRENT SURGE WHICH REACHES A PEAK OF 100,000 AMPERES AT 10 MICROSECONDS AND DROPS TO 50,000 AMPERES AT 20 MICROSECONDS.

2.0 ORBITAL ENVIRONMENT

2.1 ATMOSPHERE

FOR MANY SPACE STATION STUDIES, THE AVERAGE STATIC UPPER ATMOSPHERE MODEL DESCRIBED IN THE KSC REFERENCE ATMOSPHERE (NASA TM-X-53139) WILL BE SUFFICIENTLY ACCURATE AND MAY BE EMPLOYED. HOWEVER, SUCH DECISIONS WILL REQUIRE NASA CONCURRENCE. FOR SPACE STATION STUDIES THAT ARE SENSITIVE TO SMALL OR SHORT-TERM FLUCTUATIONS IN ATMOSPHERIC DENSITY, THE PROPERTIES SUMMARIZED IN THE FOLLOWING TABLES, WHICH ARE BASED ON THE MSFC MODIFIED JACCHIA MODEL ATMOSPHERE, MAY BE USED WITH SUFFICIENT ACCURACY FOR MOST CASES. NOMINAL CONDITIONS ARE SUMMARIZED IN TABLE 2.1-1 AND ARE BASED ON NOMINAL PREDICTIONS OF SOLAR FLUX AND GEOMAGNETIC ACTIVITY INDEX. THE LOCAL TIME OF DAY IS TAKEN AS 0900 HOURS TO OBTAIN THE MEAN ORBITAL CONDITIONS. (DAILY MAXIMUM VALUES OCCUR AT 1400 HOURS AND MINIMUM AT 0400 HOURS.)

TABLE 2.1-1
PREDICTED ATMOSPHERIC GAS PROPERTIES
FOR NOMINAL CONDITIONS

DATE - JANUARY 1, 1981			GM TIME 0900	
ALT (NM)	DENSITY (GM/CM^3)	TEMP (DEG K)	PRESSURE ($DYNE/CM^2$)	MOLE. WT. (UNITLESS)
240	1.1530E-15	950.5	5.8871E-06	15.5
250	8.2991E-16	950.5	4.3320E-06	15.1
260	6.0111E-16	950.5	3.2154E-06	14.8
270	4.3806E-16	950.5	2.4137E-06	14.3

DESIGN (TWO SIGMA) CONDITIONS ARE PRESENTED IN TABLE 2.1-2. THE LOCAL TIME OF DAY WAS TAKEN TO BE 1400 HOURS TO OBTAIN THE MAXIMUM ORBITAL VALUES. DATA PRESENTED IN TABLES 2.1-3 AND 4 ARE APPLICABLE TO SPACE STATION STUDIES THAT ARE SENSITIVE TO SHORT-TERM FLUCTUATIONS IN THE GEOMAGNETIC INDEX (USUALLY LASTING FOR SIX TO EIGHT HOURS). THE PROPERTIES ARE BASED ON PREDICTED TWO SIGMA SOLAR FLUX VALUES, A LOCAL TIME OF 1400 HOURS, AND A GEOMAGNETIC INDEX OF 200 AND 400. (THE DATA IN TABLE 2.1-4 REPRESENT AN ESTIMATE OF PROPERTIES THAT WOULD OCCUR FOR A SHORT TIME DURING AN EXTREMELY LARGE GEOMAGNETIC STORM.)

TABLE 2.1-2
PREDICTED ATMOSPHERIC GAS PROPERTIES
FOR PLUS TWO SIGMA CONDITIONS

DATE - JANUARY 1, 1981 GM TIME 1400

ALT (NM)	DENSITY (GM/CM^3)	TEMP (DEG K)	PRESSURE $(DYNE/CM^2)$	MOL. WT. (UNITLESS)
240	4.4644E-15	1324.0	2.8846E-05	17.0
250	3.4450E-15	1324.2	2.2623E-05	16.8
260	2.6741E-15	1324.3	1.7832E-05	16.5
270	2.0869E-15	1324.4	1.4125E-05	16.3

TABLE 2.1-3
PREDICTED ATMOSPHERIC GAS PROPERTIES
FOR PLUS TWO SIGMA CONDITIONS WITH AP=200

DATE - JANUARY 1, 1981 GM TIME 1400

ALT (NM)	DENSITY (GM/CM^3)	TEMP (DEG K)	PRESSURE $(DYNE/CM^2)$	MOL. WT. (UNITLESS)
240	6.5263E-15	1511.0	4.6577E-05	17.6
250	5.1526E-15	1511.7	3.7378E-05	17.3
260	4.0911E-15	1512.1	3.0135E-05	17.1
270	3.2652E-15	1512.4	2.4401E-05	16.8

TABLE 2.1-4
PREDICTED ATMOSPHERIC GAS PROPERTIES
FOR PLUS TWO SIGMA CONDITIONS WITH AP=400

DATE - JANUARY 1, 1981 GM TIME 1400

ALT (NM)	DENSITY (GM/CM^3)	TEMP (DEG K)	PRESSURE ($DYNE/CM^2$)	MOL. WT. (UNITLESS)
240	8.5849E-15	1706.9	6.7333E-05	18.1
250	6.9124E-15	1708.5	5.5118E-05	17.8
260	5.5954E-15	1709.7	4.5310E-05	17.6
270	4.5516E-15	1700.5	3.7395E-05	17.3

2.2 THERMAL ENVIRONMENT

SOLAR FLUX = 429 BTU/SQ-FT/HOUR (ALL WAVE LENGTHS)
EARTH EMISSION = 73 BTU/SQ-FT/HOUR (EXCLUDING REFLECTION)
EARTH AVERAGE ALBEDO = 0.40 (VISUAL RANGE)
EARTH AVERAGE TOTAL ALBEDO = 0.30
SPACE SINK TEMPERATURE = ZERO DEGREES RANKINE
MOON EMISSION-
LOCAL ON SUNLIT PORTION = (1-A)429 COS(B) BTU/SQ-FT/HOUR
WHERE- A = ALBEDO
B = ANGLE FROM SUBSOLAR POINT
ANTISOLAR = 2.2 BTU/SQ-FT/HOUR
MOON AVERAGE NORMAL ALBEDO = 0.073

2.3 RADIATION ENVIRONMENT

THE NATURAL RADIATION ENVIRONMENT IS DERIVED FROM THREE PRIMARY CONTRIBUTORS- (A) EARTH'S TRAPPED RADIATION (PROTON AND ELECTRON FLUXES), (B) GALACTIC COSMIC RADIATION, AND (C) SOLAR FLARE EVENTS.

EARTH TRAPPED RADIATION- THE LEVELS OF EARTH TRAPPED RADIATION ARE DEPENDENT ON ORBITAL ALTITUDE AND INCLINATION BECAUSE OF THE CONTOUR OF THE VAN ALLEN BELTS, AND ARE PARTICULARLY INFLUENCED BY PASSAGE THROUGH A REGION OF RELATIVELY HIGH FLUX REFERRED TO AS THE 'SOUTH ATLANTIC ANOMALY.' DIFFERENTIAL ENERGY SPECTRA FOR PROTON AND ELECTRON RADIATION ARE PRESENTED IN FIGURES 2.3-1 AND -2, RESPECTIVELY. DATA ARE PRESENTED FOR TWO TYPICAL ORBITS (200 NM,

90 DEGREE INCLINATION AND 255 NM, 55 DEGREE INCLINATION). THE DOSE RATE AT SKIN SURFACE IS PLOTTED IN FIGURE 2.3-3. THE DEPTH DOSE RATE (5 CM) IS PLOTTED IN FIGURE 2.3-4. FIGURES 2.3-3 AND -4 REPRESENTS THE MAXIMUM NOMINAL DOSE RATE FOR THE RANGE OF ORBITAL ALTITUDES AND INCLINATIONS TO BE CONSIDERED. THE PLOTTED CURVES REPRESENT NOMINAL VALUES, MULTIPLYING FACTORS TO OBTAIN 10 PERCENT AND 1 PERCENT PROBABILITY DESIGN VALUES ARE ALSO LISTED ON THESE FIGURES. A CYLINDRICAL SHELL WITH HEAVY ENDS IS ASSUMED AS THE SHIELDING MODEL.

GALACTIC COSMIC RADIATION- GALACTIC COSMIC RADIATION LEVELS ARE A FUNCTION OF SOLAR ACTIVITY AND ORBITAL INCLINATION. NOMINAL RADIATION DOSE RATES FOR THE 255 N. MILE 55 DEGREE INCLINATION IS LISTED IN TABLE 2.3-1 BELOW. BECAUSE OF THE EXTREME PENETRATING POWER OF THIS TYPE OF RADIATION, THE INFLUENCE OF SHIELD THICKNESS IS NOT SIGNIFICANT OVER A PRACTICAL DESIGN RANGE AND THE SKIN AND DEPTH DOSES ARE ESSENTIALLY THE SAME.

TABLE 2.3-1
GALACTIC COSMIC RADIATION DOSE RATES (REM/DAY)
LOW EARTH ORBIT (255 NM)

	55 DEG.
SOLAR MINIMUM	0.008
SOLAR MAXIMUM	0.005

SOLAR FLARE RADIATION- RADIATION LEVELS DUE TO SOLAR FLARES WILL BE NEGLIGIBLE FOR LOW INCLINATION ORBITS (LESS THAN 45 DEGREES) BECAUSE OF THE SHIELDING EFFECT OF THE EARTH'S MAGNETCSPHERE. HOWEVER, SOLAR FLARE RADIATION CAN BE VERY SIGNIFICANT FOR HIGHER INCLINATION EARTH ORBITS AND GEOSYNCHRONOUS, OR LUNAR ORBIT MISSIONS. DESIGN SOLAR FLARE RADIATION FLUX AND DOSE RATE VS. SHIELDING DENSITY DATA GIVEN IN FOLLOWING SECTIONS ARE TAKEN FROM TMX-53865, 'NATURAL ENVIRONMENT CRITERIA FOR THE NASA SPACE STATION PROGRAM'.

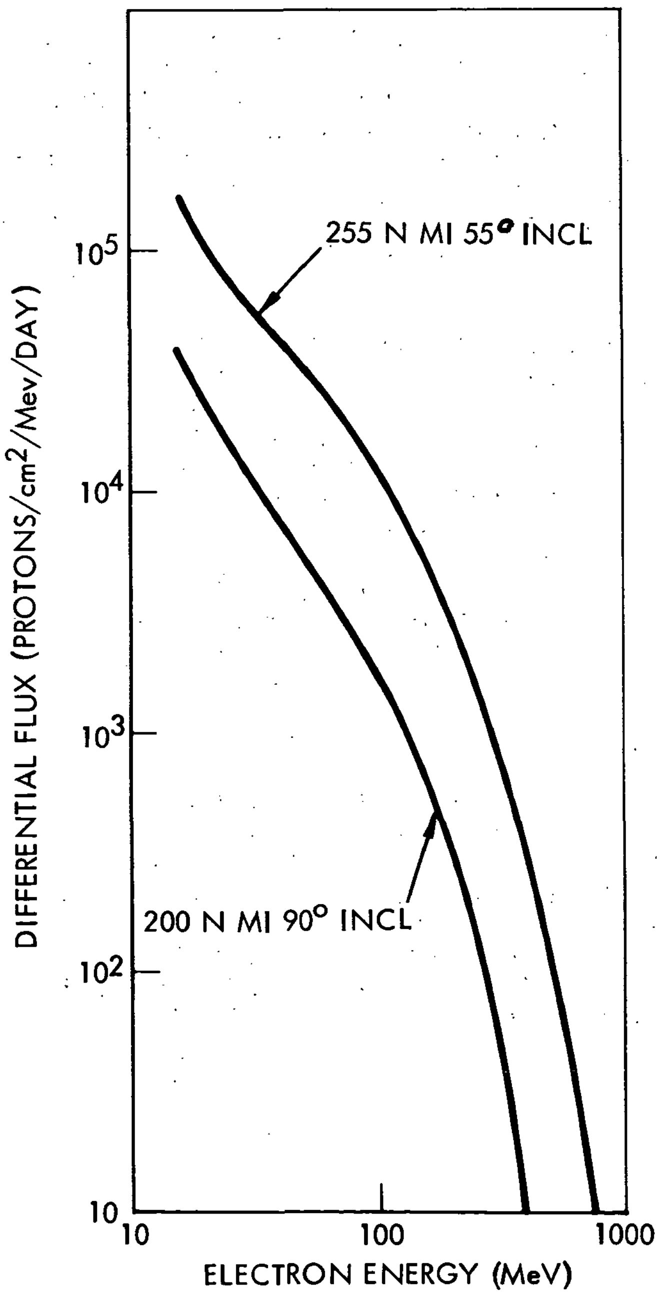

FIGURE 2.3-1 PROTON DIFFERENTIAL ENERGY SPECTRA

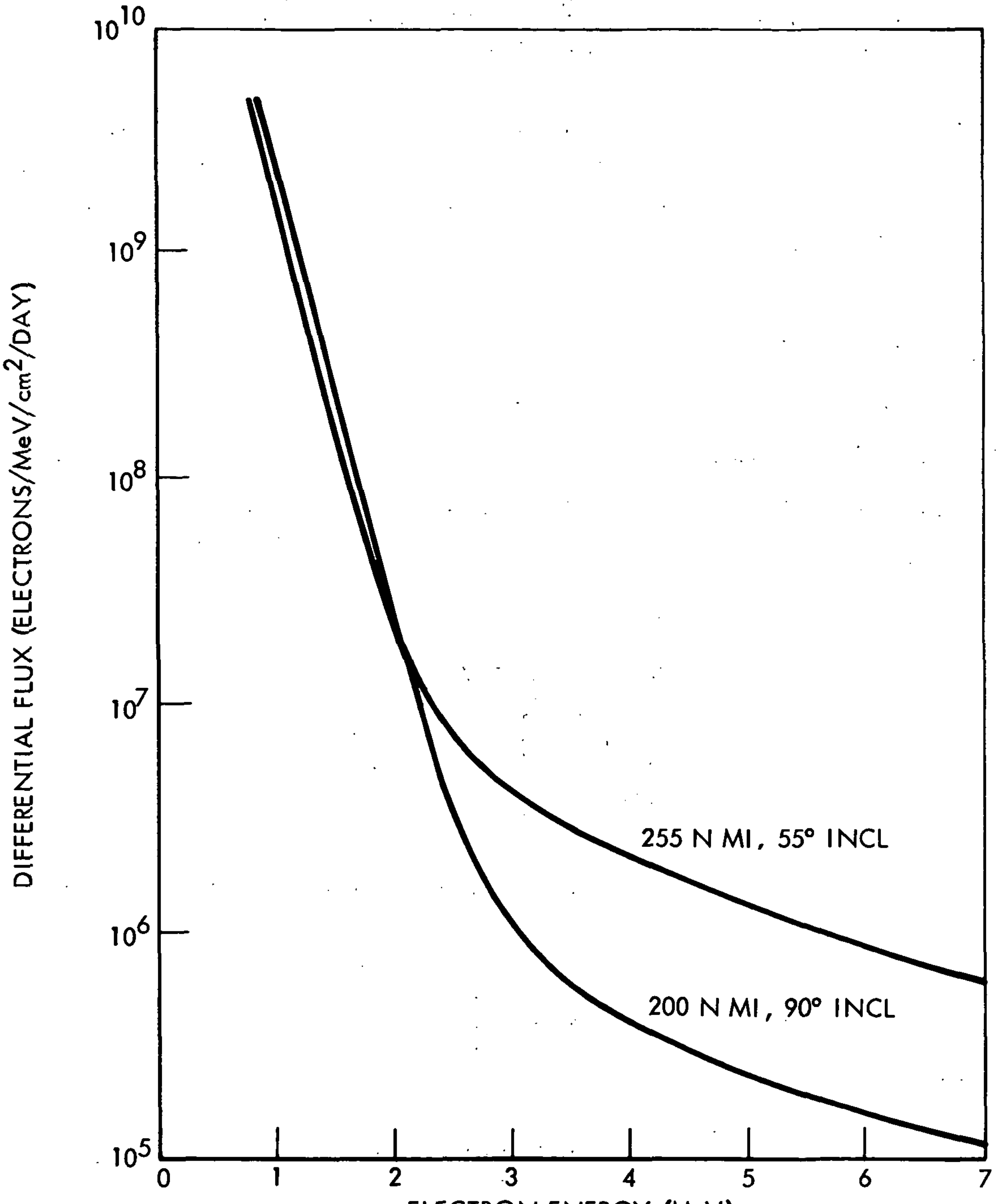

FIGURE 2.3-2 ELECTRON DIFFERENTIAL ENERGY SPECTRA

THIS MODEL DESCRIBES THE NATURAL ENVIRONMENTAL CRITERIA EFFECTING SPACE STATION DESIGN BASED ON THE FOLLOWING FUNDAMENTAL DESIGN REQUIREMENTS.

1. CAPABLE OF OPERATION IN ORBITS FROM 240 TO 270 NM WITH INCLINATION OF 55.0 DEGREES.

2. A MINIMUM OPERATIONAL LIFE OF TEN YEARS.

3. OPERATIONAL USE IN THE 1981 - 1991 APPROXIMATE TIME PERIOD

4. LAUNCH FROM KENNEDY SPACE CENTER IN A SHUTTLE VEHICLE.

FOR CONVENIENCE, THE NATURAL ENVIRONMENTS EXPECTED DURING SPACE STATION OPERATIONS ARE PRESENTED IN CHRONOLOGICAL SEQUENCE AS FOLLOWS - (1.0) GROUND OPERATIONS, AND (2.0) ORBITAL OPERATIONS.

1.0 GROUND ENVIRONMENT

1.1	TEMPERATURE (AIR)	-15F TO +115F
1.2	PRESSURE	[illegible] 2 PSIA) MAXIMUM TO 900 MB. (13.1 PSIA) MINIMUM
1.3	HUMIDITY	0 TO 100 PERCENT RELATIVE HUMIDITY
1.4	SUNSHINE	SOLAR RADIATION OF 360 BTU/SQ-FT/HR FOR SIX HOURS PER DAY
1.5	RAIN	UP TO 0.6 INCH PER HOUR FOR 12 HOURS; 2.5 INCHES PER HOUR FOR ONE HOUR
1.6	SAND AND DUST	AS ENCOUNTERED IN OCEAN BEACH AREAS, EQUIVALENT TO 140-MESH SILICA FLOUR WITH PARTICLE VELOCITY UP TO 500 FT/MIN AND A DENSITY OF 0.25 GM/CU-FT.
1.7	FUNGUS	AS EXPERIENCED IN FLORIDA CLIMATE. MATERIALS WILL NOT BE USED WHICH WILL [illegible]ED BY FUNGI.

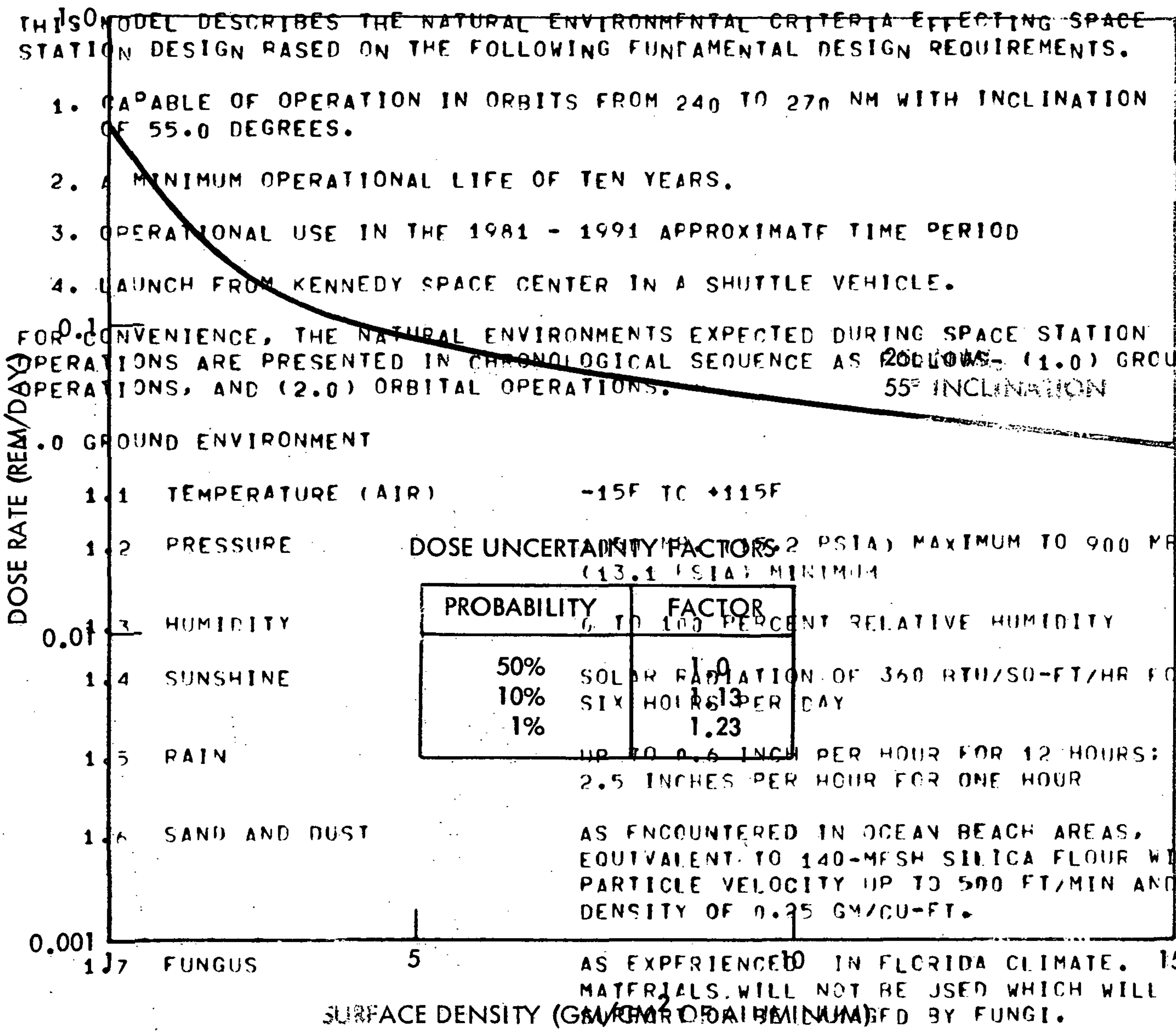

FIGURE 2.3-3 DOSE RATE AT SKIN - EARTH TRAPPED RADIATION

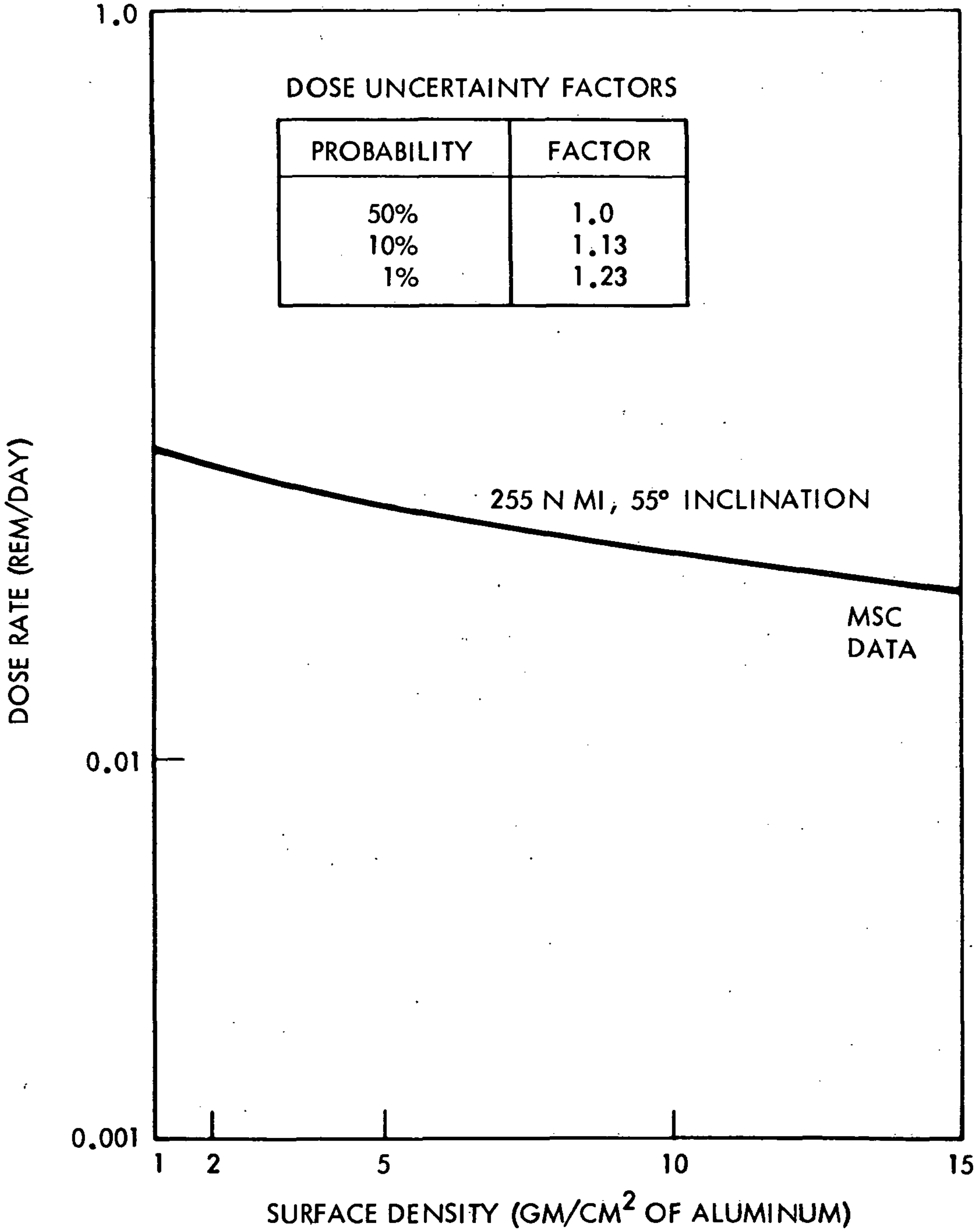

FIGURE 2.3-4 DEPTH DOSE RATE - EARTH TRAPPED RADIATION

THE FREE SPACE SOLAR PARTICLE EVENT ENVIRONMENT TO BE USED IN SPACECRAFT DESIGN IS AS FOLLOWS-

$$\text{PROTONS}\quad N_P(>T) = \begin{cases} 7.25 \times 10^{11}\, T^{-1.2} & ;\ 1\ \text{MEV} \le T \le 10\ \text{MEV} \\ 3.54 \times 10^{11}\, E^{-P(T)/67} & ;\ 10\ \text{MEV} \le T \le 30\ \text{MEV} \\ 2.64 \times 10^{11}\, E^{-P(T)/73} & ;\ T \ge 30\ \text{MEV} \end{cases}$$

$$\text{ALPHAS}\quad N_A(>T) = \begin{cases} N_P(>T) & ;\ T < 30\ \text{MEV} \\ 7.07 \times 10^{12}\, T^{-2.14} & ;\ T > 30\ \text{MEV} \end{cases}$$

WHERE

$N_P(>T)$ = INTEGRAL FLUX - PROTONS/CM^2

$N_A(>T)$ = INTEGRAL FLUX - ALPHAS/CM^2

T = PARTICLE KINETIC ENERGY - MEV

$P(T)$ = PARTICLE MAGNETIC RIGIDITY - MV

$$P(T) = \frac{1}{Z_E}\sqrt{T(T + 2 M_0 C^2)}$$

Z_E = PARTICLE CHARGE IN UNITS OF ELECTRON CHARGE (Z_E = 1 FOR PROTONS, Z_E = 2 FOR ALPHAS)

$M_0 C^2$ = PARTICLE REST MASS ENERGY ($M_0 C^2$ = 938 MEV FOR PROTONS, 3728 MEV FOR ALPHA PARTICLES)

SKIN AND DEPTH RADIATION DOSES FOR THE DESIGN ORBIT AS A FUNCTION OF SHIELDING DENSITY ARE PLOTTED IN FIGURE 2.3-5. THESE CURVES ARE BASED ON THE FREE SPACE RADIATION FLUX DEFINED ABOVE AND ACCOUNT FOR INTERACTION WITH THE EARTH'S MAGNETIC FIELD.

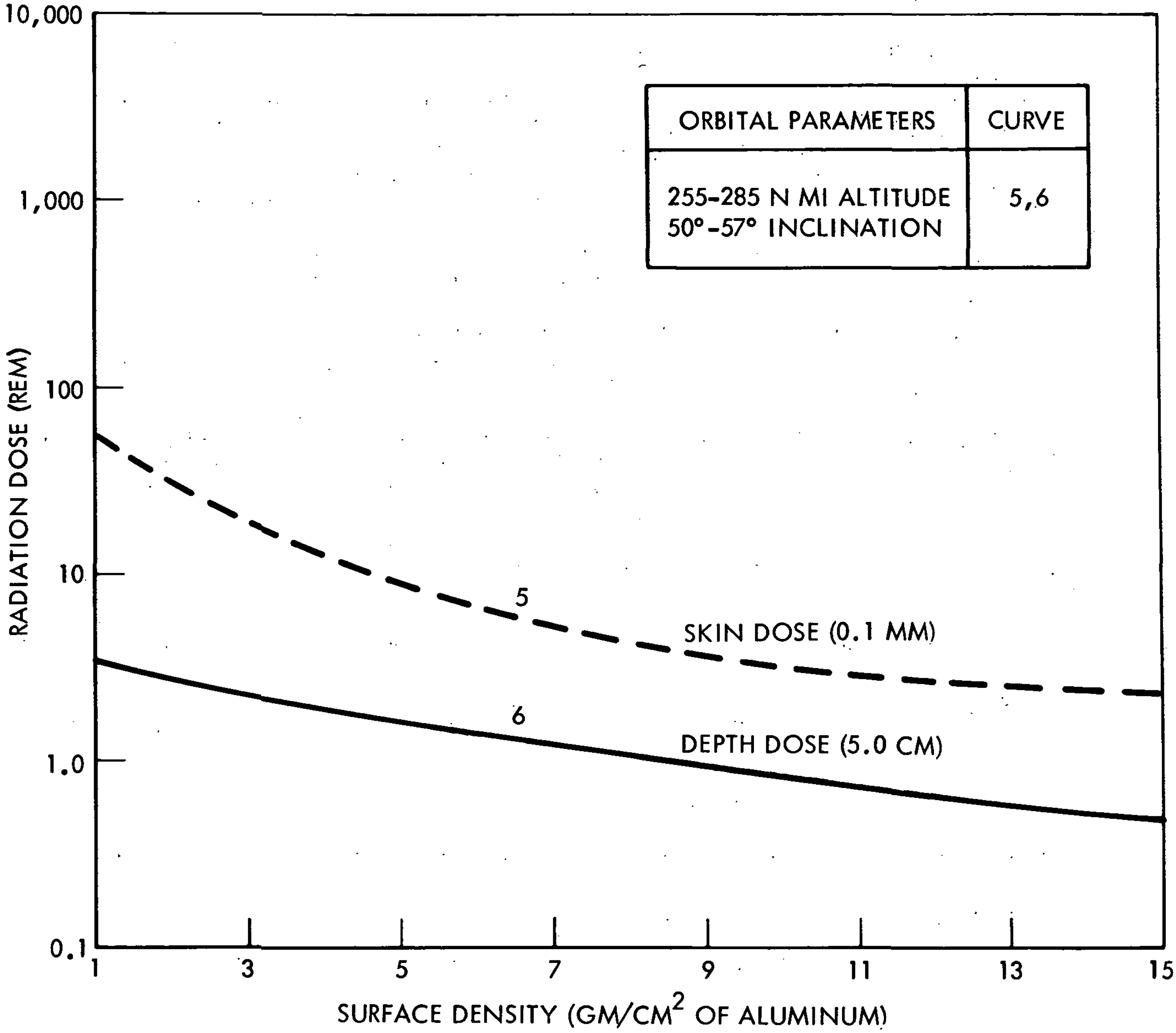

FIGURE 2.3-5 RADIATION DOSE-SOLAR PARTICLE EVENT VS CYLINDER WALL THICKNESS

2.4 METEOROID ENVIRONMENT TABLE 2.1-4

PREDICTED ATMOSPHERIC GAS PROPERTIES

A DETAILED DEFINITION OF METEOROID ENVIRONMENT INDICATES THE FLUX TO BE DEPENDENT ON TIME OF THE YEAR BECAUSE OF SEASONAL INFLUENCES ON SPORADIC METEOROID FLUX AND METEOR SHOWERS. HOWEVER, FOR LONG-TERM MISSIONS, THESE SEASONAL VARIATIONS CAN BE AVERAGED TO OBTAIN A SIMPLER DEFINITION OF METEOROID FLUX FOR DESIGN PURPOSES. THIS PROCEDURE HAS BEEN APPLIED IN BASIC DATA REPRESENTED IN NASA REPORT TM-X-53865, AND SUMMARIZED AS DESIGN INFORMATION BELOW -

240	PARTICLE DENSITY	1706 MASS	DENSITY - 0.5	GM/CM 3 FOR ALL
250	6.9124E-15	1708 METEOROID PARTICLE		SIZES
260	5.5954E-15	1709.7	4.5310E-05	17.6
270	PARTICLE VELOCITY	1710 AVERAGE METEOROID	PARTICLE	VELOCITY IS

20 KM/SEC., WITH DISTRIBUTION AS GIVEN IN FIGURE 2.4-1.

2.2 THERMAL MODEL FLUX MASS MODEL - AVERAGE ANNUAL CUMULATIVE SPORADIC FLUX - MASS MODEL IN LOGARITHMIC PLOT FORM IS DEFINED MATHEMATICALLY AS FOLLOWS;

SOLAR FLUX = 429 BTU/SQ-FT/HOUR

EARTH EMISSION = 73 BTU/SQ-FT/HOUR (EXCLUDING REFLECTION)

EARTH AVERAGE ALBEDO = 0.40 (VISUAL RANGE)

EARTH AVERAGE NORMAL ALBEDO = 0.37 LOG N = -14.37 - 1.213 LOG M

SPACE SINK TEMPERATURE = ZERO DEGREES RANKINE

MOON EMISSION - -6 2

LOCATION SUBSOLAR POINT = 1.14 + 1.2 COS B 4 BTU/SQ-FT/HOUR (LOG M)

WHERE - A = ALBEDO T

WHERE B = ANGLE FROM SUBSOLAR POINT

ANTISOLAR = NUMBER OF PARTICLES/METER /SEC OF MASS M OR GREATER

MOON AVERAGE NORMAL ALBEDO = 0.073

2.3 RADIATION ENVIRONMENT M = MASS IN GRAMS

THE NATURAL RADIATION ENVIRONMENT CONSISTS OF THREE PRINCIPAL CONTRIBUTORS- (A) EARTH'S TRAPPED RADIATION (PROTON AND ELECTRON FLUX), (B) GALACTIC COSMIC RADIATION, AND (C) SOLAR FLARE EVENTS.

THE FLUX OF EARTH'S TRAPPED RADIATION ARE DEPENDENT ON ORBITAL ALTITUDE AND INCLINATION BECAUSE OF THE CONTOUR OF THE VAN ALLEN BELTS, AND ARE PARTICULARLY INFLUENCED BY PASSAGE THROUGH A REGION OF RELATIVELY HIGH FLUX REFERRED TO AS THE 'SOUTH ATLANTIC ANOMALY.' DIFFERENTIAL ENERGY SPECTRA FOR PROTON AND ELECTRON RADIATION ARE PRESENTED IN FIGURES 2.3-1 AND -2, RESPECTIVELY. DATA ARE PRESENTED FOR TWO TYPICAL ORBITS (200 NM, WHERE

R = DISTANCE FROM CENTER OF EARTH TO ORBIT ALTITUDE IN UNITS OF EARTH'S RADIUS

THE BODY SHIELDING FACTOR FOR RANDOMLY ORIENTED SPACECRAFT (K_S) IS DETERMINED BY THE FOLLOWING PROCEDURE -

$$K_S = \frac{\text{SHIELDED FLUX}}{\text{UNSHIELDED FLUX}} = \frac{1 + \text{COSINE THETA}}{2}$$

WHERE

$$\text{SINE THETA} = \frac{R}{R + H}$$

R = RADIUS OF SHIELDING BODY

H = ALTITUDE ABOVE SURFACE

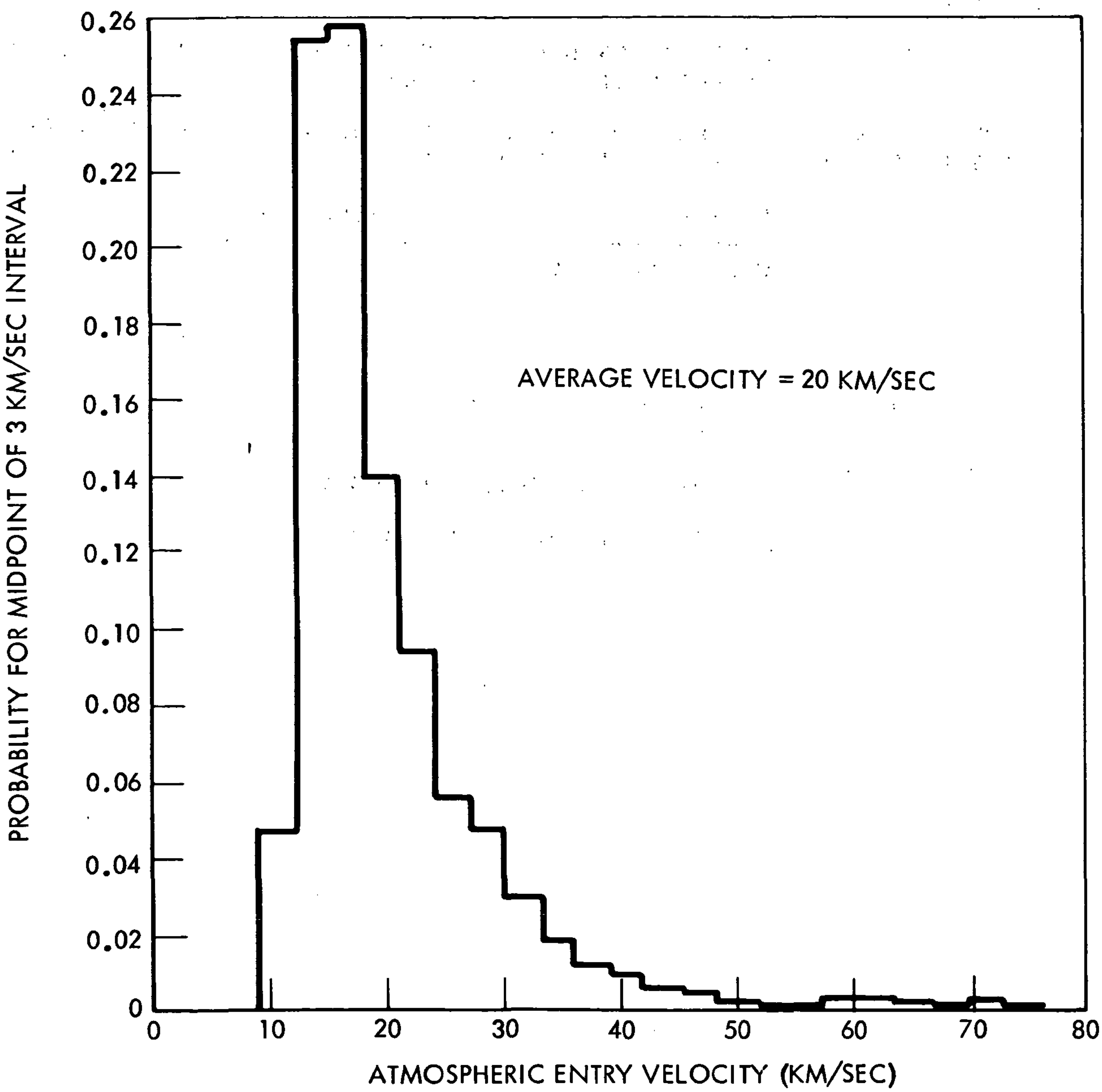

FIGURE 2.4-1 VELOCITY PROBABILITY DISTRIBUTION FOR SPORADIC METEOROIDS

10.2 INDUCED ENVIRONMENT MODEL

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THIS MODEL SUMMARIZES THE INDUCED ENVIRONMENT FOR THE SPACE STATION ELEMENTS DURING THE FOLLOWING OPERATIONAL PHASES -

1. LAUNCH FROM KENNEDY SPACE CENTER IN A SHUTTLE VEHICLE.
2. OPERATION IN ORBITS FROM 240 TO 270 NAUTICAL MILES (NM) WITH ORBITAL INCLINATION OF 55 DEGREES.

1.0 GROUND ENVIRONMENT

GROUND HANDLING AND TRANSPORTATION INCLUDES THE ENVIRONMENTS DUE TO HOISTING, JACKING, AND TRANSPORTATION ON TRUCK, SEMI-TRAILER, TRAILER, AND SHIP. THE GROUND HANDLING AND TRANSPORTATION OF THE SPACE STATION SHALL NOT IMPOSE LOADS GREATER THAN THOSE EXPERIENCED IN FLIGHT. THIS IS ACCOMPLISHED BY DIVIDING THE SPACE STATION STRUCTURAL CAPABILITY BY 2.0 TO DEFINE A MAXIMUM LIMIT LOADING CONDITION WHICH NO GROUND HANDLING OR TRANSPORTATION MODE MAY EXCEED. IN THIS MANNER, ALL GROUND HANDLING AND TRANSPORTATION LOADS ARE LIMITED BY THE STRUCTURAL ALLOWABLES. REALISTIC LAUNCH WEIGHTS SHOULD BE USED FOR THIS CONDITION. LOADS AND CRITERIA FOR THE DESIGN OF SPACE STATION GROUND SUPPORT EQUIPMENT WERE NOT DEVELOPED IN THE PRESENT STUDY. THE FOLLOWING SHALL BE APPLIED IF IT DOES NOT CONFLICT WITH THE ABOVE-

1.1 ACCELERATION (APPLIED TO COMPLETE MODULE ASSEMBLIES IN GROUND HANDLING AND TRANSPORTATION.)
PLUS OR MINUS 2.0 G IN ANY DIRECTION (SUPERIMPOSED ON 1.0 G STATIC WEIGHT ACTING DOWNWARD)

1.2 SHUTTLE BASELINE CONFIGURATION FIGURE 1.2-1 ILLUSTRATES THE BASELINE SHUTTLE CONFIGURATION

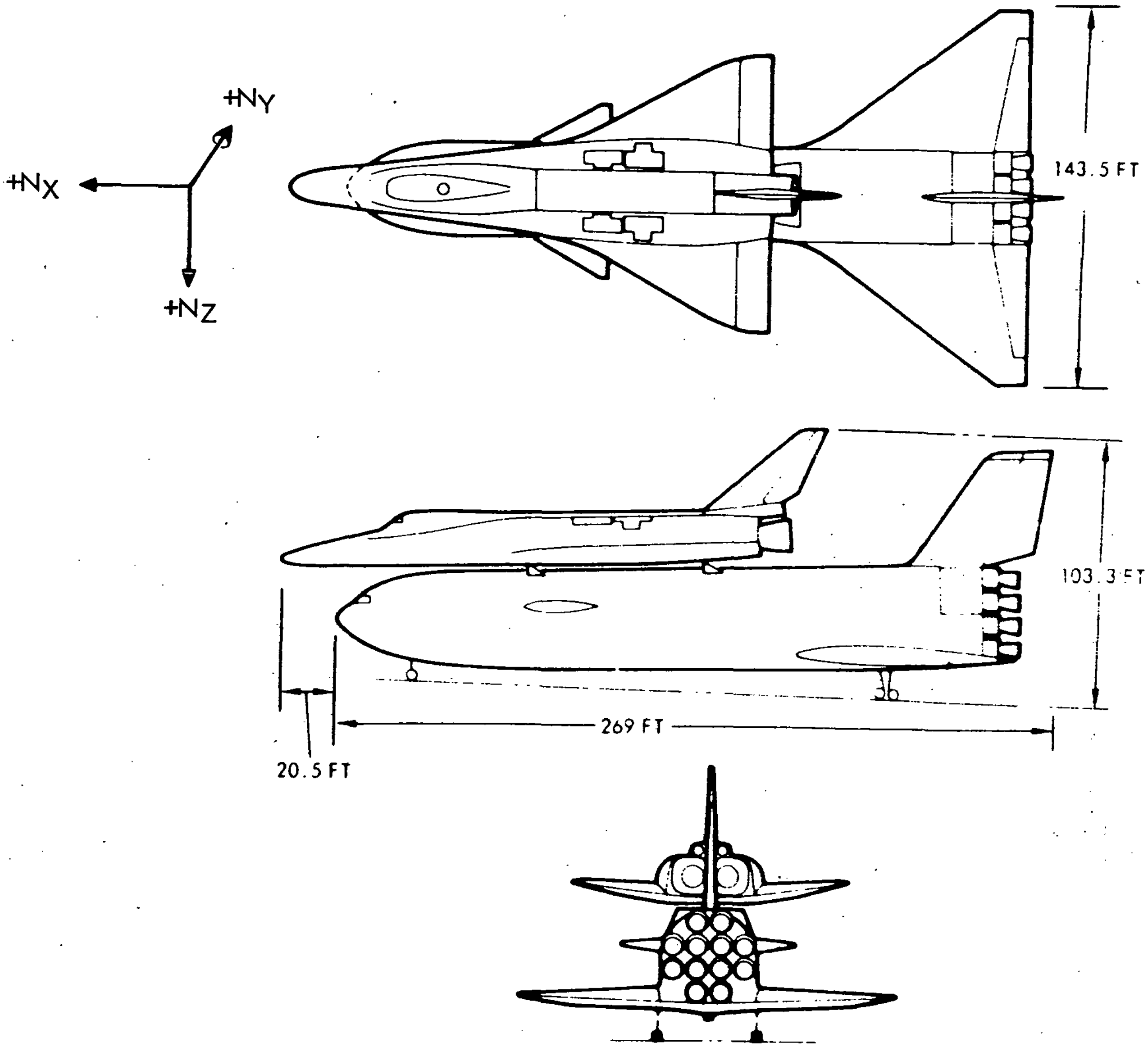

FIGURE 1.2-1 SHUTTLE BASELINE CONFIGURATION

2.0 LAUNCH BOOST ENVIRONMENT (SHUTTLE)

2.1 INTERNAL PRESSURE

THE ABSOLUTE PRESSURE IN THE SHUTTLE CARGO BAY IS GIVEN IN FIGURE 2.1-1 FOR ASCENT AND IN FIGURE 2.1-2 FOR DESCENT FLIGHT PHASES.

THE INTERNAL PRESSURE WITHIN THE SPACE STATION ELEMENTS TRANSPORTED IN THE SHUTTLE IS -

PRESSURIZED COMPARTMENTS - 14.7 +/- 0.3 PSI

UNPRESSURIZED COMPARTMENTS - AS DETERMINED BY DESIGN OF CONTROLLED VENTING PROVISIONS.

2.2 TEMPERATURE

A SUMMARY OF THERMAL REQUIREMENTS FOR THE MODULES IS SHOWN IN TABLE 2.2-1. BOUNDARIES OF TEMPERATURE ENVIRONMENT IN THE SHUTTLE CARGO BAY ARE DEPICTED IN TABLE 2.2-2.

TABLE 2.2-1 MODULE THERMAL REQUIREMENTS

NORMAL AIR TEMPERATURE	70 +/- 5 F
MINIMUM WALL TEMPERATURE	57 F
MAXIMUM WALL TEMPERATURE	105 F
MAXIMUM HEAT LOAD TO MODULE (ON ORBIT)	1000 BTU/HR
MAXIMUM HEAT LOSS FROM MODULE (ON ORBIT)	2000 BTU/HR

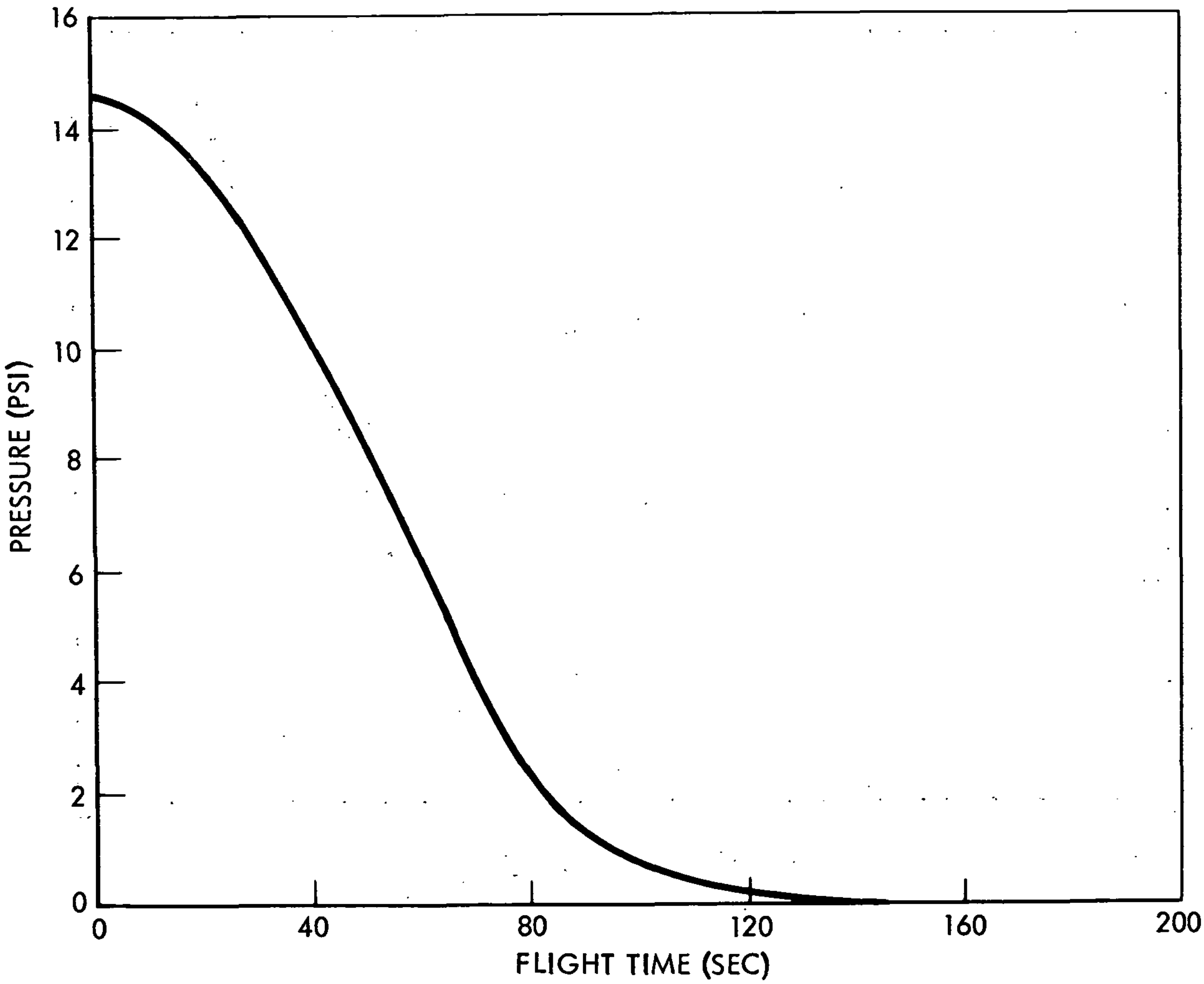

FIGURE 2.1-1 SHUTTLE CARGO BAY ABSOLUTE INTERNAL PRESSURE (ASCENT)

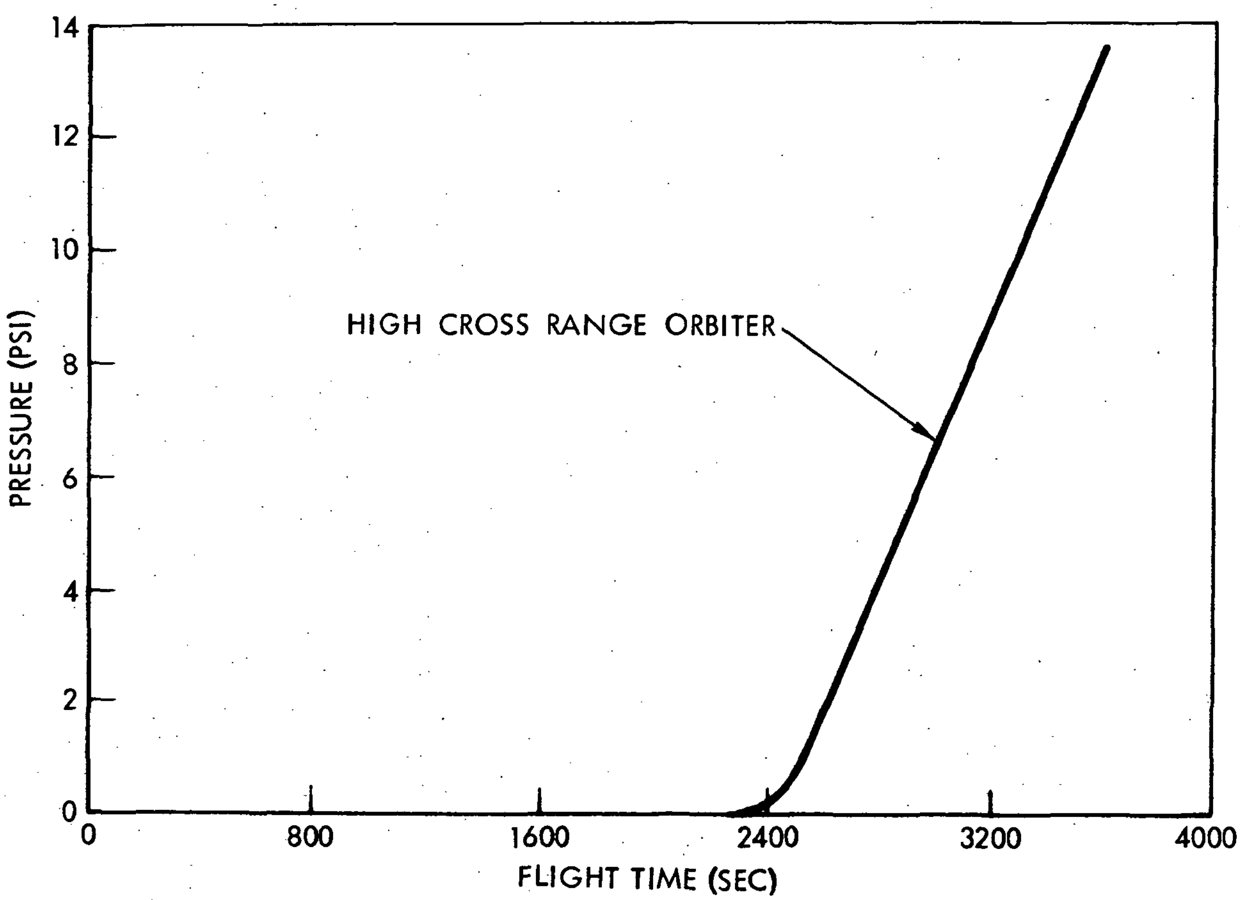

FIGURE 2.1-2 SHUTTLE CARGO BAY ABSOLUTE INTERNAL PRESSURE (REENTRY)

TABLE 2.2-2 TEMPERATURE LIMITS FOR THE INTERNAL WALLS OF THE CARGO BAY
(WITH INSULATED COMPARTMENT WALLS)

PAYLOAD EXTERNAL SURFACE TEMPERATURE (F)	CARGO BAY DOORS (F)									
	PRELAUNCH*		LAUNCH		ON-ORBIT (DOORS CLOSED)		ON-ORBIT (DOORS OPEN)		ENTRY	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX+
100	80	120	80	150	-100	150	N/A	N/A	-100	250
70	50	120	50	150	-100	150	N/A	N/A	-100	250
0	-20	120	-20	150	-100	150	N/A	N/A	-100	250
-300	-100	120	-100	150	-150	150	N/A	N/A	-150	250
-420	-100	120	-100	150	-150	150	N/A	N/A	-150	250
PAYLOAD EXTERNAL SURFACE TEMPERATURE (F)	OTHER CARGO BAY AREAS (SIDES, BOTTOM, ENDS) (F)									
	PRELAUNCH*		LAUNCH		ON-ORBIT (DOORS CLOSED)		ON-ORBIT (DOORS OPEN)		ENTRY	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX+
100	80	120	80	130	0	130	0	130	0	200
70	50	120	50	130	-25	130	-25	130	-25	180
0	-20	120	-20	130	-75	130	-75	130	-75	160
-300	-290	120	-290	130	-300	130	-300	130	-300	150
-420	-290	120	-290	130	-420	130	-420	130	-420	150

THE EXPOSED SURFACES OF THE PAYLOAD WILL BE SUBJECTED TO THE DEEP SPACE ENVIRONMENT WHICH INCLUDES A BLACK BODY RADIATION SINK AT 4K AND DIRECT SUN RADIATION.

*CARGO BAY IS PURGED WITH DRY GN_2 FOR GROUND THERMAL CONDITIONING. FOR BARE LH_2 TANKS, SPECIAL PROVISIONS WITH He PURGING WILL BE REQUIRED TO PREVENT LIQUID AIR FORMATION.

+THESE MAXIMUM TEMPERATURES MAY POSSIBLY BE DECREASED TO ABOUT 150 F BY CERTAIN DESIGN MODIFICATIONS. THESE CHANGES ARE CURRENTLY BEING INVESTIGATED.

2.3 ACOUSTICS

THE PREDICTED ACOUSTIC SPECTRA EXTERNAL TO THE CARGO BAY OF THE SHUTTLE ARE GIVEN IN FIGURE 2.3-1. THE ACOUSTIC LEVELS INTERNAL TO THE CARGO BAY AND EXTERNAL TO THE PAYLOAD WILL DEPEND ON THE STRUCTURAL DESIGN AND SEALING CONCEPTS SELECTED FOR THE SHUTTLE, BUT ARE EXPECTED TO BE ABOUT 10 DB LESS THAN THE EXTERNAL ENVIRONMENT. FOR PRELIMINARY DESIGN PURPOSES, TWO-MINUTE EXPOSURE TO THE OVERALL ENVELOPE OF COMBINED LIFT-OFF AND TRANSONIC NOISE SHOULD BE USED FOR A TYPICAL MISSION SIMULATION.

2.4 VIBRATION AND SHOCK

THE VIBRATION SPECTRUM FOR THE SHUTTLE CARGO BAY IS GIVEN IN FIGURE 2.4-1. SHOCK LOAD CRITERIA FOR LANDING IMPACT IS GIVEN IN FIGURE 2.4-2 FOR A RANGE OF LANDING IMPACT SINK SPEEDS.

2.5 ACCELERATION

MAXIMUM ACCELERATIONS ON SPACE STATION ELEMENTS TRANSPORTED BY SHUTTLE ARE GIVEN IN TABLE 2.5-1. THE RANGE OF ABSOLUTE PRESSURE IN THE SHUTTLE CARGO BAY IS ALSO LISTED FOR EACH DESIGN CONDITION.

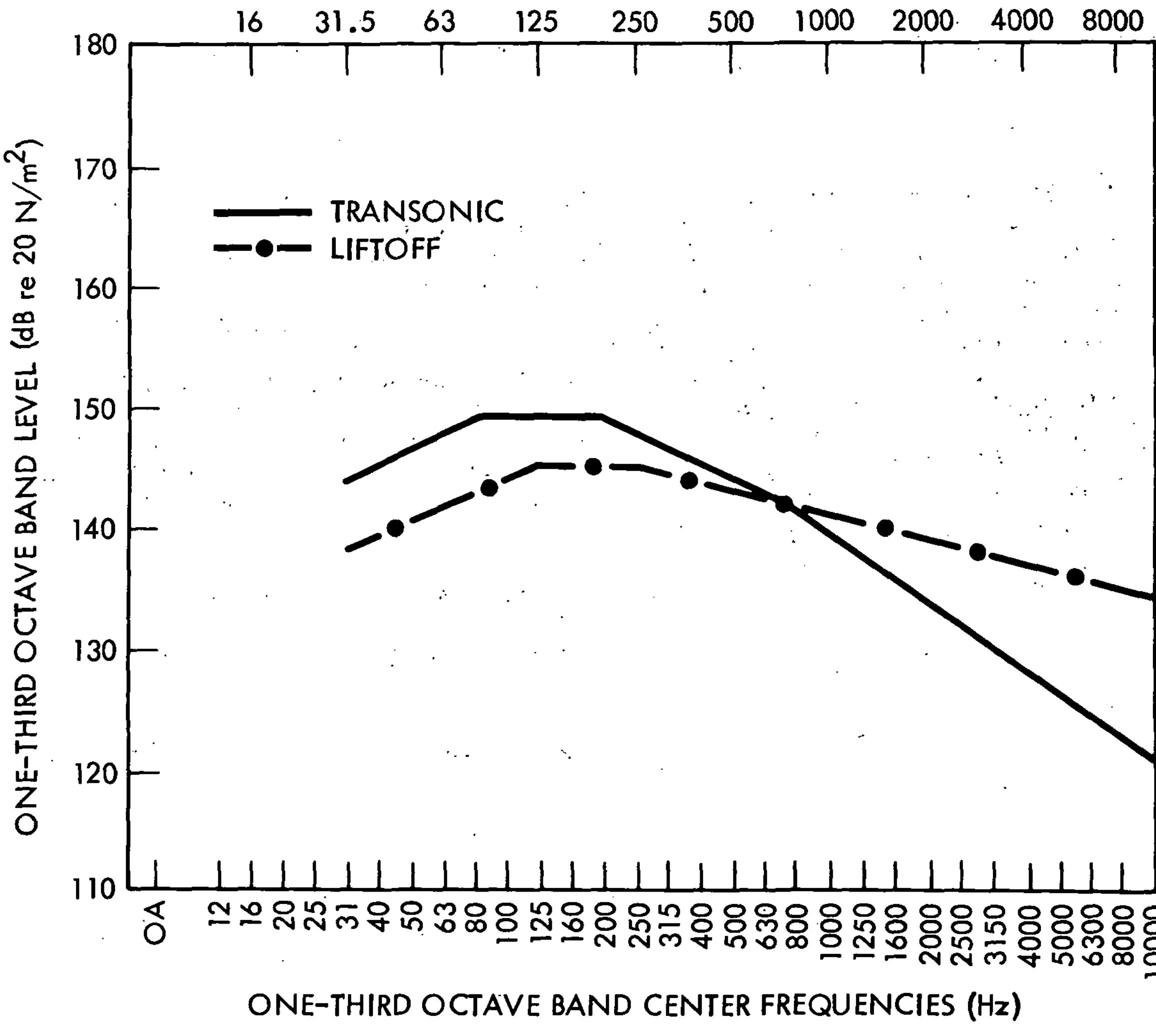

FIGURE 2.3-1 PREDICTED ACOUSTIC SPECTRA EXTERNAL TO SHUTTLE CARGO BAY

THIS MODEL SUMMARIZES THE INDUCED ENVIRONMENT FOR THE SPACE STATION ELEMENTS DURING THE FOLLOWING OPERATIONAL PHASES -

1. LAUNCH FROM KENNEDY SPACE CENTER IN A SHUTTLE VEHICLE.

2. OPERATION IN ORBITS FROM 240 TO 270 NAUTICAL MILES (NM) WITH ORBITAL INCLINATION OF 55 DEGREES.

1.0 GROUND ENVIRONMENT

GROUND HANDLING AND TRANSPORTATION INCLUDES THE ENVIRONMENTS DUE TO HOISTING, JACKING, AND TRANSPORTATION ON TRUCK, SEMI-TRAILER, TRAILER, AND SHIP. THE GROUND HANDLING AND TRANSPORTATION OF THE SPACE STATION SHALL NOT IMPOSE LOADS GREATER THAN THOSE EXPERIENCED IN FLIGHT. THIS IS ACCOMPLISHED BY DIVIDING THE SPACE STATION STRUCTURAL CAPABILITY BY 2.0 TO DEFINE A MAXIMUM LIMIT LOADING CONDITION WHICH NO GROUND HANDLING OR TRANSPORTATION MODE MAY EXCEED. IN THIS MANNER, ALL GROUND HANDLING AND TRANSPORTATION LOADS ARE LIMITED BY THE STRUCTURAL ALLOWABLES. REALISTIC LAUNCH WEIGHTS SHOULD BE USED FOR THIS CONDITION. LOADS AND CRITERIA FOR THE DESIGN OF SPACE STATION GROUND SUPPORT EQUIPMENT WERE NOT DEVELOPED IN THE PRESENT STUDY. THE FOLLOWING SHALL BE APPLIED IF IT DOES NOT CONFLICT WITH THE ABOVE-

1.1 ACCELERATION (APPLIED TO COMPLETE MODULE ASSEMBLIES IN GROUND HANDLING AND TRANSPORTATION.)

PLUS OR MINUS 2.0 G IN ANY DIRECTION (SUPERIMPOSED ON 1.0 G STATIC WEIGHT ACTING DOWNWARD)

1.2 SHUTTLE BASELINE CONFIGURATION FIGURE 1.2-1 ILLUSTRATES THE BASELINE SHUTTLE CONFIGURATION

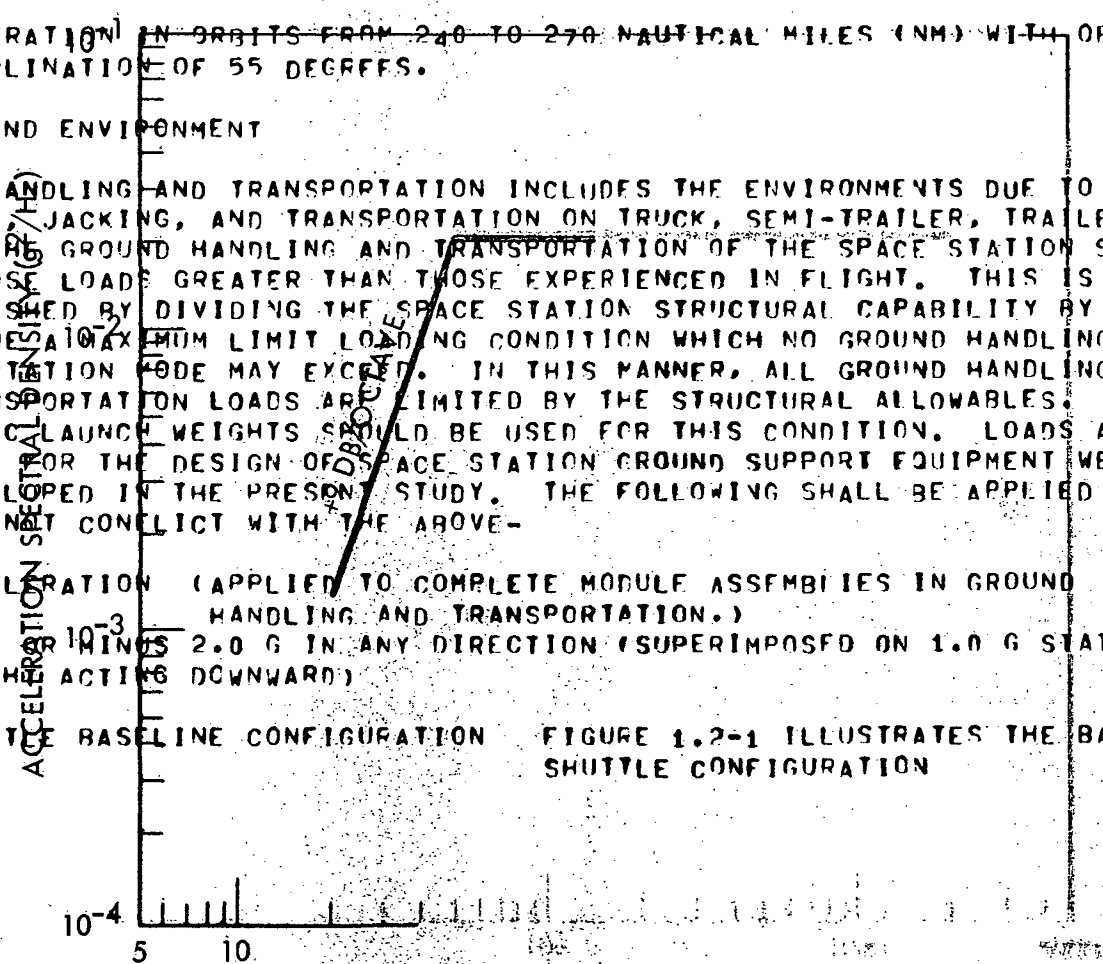

FIGURE 2.4-1 VIBRATION

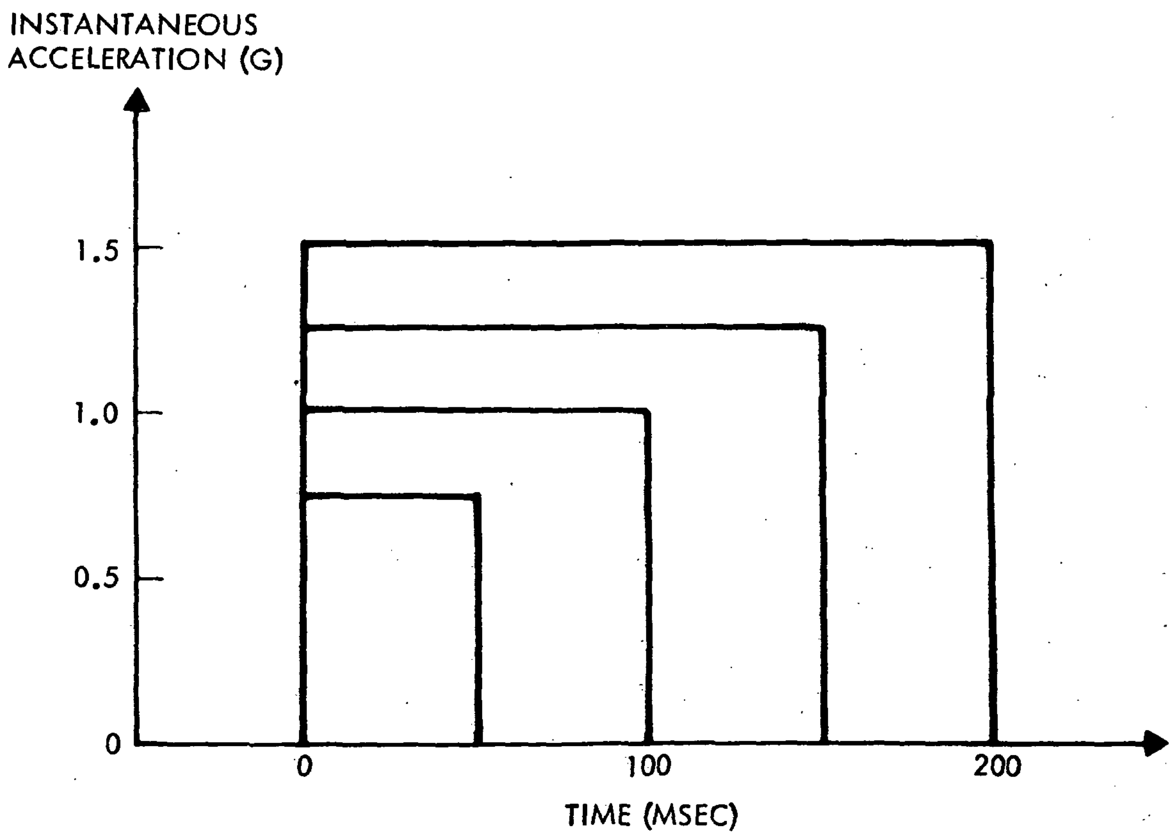

FIGURE 2.4-2 SHOCK LOAD CRITERIA FOR LANDING IMPACT

TABLE 2.5-1 LIMIT LOAD FACTOR ON SHUTTLE CARGO

LOAD FACTOR AS USED HERE IS EQUAL TO THE TOTAL EXTERNALLY APPLIED LOAD DIVIDED BY THE TOTAL VEHICLE WEIGHT AND CARRIES THE SIGN OF THE EXTERNALLY APPLIED LOAD.

CONDITION	LOAD FACTOR G=S		
	X	Y	Z
LIFTOFF	1.4	+/-0.8	+/-0.8
HIGH Q BOOST	2.1	+/-0.42	+0.6 -0.84
BOOSTER END BURN	3.3	+/-0.11	-0.55
ORBITER END BURN	3.3	+/-0.11	-0.55
OMS OPERATION	0.2	+/-0.1	0.1
ACPS OPERATION	+/-0.1	+/-0.1	+/-0.1
ENTRY	+/-0.25	+/-0.6	-3.0
FLY-BACK	+/-0.25	+/-0.6	+1.2 -3.0
LANDING AND BRAKING	+0.96 -1.2	+0.6	-3.0
CRASH(CARGO AND EQUIP.)*	-8.0 +1.5	+/-1.5	-4.5 +2.0

*CRASH LOAD FACTORS ARE ULTIMATE. THESE FACTORS SHALL BE USED IN DESIGN OF STRUCTURE WHOSE FAILURE COULD RESULT IN INJURY TO PERSONNEL DURING A CRASH OR PREVENT EGRESS FROM A CRASHED VEHICLE.

3.0 ORBITAL ENVIRONMENT

3.1 INTERNAL ATMOSPHERE (CREW COMPARTMENTS)

PRESSURE

TOTAL PRESSURE RANGE	0 TO 14.7 PSIA
NOMINAL OPERATING	14.7 PSIA
DESIGN	14.7 PSIA

TEMPERATURE

ATMOSPHERE	65 TO 75 F
DEW POINT AT 14.7 PT	57 F (MAX.)
RELATIVE HUMIDITY	21 PER. TO 76 PER.

ATMOSPHERIC COMPOSITION

OXYGEN RANGE	3.1 TO 3.5 PSIA 3.1 PSIA MINIMUM O2
NITROGEN	6.9 TO 11.7 PSIA
CARBON DIOXIDE	
NOMINAL	3 MMHG
MAXIMUM	7.6 MMHG FOR 14 DAYS
EMERGENCY	15.0 MMHG FOR 8 HOURS
WATER VAPOR	8.0 TO 12.0 MMHG

CONTAMINANTS

BIOLOGICAL AIRBORNE	100 ORGANISMS/FT^3
ORGANIC	100 PPM TOTAL - CH4 EQUIVALENT

PARTICULATE

AIR CLEANLINESS LEVEL CLASS 100,000

250,000 PARTICLES PER FT^3 EQUAL TO OR LESS THAN 0.5 MICRONS

NOTE - SPACE STATION SYSTEMS AND EQUIPMENT ARE REQUIRED TO FUNCTION PROPERLY WITHIN THE INDICATED NOMINAL OPERATING INTERNAL ATMOSPHERE AFTER TEMPORARY EXPOSURE TO VACUUM CONDITIONS.

3.2 EXTERNAL ATMOSPHERE

THE NATURAL ENVIRONMENT EXTERIOR TO THE SPACECRAFT WILL BE CONTAMINATED BY MATERIALS LOST FROM THE SPACECRAFT THROUGH LEAKAGE, VENTING, AND PROPULSION EXHAUST PRODUCTS. CONCENTRATIONS OF THESE CONTAMINANTS ARE AS FOLLOWS.

A. LEAKAGE - 10 LB/DAY TOTAL, COMPOSED OF THE FOLLOWING

O2 - 2.3 LB/DAY
N2 - 7.6 LB/DAY
CO2 - 0.06 LB/DAY (2.7 MMHG)
H20 - 0.08 LB/DAY (10 MMHG)

B. VENTING

1. TOILET

O2 - 0.032 LB/MAN-DAY
N2 - 0.12 LB/MAN-DAY
H20 - 0.225 LB/MAN-DAY
OTHER HEAVY FRACTIONS - 0.0416 LB/MAN-DAY
EVENT IS NON-PROGRAMMABLE

2. TRASH DRYING CHAMBER

O2 - 0.03 LB/DAY
N2 - 0.12 LB/DAY
H20 - 0.30 LB/MAN-DAY
OTHER HEAVY FRACTIONS - 0.04 LB/MAN-DAY
VENTING IS PROGRAMMABLE

3. SABATIER REACTOR CO2 REDUCTION

O2 - (.1) LB/DAY
H20 - 0.1 LB/DAY
CH4 - 3.67 LB/DAY
CO2 - 3.47 LB/DAY
N2 - TRACE QUANTITY
VENTING IS PROGRAMMABLE (12-HOUR PERIODS)

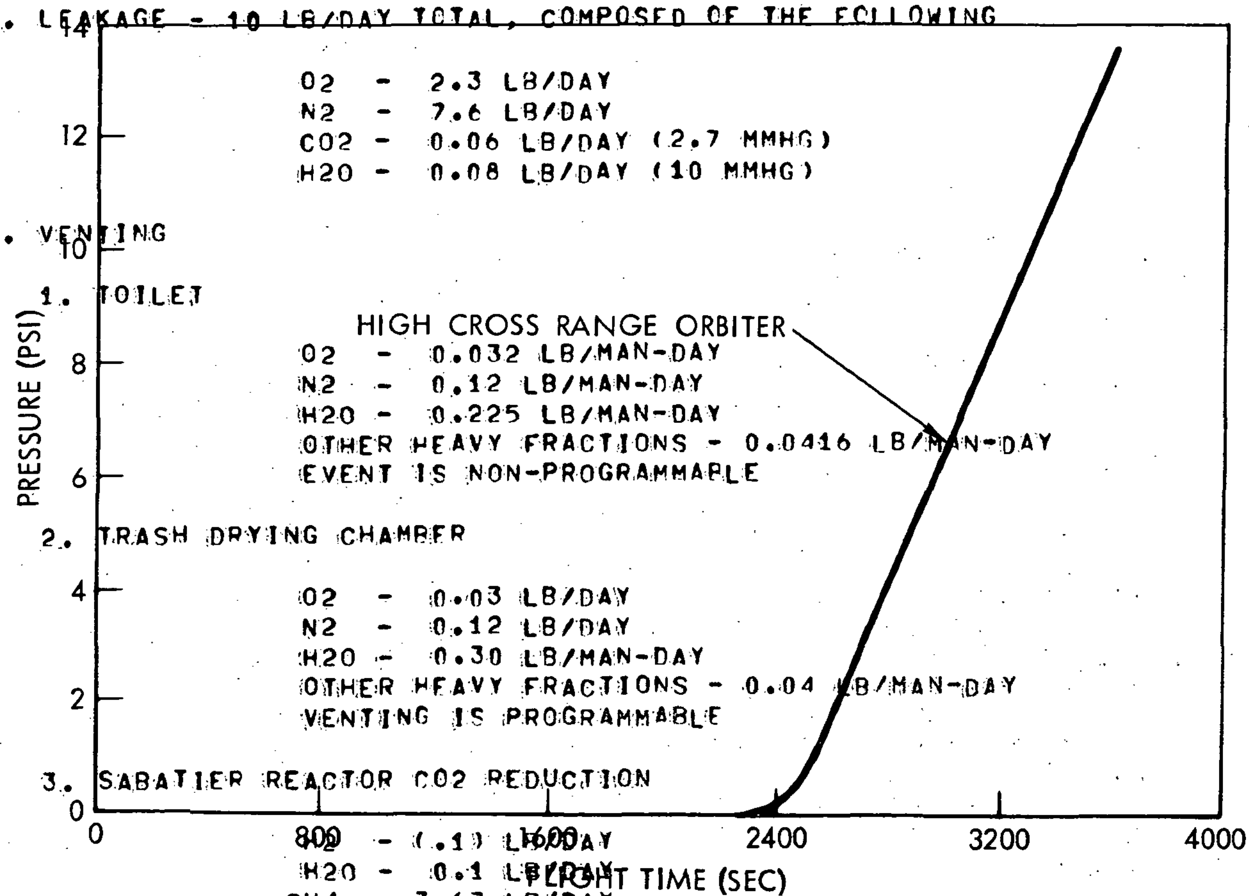

FIGURE 2.1-2 SHUTTLE CARGO BAY ABSOLUTE INTERNAL PRESSURE (REENTRY)

4. AIRLOCK USAGE

	EVA/IVA AIRLOCK	EXPER AIRLOCK
02	0.067 LB/MO	0.260 LB/MO
N2	0.221 LB/MO	0.855 LB/MO

5. EVA (2 MEN, 4 HR EVA)

02 - 3.2 LB/EVENT
H20 - 2.2 LB/EVENT

6. VAPOR COMPRESSION WATER RECLAMATION

H20 - 3.2 LB/DAY
OTHER HEAVY FRACTIONS - 0.02 LB/MAN-DAY
VENTING IS PROGRAMMABLE

7. EMERGENCY - UNDER AN EMERGENCY SITUATION, A CONTAMINATED COMPARTMENT MAY REQUIRE VENTING TO CLEAR CONTAMINATION. IN THIS CASE, THE VENTED GASES WILL CONTAIN NORMAL ATMOSPHERIC COMPOSITION AND GENERATED TOXIC CONTAMINANTS.

8. EXPERIMENT MODULE DEPRESSURIZATION (5000 CU FT)

02 - 87 LB/EVENT
N2 - 288 LB/EVENT
H20 - TBD
CO2 - TBD
OTHER HEAVY FRACTIONS - TBD

C. PROPULSION - PROPELLANT 02/H2 CONSUMPTION FOR ATTITUDE CONTROL AND ORBIT MAKE-UP IS 7.5 LB/DAY, EXPENDED TWICE DAILY. COMPOSITION OF EXHAUST PRODUCTS IS AS FOLLOWS - WATER, 02 AND HYDROGEN. NO EXTERNAL VIEWING EXPERIMENTS WILL BE OPERATED DURING THIS PERIOD. CMG DESATURATION WILL NOT BE SCHEDULED FOR LESS THAN EVERY 8 ORBITS (APPROX 12 HOURS).
EXPERIMENTS WILL BE OPERATED DURING THIS PERIOD. CMG DESATURATION WILL NOT BE SCHEDULED FOR LESS THAN EVERY 6 ORBITS (APPROX 9 HRS).

D. OUTGASSING - FOLLOWING ARE CURRENT ESTIMATES OF THE GENERIC TYPES AND AMOUNTS OF ORGANIC MATERIALS WHICH WILL BE EXPOSED TO THE VACUUM/THERMAL SPACE STATION EXTERNAL ENVIRONMENT. THESE DATA SHOULD BE USED AS A BASIS FOR ESTIMATING THE NATURE AND AMOUNT OF BULK OUTGASSING.

1. MICROMETEOROID SHIELD

   MATERIAL - GLASS CLOTH LAMINATE, PHENOLIC OR POLYIMIDE RESIN AND ALUMINUM

   AREA - TBD FT^2

   THICKNESS - TBD IN.

2. THERMAL CONTROL COATING

   MATERIAL - TBD

   AREA - TBD FT.

   THICKNESS - TBD IN.

3. INSULATION

   A. UNDER RADIATORS (TBD)

   B. UNDER MICROMETEOROID SHIELD (TBD)

3.3 ACCELERATION

(A) ZERO GRAVITY IS THE NORMAL ORBITAL OPERATING MODE.
(B) MAXIMUM ACCELERATION FOR TRANSIENT PERIODS ASSOCIATED WITH ZERO GRAVITY OPERATIONS (ORBIT MAKE-UP, MANEUVERS AND ATTITUDE CHANGES, DOCKING OF LOGISTICS VEHICLES OR EXPERIMENT MODULES, ETC.) ARE AS FOLLOWS -

1. CMG DESATURATION AND ORBIT MAKEUP	1.4 X 10(-4) G MAX FOR 140 SECONDS
2. BERTHING	4.0 X 10(-2) G FOR 0.3 SEC
3. NORMAL OPERATIONS (QUIESCENT)	10(-4) G FOR 6 HOURS OR 10(-5) G FOR 2 HOURS

3.4 STRUCTURAL LOADS (TBD)

STATIC AND DYNAMIC STRUCTURAL LOADS WILL BE EXPERIENCED DURING ORBITAL OPERATIONS, RESULTING FROM THE FOLLOWING MAJOR SOURCES -

(A) ASSEMBLY BERTHING
(B) GYROSCOPIC AND CORIOLIS FORCES DUE TO ATTITUDE CHANGES AND ORBITAL MANEUVERS
(C) BERTHING OF LOGISTICS VEHICLES AND DETACHED RAMS
(D) PROPULSION FOR ORBIT MAKE-UP

10.3 GLOSSARY

THIS GLOSSARY DEFINES THOSE TERMS THAT ARE UNIQUE TO THE SPACE STATION AS WELL AS TERMS FOR WHICH NO STANDARD DEFINITION EXISTS.

ACCIDENT - AN UNPLANNED EVENT WHICH RESULTS IN AN UNACCEPTABLE SITUATION OR OPERATIONAL MODE.

AVV - ALONG VELOCITY VECTOR

AVERAGE POWER(LOAD) - 24 HOUR INTEGRATED ELECTRICAL POWER AVERAGE FOR WORST CASE ROUTINE DAY.

CCTV - CLOSED CIRCUIT TELEVISION

CDDT - COUNTDOWN DEMONSTRATION TEST

CM - CARGO MODULE

CM - CORE MODULE

CMG - A CONSTANT SPEED MOMENTUM EXCHANGE DEVICE THAT IS GIMBALLED WITH RESPECT TO THE STATION BODY AXES. THE GYROS CAN BE EITHER ONE OR TWO DEGREES OF FREEDOM. TORQUE MOTORS ARE USED AT THE GIMBALS TO EXERT TORQUES BETWEEN THE ROTOR AND THE STATION STRUCTURE. CONTROL OF CYCLIC STATION DISTURBANCE TORQUES IS ACHIEVED BY MOMENTUM EXCHANGE; I.E., BY ORIENTATION OF THE MOMENTUM VECTOR OF THE CMG DURING ONE HALF CYCLE OF A CYCLIC DISTURBANCE TO COUNTERACT THE DISTURBANCE, AND THEN REORIENTATION OF THE MOMENTUM VECTOR OF THE CMG DURING THE OPPOSITE HALF CYCLE TO COUNTERACT THE DISTURBANCE TORQUE OF THAT HALF CYCLE.

CMG DESATURATION - WHEN CMG GIMBAL ANGLES REACH THEIR LIMIT DUE TO BUILDUP OF NON-PERIODIC DISTURBANCE TORQUES, OTHER MEANS OF APPLYING VEHICLE TORQUE MUST BE USED TO RE-INITIALIZE CMG GIMBAL ANGLES TO ALLOW CONTINUATION OF THE CMG MOMENTUM EXCHANGE FUNCTION.

CONTAINING A HAZARD - LIMITING THE AREA AND TIME OVER WHICH A HAZARD EXTENDS.

CONTROL MOMENT GYRO - SEE CMG

CONUS - CONTINENTAL UNITED STATES

CREDIBLE - WITHIN THE ASSUMED PROBABILITY OF OCCURRENCE FOR WHICH IT IS DESIRED TO DESIGN AND OPERATE A SYSTEM.

CONTROLLED HAZARDS - THOSE WHICH HAVE BEEN COUNTERACTED BY APPROPRIATE DESIGN SAFETY DEVICES, ALARMS/CAUTION AND WARNING, AUTOMATIC/MANUAL ACTION. TIME IS NOT A SIGNIFICANT FACTOR FOR CORRECTIVE ACTION.

CRITICAL FUNCTION - THOSE FUNCTIONS REQUIRED FOR PERSONNEL SAFETY AND FOR SPACE STATION SURVIVAL FOLLOWING CREDIBLE MALFUNCTIONS AND/OR ACCIDENTS.

DRSS - DATA RELAY SATELLITE SYSTEM

DSIF - DEEP SPACE INSTRUMENTATION FACILITY

ECI COORDINATES (EARTH CENTERED INERTIAL COORDINATES) - A COORDINATE SYSTEM WITH ORTHOGONAL X, Y AND Z AXES DIRECTED FROM THE CENTER OF THE EARTH. THE +X AXIS IS DIRECTED TOWARD THE FIRST POINT OF ARIES (VERNAL EQUINOX) AND THE +Z AXIS IS DIRECTED THRU THE GEOGRAPHIC NORTH POLE.

EMERGENCY LEVEL - AT A LEVEL SUFFICIENT ONLY FOR CREW SURVIVAL. REDUNDANCY OF SOME CRITICAL FUNCTIONS MAY HAVE BEEN LOST.

EMI - ELECTROMAGNETIC INTERFERENCE

ENERGY MANAGEMENT - SCHEDULING OF CONTROL FUNCTIONS SO AS TO TAKE ADVANTAGE OF STATION FUNCTIONS WHICH CREATE VEHICLE DISTURBANCE TORQUES.

EPHEMERIS - LOCI OF POSITIONS OF CELESTIAL BODIES AND SPACE VEHICLES RELATIVE TO EPOCHS OF TIME.

ECLSS - ENVIRONMENTAL CONTROL LIFE SUPPORT SUBSYSTEM

FALLBACK - A HIERARCHY OF PROCEDURES USED TO MODIFY THE DATA PROCESSING ASSEMBLY MODE OF OPERATION TO CIRCUMVENT EQUIPMENT FAULTS AND PROVIDE A DEGRADED SERVICE BUT STILL PERFORM CRITICAL TASKS.

FPE (FUNCTIONAL PROGRAM ELEMENT) - GROUPING OF SPECIFIC EXPERIMENTS WHICH PLACE RELATED DEMANDS ON STATION SUBSYSTEMS.

GEOMETRIC AXES - SET OF AXES DEFINED RELATIVE TO THE STATION STRUCTURE.

GPL 'GENERAL PURPOSE LABORATORY' - SYNONYMOUS WITH INTEGRAL LABORATORY FACILITIES'. A SET OF ASSEMBLIES AND EQUIPMENT CAPABLE OF PERFORMING SELECTED FUNCTIONS IN SUPPORT OF EXPERIMENT AND STATION OPERATIONS. TYPICAL LABORATORY ELEMENTS ARE PHYSICS, MATERIALS PROCESSING, FLUID-MECHANICAL, OPTICAL, PHOTO, DATA ANALYSIS, MEDICAL.

GRAVITY GRADIENT MODE - A FLIGHT MODE WHERE THE STATION LONGITUDINAL AXIS IS ORIENTED NOMINALLY ALONG THE RADIUS VECTOR. THE BASIC FEATURE OF THIS MODE IS THAT GRAVITY GRADIENT TORQUES TEND TO MAINTAIN THE STATION IN THIS ORIENTATION.

HAZARD - ANY SITUATION OR CONDITION WHICH SIGNIFICANTLY INCREASES THE PROBABILITY OF INJURY TO PERSONNEL OR PERMANENT DAMAGE TO EQUIPMENT.

IN FLIGHT REPLACEABLE UNIT (IFRU) - ANY PORTION OF THE MODULAR SPACE STATION SUBSYSTEMS BELOW THE PACKAGE LEVEL, WHICH IS CAPABLE OF BEING REPLACED ON-ORBIT.

INT-20 INTERMEDIATE-20 LAUNCH VEHICLE. THIS VEHICLE CONTAINS A S-IC STAGE, A S-IVB STAGE, AND A INSTRUMENT UNIT (IU).

INT-21 - INTERMEDIATE-21 LAUNCH VEHICLE. THIS VEHICLE CONTAINS A S-IC STAGE, S-II STAGE, AND AN INSTRUMENT MODULE.

LCC - LAUNCH CONTROL CENTER

LV - LAUNCH VEHICLE

ML - MOBILE LAUNCHER

MODEM - MODULATES A SIGNAL INTO ANOTHER FORM SUITABLE FOR TRANSMISSION AND DEMODULATES SIGNALS FOR FURTHER PROCESSING.

MODULE - A SINGLY HABITABLE END ITEM WHICH CAN BE TRANSPORTED TO AND FROM ORBIT INTERNAL TO THE SPACE SHUTTLE, AND CONTAINS ONE OR MORE OF THE 'BASIC STATION FACILITIES'.

MOLECULAR SIEVE - A SUBASSEMBLY CONSISTING OF CO2 ABSORBER AND DESICCANT BEDS OPERATED ON A REGENERATIVE CYCLE WHICH PROVIDES FOR REMOVAL OF CO2 FROM THE CABIN ATMOSPHERE AND FOR CONCENTRATION OF THE CO2 FOR OXYGEN RECLAMATION.

MULTIPROCESSING - AN OPERATIONAL TECHNIQUE USED BY COMPUTER CONFIGURATION

WITH MORE THAN ONE PROCESSOR. WHERE MORE THAN ONE PROCESSOR IS LINKED INTO THE SAME SYSTEM, IT IS POSSIBLE FOR EACH PROCESSOR TO BE HANDLING A SEPARATE APPLICATION FUNCTION.

MULTIPROGRAMMING - A TECHNIQUE UNDER WHICH SEVERAL APPLICATION PROGRAMS CAN BE RUNNING CONCURRENTLY IN A SINGLE PROCESSOR. WHEN MULTI-PROGRAMMING TAKES PLACE, THE PROCESSOR SWITCHES BACK AND FORTH FROM ONE TASK TO ANOTHER.

MSFN - MANNED SPACE FLIGHT NETWORK

NADIR - VECTOR DIRECTED ALONG THE LOCAL VERTICAL FROM THE STATION TO THE CENTER OF THE EARTH (SEE ZENITH).

NEUTER DOCKING SYSTEM - A SYSTEM WHERE TWO ACTIVE OR ONE ACTIVE AND ONE PASSIVE SYSTEM CAN BE MATED.

NLT - NO LESS THAN

NMT - NO MORE THAN

NOMINAL LEVEL - AT THE LEVEL PLANNED FOR NORMAL OPERATIONS. REDUNDANCY OF ALL CRITICAL FUNCTIONS IS AVAILABLE.

OBCO - ONBOARD CHECKOUT

ORBITAL PLANE - PLANE WHICH CONTAINS THE LOCUS OF THE SPACE STATION'S ORBIT AND BISECTS THE EARTH AT THE ORBIT INCLINATION ANGLE MEASURED FROM THE EARTH'S EQUATORIAL PLANE.

OVV - OPPOSITE VELOCITY VECTOR

PACKAGE - A NON-HABITABLE SPACE STATION ELEMENT THAT IS ATTACHED TO A MODULE (AND IS DETACHABLE) WHICH CAN BE DELIVERED TO ORBIT AND RETURNED TO EARTH IN THE SPACE SHUTTLE ATTACHED TO A MODULE OR SEPARATELY, AND CONTAINS A SELECTED SUBSYSTEM FUNCTIONAL ASSEMBLY OR SET OF FUNCTIONAL ASSEMBLIES.

PCM - PULSE CODE MODULATION

PEAK POWER (LOAD) - MAXIMUM LOAD WHICH WILL BE APPLIED. FOR MAXIMUM PEAK LOAD DESIGN-TO LIMITATIONS, THE DURATION IS CONSIDERED TO BE LIMITED TO LESS THAN 1 MINUTE AND THE FREQUENCY OF OCCURRENCE TO BE NO MORE OFTEN THAN TWICE IN ONE HOUR.

PRESSURE ISOLATABLE VOLUME - A PRESSURE ISOLATABLE VOLUME IS A COMBINATION OF SHIRTSLEEVE CONNECTED MODULES AND/OR PORTIONS OF MODULES WHICH CAN BE PRESSURE ISOLATED FROM THE REMAINDER OF THE SPACE STATION, AND WHICH CAN PROVIDE ENVIRONMENTAL CONTROL, LIFE SUPPORT, POWER, BERTHING PORTS, AND OTHER FUNCTIONS NECESSARY FOR CREW SAFETY AND RETURN TO EARTH WITHOUT REQUIRING ACCESS OR HAVING TO USE HARDWARE IN OTHER PRESSURE ISOLATABLE VOLUMES.

PRINCIPAL AXES - SET OF AXES CENTERED AT THE COMBINED VEHICLE CG AND ORIENTED SUCH THAT THE PRODUCTS OF INERTIA VANISH. THE VARIATION BETWEEN THE STATION'S GEOMETRIC AXES AND THE PRINCIPAL AXES MAY BE CONSIDERED A ROUGH GAUGE OF THE AMOUNT OF VEHICLE ASYMMETRY (IGNORING NON-UNIFORM WEIGHT DISTRIBUTION).

PROCESSOR - A DEVICE CAPABLE OF ACCEPTING DATA, APPLYING PRESCRIBED PROCESSES TO THEM, AND SUPPLYING THE RESULTS OF THESE PROCESSES. A PROCESSOR CONSISTS OF A CONTROL UNIT, ARITHMETIC AND LOGIC UNIT.

PROGRAM INTERACTION - DIFFERENT PROGRAMS MAY USE THE SAME DATA RECORDS, SAME ROUTINE, POSSIBLY AT THE SAME TIME.

QUEUE - A LIST OF TRANSACTIONS WAITING FOR THE ATTENTION OF A PROCESSOR, A FILE CHANNEL TO BECOME FREE, OR FOR AN OUTPUT LINE TO BECOME AVAILABLE.

RACU - 'REMOTE ACQUISITON AND CONTROL UNIT'. THESE UNITS WILL ACCEPT PRECONDITIONED DATA SIGNALS IN EITHER DIGITAL OR ANALOG FORM, DIGITIZE AND FORMAT DATA FOR TRANSMISSION TO THE DATA PROCESSING ASSEMBLY, AND WILL DECODE AND DISTRIBUTE COMMANDS TO THE USER.

RAD - UNIT OF MEASUREMENT WHERE ONE RAD REPRESENTS RADIATION ENERGY OF 100 ERGS PER GRAM IMPARTED BY IONIZING PARTICLES TO THE IRRADIATED MATERIAL AT THE POINT OF INTEREST. RADIATION DESCRIBED IN RADS IS CALLED THE ABSORBED DOSE.

RAM - RESEARCH APPLICATIONS MODULE - A SEPARATE EXPERIMENT DEDICATED MODULE CONTAINING EXPERIMENT (FPE) EQUIPMENT AND SUBSYSTEM EQUIPMENT AS REQUIRED TO AUGMENT STATION SUPPLIED UTILITIES. THE TWO CLASSES OF RAM'S ARE -

ATTACHED - THOSE WHICH OPERATE WHILE ATTACHED TO THE STATION.
DETACHED - THOSE WHICH OPERATE IN A FREE FLYING MODE AROUND

THE STATION, BUT ARE PERIODICALLY ATTACHED FOR SERVICING.

REDLINE QUANTITY - THE QUANTITY OF CONSUMMABLES REQUIRED IN ADDITION TO THE NORMAL 120 DAYS SUPPLY IN THE EVENT OF THE OCCURRENCE OF TWO FAILURES CONSTITUTING THE LARGEST REQUIREMENT FROM A LIST OF CREDIBLE FAILURES. THE REDLINE VALUE IS THE MINIMUM QUANTITY WHICH IS ACCEPTABLE FOR NORMAL OPERATIONS. NO NORMAL OPERATIONS WILL BE PLANNED WHICH RESULT IN LESS THAN THE REDLINE FOR EACH CONSUMMABLE. IN THE EVENT OF AN UNPLANNED REDUCTION OF ANY ONE CRITICAL CONSUMMABLE BELOW THE REDLINE VALUE, A LAUNCH OF A SPACE SHUTTLE IS REQUIRED FOR RESUPPLY.

REDUCED LEVEL - AT A LEVEL LOWER THAN PLANNED, BUT STILL SUFFICIENT FOR LIMITED MISSION ACCOMPLISHMENT. REDUNDANCY OF ALL CRITICAL FUNCTIONS IS AVAILABLE.

REM (ROENTGEN EQUIVALENT MAN - QUANTITY OF RADIATION THAT HAS THE SAME BIOLOGICAL EFFECT ON MAN AS THE ABSCRPTION OF THE ROENTGEN OF GAMMA OR X RADIATION.

RESCUE - EVACUATION OF PERSONNEL FROM A DISTRESSED VEHICLE USING SEPARATELY BASED VEHICLE(S) AND THE SUBSEQUENT SAFE RETURN TO EARTH OR TO A SPACE VEHICLE CAPABLE OF SUSTAINING THE PERSONNEL.

RESIDUAL HAZARDS - THOSE FOR WHICH DESIGN PROVISIONS, SAFETY OR WARNING DEVICES, OR SPECIAL PROCEDURES HAVE NOT BEEN PROVIDED FOR COUNTERACTING THE HAZARD.

RESTRICTED ACCESS - ACCESS TO AN AREA SUCH THAT A SINGLE FAILURE OR ACCIDENT COULD PREVENT SAFE CREW PASSAGE THROUGH THAT PATH.

SABATIER REACTOR - A SUBASSEMBLY WHICH RECLAIMS OXYGEN BY THE COMBINATION OF HYDROGEN WITH COLLECTED CO2 FROM THE MOLECULAR SIEVE TO FORM METHANE AND WATER. THE WATER IS SUBSEQUENTLY ELECTROLYZED TO PRODUCE OXYGEN FOR METABOLIC AND LEAKAGE NEEDS ON THE SPACE STATION.

SAFE - FREE OF HAZARDS

SHUTTLE - SPACE SHUTTLE

SM - STATION MODULE

SO/SI (SPACE OPERATIONS/SCIENTIFIC INVESTIGATIONS) - AN ACRONYM FOR ON-ORBIT EXPERIMENT AND APPLICATION ACTIVITIES.

STATE VECTOR - A GENERALIZED N-DIMENSIONAL VECTOR REPRESENTING THE COMPONENTS OF VEHICLE POSITION AND VELOCITY. THIS VECTOR MAY BE EXPRESSED IN TERMS OF ORBITAL ELEMENTS OR INERTIAL COORDINATES.

STRAPDOWN IMU - AN INERTIAL MEASUREMENT UNIT WHOSE INERTIAL SENSING ELEMENTS (ACCELEROMETERS AND SENSING GYROS) ARE MOUNTED IN A FIXED ORIENTATION WITH RESPECT TO THE STATION BODY AXES (NAVIGATION BASE). THE INERTIAL REFERENCE FRAME IS MAINTAINED IN STATION BODY AXES BY SOFTWARE.

SUSTAINED POWER(LOAD) - MAXIMUM LOAD WHICH WILL BE APPLIED FOR A PERIOD GREATER THAN ONE MINUTE. FOR MAXIMUM SUSTAINED LOAD DESIGN-TO LIMITATIONS, THE DURATION OF THE APPLIED LOAD IS CONSIDERED TO BE LIMITED TO LESS THAN 1.0 HOUR AND TO OCCUR NO MORE THAN TWICE IN ANY 24 HOUR PERIOD.

TARGETS OF OPPORTUNITY - UNPLANNED TARGETS OF INTEREST FOR EXPERIMENT VIEWING.

TBD - TO BE DETERMINED IN PHASES C AND D

TOXIC CONSTITUENTS - MAY BE DELETERIOUS TO THE HEALTH OR WELL-BEING OF ONBOARD PERSONNEL, OR MAY DEGRADE CREW PERFORMANCE SO AS TO AFFECT MISSION PERFORMANCE, OR MAY INTERFERE WITH PHYSIOLOGICAL FUNCTIONS IN SUCH A MANNER AS TO BIAS RESULTS OF MEDICAL EXPERIMENTS.

UTE - UNIVERSAL TEST EQUIPMENT.

VAB - VERTICAL ASSEMBLY BUILDING

X-POP - A FLIGHT MODE CONSISTING OF THE STATION X-AXIS ORIENTED PERPENDICULAR TO THE ORBITAL PLANE. X-POP MAY BE VISUALIZED AS FLYING 'BROADSIDE' (LONGITUDINAL AXIS PERPENDICULAR TO THE ORBITAL PLANE) AS OPPOSED TO FLIGHT LIKE AN ARROW.

X-POP INERTIAL - THE FLIGHT MODE WITH THE STATION X-AXIS PERPENDICULAR TO THE ORBITAL PLANE AND ALL STATION AXES MAINTAINED IN A FIXED ORIENTATION WITH RESPECT TO THE ORBIT PLANE.

X-POP LEVEL - THE FLIGHT MODE WITH THE STATION X AXIS PERPENDICULAR TO THE ORBITAL PLANE WITH THE STATION ROTATING AT ORBITAL RATE ABOUT THE X-AXIS TO MAINTAIN THE +Z-AXIS ORIENTED ALONG THE RADIUS VECTOR AND POINTED TO THE GROUND.

Y-POP - A FLIGHT MODE CONSISTING OF THE STATION Y-AXIS ORIENTED PERPENDICULAR TO THE ORBITAL PLANE. Y-POP MAY BE VISUALIZED AS FLYING LIKE AN ARROW (LONGITUDINAL AXIS PARALLEL TO THE VELOCITY VECTOR).

Y-POP INERTIAL - THE FLIGHT MODE WITH THE STATION Y-AXIS PERPENDICULAR TO THE ORBITAL PLANE AND ALL STATION AXES MAINTAINED IN A FIXED ORIENTATION WITH RESPECT TO THE ORBIT PLANE.

Y-POP LEVEL - THE FLIGHT MODE WITH THE STATION Y-AXIS PERPENDICULAR TO THE ORBITAL PLANE WITH THE STATION ROTATING AT ORBITAL RATE ABOUT THE Y-AXIS TO MAINTAIN THE +Z-AXIS ORIENTED ALONG THE RADIUS VECTOR AND POINTED TO THE GROUND.

ZENITH - VECTOR DIRECTED ALONG THE LOCAL VERTICAL FROM THE STATION AWAY FROM THE CENTER OF THE EARTH (SEE NADIR).

Z-POP - A FLIGHT MODE CONSISTING OF THE STATION Z-AXIS ORIENTED PERPENDICULAR TO THE ORBITAL PLANE.

Z-POP INERTIAL - THE FLIGHT MODE WITH THE STATION Z-AXIS PERPENDICULAR TO THE ORBITAL PLANE AND ALL STATION AXES MAINTAINED IN A FIXED ORIENTATION WITH RESPECT TO THE ORBIT PLANE.

Z-POP LEVEL - THE FLIGHT MODE WITH THE STATION Z-AXIS PERPENDICULAR TO THE ORBITAL PLANE WITH THE STATION ROTATING AT ORBITAL RATE ABOUT THE Z-AXIS.