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SPACE STATION TASK FORCE PERSPECTIVE

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No text available at time of printing.

PRESENTATION OUTLINE

- PRELIMINARY PROGRAM DESCRIPTION
  - DEFINITIONS
  - FUNCTIONS
  - CAPABILITIES
  - MANAGEMENT APPROACH
  - SCHEDULES
- SPACE STATION SERVICING CAPABILITY
- SPACE STATION – ORBITAL TRANSFER VEHICLE (OTV) PROGRAM INTERFACES

Figure 1

SPACE STATION PLANNING GUIDELINES

MANAGEMENT RELATED

- **Three year extensive definition (5-10% of program cost)**
- **NASA-wide participation**
- **Development funding in FY 1987**
- **IOC: early 1990's**
- **Cost of initial capability: $8.0B**
- **Extensive user involvement**
  - Science and applications
  - Technology
  - DoD
  - Commercial
- **International participation**

ENGINEERING RELATED

- **Continuously habitable**
- **Shuttle dependent**
- **Manned and unmanned elements**
- **Evolutionary**
- **Maintainable/restorable**
- **Operationally autonomous**
- **Customer friendly**
- **Technology transparent**

Figure 2

SPACE STATION PROGRAM ARCHITECTURE: WHAT IS A SPACE STATION

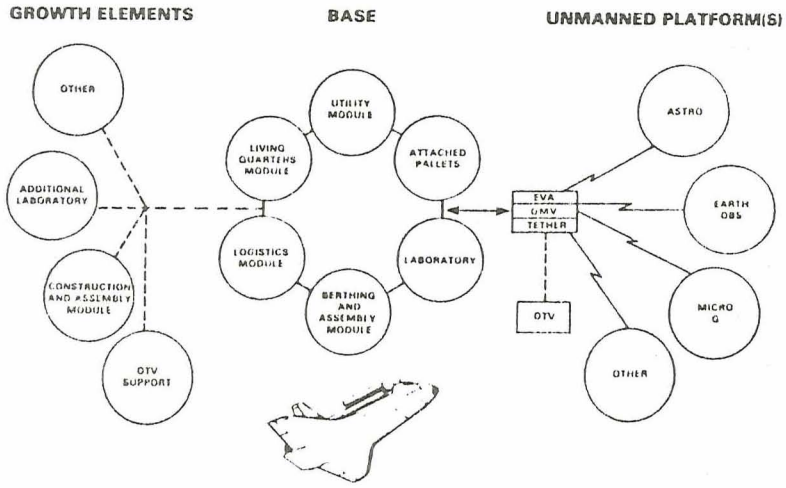


Figure 3

FUNCTIONS OF A SPACE STATION

- On-orbit laboratory
  - — Science and applications
  - — Technology
- Permanent observatory(s)
- Transportation node
- Servicing facility
  - — Free flyers
  - — Platforms
- Communications and data processing node
- Manufacturing facility
- Assembly facility
- Storage depot

A space station is a multi-purpose facility

Figure 4

SPACE STATION
FUTURE

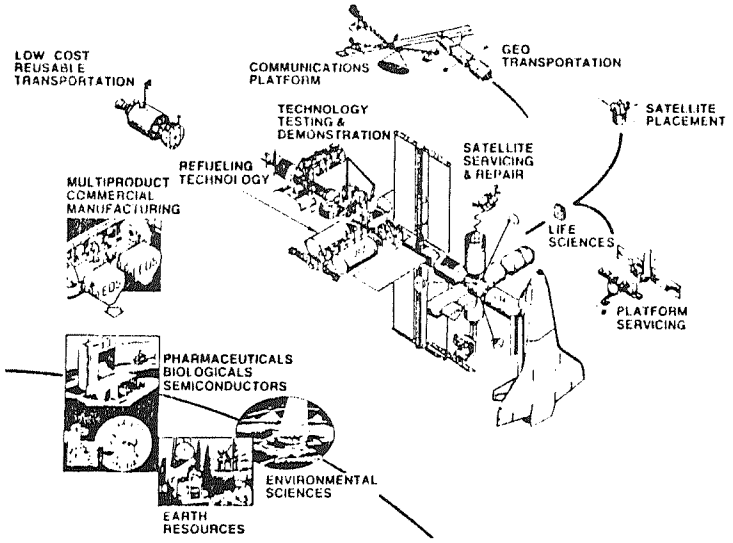


Figure 5

SPACE STATION
INITIAL

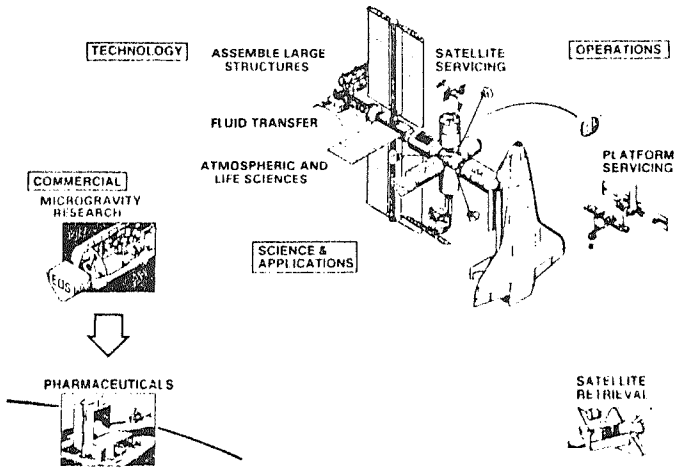


Figure 6

THE RELATIONSHIP BETWEEN THE SPACE STATION PROGRAM AND OTHER PROGRAMS

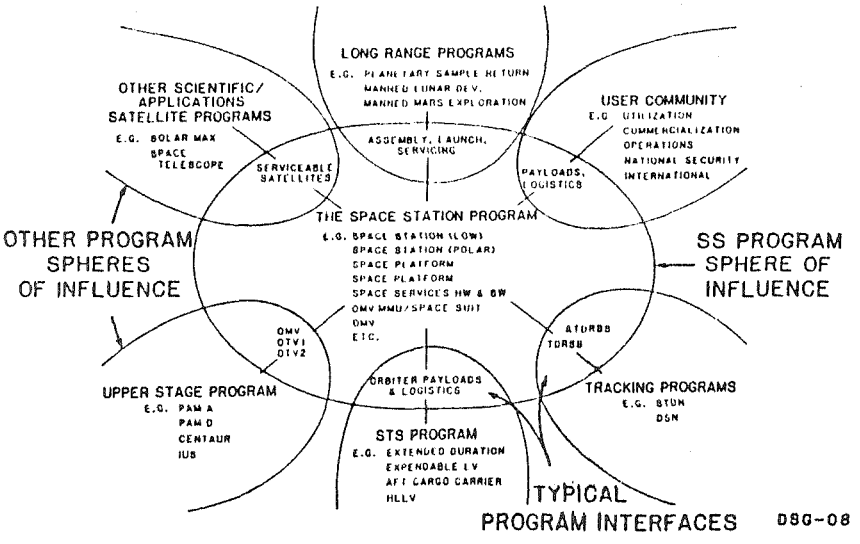


Figure 7

SPACE STATION DEFINITION PRELIMINARY MISSION DATA BASE (1991-2000)

- Initial Data Base
- Derived from Shuttle and ELV Base
- Will Change as Station Capabilities Become Better Understood and Mission Priorities Shift
- Not the List of Mission/Payloads the Station Will Fly in 1991

SCIENCE AND APPLICATIONS
- Astrophysics
- Earth Science and Applications
- Solar System Exploration
- Life Sciences
- Materials Science
- Communications

COMMERCIAL
- Materials Processing in Space
- Earth and Oceans Observations
- Communications

TECHNOLOGY DEVELOPMENT
- Materials and Structures
- Energy Conversion
- Computer Science and Electronics
- Propulsion
- Controls and Human Factors
- Space Station Systems/Operations
- Fluid and Thermal Physics

Figure 8

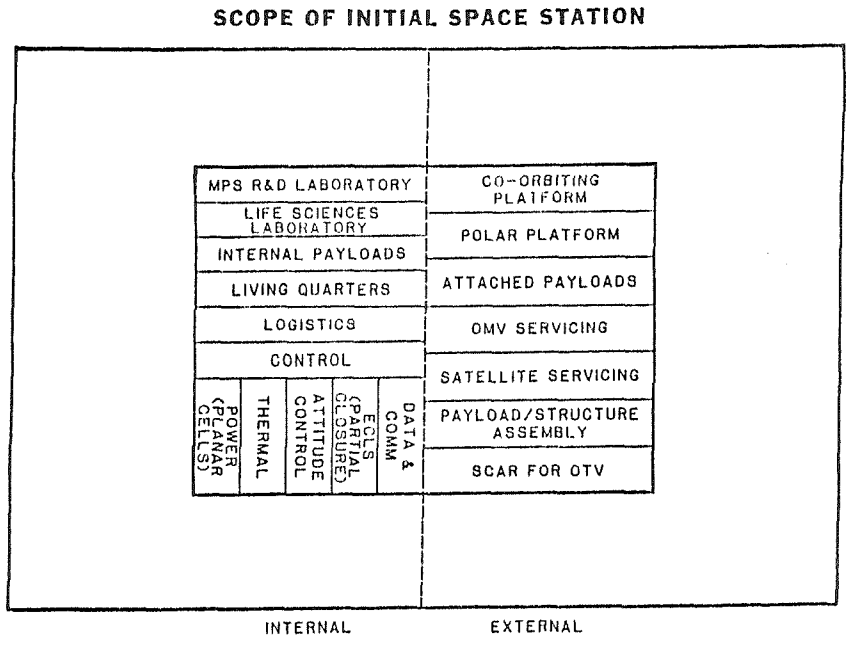


Figure 9

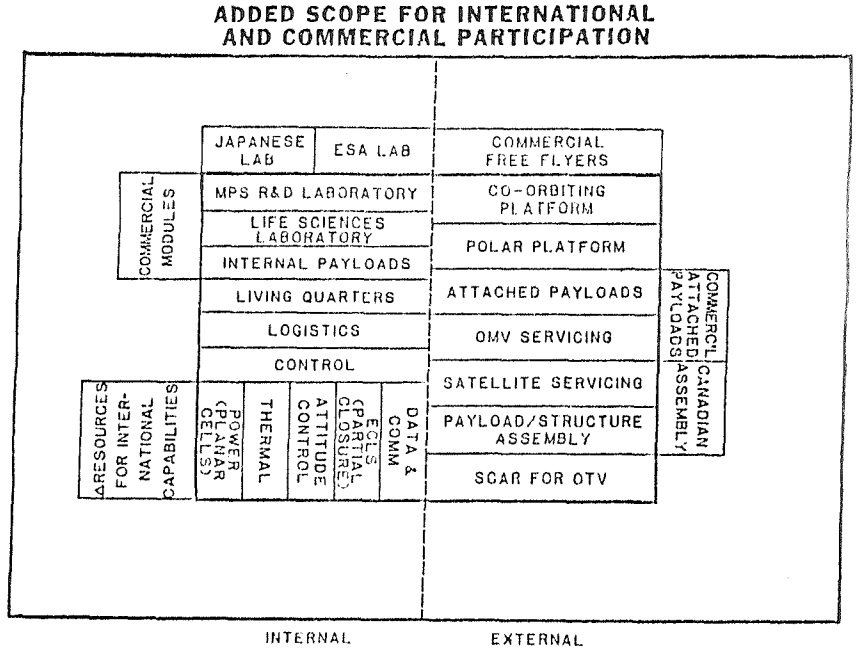


Figure 10

SCOPE OF GROWTH CONFIGURATION

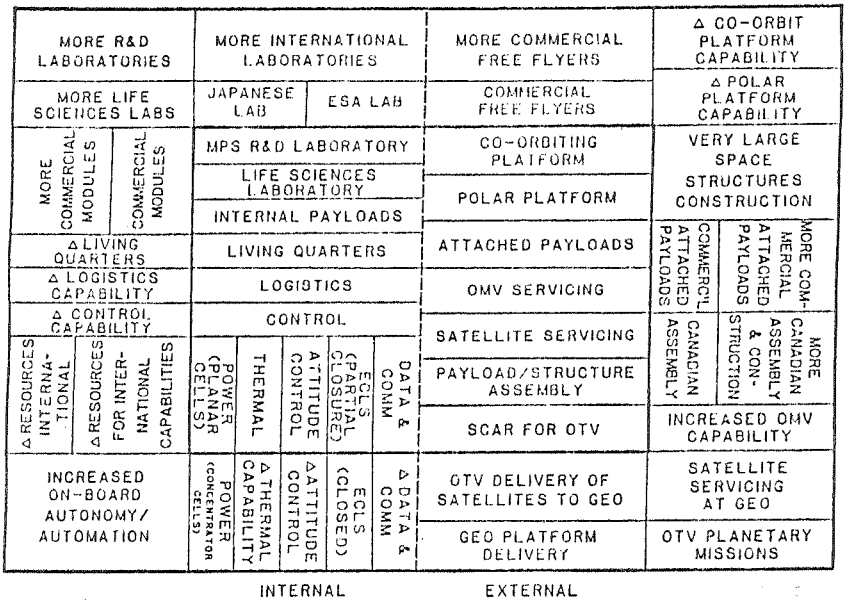


Figure 11

THE SPACE STATION PROGRAM WILL EVOLVE THROUGH A "BLOCK" SERIES

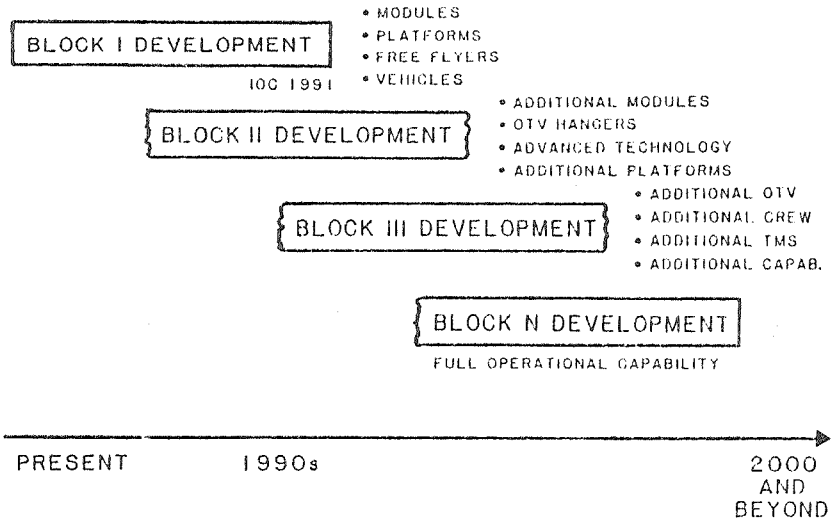


Figure 12

SPACE STATION PROGRAM EXTENDED DEFINITION

- SCOPE AND DURATION BEYOND "PHASE B"
- TWO CONTRACTORS COMPETE FOR EACH WORK PACKAGE
- PRODUCTS ARE A BLEND OF DOCUMENTATION AND HARDWARE DEMONSTRATIONS

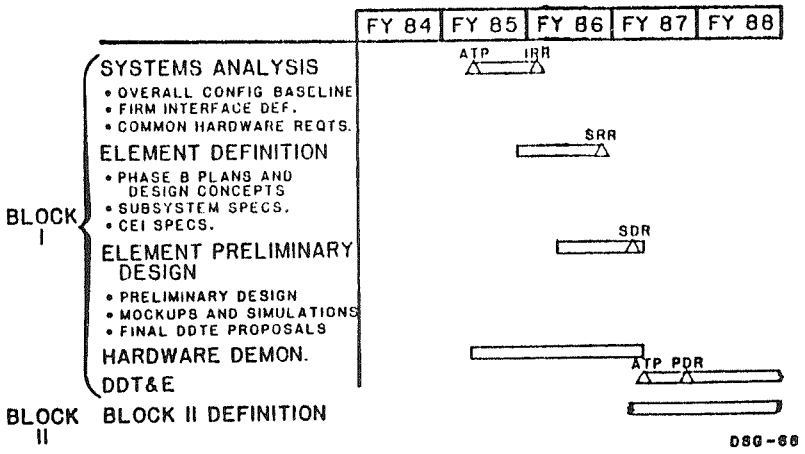


Figure 13

SPACE STATION OVERALL SCHEDULE

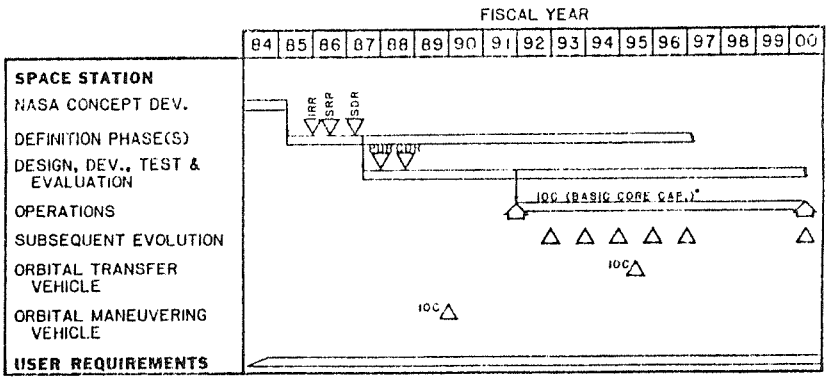
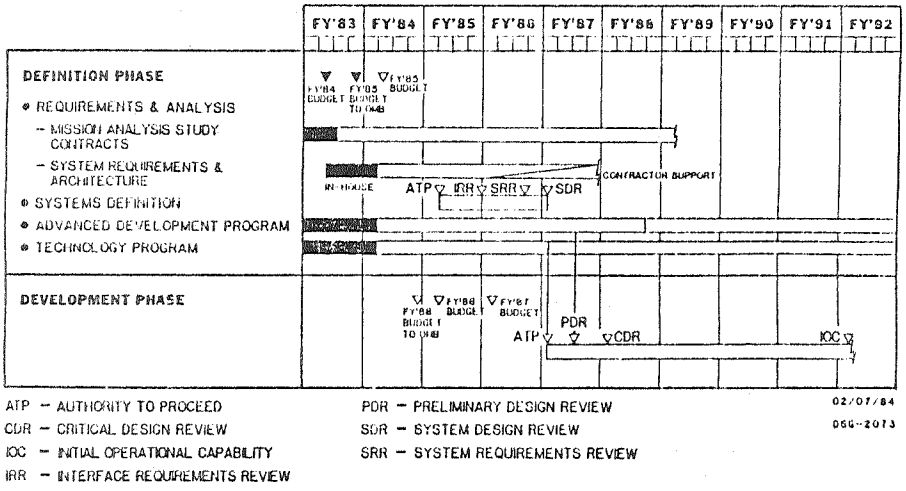


Figure 14

SPACE STATION PLANNING SCHEDULE



ATP – AUTHORITY TO PROCEED
CDR – CRITICAL DESIGN REVIEW
IOC – INITIAL OPERATIONAL CAPABILITY
IRR – INTERFACE REQUIREMENTS REVIEW
PDR – PRELIMINARY DESIGN REVIEW
SDR – SYSTEM DESIGN REVIEW
SRR – SYSTEM REQUIREMENTS REVIEW

Figure 15

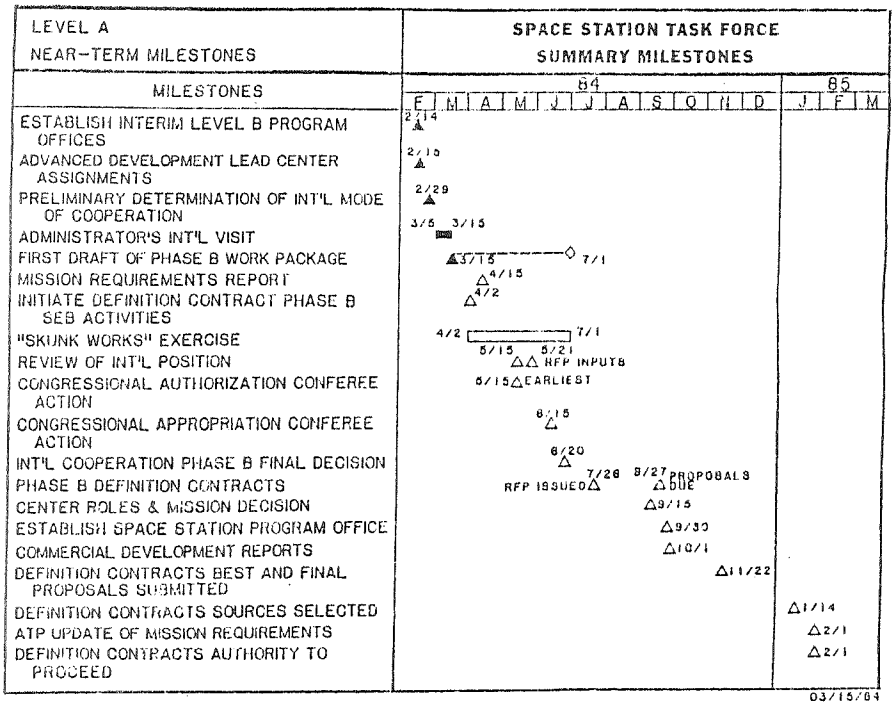


Figure 16

SPACE STATION PROGRAM DEFINITION ACTIVITY

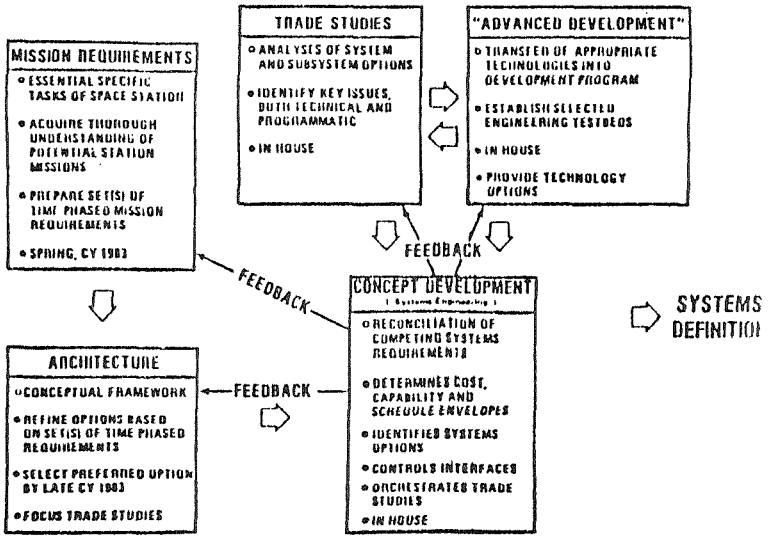


Figure 17

SPACE STATION SERVICING CAPABILITY

THE SPACE STATION BASE WILL HAVE THE CAPABILITY TO SERVICE OR PROVIDE SERVICING SUPPORT FOR:

- PAYLOADS ATTACHED TO THE STATION
- SATELLITES BROUGHT TO THE STATION BY THE TMS OR SERVICED REMOTELY BY THE TMS
- TMS BASED AT THE STATION
- CO-ORBITING PLATFORM AND ITS PAYLOADS
- LARGE SPACE STRUCTURE TDM'S
- PAYLOADS TO BE PLACED IN ORBIT BY THE TMS AND TO BE LAUNCHED TO HIGHER ENERGY ORBITS
- SPACE-BASED REUSEABLE OTV
- SATELLITES IN GEO SERVICED REMOTELY BY THE TMS

SERVICING FUNCTIONS AT THE SPACE STATION WILL INCLUDE:

- REPLENISHMENT OF CONSUMABLES
  - PROPELLANTS
  - PRESSURANTS
  - COOLANTS
- RECHARGING/REPLACEMENT OF BATTERIES
- CONSTRUCTION OF LARGE SPACE STRUCTURES
- ASSEMBLY (POSSIBLE FUELING) AND MATING OF PAYLOADS
- CHECKOUT
  - SATELLITES
  - TMS
  - OTV
  - PAYLOADS
- REPAIR AND UPGRADING, PRIMARILY BY ORU EXCHANGE

Figure 18

SERVICING FACILITIES AT THE SPACE STATION

COMMON FACILITIES

- SUPPORT STRUCTURE
- REMOTE MANIPULATOR SYSTEM (RMS) – RELOCATABLE
- MANIPULATOR FOOT RESTRAINT (MFR)
- MANNED MANEUVERING UNITS (MMU) – TWO
- MODULAR EQUIPMENT STORAGE ASSEMBLY (MESA)
- GENERAL STORAGE AREA – ENCLOSED

  MMU'S, MFR, MESA
- WORK AREA (CONSTRUCTION OF LARGE SPACE STRUCTURES)
- EXTERNAL WORK SITE MONITORING AND CONTROL STATION (IN A PRESSURIZED MODULE)

MULTIPURPOSE PRESSURIZED WORK VOLUME-NEED TO BE DETERMINED

ORBITAL TRANSFER VEHICLE (OTV) FACILITIES

- BERTHS – TWO
- PROPELLANT AND PRESSURANT TANKS
- ELECTRICAL POWER STATION
- CHECKOUT EQUIPMENT
- HANGARS UNPRESSURIZED – TWO
- PAYLOAD ASSEMBLY/CHECKOUT AREA – ENCLOSED
- STORAGE AREA – ENCLOSED

  SPARE ASSEMBLIES, ORU'S, MANNED GEO MISSION MODULE

Figure 19

THE SERVICING FACILITY AND OPERATIONS

- PLACE SEVERE REQUIREMENTS ON THE SPACE STATION
  - SAFETY
  - CONTAMINATION
  - CONTROL STATION VIEWING OF SERVICING OPERATIONS
  - APPROACH/DEPARTURE CORRIDORS
  - THERMAL CONTROL OF FLUIDS STORED ON THE STATION
  - EVA CORRIDORS
  - ACCESS TO PRESSURIZED WORK VOLUME (IF DEEMED NECESSARY)
  - CONSUMABLES AND CARGO TRANSFER
  - ATTITUDE CONTROL AND PROPULSION
  - RMS REACH CAPABILITY
  - POSSIBLE CRYOGENIC PROPELLANT BOIL-OFF USAGE (ECLS, PROPULSION, POWER)
  - GROWTH CAPABILITY
- AFFECT OTHER ELEMENTS OF THE SPACE STATION
  - SCIENTIFIC INSTRUMENTS FIELDS OF VIEW
  - G LEVEL OF THE LABORATORIES
  - CONTAMINATION OF ENVIRONMENT

THE SERVICING FACILITY AND OPERATIONS ARE A MAJOR DRIVER FOR BOTH THE INITIAL AND GROWTH STATIONS

Figure 20

CRITICAL TECHNOLOGY DEVELOPMENT FOR OMV/OTV/SATELLITE SERVICING

- FLUID MANAGEMENT
  - CRYOGENICS
  - STORABLE FLUIDS
- LONG-TERM ORBITAL STORAGE OF CRYOGENICS
- CONTAMINATION CONTROL/REMOVAL
- IMPROVED EXTRAVEHICULAR MANEUVERING UNIT (EMU)
- ROBOTIC SERVICING CAPABILITY
- RENDEZVOUS, APPROACH, AND BERTHING
  - OMV
  - OTV
  - SATELLITES
  - PLATFORM

Figure 21

TOP LEVEL SERVICING FACILITY ISSUES

- OTV PROPELLANT DEPOT LOCATION
  - ATTACHED
  - TETHERED
  - FREE FLYING
- DEGREE OF SERVICING AUTOMATION
  - INITIAL STATION
  - GROWTH STATION
- NEED FOR A PRESSURIZED WORK VOLUME

Figure 22

DESIRABLE FEATURES FOR A SPACE STATION BASED OTV

- SPACE MAINTAINABLE
- MODULAR
- HIGH REUSEABILITY
- SIMPLE PAYLOAD INTEGRATION AND SERVICING CAPABILITY
- SYNERGISTIC WITH SPACE STATION SYSTEMS/ ELEMENTS
- COMMONALITY WITH SPACE STATION SYSTEMS/ ELEMENTS
- STANDARDIZED INTERFACES - OMV, SATELLITES, SPACE STATION
- GROWTH CAPABILITY
- HIGH EFFICIENCY (LOW WEIGHT, HIGH ISP)
- NON-CONTAMINATING
- WIDE THRUST LEVEL CAPABILITY

Figure 23

PROPOSED OTV TECHNOLOGY DEVELOPMENT FLIGHT EXPERIMENTS

SHUTTLE SORTIE FLIGHTS (1987 - 1990)

- PROPELLANT TRANSFER, STORAGE, AND REFRIGERATION/ RELIQUEFACTION
- DOCKING AND BERTHING
- EMU/EVA OPERATIONS
- PAYLOAD MATING/INTERFACE
- OTV SHELTER STRUCTURE
- SERVICING FACILITIES/EQUIPMENT

TECHNOLOGY DEVELOPMENT MISSIONS ON SPACE STATION (1991 -)

- PROPELLANT TRANSFER, STORAGE, AND REFRIGERATION/ RELIQUEFACTION
- DOCKING AND BERTHING
- MAINTENANCE
- PAYLOAD INTEGRATION

SPACE-BASED OTV OPERATIONS (1995)

Figure 24

ORBITAL TRANSFER VEHICLE (OTV) - SPACE STATION PROGRAM INTERFACES

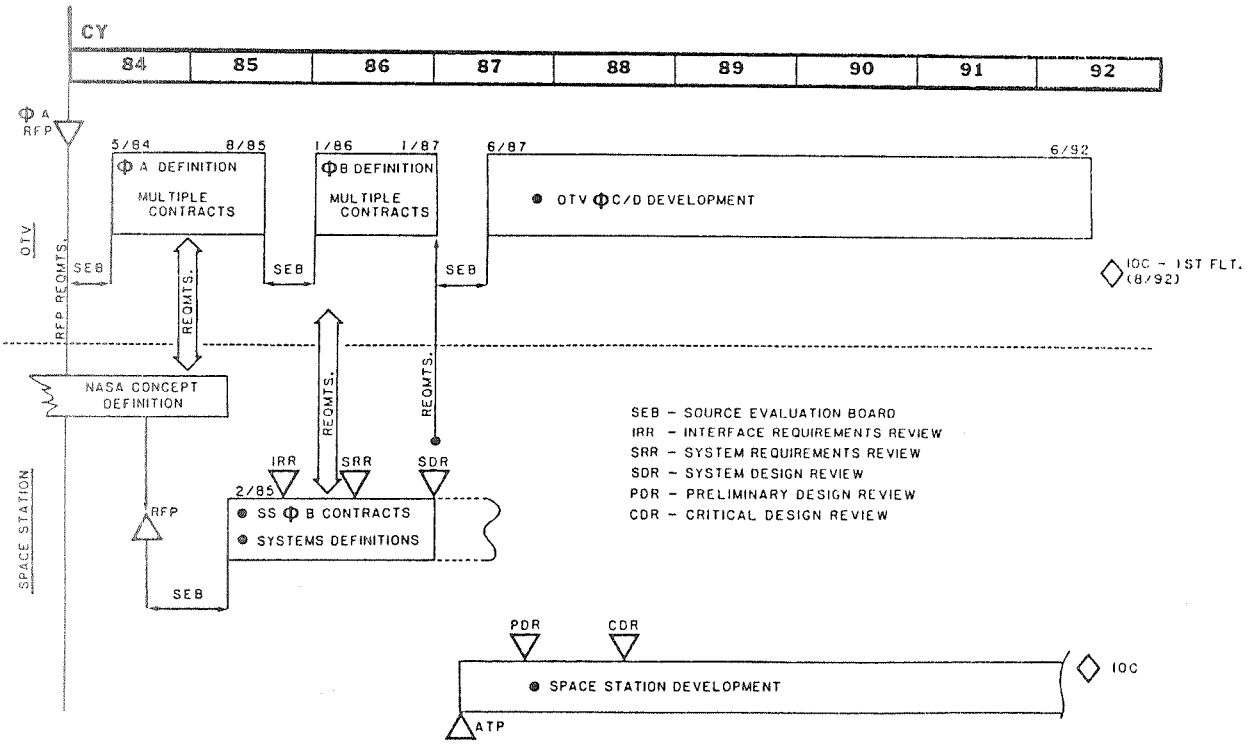


Figure 25