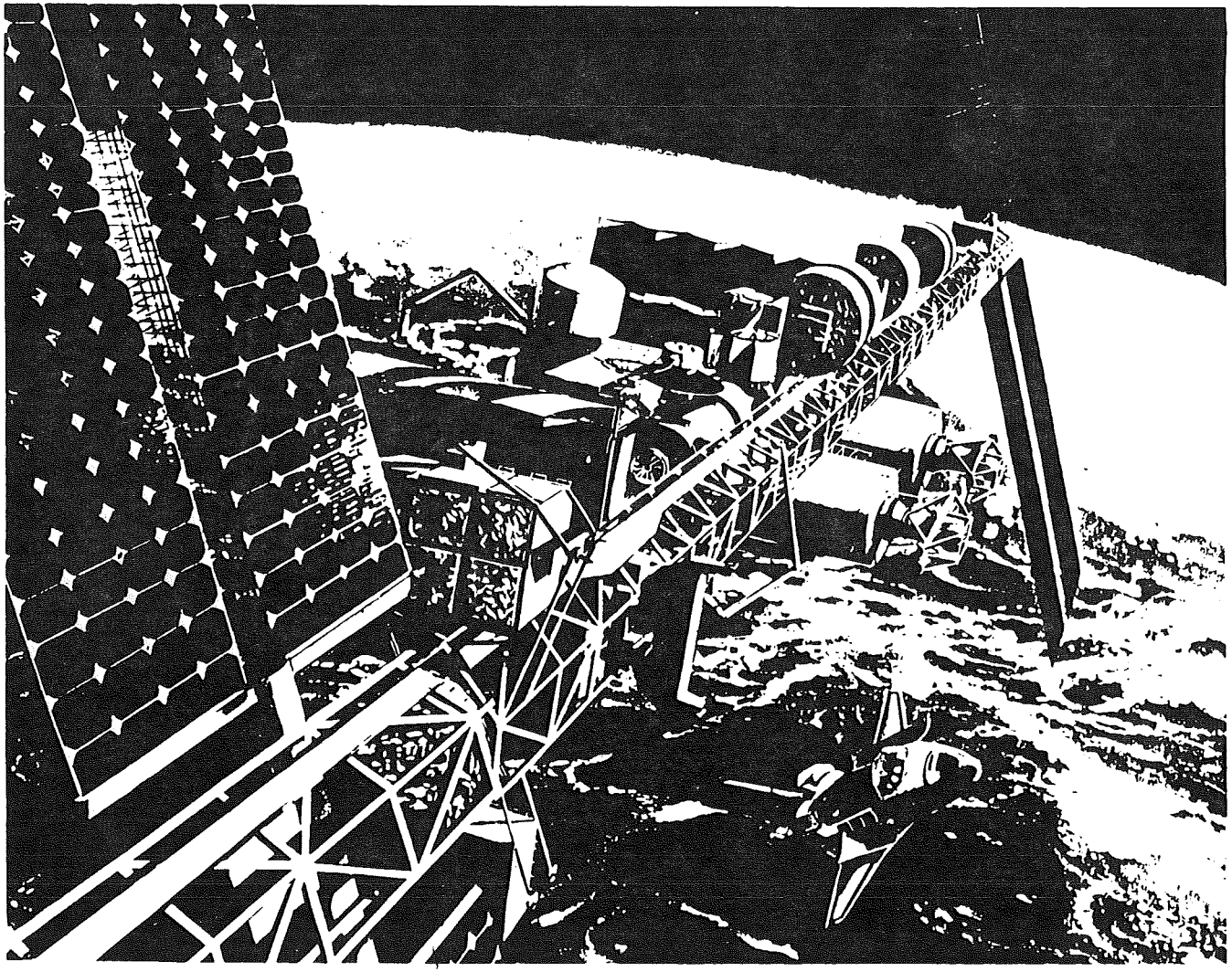
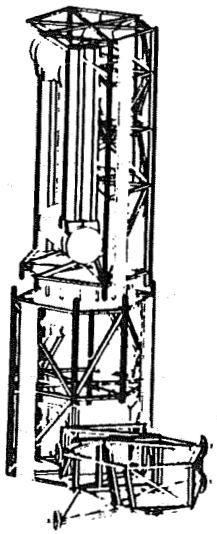
Space Station Freedom Status



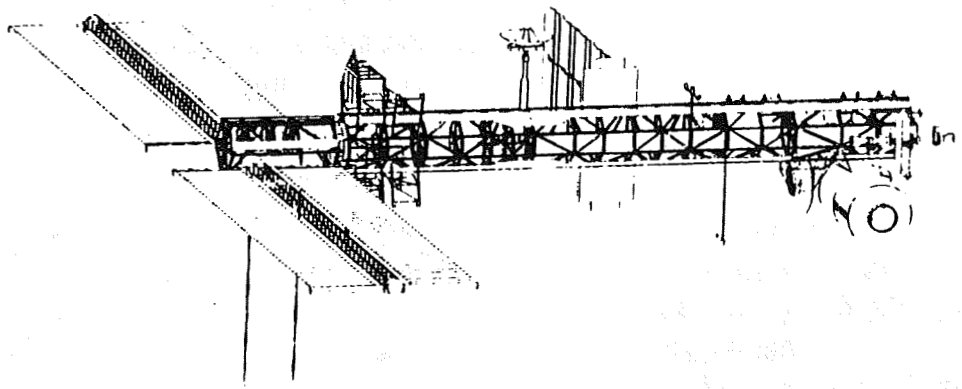
Space Station Evolution
Beyond the Baseline
August 6-8, 1991

John Cox
Deputy Manager for Operations
Space Station Freedom Program & Operations

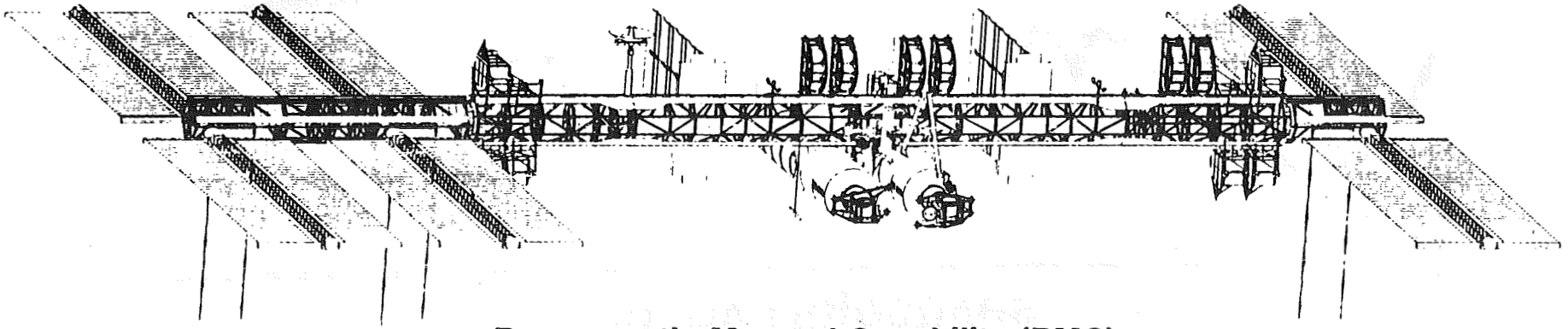
Space Station Freedom



First Element Launch (FEL)



Man-tended Capability (MTC)



Permanently-Manned Capability (PMC)

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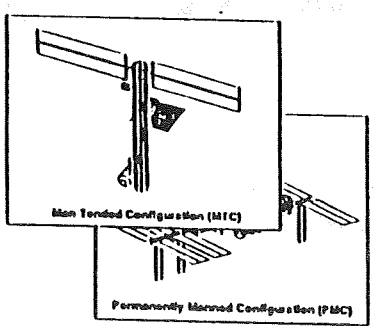
Restructuring Integrates Many Objectives

FREEDOM

RESTRUCTURED PROGRAM



NASA

- Provide Preeminent On-orbit Laboratory
  - 28 U.S. User Racks
  - 30 kW of Power
- Honor International Commitments
- Increase Ground Integration and Testing
- Simplify On-Orbit Assembly
- Reduce EVA
- Assure Crew Return
- Provide Flexibility for Changing Priorities and Budget Variations

CONGRESS

- Reduce Budget
- Provide Discrete Phases
- Emphasize Microgravity Sciences
- Achieve Early Man-Tended
- Utilization Flights During Man-Tended
- Adequate Power for U.S. Users
- Maintain International Committments

AUGUSTINE

- Accommodate Two Missions
  - Materials Science
  - Life Sciences
- Increase Ground Integration & Testing
- Reduce Transportation Requirements
- Reduce EVA
- Provide Crew Recovery Capability
- Reduce Size and Complexity

Restructured Space Station Freedom Program Meets Objectives

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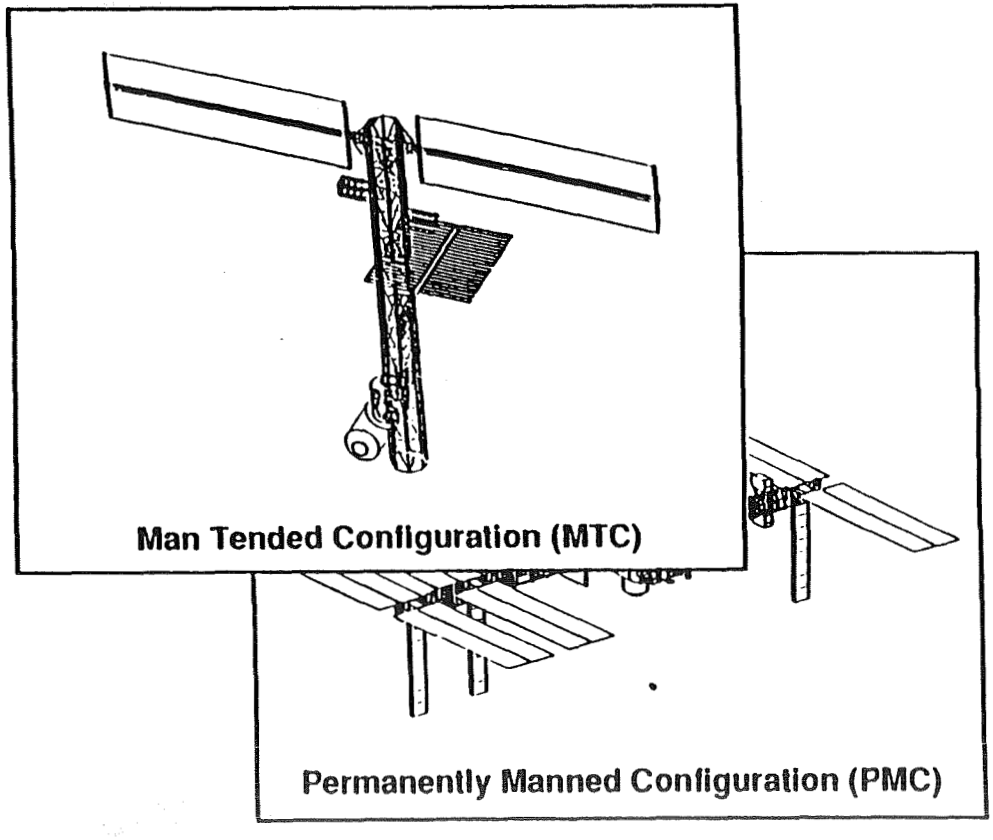
FREEDOM

- **Meets Cost Guidelines**
- **Man-Tended Capability Meets All Objectives**
  - Microgravity Laboratory
    - 13 kW Users
    - 15 User Rack Locations
  - Reduced Size and Complexity
  - Simplified Assembly
- **Permanently Manned Capability Balances Cost with Capabilities**
  - Ability to Expand Life Sciences
  - Accommodates Crew of 4 and ACRV
  - Capability to Grow to Crew of 8, 75 kW Power



Restructuring Followed a Well-Integrated Process

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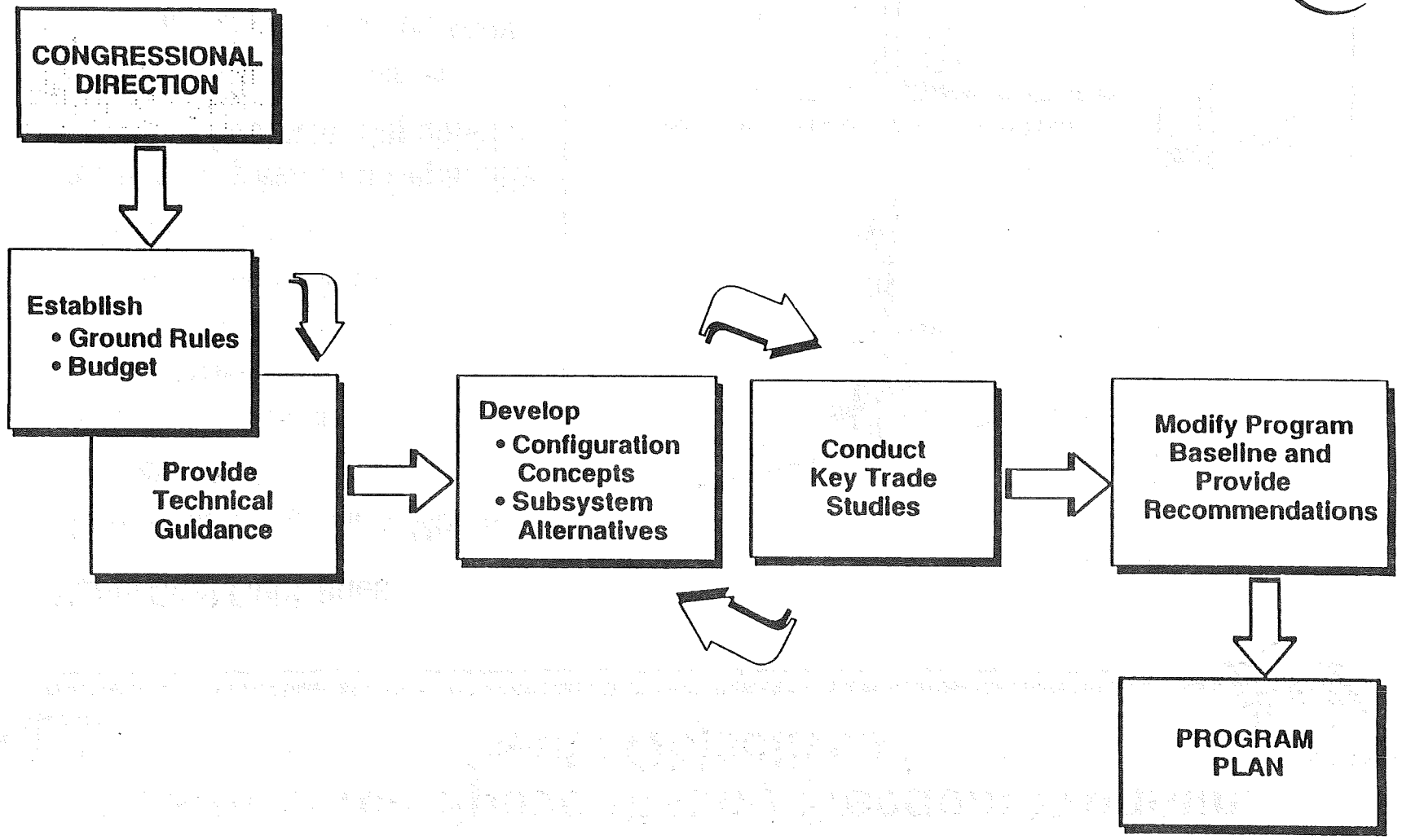
FREEDOM



Ground Rules Are Reflected In Program Themes

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FREEDOM

GROUND RULES

- Budget
- Phased Approach
- Material/Life Sciences
- Early FEL; MTC
- Reduce Complexity & Transportation Requirements
- Honor International Commitments
- Build to PMC

RESTRUCTURING THEMES

- **Implement Program Management Directions**
  - Reduce Shuttle Flight Rate
  - Program Schedule Changes
- **Provide Design Simplification Guidelines**
  - Truss
  - Robotic Access
- **Preserve Design Flexibility**
  - Discrete Phases

Solution Adopted Best Features From Alternative Concepts

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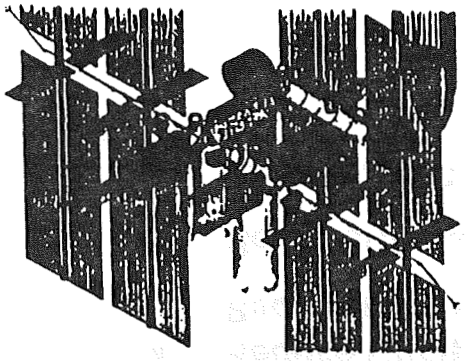
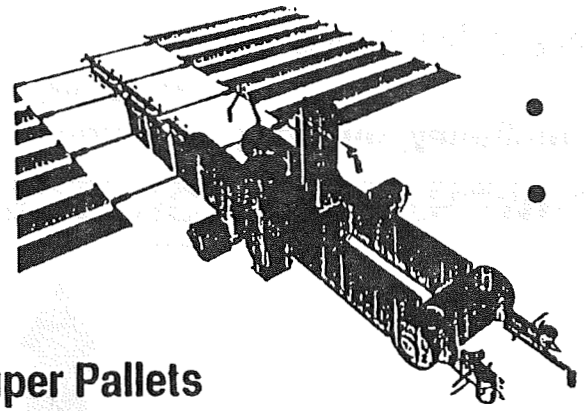
FREEDOM

Solar Inertial Station Concept (SISC) (Boeing)



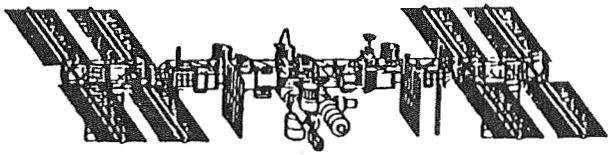
- Ground Integration & Test
- Simplify Assembly

"Starship Enterprise"(JSC)



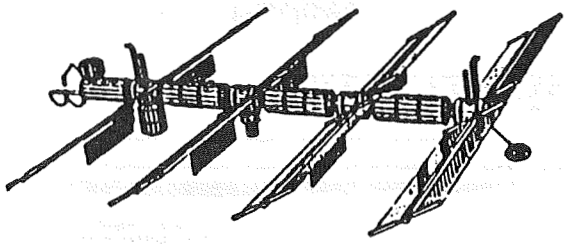
- Simplify Assembly
- Reduce Amount of External Hardware

Ground Integrated Super Pallets (Grumman)



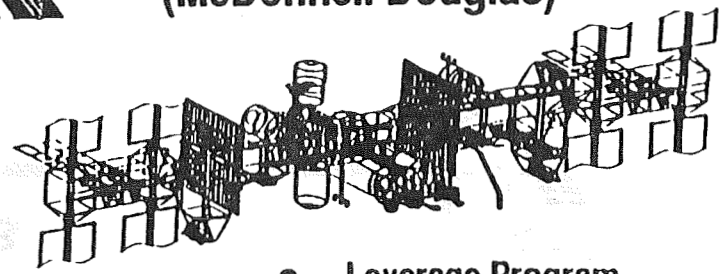
- Pre-Integrated Truss
- Short Lab/Hab

S.P.R.I.N.T. Concept (Martin Marrietta)



- Reduce amount of external hardware

ECAS (McDonnell Douglas)



- Leverage Program Investment to date

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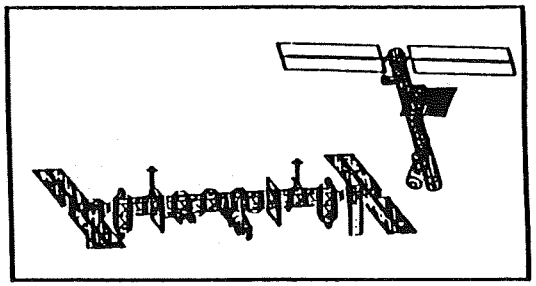
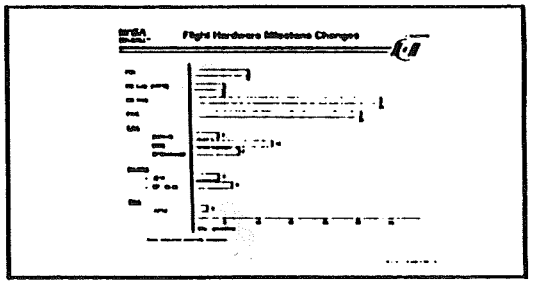
Key Decisions Modify The Program Baseline

FREEDOM

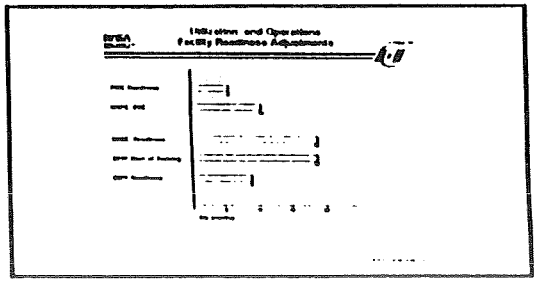
- **Selected 1/2 Boom Configuration for MTC**
  - Meets Microgravity Mission Requirements
  - Accelerates Lab Delivery



- **Deferred Key PMC Hardware Development**
  - Slipped Hab Module by 2 Years
  - Slipped PMC Accordingly
  - Relaxed Transportation Requirements



- **Phased Ground Capabilities Consistent With Flight Hardware**
  - Deferred Payload Operations Integration Center (POIC)
  - Deferred Space Station Outfitting
  - Reduced Processing Facility (SSPF) Footprints
  - Phased Space Station Control Center (SSCC)



- **Simplified and Reduced Hardware Complexity**

Man-Tended Configuration Meets User Needs

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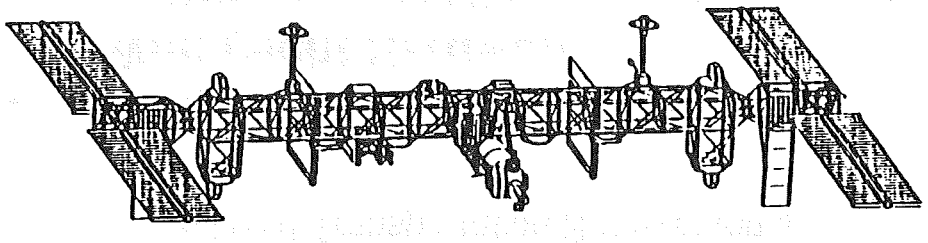
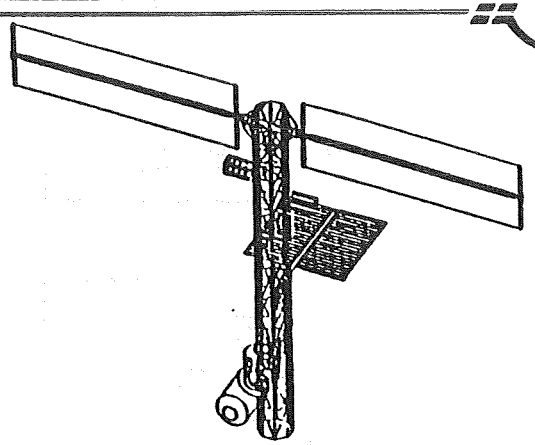
FREEDOM





1990

- June 1996 (7 flights)
- Erectable Truss
- 2 Power Modules (25 kW User Power)
- 44' Microgravity Lab (24 User Racks)
- 1 APAE & FTS
- Mobile Transporter/Assembly Support Equipment
- 300 MB Communications Downlink

1991

- December 1996 (6 flights)
- Pre-Integrated Truss
- 1 Power Modules (13 kW User Power)
- 27' Microgravity Lab (15 User Racks)
- APAE deferred
- FTS transferred to OAET (Code R)
- Mobile Transporter Simplified
- 50 MB Communications Downlink
- On-orbit Integration Reduced

User Needs are Satisfied and Complexities Reduced

Space Station Freedom Allows Significantly Greater Utilization Opportunities Than Other Programs

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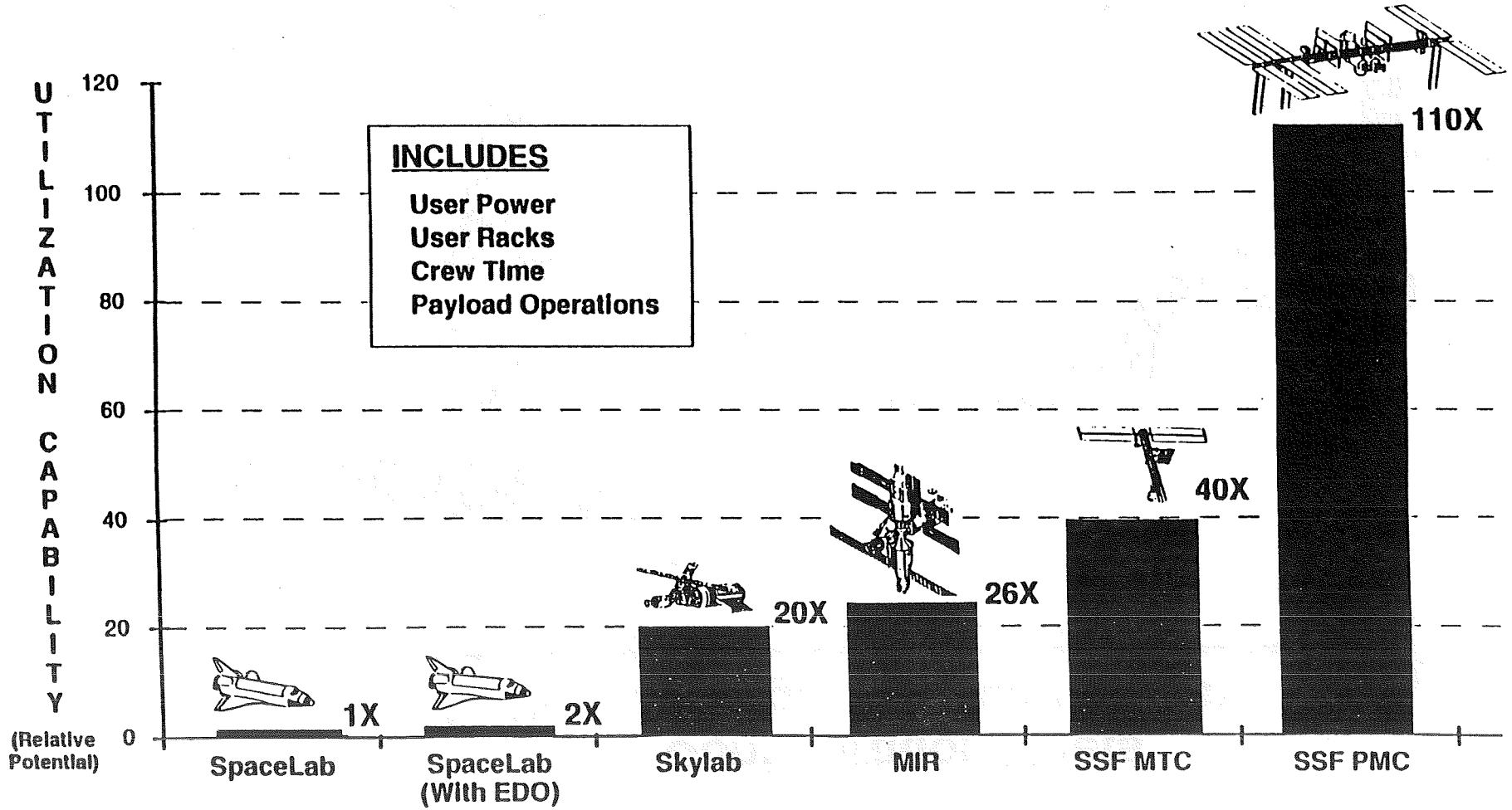
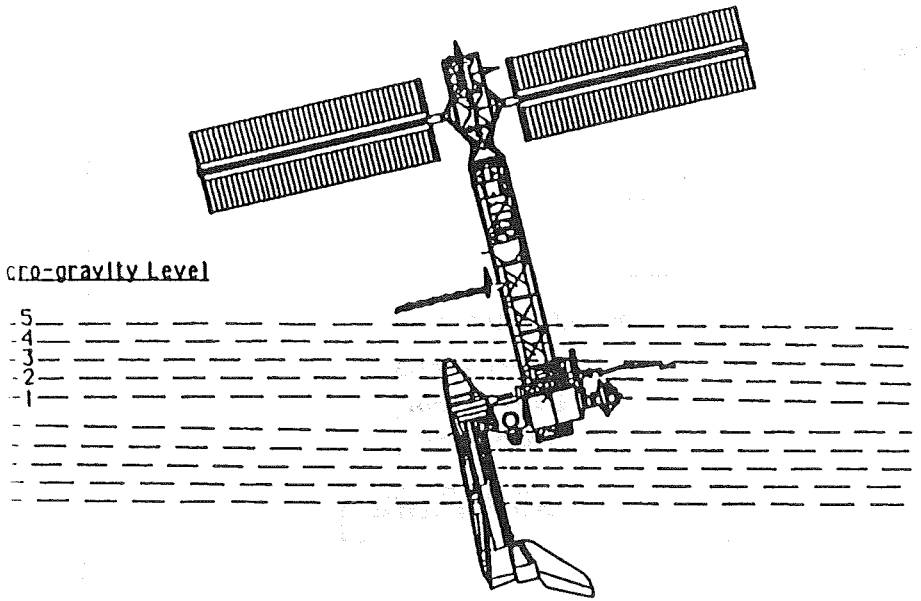
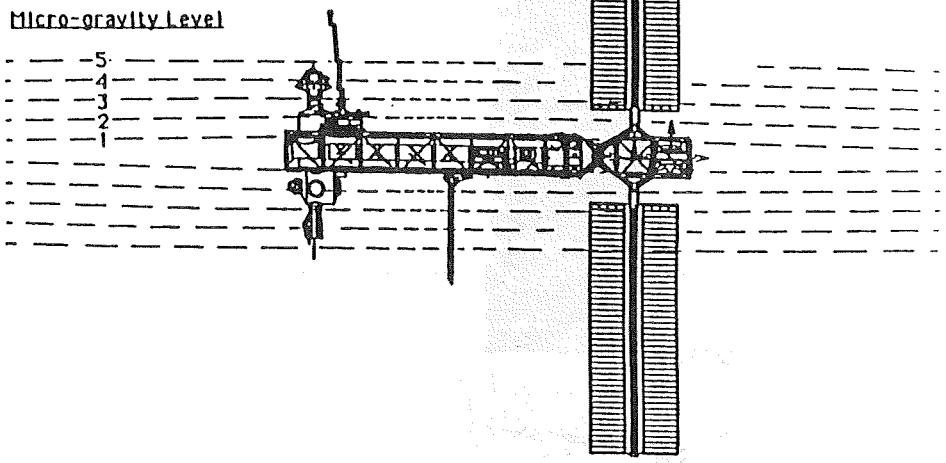
FREEDOM



MTC Configuration Meets US User Microgravity Requirements



Shuttle-Tended



Free-Flyer

Microgravity Science Community Helped Drive Restructuring Changes

Pre-Integration Simplifies On-Orbit Assembly Planning and Operations

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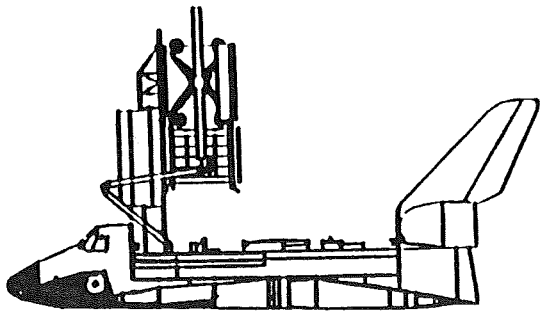
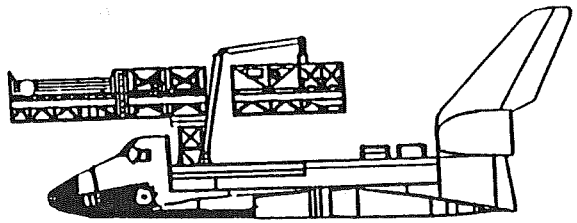
FREEDOM

- Simplifies On-orbit Assembly Planning and Operations
- Reduces EVA Time 50%
- Eliminates Costly Training
- Maximizes Ground Testing and Verification

	1990	1991
		
	Erectable Truss Assembly (Beginning of MB-2)	Pre-Integrated Truss (Beginning of MB-2)
• Assembly Elements to Manifest External Structure	128	20
• Assembly Elements to Outfit Module Pattern	69	13

Capability in 1999 Supports Life Sciences

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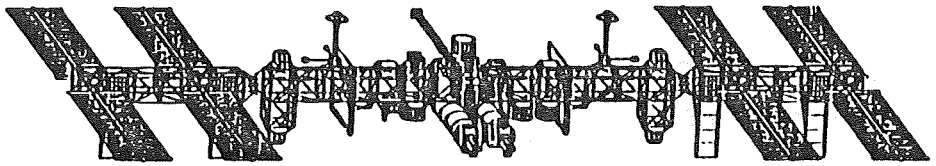
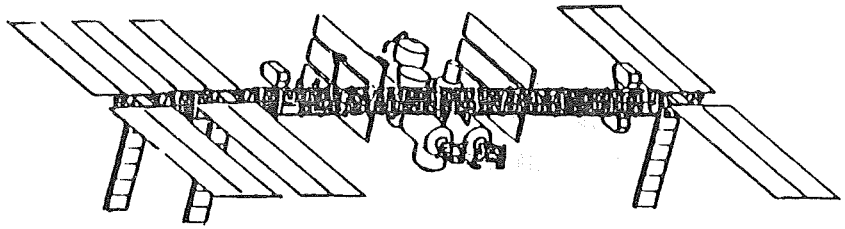
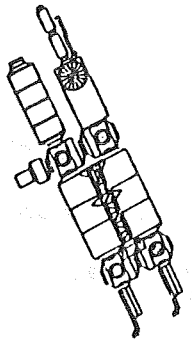
FREEDOM





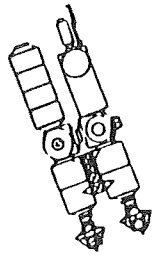
1990

- Assembly Complete Configuration
- 4 Power Modules (30 kW to User Power)
- 44' Lab Module (24 User Racks)
- 44' Hab Module (Crew of 8)
- Partner Modules (16 User Racks)
- 4 Nodes
- Closed Module Pattern
- 300 Mbps Downlink
- 20 Rack Logistics Module



1991

- Permanently Manned Configuration
- 3 Power Modules (30 kW to User Power)
- 27' Lab Module (12 User Racks)
- 27' Hab Module (Crew of 4)
- Partner Modules (16 User Racks)
- 2 Nodes
- Open Module Pattern
- 50 Mbps Downlink
- 20 Rack Logistics Module (Deferred)
  8 Rack Logistics Module
- Capability to Grow to Crew of 8, 75 kW
- Accommodates an ACRV



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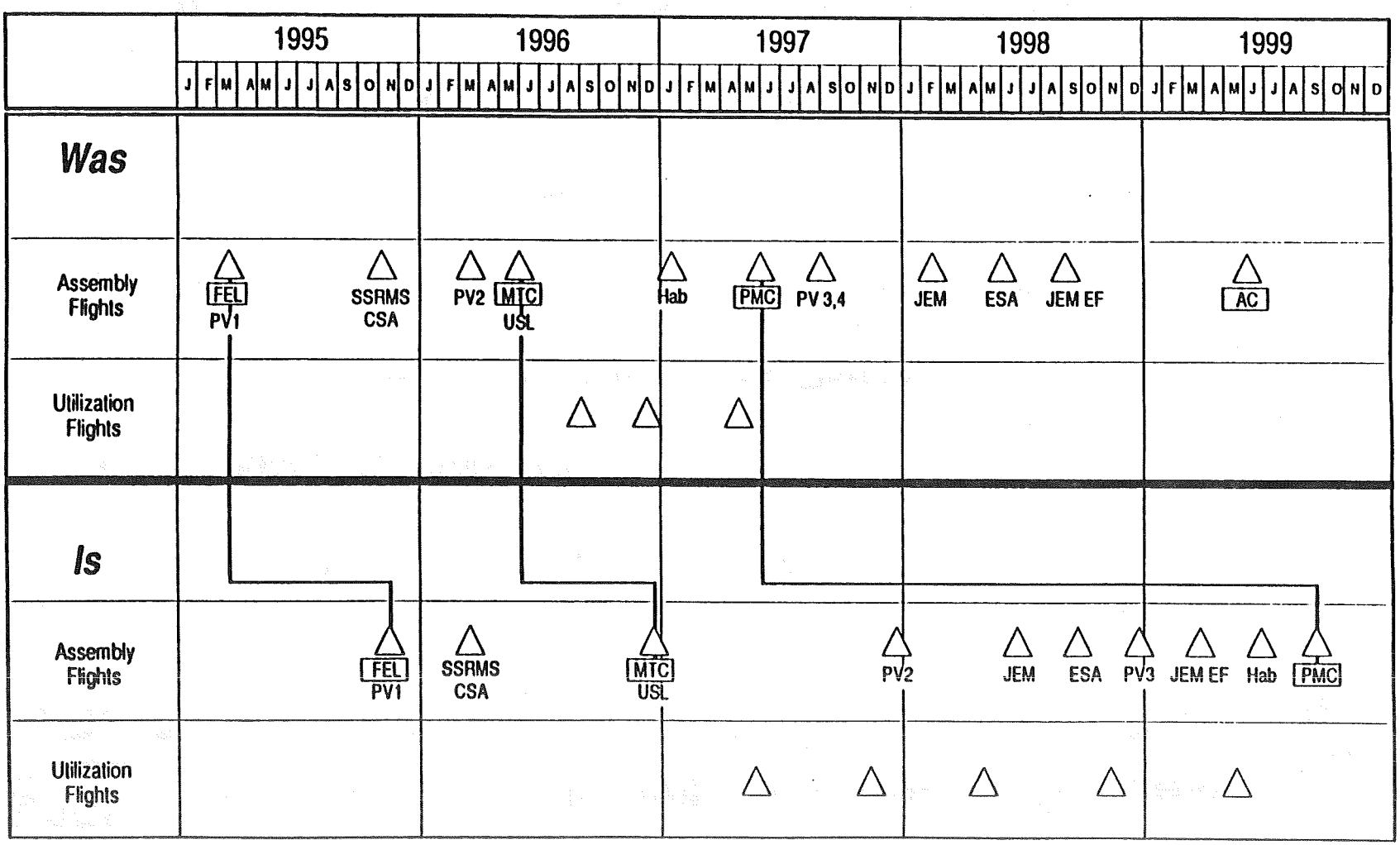
Program Milestones Phased to Meet Restructured Objectives

FREEDOM



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Restructuring Activity Has Been a Success

FREEDOM

- Balanced Program Meets Budget Through PMC
- Reduced Size and Complexity of Station
- Reduced Assembly Risk
- Minimized Impacts to International Partners
- Increased Ground Integration of Truss and Modules
- Increased Ground Based Test and Verification
- Reduced Demands on Transportation System
- Reduced On-Orbit Assembly and Checkout Requirements

THE NASA/Contractor Team is Behind the Restructured Program and Ready to Go

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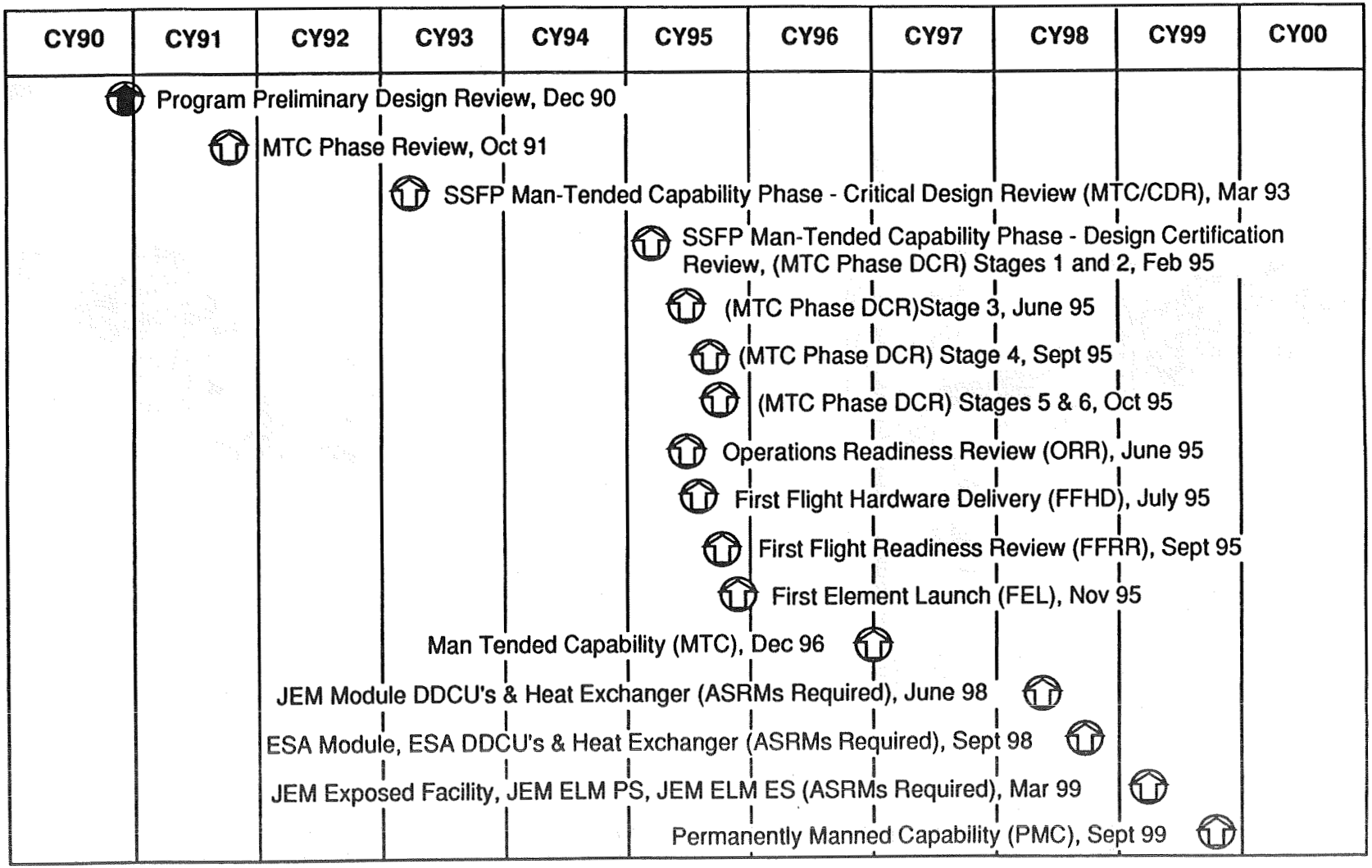
Space Station Freedom Program
Program Milestones

FREEDOM

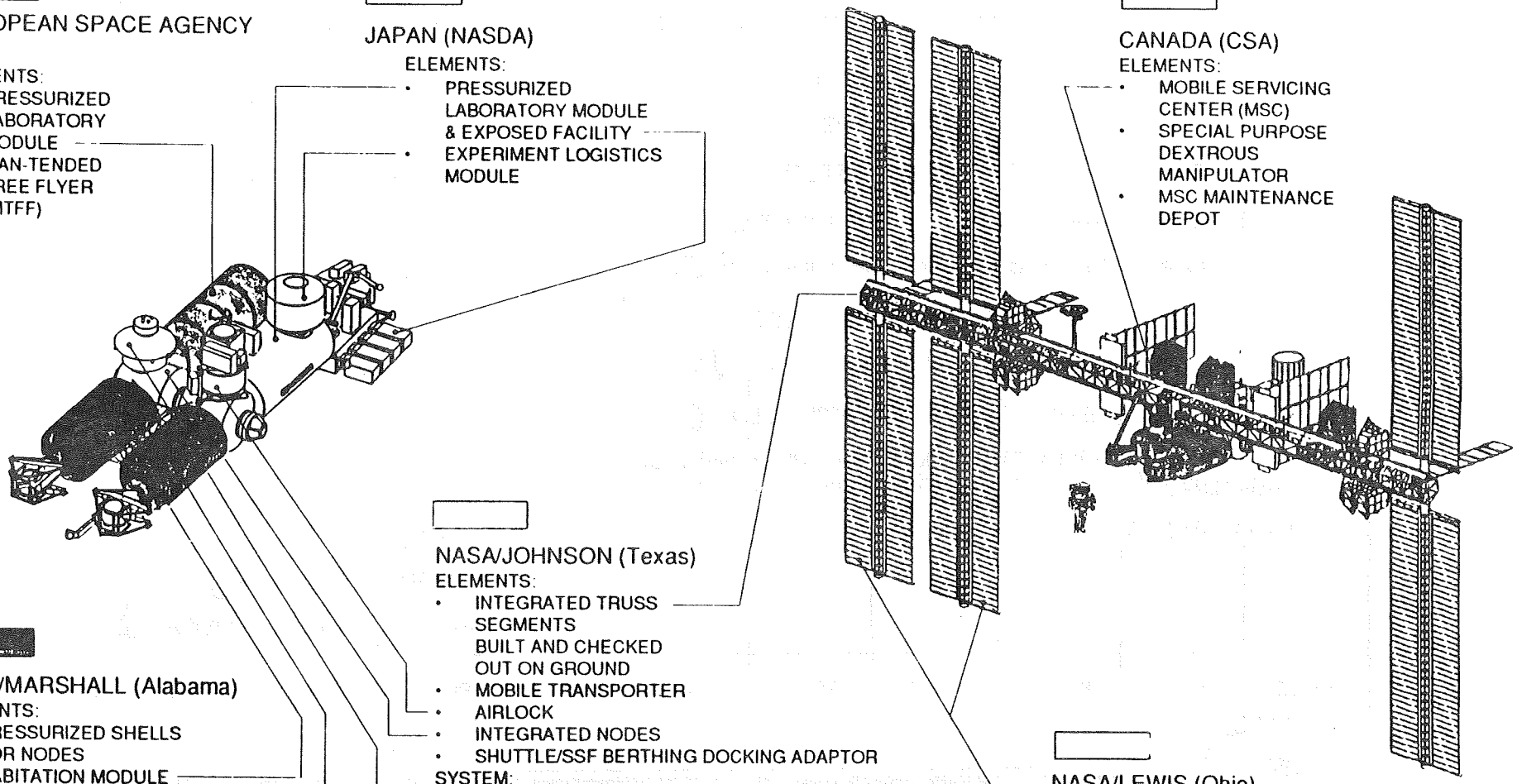


Station Freedom
Permanently Manned Configuration

EUROPEAN SPACE AGENCY (ESA)
ELEMENTS:
- PRESSURIZED LABORATORY MODULE
- MAN-TENDED FREE FLYER (MTFF)

JAPAN (NASDA)
ELEMENTS:
- PRESSURIZED LABORATORY MODULE & EXPOSED FACILITY
- EXPERIMENT LOGISTICS MODULE

CANADA (CSA)
ELEMENTS:
- MOBILE SERVICING CENTER (MSC)
- SPECIAL PURPOSE DEXTROUS MANIPULATOR
- MSC MAINTENANCE DEPOT



NASA/JOHNSON (Texas)
ELEMENTS:
- INTEGRATED TRUSS SEGMENTS BUILT AND CHECKED OUT ON GROUND
- MOBILE TRANSPORTER
- AIRLOCK
- INTEGRATED NODES
- SHUTTLE/SSF BERTHING DOCKING ADAPTOR

SYSTEM:
- EXTERNAL THERMAL CONTROL
- EVA SUPPORT EQUIPMENT
- DATA MANAGEMENT
- COMMUNICATIONS & TRACKING
- GUIDANCE, NAVIGATION & CONTROL
- PROPULSION
- ASSURED CREW RETURN VEHICLE

NASA/MARSHALL (Alabama)
ELEMENTS:
- PRESSURIZED SHELLS FOR NODES
- HABITATION MODULE
- LABORATORY MODULE
- LOGISTICS MODULES (PRESS & UNPRESS)

SYSTEM:
- ECLSS
- INTERNAL THERMAL CONTROL
- INTERNAL AUDIO & VIDEO
- MAN SYSTEMS EQUIPMENT

NASA/LEWIS (Ohio)
ELEMENTS:
- POWER MODULES - PV

SYSTEM:
- ELECTRICAL POWER SYSTEM

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Space Station Freedom: Reasons Why

- Advance space science applications
- Explore the universe
- Preserve our planet
- Promote international cooperation
- Expand man's presence into the solar system
- Establish commercial opportunities
- Advance our nation's civil space program

The Logical Next Step