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# ADVANCED STUDIES PROGRAM OVERVIEW

SPACE STATION EVOLUTION BEYOND THE BASELINE - 1991

**AUGUST 7, 1991** 

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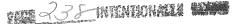
Peter R. Ahlf NASA HQ Space Station Engineering

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## **OBJECTIVES**

- Develop evolution requirements & feasible evolution paths
- Identify design provisions that enable evolution of baseline systems
- Identify technologies that enable/enhance operations and evolution
- Perform early programmatic planning for development programs beyond the baseline
- Include international partner participation in evolution



# **APPROACH**

- Evolution responsibility assigned to Level I, Space Station Engineering
- LaRC provides technical oversight and integration
- Evolution Working Group established to provide support from work packages and field centers
- Studies program provides primary interface between SSF and other agency advanced programs such as Space Exploration Initiative
- International Evolution Working Group provides forum for participation by the international partners (MOU agreement)

NASA

FREEDOM



# LEVEL 1 ENGINEERING ORGANIZATION

Space Station Freedom Office (LaRC)

Space Station Engineering (MT)

Configuration Management Office (MT-1)

- Advanced Systems Studies
- Level I System Engineering and Analysis Support

- Level I Configuration Management Support
- MIC/VITS Support

System Engineering and Analysis (MTE)

- Systems Req., Anal. & Definition
- Systems Engr. Studies
- Tech.Assessment of Change Requests
- Independent Assess. of Flight & Ground Systems Performance

System
Development
(MTD)

- Req'ts Implem. Oversight
- Budget, Schedule, & Content
- Oversight and Assessment
- Development Status Reporting
- Development Assess.
- Level I TMIS Support

Advanced Programs (MTE)

- Advanced Planning
- Advanced System Studies
- Technology Req'ts Definition & Assess.
- Advanced Dev.
- · Commercial Dev.
- International Evolution

Space Station Engineering

- Advanced Studies Program-

MAGA

FREEDOM



# ADVANCED STUDIES PROGRAM ORGANIZATION

### **NASA HQ**

- Management & Budget
- Interface w/related programs

# INTERNATIONAL EVOLUTION WORKING GROUP

- MOU Created
- · U.S., ESA, NASDA, & CSA

### **NASA LaRC**

- Technical Oversight, Integration,
   & Analysis
  - Chairs the Evolution Working Group
    - Configuration & Concept Development

# EVOLUTION WORKING GROUP

- Independent Advisory Group
- KSC, JSC, LeRC, ARC, MSFC, JPL, GSFC, and SSFPO

KSC

JSC

LeRC

ARC

MSFC

Space Station Engineering

Advanced Studies Program-

MSA

- FREEDOM



# NASA CENTER SUPPORT AREAS

NASA KSC

• Assembly & Processing Operations

**NASA LeRC** 

- Electrical Power System Evolution
- Cryogenic Operations

• DMS Evolution

**NASA LaRC** 

Technical Integration

**NASA JSC** 

- Distributed Systems Evolution Analysis
  - Crew Operations

**NASA MSFC** 

 Modules / Internal Systems Evolution

Space Station Engineering

- Advanced Studies Program



# **WORK BREAKDOWN**

# TASK AREAS Long Term Utilization

Distributed Systems Evolution

**Concepts and Configurations** 

**Operations Feasibility** 

# **PRODUCTS**

**Level 1 Growth Requirements** 

**Reference Growth Paths** 

**Technology Requirements** 

**Early Programmatic Planning** 

Space Station Engineering

Advanced Studies Program

NASA





# SPACE STATION FREEDOM PROGRAM PHASES



Long Term Utilization

**Distributed Systems Evolution** 

Operations Feasibility

\* Enhanced Operating Capability based on SSF Continued Development Plan



Space Station Engineering

- Advanced Studies Program-

SEI Life Sciences/Tech

**Verification Ops** 

Space Station Engineering

FREEDON MSA **BUTED SYSTEMS EVOLUTION** CTCS, 2-ø NH3 Loop ITCS, 1-ø H2O TASK AREAS Long Term Utilization 2-ø Distributed Systems Evolution Liquid Operations Feasibility Concepts and Configurations Growth Trunk Line Load Liquid Liquid A Heat Load TRRJ Cavitating Venturi Growth Liquid Liquid Trunk Line Vapor Vapor Variable Pump Evaporator Loop BPRV Compressor Condenser Loop / Vapor Compression Cycle

Advanced Studies Program

MSA

FREEDOM

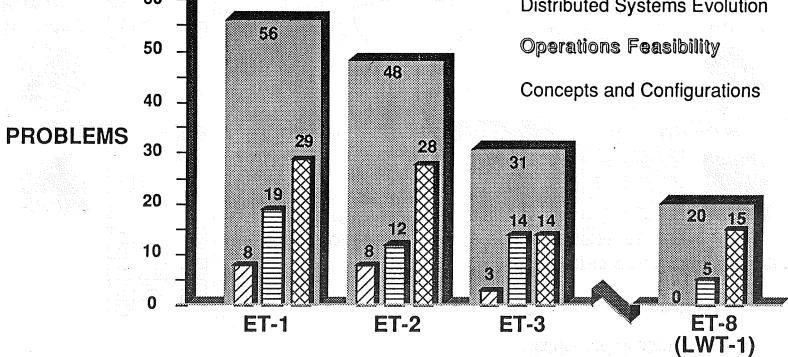


# SHUTTLE ET MATING ANALOGY TO ON-ORBIT TANK MATING



Long Term Utilization

**Distributed Systems Evolution** 



CATEGORY 1 = REQUIRES REPLACEMENT HARDWARE FROM EARTH

CATEGORY 2 = REPAIR RESULTING IN ON-ORBIT SCHEDULE IMPACT

**CATEGORY 3 = NOT LIKELY TO CAUSE A SIGNIFICANT ON-ORBIT PROBLEM** 

Space Station Engineering

Advanced Studies Program

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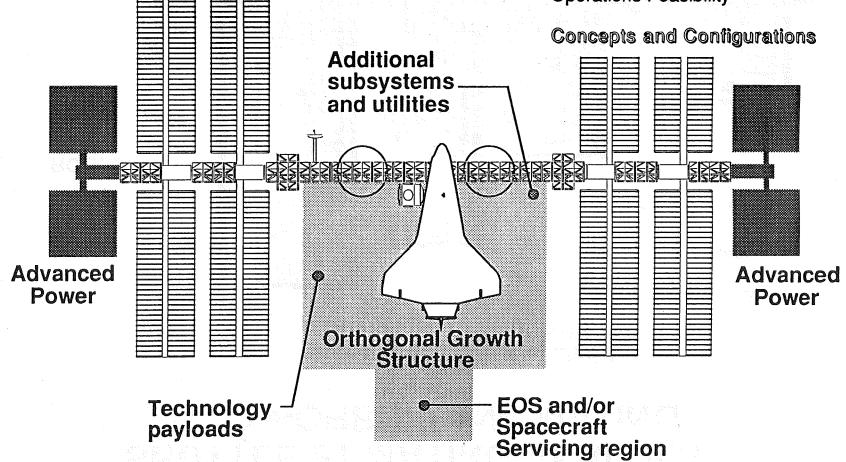


# REFERENCE GROWTH CONCEPT

TASK AREAS
Long Term Utilization

**Distributed Systems Evolution** 

**Operations Feasibility** 



Space Station Engineering

Advanced Studies Program-

MSA

- FREEDOM



# **TECHNOLOGY ASSESSMENT PROCESS**

**Space Station Evolution Requirements Definition** 

FY 86 - 89 Advanced Systems Studies Continued Development Plan

FY90 Advanced Studies

Preliminary Evolution Requirements

Detailed Evolution Requirements

**Technology Identification** 

Technology for Space Station Evolution Conference

Advanced Studies Reports

Lots of Good Ideas

EWG Technology
Requirements
Team
Assessment

Focused Technology Needs

Space Station Engineering

- Advanced Studies Program

# **TECHNOLOGY DRIVERS**

Supports expanded Research & Development utilization

Supports Space Exploration Initiative utilization

Enhances crew safety / productivity

Reduces operations cost



# SSF TECHNOLOGY PRIORITIES

- Vehicle Health Management
- Crew Training Systems
- Advanced Heat Rejection
- High Efficiency Space Power Systems
- Water Recovery & Management
- Robotics
- Advanced Extravehicular Mobility Unit
- Orbital Debris Protection
- Advanced Avionics Architectures

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# **ACCOMPLISHMENTS**

- Created a Continued Development Plan for Space Station Freedom
- Evaluated growth capability and limitations of the baseline design to a detailed subsystem level
- Developed and baselined evolution requirements in the Program Requirements Document
- Developed technology requirements for long term Space Station Freedom utilization

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# **NEAR TERM DIRECTION**

Document a reference growth concept

Advocate and implement critical scars in the baseline design

Lay the groundwork for on-time technology availability

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