



**OPERATIONS AND  
UTILIZATION  
DIVISION**

# Space Station Freedom Baseline Operations Concept

**Presentation to the Evolution Symposium  
6-8 August 1991**

**Granville Paules  
Space Station Freedom Program  
Operations Integration Branch  
NASA Headquarters**

349

PRECEDING PAGE BLANK NOT FILMED

*N 4452481*

*N 92-17410*

*P-17*

*5-18*

... ..  
... ..  
... ..  
... ..

... ..  
... ..  
... ..

... ..  
... ..  
... ..



... ..  
... ..  
... ..



## FUNDAMENTAL MANNED BASE OPERATIONS REQUIREMENTS

OPERATIONS AND  
UTILIZATION  
DIVISION

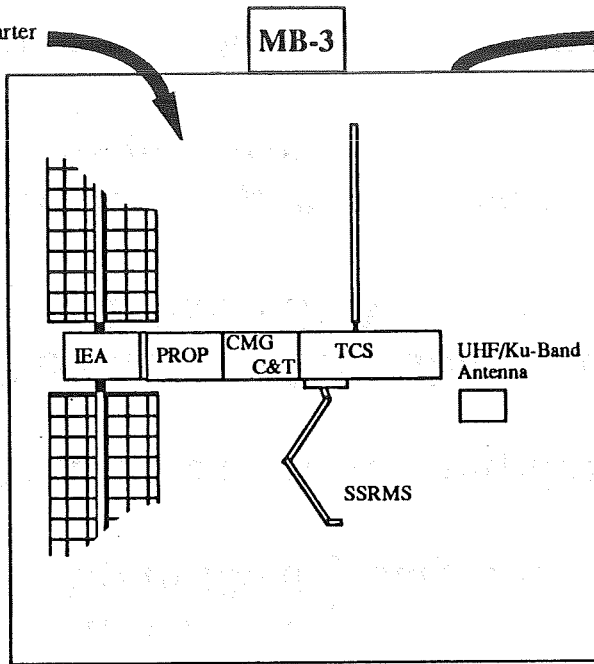
- Assemble using the Shuttle
  - Assemble in components with each stage left in a safe configuration
  - EVA required (but minimized)
- Conduct Utilization at earliest practical opportunity during Assembly
  - Operate and utilize man-tended for several visits
- Permanently man when Assured Crew Return Capability exists
  - Initially four crew, growing to eight as program allows
  - Up to 180 day stay times
- Minimize crew time required for routine system operations and housekeeping
- Provide on-orbit maintenance
  - minimize EVA
- Provide long term logistics and utilization support with four Shuttle visits per year
- Plan for a 30 year operational-life

351

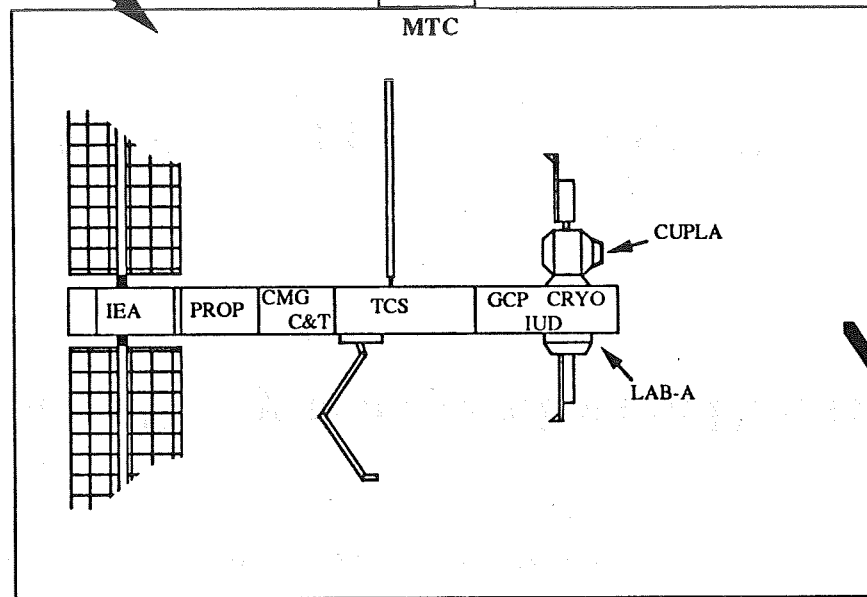
PRECEDING PAGE BLANK NOT FILMED

# Representative Assembly Configurations

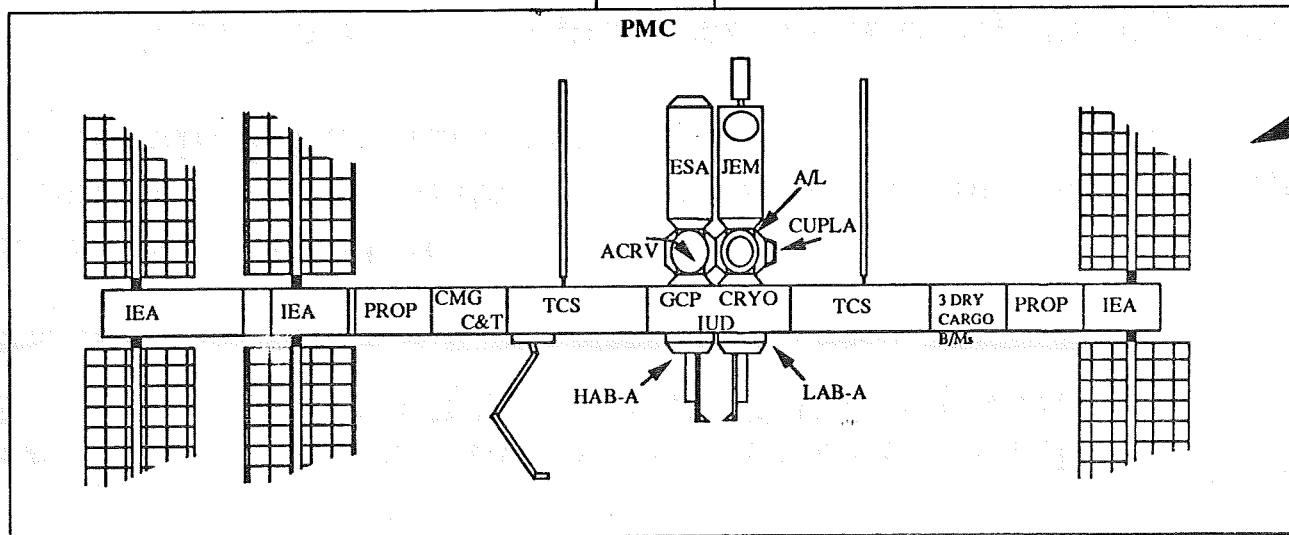
**MB-1** 2nd Quarter 1996  
FEL



**MB-6** 3rd Quarter 1997  
MTC



**MB-17** FY 2000



10 Mission Build Flights  
8 Utilization/Logistics Flights

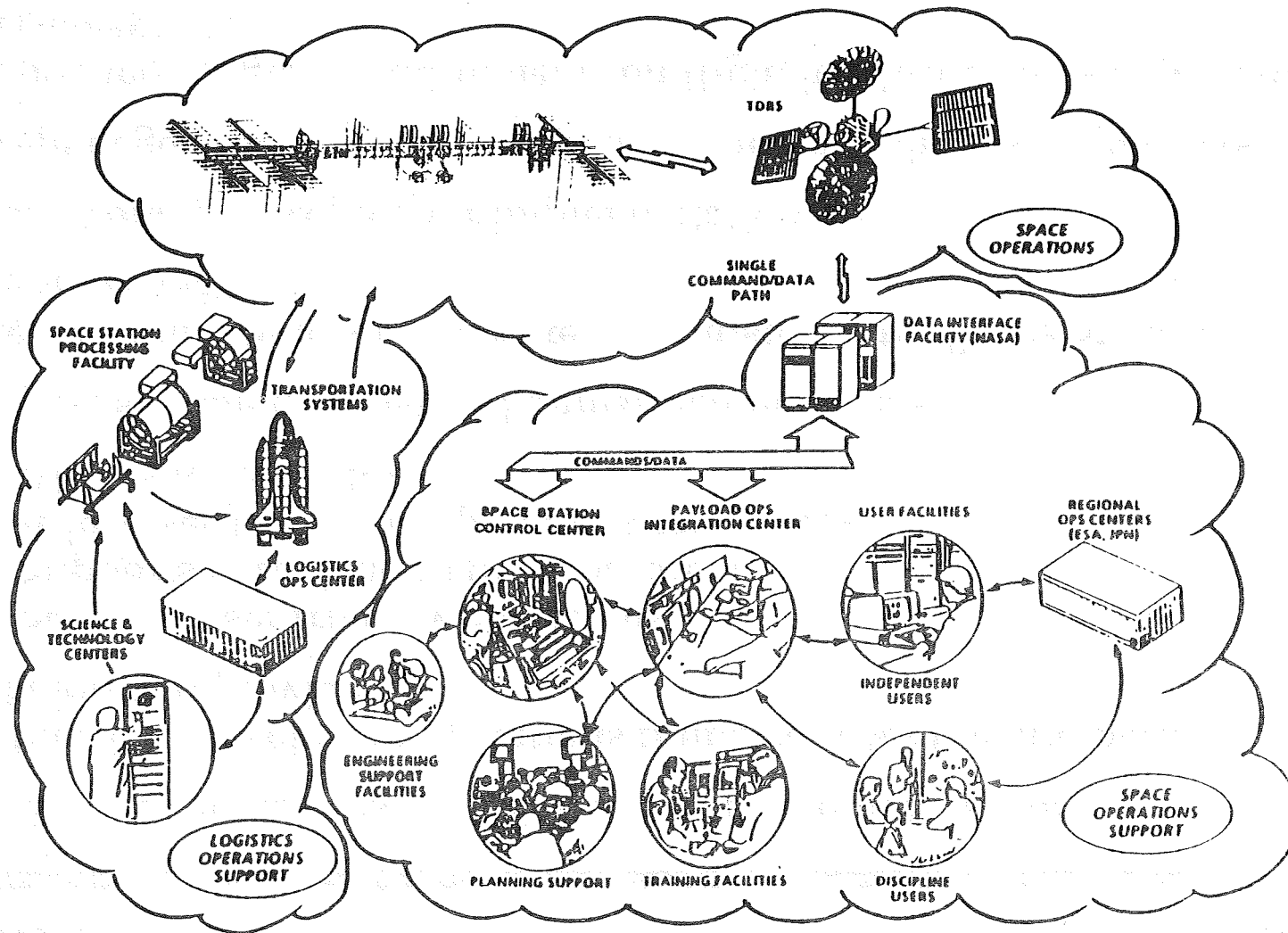


## OPERATIONS CONCEPT DEVELOPMENT

OPERATIONS AND  
UTILIZATION  
DIVISION

- **Space Station Operations Task Force established in Fall 1986**
  - **Objective: Develop an operations framework for the international Space Station that provides:**
    - **Safe and user friendly operations**
    - **Supports participation of all partners**
    - **Addresses long-term operations cost issues**
    - **Allows for evolution**
  - **Expertise from manned and unmanned programs**
  - **Recommendations to Associate Administrator for Space Station in Summer 1987**
  - **Basic concept accepted for implementation**
- **Concept negotiated into Memoranda of Understanding with partners**
- **Documented Program requirements on flight hardware and software to meet concept**
- **Ground Systems Program Directive put ground infrastructure in place in May 1989**

# MANNED BASE OPERATIONS INFRASTRUCTURE



354



## INTERNATIONAL PARTNER AGREEMENT

OPERATIONS AND  
UTILIZATION  
DIVISION

---

- All partners provide flight hardware and supporting ground elements
  - Exchange of partner element user space for U.S. provided resources such as power
- All partners participate in management of station
  - Manned base operated as an integrated unit
  - Free-flying elements operated more autonomously
- All partners provide crew
- All partners share operating costs



## OPERATIONS MANAGEMENT

## OPERATIONS AND UTILIZATION DIVISION

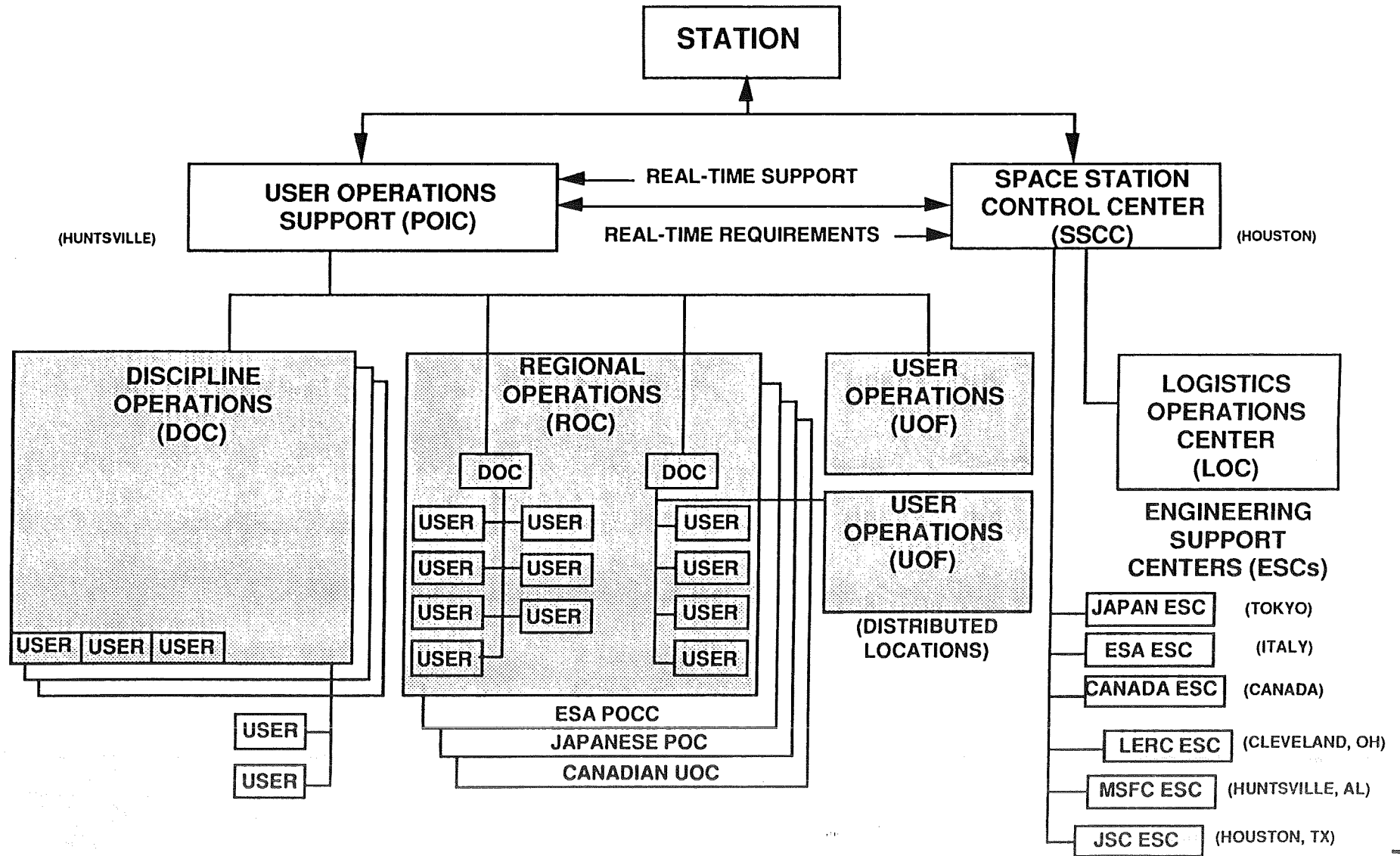
- **Space Station Freedom is managed and operated as an integrated on-orbit facility**
  - **Focused systems operations**
  - **Focused integration of user operations**
  - **Crew members work as team with assignments throughout Station**
  
- **Management and implementation is hierarchical**
  - **Strategic (Policy) planning with 5-year horizon**
    - **Long term planning issues**
  - **Tactical (Integration) planning with 2-year horizon**
    - **Coordination across functions and operations centers**
  - **Execution planning and implementation**
    - **Detailed plans, real-time operations execution**





# SPACE STATION OPERATIONS EXECUTION

## OPERATIONS AND UTILIZATION DIVISION



357



## Space Operations

- All activities conducted on-board the Space Station Freedom manned base
  - Systems reconfiguration, monitoring, and control
  - Payload operations, monitoring, and control
  - On-board planning and replanning
  - Systems and payload maintenance and repair
  - Proximity operations
  - Communication with systems and payload controllers and users
  - Habitation activities



## Space Operations Support

- **Systems planning, monitoring, and control by the Space Station Control Center (SSCC) at JSC**
  - **SSCC has prime responsibility for safety of the crew and integrity of the manned base**
  - **Supported by Engineering Support Centers (ESC) at all development sites**
  - **Systems training to be accomplished primarily at the Space Station Training Facility (SSTF) at JSC**
    - **Additional training available at the international partner's training centers**
  - **Systems and payload activities integrated into common timelines**



## Space Operations Support (cont.)

- User operations planning, monitoring, and control integrated at the Payload Operations Integration Center (POIC) at MSFC
  - Support to users located at user-developed operations centers, Discipline Operations Centers (DOC), Regional Operations Centers (ROC), and User Operations Facilities (UOF)
    - Flexible architecture to expand with the needs of the user community
  - User operations planning is distributed, then integrated by POIC
  - User decision-making body is the Investigator Working Group (IWG)
  - Support to user commanding is transparent to the user
    - Enable telescience while ensuring all commands are safe
  - Payload Training Center (PTC) at MSFC provides integrated payload training capability



Logistics/Ground Operations Support

- Prime center of responsibility is KSC
  - Common logistics support for all programs at KSC being considered
- Space Station Processing Facility (SSPF) provides for physical integration:
  - Payloads-to-racks
  - Racks-to Logistics Modules
  - Logistics Modules and other flight hardware into Shuttle cargo elements
  - Logistics Module Maintenance
- Preflight integration of payload racks enabled at Payload Integration Center, domestic or international
- Logistics Support Analyses during DDT&E is basis for logistics requirements for spares, reliability, and maintenance
- Initial logistics operations support by the developer
  - KSC integrates resupply and sparing requirements
  - Logistics Operations Center at KSC after PMC
- Initial logistics information available via:
  - Distributed logistics databases at developer
  - Integrated Logistics Information Systems after PMC
- Logistics Module load planning using optimizing techniques



## Current Approach & Future Opportunities

**OPERATIONS AND  
UTILIZATION  
DIVISION**

<b>Management &amp; Integration</b>	<b>Current Approach</b>	<b>Expert Systems/ Analytical Tools</b>	<b>Advance Information Systems</b>
<b>Program Management - Decision Support Systems</b>			
<b>Manifest Planning Systems</b>			
<b>Analytical Integration Support Tools (Systems &amp; Payloads)</b>			
<b>Increment Plans Management - Decision Support Systems</b>			

362



## Current Approach & Future Opportunities

**OPERATIONS AND  
UTILIZATION  
DIVISION**

<b>Space Operations</b>	<b>Current Approach</b>	<b>Expert Systems/ Analytical Tools</b>	<b>Telescience/ Teleoperations</b>	<b>Advance Info. &amp; Communications Systems</b>	<b>Robotics</b>
<b>Space Systems Operations</b> - Systems Reconfiguration & Load Management - Contingency Management - Equipment Operation					
<b>Payload Operations</b> - Experiment Execution - Resource Allocation - Conflict Resolution					
<b>Maintenance Operations (EVA / IVA)</b> - Diagnostic and Maintenance Procedures - Repair/Replace/Reverification					
<b>Crew Health Care &amp; Medical            Operations</b>					
<b>Crew Workload Scheduling</b>					

363



## Current Approach & Future Opportunities

## OPERATIONS AND UTILIZATION DIVISION

<b>Space Operations Support</b>	Current Approach	Expert Systems/ Analytical Tools	Telescience/ Teleoperations	Advance Info. & Comm. Systems	Robotics
<b>Integrated Schedule Development - Systems/Payloads/Resources</b>					
<b>Systems Performance Assessment &amp; Diagnostic Support - Sustaining Engineering</b>					
<b>Flight Software &amp; Hardware Configuration Management</b>					
<b>Communication Systems Management - Resource Allocation - Scheduling</b>					
<b>Flight Techniques Development - Training Techniques - Training Equipment &amp; Systems</b>					
<b>Trajectory Control</b>					
<b>Station/Shuttle Operations - Proximity Operations Management - Joint Activity Management</b>					





# Current Approach & Future Opportunities

**OPERATIONS AND  
UTILIZATION  
DIVISION**

Logistics/Ground Operations Support	Current Approach	Expert Systems/ Analytical Tools	Advance Information & Communications Systems	Robotics
Transportation Services				
Cargo Element Ground Processing - Procedures - Equipment				
Payload Physical Integration				
Prelaunch Acceptance Testing				
Logistics Module Processing - Load Planning/Module Reconfiguration - Module Cleaning				
Integrated Spares Inventory - Stock Management				
Ground Maintenance of Spares				<b>15</b>



## SUMMARY

OPERATIONS AND  
UTILIZATION  
DIVISION

---

- **The Baseline Operations Concept is designed to support the multiflight-multistage Assembly Sequence and the Post-PMC era**
- **Initial implementation of procedures and systems to support the concept are consistent with Shuttle and Spacelab experience**
- **Many opportunities exist to enhance the approaches initially being implemented**
- **Further insight during the Program's development phase and during early operations will help select and focus potential evolutionary paths**