Evolving EVA System Capability for the Evolving Space Station Freedom Requirements

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EVOLVING EVA SYSTEM CAPABILITY FOR THE EVOLVING SPACE STATION FREEDOM (SSF) REQUIREMENTS

INTRODUCTION

- **SSF capability phased over the next 35 years**
  - First Element launch 1995
  - Manned tended capability 6/1996
  - Permanent manned capability (PMC) 7/1997
  - Assembly complete 7/1999
  - Phase 2 operation: 2001 and beyond
  - Transportation node: 2010 and beyond?
  - Design life 30 years - out to ~2025

- **The expanding SSF capability requires expanding EVA (manned activities) and telerobotic operations**
  - NASA is in the process of defining approach to phased capability
  - Present planning emphasis is on phasing of manned EVA
  - EVA and telerobotics must be balanced

PRE-SCRUB '89 BASELINE

- NSTS EMU for assembly
- Up to 156 EVAs/year (3 per week) at PMC
- Up to 250 EVAs/year (~5 per week) for growth
- 2 Airlocks with capability to support two 2-man EVA crews
- Heavy use of telerobotics where cost effective

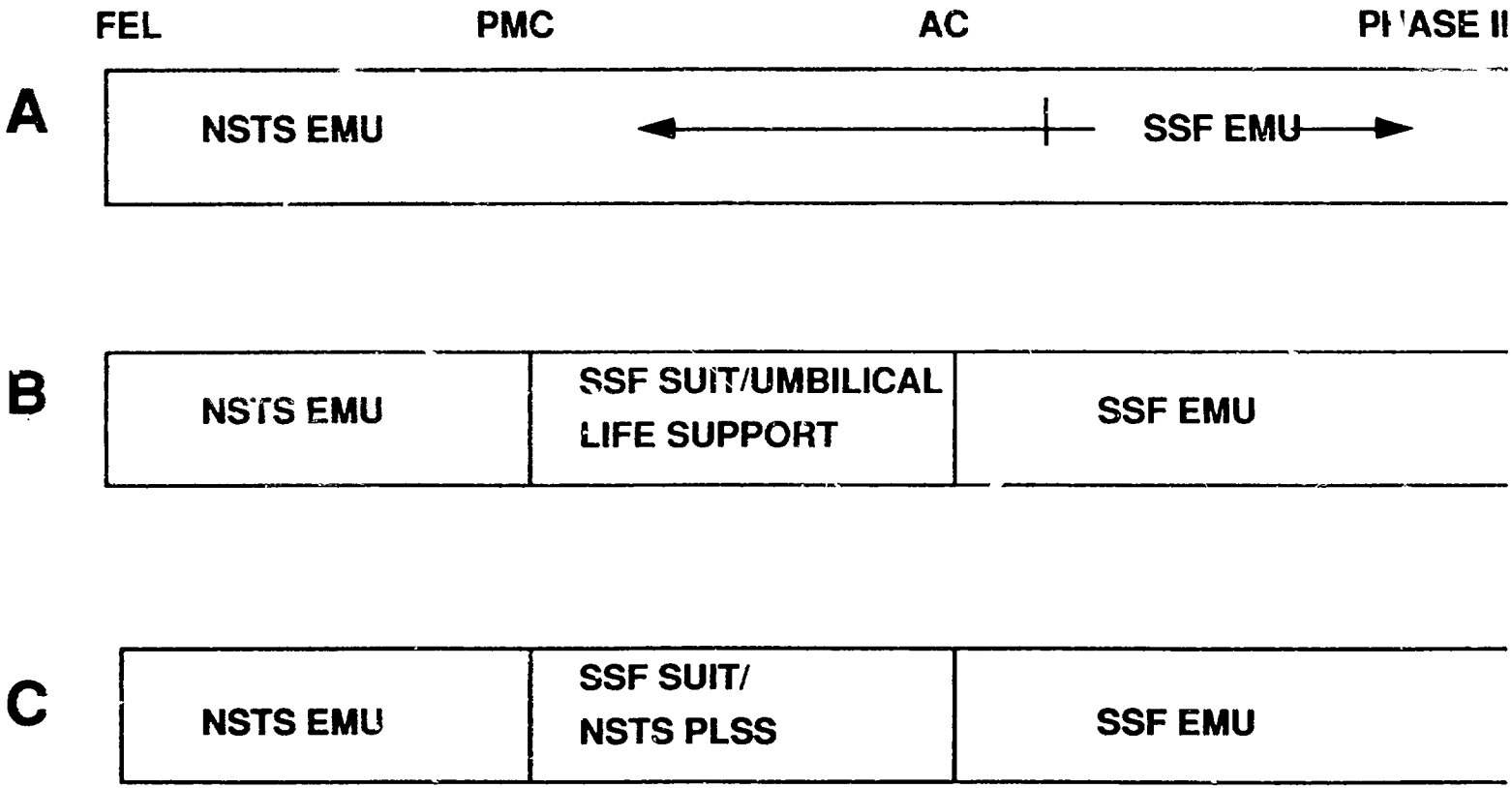
APPROACH SHIFT RESULTING FROM SCRUB '89

- Reduce program front end EVA costs
- Maximize telerobotics capability with target being 100%. EVA as contingency only. One SSF Airlock only
- Allocated EVA time per year 40 to 80 man hours
- Convergence of EVA demand and EVA allocation still in question for Phase I space station
- EVA demand for SSF outyears anticipated to be high
  - Transportation node
  - Increased maintenance, upgrades
  - Consideration of Phase II users?
- NASA assessing various EVA options to meet SSF growth

CONSIDERATIONS FOR ALTERNATIVE SELECTION

- Low front end cost
- Life cycle costs
  - — Dependent on number of EVAs
- Minimize dead-ended costs
- EVA productivity
  - — Prebreathe time
  - — Suit comfort - gloves
  - — Eliminate prebreathe as soon as feasible
- 100% telerobotics use probably not possible nor cost effective

EVA SUPPLY OPTIONS



KEY TECHNOLOGIES FOR EVOLUTION OF EVA SYSTEM LIFE SUPPORT

TECHNOLOGY	APPLICATION	CHARACTERISTICS	BENEFIT
HFM	Selective removal of CO_2 / H_2O from vent loop	No power, low volume No moving parts, venting	Low life cycle $
Metal Oxides	Selective removal of CO_2 from vent loop	Regenerable, closed loop	Low life cycle $
Metal Hydrides	Heat rejection for EVA	Low volume, venting, Regenerable	Low life cycle $, Less contamination
High Pressure Glove	Zero prebreathe suit	Dexterous, low torque	Low IV overhead, EVA productivity
Rotary Coupling	Fluid and electrical connections for umbilical EVA reel	Low leakage, high cycle, Low torque	Facilitate Umbilical Management
Fuel Cell	EMU power supply	Regenerable, closed loop, High current density	Low life cycle $