OSSA SPACE STATION FREEDOM SCIENCE UTILIZATION PLANS

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ABSTRACT

Long duration exposure to an essentially zero-gravity environment is a phenomenon exclusive to the Space Station Freedom that cannot be duplicated on Earth. The Freedom Station will offer periods of time on orbit extending to weeks and months rather than hours or days, allowing for in-depth space-based research and analysis to a degree never before achieved. OSSA remains committed to exploiting the unique capabilities provided by the Space Station as well as other space-based facilities to study the nature of physical, chemical, and biological processes in a low-gravity environment and to apply these studies to advance science and applications in such fields as biomedical research, plant and animal physiology, exobiology, biotechnology, materials science, fluid physics, and combustion science. The OSSA focus is on progressive science investigations, many requiring hands-on scientist involvement using sophisticated experiment hardware. OSSA science utilization planning for the Freedom Station is firmly established. For this presentation, this planning is discussed in three general areas: OSSA goals and overall approach, the current and on-going program, and plans for space station utilization. In the first area, OSSA addresses its overall approach to space science research, its commitment to transition to Space Station Freedom, and its top-level strategy for the utilization of Freedom. The current and on-going program is next discussed, focusing on the various Spacelab series of missions which are providing the stepping-stones to Space Station Freedom. Selected science results from SLS-I and USML-1 are cited which underline the value of properly outfitted laboratories in space in which crew-intensive experiment interactions are possible. The presentation is concluded with a discussion of top-level goals and strategies for utilizing the Freedom Station by OSSA’s Life Sciences Division and its Microgravity Science and Applications Division.
OFFICE OF SPACE SCIENCE AND APPLICATIONS GOALS

- To advance scientific knowledge of the planet Earth, the solar system and the universe
- To use the unique vantage point and environment of space to study the universe, to understand the factors that influence our planet's environment, and to solve practical problems on Earth
- To expand the human presence beyond the Earth into the solar system
EVOLVING U.S. SPACE SCIENCE CAPABILITIES

SOUNDOCK ROCKETS AND BALLOONS
- ASTRONOMY
- PLASMA PHYSICS

FREE FLYING OBSERVATORIES
- ASTRONOMY
- PLASMA PHYSICS
- PLANETARY

SKYLAB
- ASTRONOMY
- LIFE AND MATERIALS SCIENCES

SPACE LAB
- LIFE AND MATERIALS SCIENCES
- OBSERVING SCIENCES

SPACE STATION
- LIFE SCIENCES
- MICROGRAVITY SCIENCES
- ATTACHED PAYLOADS

1940s 1950s 1960s 1970s 1980s 1990s 2000s 2010s

N A S A

TRANSITION TO SPACE STATION

BEGINNING WITH SPACELAB AND OTHER IN-SPACE FACILITIES, WE ARE MOVING AGGRESSIVELY, BUT SENSIBLY, TO DEVELOP THE PRINCIPAL AREAS OF SPACE SCIENCE AND APPLICATIONS THAT WILL TAKE ADVANTAGE OF UNIQUE FREEDOM STATION OPPORTUNITIES, FOR MICROGRAVITY SCIENCE AND LIFE SCIENCES RESEARCH IN PRESSURIZED LABORATORIES

OSSA STRATEGIC PLAN 1991
OSSA STRATEGY

• PLAN UTILIZATION TO SUPPORT PREPARATION FOR HUMAN EXPLORATION
• EMPHASIZE PRESSURIZED VOLUME UTILIZATION
  – Life Sciences
  – Microgravity Science and Applications
• TRANSITION SENSIBLY FROM SPACELAB TO SPACE STATION
• ENSURE A RANGE OF UTILIZATION OPTIONS
  – Facility-Class Payloads
  – Middeck and Drawer-Class Payloads
  – Small and Rapid Response Payloads
  – Attached (Observational) Payloads
• SOLICIT FIRST-CLASS SCIENCE
  – Planned AOIs and NRAIs
  – International Collaborations
• INTEGRATE THE INTERESTS OF THE U.S. SCIENCE COMMUNITY

THE CURRENT PROGRAM

OSSA IS LAYING THE FOUNDATION FOR SPACE STATION FREEDOM WITH ITS SPACELAB SERIES OF MISSIONS

SLS - Spacelab Life Sciences missions dedicated to human, animal, plant, and cell research

USML - US Microgravity Laboratory missions dedicated to materials, fluids, and combustion research

IML - International Microgravity Laboratory missions which emphasize international cooperation in microgravity research
SOME RECENT SCIENCE RESULTS

SLS-1
• RAPID TRANSITION IN MUSCLE ACTIVITY AWAY FROM MUSCLES THAT CONTROL WALKING AND POSTURE
• SHIFTS IN MUSCLE NUTRIENT USAGE TO MORE CARBOHYDRATES AND LESS FAT
• IMPAIRMENT OF BLOOD PRESSURE REGULATORY MECHANISMS
• UNEXPLAINED RETENTION OF 1-g LUNG CHARACTERISTICS IN 0-g
• UNEXPECTED INCREASED BLOOD FLOW TO THE KIDNEYS

USML-1
• SEVERAL INORGANIC CRYSTALS APPEAR TO BE LARGEST AND HIGHEST QUALITY GROWN TO DATE
• OVER 700 CREW MANIPULATIONS OF PROTEIN CRYSTAL SAMPLES INCREASED QUALITY AND YIELD
• MANY CRYSTALS WERE OBSERVED TO BEGIN GROWING ONLY LATE IN THE FLIGHT
• MANY UNPLANNED/UNEXPECTED RESULTS WERE OBTAINED

LIFE SCIENCES STRATEGY

PHASE I
- Focus on Monitoring Human Health and SSF Environment

PHASE II
- Build upon Established Infrastructure to Provide an Initial SSF National and International Life Sciences Research Capability

PHASE III
- Provide International Life Science Research Facility for In-Depth Studies Over Dedicated Periods of Time
- Address Medical Issues Relevant to Space Exploration Missions Involving Humans
SPACE STATION MILESTONES

MAN-TENDED TRANSITION HARDWARE
- Use Shuttle Station Transition Hardware
- Conduct Experiments in Materials Science, Combustion Science, and Protein Crystal Growth

MAN-TENDED FACILITY CLASS HARDWARE
- Increase Use of Station Facility Class Hardware
- Continue Research Begun in Phase I but Address More Mature Questions
- Begin Studies in Fluid Physics
- Begin Use of Small and Rapid Response Payloads

PERMANENT MANNED PRESENCE
- Conduct Experiments Requiring Long Periods of Manned Interaction
- Address More Complex Questions in All Research Areas

EVOLUTION TO MAN-TENDED FREE FLYERS

MAN-TENDED TRANSITION HARDWARE