KENNEDY SPACE CENTER
LAUNCH AND LANDING SUPPORT

Jennifer Wahlberg
KSC Project Integration
ISS & Spacecraft Processing

Jennifer.A.Wahlberg@nasa.gov

August 5, 2010
NASA KSC
Agenda

• KSC Payload Processing
• KSC Facilities and Capabilities
• Research Development and Life Science Experience
KSC Payload Processing
Launch Site Processing

- Integrate science into hardware
- Integrate hardware for checkout/ interface testing (power, data, etc.) as required
- Physical configuration for flight
- Late stow and integration at the launch site

- Research arrives at KSC
- Logistics provides receiving and transportation to desired site
- Laboratories prepared for processing (commodities, equipment, glassware, etc.)
- Science Processing in SSPF/SLSL

- Return Payload to Customer Site
- Laboratories prepared for processing
- Science Processing in SSPF/SLSL

- Ship to KSC or to Customer Site
- Landing and Recovery Hawthorne, CA*

*Some post-flight processing capabilities may exist at Hawthorne

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Payload Processing

- **Pre-arrival coordination**
  - A Launch Site Support Manager will be assigned to be the customer’s advocate throughout processing
  - Identify Ground Support Requirements (detailed operational and administrative products and services needed for processing)
  - Identify Technical Requirements for on-line processing
  - Provide customer procedures for review of safety controls and operations compatibility
  - Identify personnel for badging; complete required training for KSC processing
  - Identify needed Logistics support
    - Transportation/receiving, warehousing, imagery, tool loan
  - Obtain Ground Safety Review Panel approval

- **Customers may utilize KSC labs and resources to complete off-line post-shipment activities prior to turnover for packing or launch**

- **KSC personnel may perform on-line tasks as needed or required**
  - Testing
  - Fluids servicing
  - Integration to carrier
Key Launch Site Processing Roles

- **Time Critical Ground Handling**
  - Final prep & install into launch vehicles, scrub refurbishment to minimize science loss
  - Physical retrieval of payload h/w, post mission operations, h/w return to PDs

- **Technical Integration**
  - Engineering requirement/criteria development, definition, and implementation for technical requirements datasets
  - Verification of payload physical and functional interfaces with applicable interface agreements through certified tests, inspections, and/or analyses

- **Customer Advocacy**
  - Advanced planning and documentation of support requirements and unique agreements
  - Arrangement of badging, development of schedules, provision of necessary documentation and general customer assistance with ground processing flow, deadlines, shipping, and offline

Research arrives at KSC
Logistics provides receiving and transportation to desired site
Laboratories prepared for processing (commodities, equipment, glassware, etc.)
Science Processing in SSPF/LSL

- Integrate science into hardware
- Integrate hardware for checkout/ interface testing (power, data, etc.) as required
- Physical configuration for flight
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Launch
Mission Ops

- Return Payload to Customer Site
- Ship to KSC or to Customer Site
- "Some post-flight processing capabilities may exist at Hawthorne"

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Landing and Recovery
Hawthorne, CA*
Key Launch Site Processing Roles

- **Customer Advocacy**
  - Advanced planning and documentation of support requirements and unique agreements
  - Support for **real-time** off-line processing changes
  - Input to research ground processing policy and philosophy
  - Operations & Maintenance (O&M) and unique outfitting of science processing laboratories
  - Prioritization of on-dock arrivals
  - Communication of launch site safety and base requirements
  - Review of ground safety packages
  - Provision of active operational support to Payload Developers during early design phases
  - Arrangement of badging, development of schedules, provision of necessary documentation and general customer assistance with ground processing flow, Ground Safety Review Panel deadlines, shipping, and offline lab outfitting
  - Launch site support oversight for customer’s payload processing, launch, and landing activities
  - Ensure applicable payload requirement documents are met
  - Review payload customer procedures ensuring Agency/Center support requirement policies are accurately reflected
Key Launch Site Processing Roles

• **Technical Integration**
  - Engineering requirement/criteria development, definition, and implementation for technical requirements datasets, including Time-Critical Ground Handling Requirements
  - Payload turnover activities (Integration Data Package review, issue resolution)
  - Procedure development and review of customer ground and flight procedures
  - Experiment off-line operations (e.g. sharp edge inspections) & on-line processing ops
  - O&M of ISS Payload Ground Support Equipment, simulators, rack testers, etc.
  - Verification of payload physical and functional interfaces with applicable interface agreements through certified tests, inspections, and/or analyses
  - Turnover and installation into launch vehicle
  - Scrub refurbishment to minimize science loss
  - Landing early destow coordination/execution
  - Developing/Coordinating implementation of experiment upload schedules
  - Remote launch/landing operational responsibilities (TBD post-Shuttle)

• **Time Critical Ground Handling**
  - Final prep & install into launch vehicles, scrub refurbishment
  - Interface with flight crew for technical issues
  - Coordination of real-time destow tasks and schedules with Flight Crew Systems
  - Physical retrieval of payload hardware, post mission operations, hardware return to PDs
  - Coordination with researchers
Leveraging KSC Experience

- Extending existing roles using current expertise
  - Commercial Vehicle Late Stow/Early Destow
  - Sub-Rack/Pallet Payload Interface Tests
  - Sub-Rack/Pallet Payload Verification
  - Sub-Rack/Pallet On-Orbit Troubleshooting
  - Ops & Science Processing Consultation during Payload Design
  - National Lab & IP Facility-Class Payload Physical Integration and Test
  - National Lab & IP Science Processing Support
  - Assistance with Animal Care processing
KSC Facilities and Capabilities
Space Station Processing Facility

- **High Bay**
  - 38,000 ft² Class 100K clean area
  - 8 footprints, completely reconfigurable
  - Available commodities include 208V/480V power, chilled water, GN₂, GHe, LN₂
  - Two 30-ton electrical bridge cranes with 50-ft hook height

- **Intermediate Bay**
  - 17,000 ft² Class 100K clean area
  - Two 5-ton electrical bridge cranes with 25-ft hook height

- **Airlock**
  - 5000 ft² Class 300K clean area
  - 15-ton electrical bridge crane with 50-ft hook height

- **Administrative Space**
  - Office Space for approximately 1000 employees
  - 25 Conference Rooms

- **Specialty Areas**
  - Off-Line Processing Rooms
    (7 Science Labs, 2 Central Services Labs, 8 Hardware Labs)
  - 9 control rooms located on raised floor areas
  - Multi-Layer Insulation (MLI) Sewing Room
  - Vapor Containment Facility to house liquid anhydrous ammonia
  - Flight Crew Room: final checkpoint for all flight crew equipment
SSPF Testing Capabilities

• Payload Rack Checkout Unit (PRCU)
  - Provides ISS interface verifications which include Power, Command & Data Handling, Video, Fluids, Vacuum, Fire Detection System, Impedance Analysis and GN₂
  - Includes a connection to MSFC HOSC for commanding and data monitoring

• Testing Capabilities
  - International Standard Payload Rack (ISPR)
  - Sub-rack payloads
  - Sub-pallet payloads (unpressurized) which will be mounted on a truss location or Express Logistics Carrier (ELC)
    - Includes final flight configuration testing with an ELC Simulator and verification testing

• Fluids Servicing
  - Spacecraft Fueling (Mono and Bipropellant)
  - Gases up to 6000 PSI (GN₂, GH₂, etc)
  - O₂ and NH₃ Servicing
  - Noble Gas servicing at lower pressures
  - Cryo Servicing
SSPF Lab Capabilities

• **Lab Capabilities Summary**
  - Class 300,000 clean rooms
  - 7 Science Labs
  - 8 Hardware Labs
  - 2 Central Services
  - Specialized Science Equipment (e.g. laminar flow benches, incubators, microscopes, biological safety cabinets, portable fume hoods, water baths, etc.)

• **Payloads Processing Support**
  - Skills, equipment and labs unique to pre/post mission support requirements at launch site for hardware integration, hardware/science integration, offline checkout, including life science & biological payloads
Baseline Data Collection Facility

- **BDCF Mission**
  - Optimize the completion of Human Life Sciences Research
  - Series of laboratories designed to study astronaut response to spaceflight immediately upon return to Earth

- **Experiment equipment**
  - Magnetic Resonance Imaging (MRI)
  - Densitometers
  - Cardiovascular devices
  - Vestibular testing equipment
    - Rotating chairs
    - Treadmills
    - Obstacle courses
Space Life Sciences Laboratory

- **Building Information**
  - 73,000 ft² available area
  - Population: 140 residents, 38 visitors
  - 25 Science Labs
  - 8 Hardware Labs
  - 6 Animal Holding Rooms

- **Partnerships**
  - NASA/KSC: Manages Research & Utilization
  - Space Florida: Owner of SLS Lab
  - Life Science Services Contract: Tenant of SLS Lab, responsible for O&M
  - University of Florida and Florida Tech: Resident university partners

- **Unique Agency Capabilities**
  - Provides infrastructure to enable ISS Research including non-exploration research and maturation of critical Exploration technologies
  - Skills, equipment and labs unique to pre/post mission support requirements at launch site of life science and biological payloads

- **Specialty Areas**
  - Animal Care Facility (ACF) provides animal husbandry & support for space flight missions and meets all necessary Agency & Federal cert/license requirements
  - Controlled Environment Lab (CEL)
    - Skills and infrastructure uniquely developed originally for biological sustainable systems (i.e. bio-regenerative life support systems), now serving multi-discipline investigations
    - Orbit Environment Simulators for science 'control' of STS/ISS pressurized environment payloads (temp, humidity, CO₂, lighting)
# SLS Lab Capabilities

<table>
<thead>
<tr>
<th>Capability</th>
<th>Details</th>
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<tbody>
<tr>
<td>Controlled Environment Lab</td>
<td>15 Controlled Environment Chambers (CEC)</td>
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<tr>
<td></td>
<td>Low Pressure Test Bed</td>
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<tr>
<td></td>
<td>Lunar/Mars Vacuum Chamber</td>
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<tr>
<td>Animal Care</td>
<td>Rodent/Aquatic/Avian/Insect</td>
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<tr>
<td>Experiment Processing Support</td>
<td>Shuttle/Station/Unmanned</td>
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<tr>
<td>Flight Experiment Development</td>
<td>Design/Testing/Integration</td>
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<tr>
<td>Flight Mission Support</td>
<td>Orbit Environment Simulators (OES)</td>
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<td>Experiment Monitoring Area (EMA)</td>
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# SLS Lab Capabilities

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Bimolecular/Microbial Ecology</td>
<td>Genetic Identification, Quantification &amp; Qualification</td>
</tr>
<tr>
<td>Analytical Chemistry</td>
<td>Organic/Inorganic/Volatile Gases</td>
</tr>
<tr>
<td>Astrobiology</td>
<td>UF &amp; FIT Resident Science Programs</td>
</tr>
<tr>
<td>Microscopy/Imaging</td>
<td>Atomic Force (AFM), X-Ray Photoelectron Spectroscopy (XPS), Scanning Electron (SEM), Confocal Fluorescence</td>
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<tr>
<td>Applied Chemistry</td>
<td>In-Situ Resource Utilization (ISRU), Environmental Remediation, Corrosion Detection &amp; Coatings, Polymer &amp; Advanced Materials</td>
</tr>
<tr>
<td>Applied Physics</td>
<td>Granular &amp; Surface Systems</td>
</tr>
<tr>
<td>Electrostatics</td>
<td>Dust Characterization &amp; Remediation, Surface Physics</td>
</tr>
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</table>
Research Development and Life Science Experience
Research Payload Development

Research Announcement Development and Feasibility Assessment

Post-Flight Analysis & Reporting

Research Proposal Selection & Assignment

Launch, On-Orbit Operations & Post-Flight Recovery

Experiment Definition w/ Flight Hardware and ISS Resources

Ground Testing, Hardware Certifications & Flight integration
KSC Life Science Expertise

**Areas of Expertise**
- Processing biological payloads
- Biological payload development and Flight execution
- Developing life support systems & flight hardware
- BRICs and ABRS flight facilities
- Maintaining commitments to Investigators
- Managing Labs to support space related research
- Managing Grants (e.g. ILSRA)

**Critical Skills**
- Mission Integration
- Project Integration
- Payload Scientist
- Science Disciplines: Exploration Life Support, Molecular Biology, Plant Physiology, Analytical Chemistry, Microbial Ecology, Wet Solid Waste, Air Purification
- OES manager, engineer, and technician
- CMDS Software Manager
- Certified Animal Care Manager
- Engineering Disciplines: Optics, Communications, Electrical, Mechanical, Spacecraft Thermal, Fluids, Power Systems, Lighting, Structural

**Customers**
- NASA HQ / ESMD & SOMD
- International Space Station
- International Science Community
- Florida State Partnership
- ISS National Lab Community
- Commercial

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