KENNEDY SPACE CENTER
LAUNCH AND LANDING SUPPORT

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KSC Project Integration
ISS & Spacecraft Processing

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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

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

Launch
Mission Ops
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

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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

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

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

- Research Announcement Development and Feasibility Assessment
- 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
- Post-Flight Analysis & Reporting
# KSC ISS-Research Flight Hardware

<table>
<thead>
<tr>
<th>Inventory</th>
<th>ABRS</th>
<th>KFT</th>
<th>Biotube</th>
<th>BRIC-PDFU &amp; LED</th>
<th>BRIC-Opti</th>
<th>BRIC-60/100</th>
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<tbody>
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<td>On ISS</td>
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<td>4</td>
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<tr>
<td>At KSC</td>
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<td>70</td>
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<td>10</td>
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</tr>
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### 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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