Shuttle Processing

Kim Guodace

United Space Alliance, LLC (USA)

Launch Site Integration

OV-105, Endeavour, Vehicle Engineer
History of USA

came into existence September, 1995
Parents – Lockheed Martin and Boeing
Space Operations Program Contract (SPOC) implemented October 1, 1995
Day-to-day management of the Space Shuttle fleet and planning, training, and operations for the ISS*

- Major Subcontractor for Shuttle Processing Locations in Texas (HQ), Florida, Alabama and Washington, D.C.

Employees approximately 8,800

*www.unitedspacealliance.com
Orbiter Element

- Provides engineering management necessary to maintain the Space Shuttle Orbiter, to solve flight or ground anomalies, and to provide new designs for safety improvements or capability enhancements.
- Responsible for management of new designs and modifications, coordination with Ground Operations for the integration of those modifications into the turnaround processing flow at KSC.
- Four Departments
  - Engineering
  - Operations and Production
  - Assembly Integration
  - Logistics Technology
Launch Site Integration

- Provide Orbiter Element management and oversight functions at the Kennedy Space Center.
  - Primary functions
    - Vehicle management
    - Operations integration
    - Hardware production support
Launch Site Integration

- Integrate all the subsystem requirements across a vehicle, and/or across the fleet
- Work with Ground Operations on matters related to design changes, vehicle modifications, and fleet-wide issues
- Provide coordination and resolution of payload-to-orbiter issues
- Represent the program at Rollout Reviews and Flight Readiness Reviews
Processing Flow

Orbiter/Shuttle Ground Processing Flow starts with Wheel Stop and ends with T-0

- Landing ➔ OPF Roll-in ➔ OPF Roll-over ➔ VAB Roll-out ➔ Launch
Processing Flow

Typical Flow times

- OIF flow extends approximately 3-4 months
  Varies from mission to mission
  Some slack is in the schedule depending on planned stay and planned work

- WAB flow extends approximately 1 week
  Usually very little slack in scheduled

- PAD flow extends approximately 5 weeks
  Some agency days are built in most of the time

- NPRS flow: 90 days total lead timeline
Landing Ops

After wheel stop, SCAPE (Self-Contained Atmospheric Protection Ensemble) crew performs evaluation of Orbiter to verify hazardous vapors are within limits. Once area is deemed safe, Purge and Coolant Umbilical Access Vehicle are positioned behind the orbiter, and purge is hooked up. Purge air provides cool and humidified air conditioning to the payload bay and other cavities thereby removing any residual explosive or toxic fumes.
Landing Ops

- Once purge is hooked up, crew is escorted off the vehicle and ground crews enter the flight deck to prepare the Orbiter for tow to the OPF as well as perform initial inspections.
- Switch guards are installed, data packages from on-board experiments are removed, etc.
- External inspections of TPS, etc are then performed.
Landing Ops

Approximately 4-5 hours after Wheel Stop, the Orbiter is then moved to the OPF
Landing Ops (Dryden)

- Turnaround time varies – nominal ops run approximately 7 days from landing to SCA wheels up.
- Travel time from Dryden to KSC is approximately 2 days, weather dependent.
OPF Ops

OPF operations run approximately 3-4 months, starting with initial spotting in the OPF after landing to OPF roll-over to the VAB.

- Inspections, testing, repairs, modifications, etc are performed during the OPF stay
OPF Ops

$\text{Spotting in the OPF/Jack and Level}$
- Get Offload
- Payload Bay door opening/destow of payload
- RCC thermography
- SSME removal/instillation
- OBSS removal/instillation
- Nominal testing of electrical/mechanical systems
- Main Tire R/R, brake inspections, NLG tire inspections
- Drag Chute Installation
- Payload premate testing

Payload Bay Door closure
- Weigh Out
VAB Ops

- VAB operations for SRB/ET
  - SRB stacking ops run approximately 20 days
  - ET ops from on-dock to SRB mate run approximately 3-4 weeks
- VAB operations for Shuttle run approximately 1 week, starting with roll-in thru first motion for roll-out to the Pad
  - Mate, Integrated vehicle testing, inspections, testing, repairs, etc are performed during the VAB
VAB Ops

- VAB stacking
- ET on dock/inspections
- ET/SRB mate
- Orbiter RT

- Sling Installation
- LH/ET mate
- Sling Removal
- Traverse testing
Pad Ops

- Approximately 3 miles from VAB to Pad A
- Takes approximately 7 hrs, moving <1 mph

Pad Validation
- Payload Installation
- TCDD (Terminal Count and Demonstration Test)

Closeout
- Safeguard
Mission Ops

- Mission Support
  - Mission Control (Houston)
  - Mission Evaluation Room (Houston)
- Landings
  - KSC, FL
  - Edwards Air Force Base, CA
  - White Sands, NM
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• Four Departments
  – Engineering
  – Operations and Production
  – Launch Site Integration
  – Avionics Technology
Launch Site Integration

• Provide Orbiter Element management and oversight functions at the Kennedy Space Center.

• Primary functions
  – Vehicle management
  – Operations integration
  – Hardware production support
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    • Varies from mission to mission
    • Some slack is in the schedule depending on planned stay and planned work
  – VAB flow extends approximately 1 week
    • Usually very little slack in scheduled
  – PAD flow extends approximately 5 weeks
    • Contingency days are built in most of the time
    • Varies on mission/payload/timeline
Landing Ops

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OPF Ops

- Spotting in the OPF/Jack and Level
- Cryo Offload
- Payload Bay door opening/destow of payload
- RCC thermography
- SSME removal/installation
- OBSS removal/installation
- Nominal testing of electrical/mechanical systems
- MLG Tire R/R, brake inspections, NLG tire inspections
- Drag Chute installation
- Payload premate testing
- CEIT
- Payload Bay Door closure
- Weight/CG
- Rollout
VAB Ops

• VAB operations for SRB/ET
  – SRB stacking ops run approximately 20 days
  – ET ops from on-dock to SRB mate run approximately 3-4 weeks
• VAB operations for Shuttle run approximately 1 week, starting with roll-in thru first motion for roll-out to the Pad
• Lift/mate, Integrated vehicle testing, inspections, testing, repairs, etc are performed during the VAB stay
VAB Ops

- SRB stacking
- ET on dock/inspections
- ET/SRB mate
- Orbiter Roll-in
- Sling Installation
- Lift/ET mate
- Sling Removal
- Interface testing
- Rollout
Pad Ops

• Rollout
  – Approximately 3 miles from VAB to Pad A
  – Takes approximately 7 hrs, moving <1 mph

• Pad Validation

• Payload Installation

• TCDT (Terminal Count and Demonstration Test)

• Aft closeout

• Late Stow

• Countdown
Mission Ops

• T-0

• Mission Support
  – Mission Control (Houston)
  – Mission Evaluation Room (Houston)

• Landing
  – KSC, FL
  – Dryden - Edwards Air Force Base, CA
  – White Sands, NM