



# STS-LAST Hardware Retention Effort

Integrated List Status

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# STS-LAST – Integrated List Status



## **Background:**

- Per MA's request, EA42 pulled together an integrated listing of all STS-LAST hardware requests from the following centers/organizations:
  - JSC-Engineering (with assistance from MA)
  - KSC-Engineering
  - MSFC-Engineering
  - NESC
  - WSTF

# STS-LAST – Integrated List Status



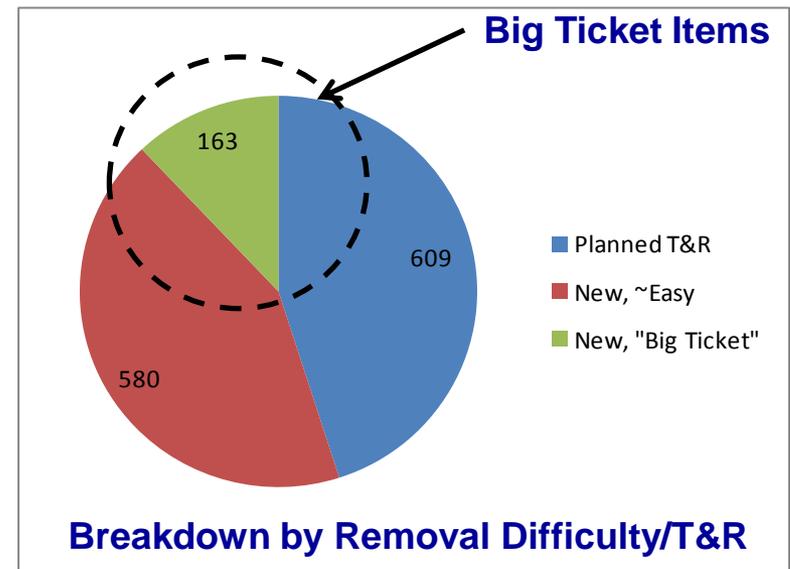
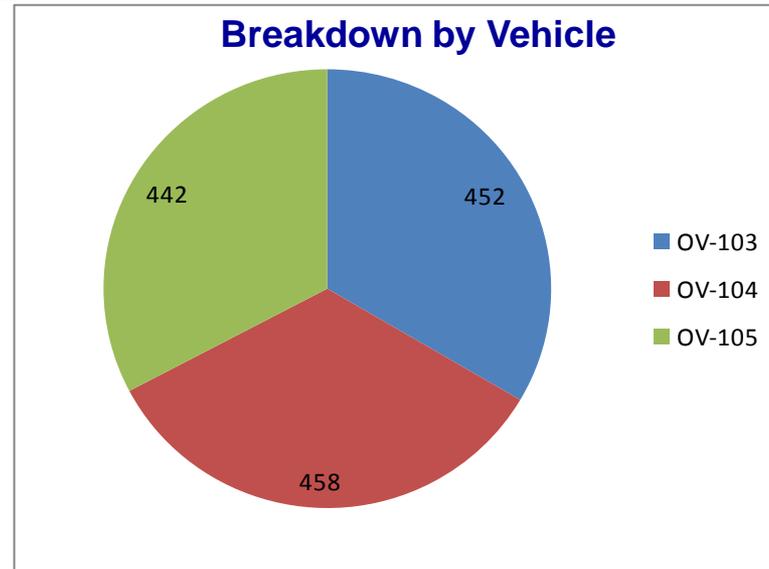
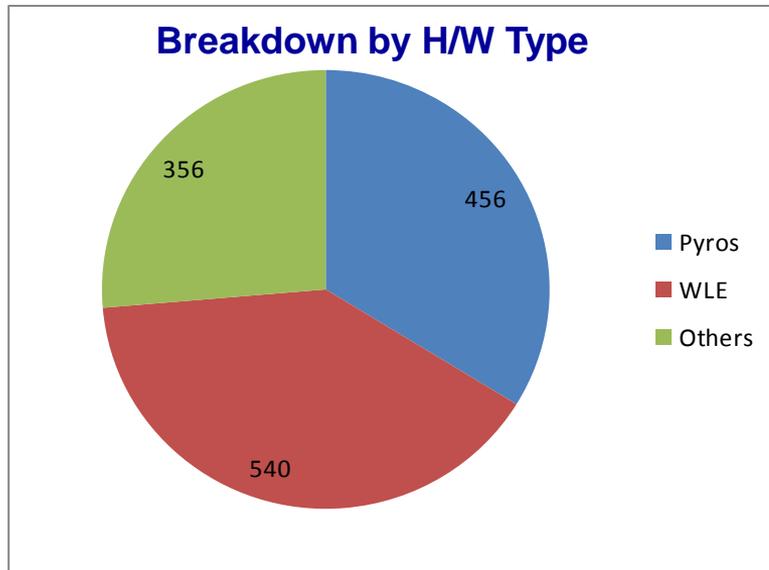
## Current Status:

- All overlaps or conflicts between the requests were resolved through telecons between JSC-EA division chief engineers (DCEs) and the point of contacts for requesting centers/organizations.
  - Coordination between points of contacts has been excellent.
  - Changes to spreadsheet expected to be minimal (vehicle removals list considered frozen)
- The integrated listing describes the following:
  - Hardware description
  - Requesting center(s) / organization(s) & Shipping Destination
  - Required actions for each request (remove from vehicle, In KSC Logistics or NSLD, Invasive action, delta to planned T&R, etc.)
  - Requested Vehicle Impacts (either h/w removals or invasive inspections, etc).
  - Requested Spares / Vendor impacts
  - H/W already planned for removal during T&R (Y / N)
  - Data Packs Requested

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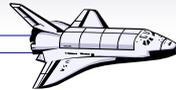


## Top Level Breakdown



- There are 1352 items requested to be removed (all three vehicles) including many already planned for removal due to T&R (almost 45% of total).
- These figures do not include the spare items desired.

# STS-LAST – Integrated List Status



## “Big ticket items”

### Removals/Actions for 103 not currently planned for T&R

## OV-103 Summary:

- H/W Removal Requests already planned for removal during T&R: 209
- H/W Removal Requests not currently planned: 243
  - 63 not counting WLEIDS components
- Invasive Actions: 7

| Description  | Cat A  | Cat B  | Cat C  |
|--|--------|--------|--------|
| 1) Remove Ammonia Boiler System Relief Vlv, Iso Vlv, Flow Control Vlv (line item 7)                        | 3      |        |        |
| 2) ACTION: Borescope Inspection of Ammonia Tank and System (line item 7)                                   |        |        | Action |
| 3) Remove oldest fleet coldplate Av Bay 1 (assume 103) (line item 31)                                      | 1      |        |        |
| 4) Remove oldest fleet coldplate from Av Bay 4 (assume 103) (line item 32)                                 | 1      |        |        |
| 5) Remove MPS 12" LH2 Feedline (flowliner, BSTRA, pre-ylv filter, gaskets) (line item 53)                  |        |        | 1      |
| 6) Remove MPS 12" LO2 Feedline (flowliner, BSTRA, pre-ylv filter, gaskets) (line item 56)                  |        |        | 1      |
| 7) Remove Power Contactors from FPCAs (line item 112)  | 4      |        |        |
| 8) Remove SSME TVC Actuators (line item 163)   |        |        | 6      |
| 9) Remove SRMS S/N 202 and End Effector S/N 303 (line item 178)  |        | 1      |        |
| 10) ACTION: Take composite core sample from OMS Pod and PLBD (line item 188)                               |        |        | Action |
| 11) ACTION: Perform Upper Surface corrosion sampling where RTV was used instead of Koropon (line item 189) |        | Action |        |
| 12) ACTION: Remove and inspect wing root attachment bolts and fittings (line item 192)                     |        |        | Action |
| 13) ACTION: Remove and inspect vertical tail-to-aft fuselage bolts and fittings (line item 193)            |        |        | Action |
| 14) ACTION: Perform IR Thermography on 103 RCC Left wing panels 1-5 (line item 205)                        | Action |        |        |
| 15) Remove Orbiter Docking System (ODS) (line item 208)  |        | 1      |        |
| 16) Remove Orbiter Windows (line items 209 & 210)  | 6      | 1      |        |
| 17) Remove CCTV Payload Bay Hardware (line item 233)   | 21     |        |        |
| 18) ACTION: Digital scanning and Data Processing (line item 243)   |        | Action |        |

**Category A** – (Grey) – Not difficult to perform, but can be time consuming

**Category B** – (Yellow) – Difficult to perform (access, complexity, crane lift) but procedures are in place

**Category C** – (Red) – Very difficult to perform or hasn't been done before or very often

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## “Big ticket items”

### Removals/Actions for 104 not currently planned for T&R

## OV-104 Summary:

- H/W Removal Requests already planned for removal during T&R: 204
- H/W Removal Requests not currently planned: 254
  - 74 not counting WLEIDS components
- Invasive Actions: 3

| Description   | Cat I | Cat II | Cat III |
|---|-------|--------|---------|
| 1) Remove Ammonia Boiler System Relief Vlv, Iso Vlv, Flow Control Vlv (line item 7) | 3     |        |         |
| 2) ACTION: Borescope Inspection of Ammonia Tank and System (line item 7)            |       |        | Action  |
| 3) Remove MPS Flow Control Valves (line item 55)                                    |       | 3      |         |
| 4) Remove MPS/RCS COPV Tank (line item 57)  |       |        | 1       |
| 5) Remove MPS GO2 Flow Control Valve (line item 90)                                 | 1     |        |         |
| 6) Remove E3 LO2 Prevalve (line item 91)  |       | 1      |         |
| 7) Remove Orbiter Electrical Harnesses (line item 108)                              |       | 3      |         |
| 8) Remove Power Contactors from FPCAs (line item 112)                               | 4     |        |         |
| 9) Remove Power Transfer Units (line item 115)                                      | 2     |        |         |
| 10) Remove Fuel Cell Powerplant (line item 140)                                     |       | 2      |         |
| 11) Remove Water Spray Boiler (line item 161)                                       |       | 1      |         |
| 12) Remove Elevon Actuator (line item 162)  |       |        | 1       |
| 13) Remove SSME TVC Actuators (line item 163)                                       |       |        | 6       |
| 14) Remove APU Water Diaphragm Tank (line item 165)                                 |       |        | 1       |
| 15) Remove Rudder/Speedbrake Actuator (line item 176)                               |       |        | 1       |
| 16) Remove SRMS S/N 301 and End Effector S/N 402 (line item 179)                    |       | 1      |         |
| 17) ACTION: WLE Spare Core Sampling for Corrosion (line item 190)                   |       |        | Action  |
| 18) Remove Orbiter Docking System (ODS) (line item 208)                             |       | 1      |         |
| 19) Remove Orbiter Windows (line items 209 & 210)                                   | 6     | 2      |         |
| 20) Remove CCTV Payload Bay Hardware (line item 233)                                | 23    |        |         |
| 21) ACTION: Digital scanning and Data Processing (line item 243)                    |       | Action |         |

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## “Big ticket items”

### Removals/Actions for 105 not currently planned for T&R

## OV-105 Summary:

- H/W Removal Requests already planned for removal during T&R: 196
- H/W Removal Requests not currently planned: 246
  - 66 not counting WLEIDS components
- Invasive Actions: 3

| Description   | Cat I | Cat II | Cat III |
|---|-------|--------|---------|
| 1) Remove Ammonia Boiler System Relief Vlv, Iso Vlv, Flow Control Vlv (line item 7) | 3     |        |         |
| 2) ACTION: Borescope Inspection of Ammonia Tank and System (line item 7)            |       |        | Action  |
| 3) Remove MPS GO2 Flow Control Valve (line item 90)                                 | 1     |        |         |
| 4) Remove Power Contactors from MPCAs and APCAs (line item 112)                     | 4     |        |         |
| 5) Remove Power Transfer Units (line item 115)                                      | 2     |        |         |
| 6) Remove Fuel Cell Powerplant (line item 140)                                      |       | 1      |         |
| 7) Remove Fuel Cell Monitoring System (line item 141)                               | 1     |        |         |
| 8) Remove H2 PRSD Tank (line item 143)  |       | 1      |         |
| 9) Remove O2 PRSD Tank (line item 144)  |       | 1      |         |
| 10) Remove SSME TVC Actuators (line item 163)                                       |       |        | 6       |
| 11) Remove APU Water Diaphragm Tank (line item 165)                                 |       |        | 1       |
| 12) ACTION: Inspect Low Life Aft Fuselage Thrust Structure Lug (line item 191)      |       |        | Action  |
| 13) Remove 2 Adjacent WLE RCC Panels w/ T-Seal (line item 207)                      | 3     |        |         |
| 14) Remove Orbiter Docking System (ODS) (line item 208)                             |       | 1      |         |
| 15) Remove Orbiter Windows (line items 209 & 210)                                   | 6     | 1      |         |
| 16) Remove CCTV Payload Bay Hardware (line item 233)                                | 21    |        |         |
| 17) ACTION: Digital scanning and Data Processing (line item 243)                    |       | Action |         |

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# RECOMMENDATION:



## Phase I:

- ◆ Recommend SSP task Orbiter and Vehicle Processing for cost estimates for Hardware Removals / Action Requests – Proposed due date: Sept. 24<sup>th</sup>, 2010
  - Cost of assessment is included in current baseline.
  - Cost estimates to be based on integrated spreadsheet and available Quad Charts
  - JSC-EA will integrate with Centers/Org for missing Quad Charts in parallel (see example in backup)
- ◆ When estimates received, Centers / Organizations go forward to pursue funding
- ◆ JSC-Engineering will prioritize listing with requesting Organizations when information obtained.

## Phase II:

- ◆ Once funding is secured, return to SSP with prioritized list of h/w requests for inclusion in Orbiter end state flows (Deadline: First Delta End State Flow Review (DESFR))



# BACKUP

# QUAD CHART EXAMPLE

DCE/NSE/DIV: Gilmore/Snapp/ES

PRT: TPS

DIVISION PRIORITY NO: XX



## HARDWARE / ACTION DESCRIPTION:

- **Orbiter Tiles**
  - Remove four orbiter tiles from body flap location which have seen the most flights (prefer OV-103, but any vehicle will suffice).

## JSC-ENGINEERING COSTS / IMPACTS:

|                                     | LOW | MED | HIGH |
|-------------------------------------|-----|-----|------|
| VEHICLE ACTION COSTS:               | X   |     |      |
| ESTIMATED TRANSPORTATION COSTS:     | X   |     |      |
| ESTIMATED ANNUAL MAINTENANCE COSTS: | X   |     |      |
| ESTIMATED STORAGE VOLUME REQ'D:     | X   |     |      |

Criteria 1 – Hardware / vehicle structure that should be inspected or analyzed given its significant benefit for increasing/advancing the understanding of space hardware environment.

Criteria 2 - Hardware needed in support of a future space vehicle architecture (including hardware that can be used for subsystem development and/or Qual testing); or hardware with remaining life that could be incorporated into EA sponsored flight/test systems. .

## ACTION / TRANSPORTATION / STORAGE REQMTS / FUTURE SUPPORT:

- **Action:** Hardware removal from vehicle
  - Difficulty of H/W Removal: Low difficulty – no special access required beyond normal OPF procedures
  - R&R Follow-on Actions: Replacement tile (or simulators) req'd to be installed after R&R (for Ferry Flt and display).
  - Vehicle Invasive Inspections Required: None
  - Specialized Expertise (KSC): Requires KSC tech support for R&R and KSC Logistics support for transportation from KSC to ARC.
  - Specialized Controls: None
- **Transportation:** Grd transportation from KSC to ARC
- **Storage (JSC):** ARC Bond/Stores with ambient environmental control
- **Future Support (JSC):** None
  - Ames Support: See justification section.

## JUSTIFICATION FOR ACTION – CRITERIA 1 :

- Ship to Ames (2 tiles) to study how surface emissivity of the tiles may have changed over time
- Ship to Ames (2 tiles) to study waterproofing burnout and chemistry of the tile
- Important for future vehicle TPS designs which may have repeated re-entry exposure

### INDICATE IF THE HARDWARE REQUIRES:

- Controlled/Bonded Storage (including Data Pack maintenance)?
- Environmental Controls – ESD, Humidity, &/or Thermal?
- GN2 Pad/Purges?
- Etc.



Note: Justification continues on pg 2 if required.



## Selection Criteria for Hardware Retention / Invasive Inspection Requests:

### Criteria 1: Knowledge Capture

- ◆ Hardware/vehicle structure that should be inspected or analyzed given its significant benefit for increasing/advancing the understanding of space hardware environment

### Criteria 2: Future Use

- ◆ Hardware needed in support of a future space vehicle architecture, including hardware that can be used for subsystem development and/or Qual testing; or hardware with remaining life that could be incorporated into flight test systems.

### Criteria 3: Display/Education

- ◆ Hardware that should be retained to develop engineering expertise (e.g., propellant valves, actuators, sensors), training aids and/or displays.