STS-115 MOD FRR
FLIGHT DESIGN AND DYNAMICS

August 2, 2006

Ray Moreno / 281-483-8040
Richard A. Theis / 281-483-1956
William Seay / 281-483-1971
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<tr>
<th>MOD Requirements Codes *</th>
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* as defined in DA8-020 “MOD Certification of Flight Readiness Process” document
Mission Overview Summary

- Insertion Altitude / Inclination 122 nm / 51.6 deg
- First Stage Design Criteria DOLILU II / High Q
- Landing Time (KSC) September 8, 2006 16:15 GMT 12:15 EDT
- FD3 rendezvous opportunities are anticipated every day in the August/September launch period
- I-load Design APM 1443 lbs (APM at open of a 3 minute window centered at in-plane)
- Projected APM* 1423 lbs (APM at open of a 3 minute window centered at in-plane)
  * Based on 07/11/06 APM simulation and manifest changes since FRR (e.g FRCS, Cryogenic O₂, middeck changes)
- Launch hold capability inside of drainback is dependent upon actual DOL performance. Abort coverage has sufficient overlap from liftoff to MECO
Significant Requirements Changes Since Design Baseline

- Launch date change from NET 02/17/06 to NET 08/28/06
- MPS Inventory update (APM gain ~800 lbs)
- ET/SRB stack change
- Implementation of 30 second delay following MPS dump initiation for ET crew handheld photography
  - Decreased APM impact by ~93 lbs compared to STS-114 and STS-121
- OMS load to full (24931 lbm)
- FRCS load change from minimum (1912 lbm) to full (2446 lbm) load
- Deletion of one GN2 tank (offload decreased to 25 lbm)
- Eliminated O2 offload (full load)
- Late inspection of Orbiter TPS post-undock
  - Posigrade Sep2 burn to 40 nmi to allow possible re-rendezvous after late inspection
Pending Changes

- Launch date change to August 27
  - NASA has negotiated close of launch window on September 7 to accommodate Soyuz launch opportunities on September 14 or 18
  - SSP wants to maximize launch opportunities
  - Imagery personnel latest lighting analysis predicts that August 27 provides acceptable lighting (possibly August 26 as well)
  - FDRD CR in work to include August 26 as potential launch date. Will be presented at August 3 PRCB
Significant Mission Firsts And Unique Items

- New weather balloons may be used on Ascent/Entry
  - AMPS low resolution balloon version LMS-5 (Lockheed Martin Sippican Model 5) will replace the current Mark2 data package
  - No impacts to DOLILU software or data

- Implementation of 30 second delay following MPS dump initiation for ET crew handheld photography

- 50 degree Beta constraint for mated operations

- If performed, flyaround required to be at range > 600 ft (CG to CG) due to addition of outboard U.S. solar arrays
  - New Twice Orbital Rate Separation (TORS) used to transition to increased flyaround range
  - Shuttle Nose In-Plane (SNIP) breakout final SEP burn Delta-V increased
Significant Mission First And Unique Items - Concluded

- Implementation of the multi-stage de-orbit for the unplanned payload return cases
  - Ascent Performance Margin (APM) maximized by using available RCS margins to decrease OMS requirement

- First flight to incorporate GPS data into PASS during entry operations (2nd flight for GPS ramp-up)
  - GPS to Auto in PASS in MM301 until deorbit burn
  - GPS to Auto in PASS after confirmation with high-speed tracking
  - GPS to remain in Inhibit for BFS
  - GPS will be taken to AUTO in OPS 2 following undock to support Entry ramp-up plans
Exceedances And Deviations

- Contingency Abort Black Zone assessment was not required
  - Liftoff mass properties did not exceed NSTS-07700 Vol III criteria (Weight > 259,000 lb. and Xcg > 1115.0 in)
    - FRR cycle Liftoff Weight = 269,837 lbs, Xcg = 1112.7 in.

- Thermal Structural Envelope Program (TSEP) version 3.6 was used for thermal assessment of EOM, TAL, ATO, and AOA trajectories
  - Violations of the chin panel thermal limits were noted (typical for OV-104)
  - Trajectories have been sent to Boeing for clearance (ref. OCR S164080BN)
  - Results show positive margins. Awaiting formal closure of OCR.
Exceedances And Deviations (continued)

- Landing weights for Unplanned Payload Return cases exceed 233 klbs NEOM downweight limit
  - Per NSTS-07700 Vol. X and Flight Rule A4-159, this case must be evaluated against the thermal criteria for a Nominal EOM
  - TSEP violations were noted and trajectories for the No-Dock PLS case (worst case) were sent to Boeing for evaluation
  - Results show positive margins. Awaiting formal closure of analysis from Orbiter element.
  - Flight rule will be submitted to document results of analysis (ECD 8/07/06)

- Low power output for new EDW TACAN (1 kW vs. 1.5 kW)
  - Primary TACAN at Edwards AFB, EDW 111, has been replaced with new hardware by Air Force
  - Flight specific rule submitted to allow use of low power TACAN on STS-115 (same approach as STS-121)
Exceedances And Deviations (continued)

Previous Mission Anomalies

- Previous mission (STS-121)
  - DOL anomalies
    - Data dropouts seen with some Jimsphere balloons
      - Probable cause => radar tracking issues, MSFC investigating
      - Backup radar data was used for wind data
    - T1 line dropout
      - Data was routed through alternate line and communication accomplished via phone instead of DVIS. MSOC investigating.
  - PLOAD application calculation error
    - Tank topping time was input incorrectly
    - Error was not software related. Procedure and training issue will be corrected for STS-115
    - NCR # 009614 has been initiated
    - A/E Flight Techniques Panel recommended initiating an IFA on this item
Exceedances And Deviations (continued)

Previous Mission Anomalies

- Low-Speed C-band Tracking Data Loss at various radar sites
  - Data circuit problems, transmitter and playback issues
  - All issues were resolved during flight
  - Navigation will follow up with the Network at the Post Mission Review
- High-Speed tracking issues seen on STS-114 were not seen on STS-121
  - Flight rule submitted making high speed tracking data mandatory
  - All procedural workarounds approved for STS-121 are in effect to support STS-115
- GPC BFS Nav errors following wheel stop
  - No issue from guidance perspective
  - Known condition documented in user note DR 109707
  - No issues for STS-115
- Heater failure on L5L vernier jet identified prior to launch
  - Attitude chosen to ensure heater viability for RPM operations
  - Post undock operations used PRCS jets only
  - No issues for STS-115. Operational procedures in place to accommodate loss of jets.
Exceedances And Deviations (concluded)

Previous Mission Anomalies

- Air data probe deploy anomaly during entry
  - Starboard air data probe deployed late
  - Delayed air data to Nav call
  - No issues expected for STS-115. Appears to be a vehicle-specific anomaly.

- Brake Pressure Anomaly
  - Variation in brake pressure noted following landing
  - No issues expected for STS-115. Human related anomaly.

- Previous flight of OV-104 (STS-112 October 2002)
  - Primary thruster L4D and F3F failed
    - Thrusters removed and replaced post flight
Issues And Concerns

• None
Exceptions and Standard Open Work

- Exceptions
  - None

- Standard Open Work (complete listing in backup charts)
  - All open work is scheduled to be completed per standard flight template
  - No issues have been identified
Non-Standard Open Work

- Non-standard Open Work – no concerns identified for completing any of the open work
  - Entry Console Operator (ECO) certification 08/04/06
    - Backup certified personnel are available if needed
  - DOLILU Database Updates (MPS Budget) 08/07/06
    - Expect implementation prior to L-4 week database freeze and verification at L-3 week sim
  - Targeting Officer certification 08/07/06
    - Backup certified personnel are available if needed
  - Range Safety Officer certification 08/07/06
    - Backup certified personnel are available if needed
  - Review ASAB28 stuck throttle status with Flight Director 08/07/06
    - Current product does not emulate stuck throttle crew checklist procedures
    - Current product results in conservative abort boundary calls for stuck throttle case
    - USA FDD/DM recommending no updates for STS-115. Flight Director will be briefed on differences.
  - PLOAD procedure and training updates 08/10/06
Rescue Mission Status

- FDD compared the expected OV-103 configuration to the existing suite of as-built OV-103 related products and I-Loads developed as part of the original STS-121 rescue mission effort
  - No FDD I-Load updates were required
  - Flight Design has identified and will redeliver several products (FDF format updates) as part of this LON effort
  - No other facility updates have been identified

- All pre-callup production has been completed with the exception of the FDF updates (ECD 8/03/06)

- Console staffing will be defined post callup – no issues anticipated

- MOD developed post-callup production schedule will be implemented, if required

- Baseline launch date is currently NET 11/11/2006
FLIGHT DESIGN AND DYNAMICS READINESS ACCOUNTABILITY STATEMENT

- **Software**: All software used to create mission products, and MCC software required for mission support including designated critical processors meets generic and mission-specific Program requirements, and is maintained under configuration control in accordance with the FDD Software Management Plan.

- **Flight Software**: All flight software Principal Functions (PFs) owned by FDD are ready for flight. All Discrepancy Reports and Program Notes and Waivers related to USA-owned PFs have been reviewed and appropriately dispositioned for this flight.

- **Anomaly Resolution**: All anomalies that could impact mission support have been closed, or have accepted and approved work-arounds in place.

- **Production**: All flight reconfiguration products and real-time console support products meet generic and mission-specific Program requirements.

- **Operations**: All mission support personnel are or will be certified and current prior to supporting mission related activities. The FDDOC Flight Readiness Review Process Plan (USA009229) and the Flight Operations Flight Preparation and Readiness Plan (USA 008977; Appendix D) which defines the processes and products required for a successful flight have been executed and the applicable Program CoFR requirements satisfied.

The undersigned certify that the Flight Design and Dynamics Department, upon satisfactory resolution of any noted exceptions, is ready to support flight STS-115.

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<th>Original signed by</th>
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<td>G. E. Schrage</td>
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<td>A. T. McDowell</td>
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## Flight Design And Dynamics Declaration Of Compliance With CoFR Endorsement Requirements For STS-115 Flight Readiness

- **Software**: All software used to create mission products, and MCC software required for mission support including designated critical processors meets generic and mission specific Program requirements, and is maintained under configuration control in accordance with the FDD Software Management Plan.

- **Flight Software**: All flight software Principal Functions (PFs) owned by FDD are ready for flight. All Discrepancy Reports (DRs) and Program Notes and Waivers (PNWs) related to USA-owned PFs have been reviewed and appropriately dispositioned for this flight.

- **Anomaly Resolution**: All anomalies that could impact mission support have been closed or have accepted and approved work-arounds in place.

- **Production**: All flight reconfiguration products and real time console support products meet generic and mission specific Program requirements.

- **Operations**: All mission support personnel are or will be certified and current prior to supporting mission related activities.

### Requirements Compliance

All requirements defined by the documents below (as required by the FIDP Compliance Matrix) have been or will be satisfied prior to flight.

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<td>Flight Implementation Data Pack (FIDP) - Flight Specific</td>
<td>115-BASE2-AV</td>
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### Waivers & Exceptions:

The FDDOC Flight Readiness Review Process Plan (USA009229, Rev. B) and the Flight Operations Flight Preparation and Readiness Plan (USA008977, Basic, Appendix D) which defines the processes and products required for a successful flight have been executed and the applicable Program CoFR requirements satisfied.

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Pending completion of open work and closure of noted exceptions, if applicable, **Flight Design & Dynamics Operations Center is ready to support STS-115.**

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Original signed by D. Brockway for A. Najarian 07/24/06

Director

Date

Flight Design & Dynamics

Operations Center
DM Flight Design and Dynamics (Trajectory Operations)
Significant Mission Firsts And Unique Items

- Start of ET Photo Pitch Maneuver is delayed until 30 sec after beginning of MPS Dump
- SEP Posgrade and stationkeep to protect re-rendezvous (late inspection)
- If flyaround, it will occur outside 600 ft for outboard solar array
  - Use TORS (Twice Orbit Rate Sep) to transition to TORF (Go from 400’ on +Vbar to 600’ at –Rbar)
- GPS:
  - Post undocking: GPS to NAV for ≥ 6 hrs in MM201 (highly desirable)
  - Entry:
    - PASS:
      - GPS to NAV in MM301 (before deorbit burn)
      - GPS to NAV in MM304 after confirmation w/high speed tracking
  - BFS: GPS to NAV inhibited
  - Crew trained OPS 3 procedures during simulations
Exceedances And Deviations

Previous Mission Anomalies

- **STS-121: Istres Status**
  - Most distance remaining markers are destroyed
    - Only 300, 600, & 900 m remaining markers are still in place (~1000, ~2000, and ~3000 ft)
  - Expected fix date is September 2006
    - Earlier fix not expected, though request is in work by KSC
  - Rwy 33 overrun has edge lighting for the first 600 m (~2000 ft)
  - FMI = GO as a TAL site as-is (same config as STS-121)
Previous Mission Anomalies

- **STS-121: Radar Restrictions**
  - New, more restrictive ODS EMI limits received before flight
  - Mission impacts:
    - KWAJ restricted during ISS tracking pass on Day of Rendezvous
    - Hindered spatula tracking; EOM-1 OA waved off due to uncertain spatula location
  - Status for STS-115:
    - New ODS pyro testing has been completed.
    - EV analysis is in work & may result in less restrictive limits.
    - Partial OPS workaround: Consider restrictions when planning tracking on DOR.
    - Working with STRATCOM on possible power reductions
      - Can the radars track at reduced power?
      - At reduced power, can the radars still track small objects?
      - If answers = NO, same situation as STS-121
  - Concern: Restrictive limits will impact ability of sensors to detect unexpected Orbiter debris.
Special Topics

- ISS altitude profile has been worked to increase number of flight day 3 rendezvous days in August-September.
  - First burn performed on July 26 (~ 1 mps)
  - 2nd burn planned on August 23 (25 = bkup) (~ 2 mps)
  - 2nd TIG will be optimized to minimize shuttle deorbit costs

- Solar Array Jettison – Safe Sep
  - Working on a baseline procedure (non-published) which can be modified to accommodate the actual flight situation (config/condition of the array)
  - Will write a FR to document jettison attitude, attitude control constraints, and the minimum required reboost Delta-V
Special Topics (concluded)

- AR 038078 (STS-121) – GNC ISP SERVER LOST MULTIPLE TIMES
  - Trj Server performance was not affected by loss of GNC ISP connection
  - No change required to DM OPS for STS-115
    - Will be connected to public GNC server
    - Same path as previously used

- RGPO ISP Server
  - Potentially susceptible to same problem as the GNC ISP server
  - Number of connections will be monitored/managed for STS-115
  - STS-121 used only one third of available connections during the undock time period (data not available for rendezvous/docking)
Issues And Concerns

- **Trj Server ARs**
  - AR 036699 (05-09-2006) – TRS3 “Silent” FAILURE
    - **IMPACT:** Primary Trj Server fails; workaround is to selectover to the backup
    - **ROOT CAUSE:** Unknown
    - **RECOVERY:** Power cycle the server
    - **LIKELIHOOD:** Has occurred every 1 to 11 months since 2002

- Is not be a constraint for STS-115 (same status as STS-121).
Exceptions and Standard Open Work

- Exceptions
  - None

- Standard Open Work (complete listing in backup charts)
  - All open work is scheduled to be completed per standard flight template
  - No issues have been identified
Non-Standard Open Work

- FDF
  - RNDZ C/L PCN-1 August 9, 2006
  - ASCENT C/L PCN-1 August 14, 2006
  - Generic Entry C/L PCN-6 August 14, 2006

- Flight Controller Certification
  - Lead LSO certification expected on 8/11/2006

- Flight Rules
  - STS-115:
    - A4-3 Shuttle EOM Orbit Adjust Burns (ECD August 3, 2006)
    - C2-X SAW Jettison Trajectory Operations (ECD August 4, 2006)
    - CR Landing weights for unplanned Payload Return cases (ECD 8/07/06)
The Flight Design and Dynamics Division has performed the reviews necessary to assess the flight readiness relating to flight design requirements definition, trajectory operations, and flight software MMU reconfiguration. We have determined all applicable responsibilities acceptable for flight pending closure of the identified open work and issues.

Original signed by

Barbara A. Conte
Chief, Flight Design Requirements and Integration Office

Original signed by G. Oliver for M. Collins

Michael F. Collins
Chief, Flight Design and Dynamics Division

As compiled by: FDM/R. Moreno
FDO/D. Theis
STS-115/12A Mission
TOPO Readiness
FDDD FRR

DM33 / W. A. Seay
ISS Trajectory Operations & Planning
(281) 483-1971
## TOPO Readiness: STS-115 / 12A

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<td>ISS Translation Maneuvers</td>
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<td>ISS Reboost on July 26 and August 25 to set phasing for 12A Launch, 13S Launch and 12S Landing.</td>
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<td>Shuttle Data Exchange</td>
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<td>ISS Altitude Strategy</td>
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<td>Maximum rendezvous altitude: (185 nmi /343 km)</td>
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<td>Joint Underspeed Recovery (JURe) Estimated Max Capability (RSA Plng - TBS kg/MSFC 50% - TBS kg Prop)</td>
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<td>Mnvrs  JURe ΔV  JURe Prop  Rec ΔV  Rec Prop  Tot ΔV  Tot Prop  In Work</td>
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<td>Mated Reboosts</td>
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<td>Discussion of possible 2 m/s mated reboost to assist with phasing Dam (DAM):</td>
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STANDARD PROPOSAL

Agenda Item 5 - Visiting Vehicle Status

DM35 (VVO)/R. Parker

August 2, 2006
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(End Notice)
Visiting Vehicle Status

- Visiting Vehicle Flights for ISS Stage 12A
  - Soyuz TMA-9 (13S), Launch on 14 or 18 September 2006
    - Dependant on 12A Launch
    - Additional details to be provided at 13S/Increment 14 FRR
  - Progress M-56 (21P), Departure from SM aft on 15 or 19 September 2006
    - Will occur between 13S Launch and Docking

- Open Issues
  - None for 21P Undock

- Standard Open Work
  - Standard OIP data exchange

- Console Support
  - No issues with maintaining currency, proficiency or certifications
  - No work guidelines violations

- Software Issues
  - None; no critical processors
Back-Up

- Flight Readiness Open Work
- PLOAD Issue
- Low-Speed C-band Tracking Data Loss

Separate pdf files:

- Launch Window Summary
- Digital Launch Window
- Launch Date Summary
- Abort Regions
- Nominal ET Impact Area
- Ascent/Descent Flight Critical Software
# Flight Readiness Open Work

<table>
<thead>
<tr>
<th>Item</th>
<th>Responsible</th>
<th>Due Date</th>
<th>Status</th>
<th>Closure Rationale</th>
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# Flight Readiness Open Work - Continued

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**PLOAD Issue**

- Post-Flight comparison of PLOAD results with MSFC PLOAD POC
  - 600 pound difference in LOX loading estimate seen between MCC and HOSC PLOAD results
  - Traced to a MCC PLOAD initialization problem
    - Topping time set incorrectly due to procedural error

- PLOAD LOX estimate was high by about 600 pounds
  - Converts to a 270 pound performance hit when assessed with the STS-121 MPS budget
  - Roughly a 30 second reduction in launch window and 1 to 2 seconds loss in uphill abort capability
  - STS-121 budget was extremely sensitive to LOX loading change due to low fuel bias

- Procedures calling for verification of “Topping Time” were misplaced in the PLOAD operator checklist

- SSP DOLILU Anomaly and a FDD AR were opened to document this problem
Low-Speed C-band Tracking Data Loss

- **Low-Speed C-band Tracking Data Loss**
  - **Kaena Point radar KPTC**
    - Data circuit problem prevented transmission of data
    - Playback issues
  - **Ascension radar ASCC**
    - Data circuit problem prevented transmission of data
    - Transmitter issue resulted in partial loss of data on multiple passes
    - Playback issues
  - **Antigua radar ANTC**
    - Timing hit that prevented transmission of data
    - 1 second time bias occurred on two passes
  - **Wallops radars**
    - Data sent in bursts
  - All of these issues were resolved during the flight
  - Navigation will follow up with the Network at the Post Mission Review