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# **STS-127 MOD FRR**

## **FLIGHT DESIGN AND DYNAMICS**

**May 5, 2009**

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# Shuttle CoFR Status Summary

MOD Requirements Codes *	DM	USA FDD
NON-CRITICAL PROC/APPL	G	G
FD-TRAJECTORY	N/A	G
FD-CONSUMABLES (PROP)	N/A	G
FD-ANALYST CERT	N/A	G
FD-CTF	N/A	G
FDF	G	G
EMCC	G	G
CREW TRAINING (RNDZ)	G	G
CERTIFIED FLIGHT CONTROLLERS	G	G
CERTIFIED INSTRUCTORS (RNDZ)	G	G
FTP-NEW OPS	G	G
FLIGHT ANOMALY RES	G	G
ANOMALY-PROCEDURE	G	G
EX/AI FROM PRIOR READINESS REVIEW	None	None
NO CONSTRAINTS	None	None
LEVEL II (PROGRAM) ACTIONS	None	None
MISSION REQUIREMENTS	G	G
CMD PROC	G	G
EXCEPTION RESOLUTION	G	None
FPPP REQ MET	G	G
CONTRACTOR PROCESS INSIGHT	G	N/A

G	Ready to support flight or standard open work
Y	Non-standard open work with expected resolution
R	Open work without expected resolution
N/A	Does not apply
None	None identified

\* as defined in DA8-020 "MOD Certification of Flight Readiness Process" document  
 Note: CRIT PROC/APPL responsibility has been transitioned to FDOC

# Mission Overview Summary

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<b>Launch/Landing Times</b>	<b>Date</b>	<b>GMT</b>	<b>EDT</b>	
<b>Launch Window Open</b>	<b>June 13, 2009</b>	<b>11:14:50</b>	<b>07:14:50</b>	(hh:mm:ss)
<b>Launch Window Close</b>		<b>11:24:50</b>	<b>07:24:50</b>	(hh:mm:ss)
<b>Landing Time (KSC)</b>	<b>June 28, 2009</b>		<b>23:37</b>	(hh:mm)

Consecutive FD3 rendezvous opportunities are anticipated through a launch on June 21<sup>st</sup>. The 60-degree mated solar beta angle will be violated for launch dates from June 20<sup>th</sup> through July 10<sup>th</sup> (KSC), 2009.

**First Stage Design Criteria**      **DOLILU II / High Q**  
**Insertion Altitude/Inclination**    **122 nm / 51.6 deg**

**APM** (above a 5 minute window centered at in-plane)

**I-load Design**                      **2,558 lbs**

**Projected APM\***                      **1,234 lbs**

\* Based on 4/27/09 APM simulation and 4/28/09 Greenbook

Launch hold capability inside of drainback is dependent upon actual DOL performance.  
Abort coverage has sufficient overlap from liftoff to MECO.

# Significant Changes Since Design Baseline

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- **Launch date changed from April 23, 2009 to May 15, 2009 to June 13, 2009.**
- **Forward Reaction Control System (FRCS) load updated from minimum to midpoint**
- **Maximum Rendezvous Altitude update from 195 nmi to 191 nmi**
- **DOLILU Wind Change Redline update in work (ECD 4/28/09)**
  - Data has been updated and redefined to reflect seasonal vs. annual variations
  - Reviewed at Ascent/Entry Flight Techniques Panel on 4/13/09
  - Approved at the SICB on 4/28/09
  - Change will be implemented by MSFC Natural Environments
- **Due to new MPS Inventory (R0901S), DOL Flight Derived Dispersion updates and New DOLILU S9 Rule updates are in work (CR84799AW)**
  - Reviewed at GNC/Loads Panel on 4/24/09
  - Final authorization will come from the SICB (05/05/09)
  - DOLILU process implementation to be completed by TCDT (5/25/09)

# Significant Mission Firsts and Unique Items

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- **First flight using the new MPS Propellant Inventory R0901S for DOL Support**
  - STS-400 will be the first flight to fly with the new MPS Propellant Inventory R0901S if call-up is required.
- **Launch scheduled 6 days prior to a mated beta angle cutout**
  - 60-degree mated operations beta angle cutout starting June 20<sup>th</sup> through July 11<sup>th</sup> (July 10<sup>th</sup> KSC), 2009.
- **Propellant budgeted for Passive Thermal Control (PTC) attitude control at End Of Mission (EOM) through EOM + 2 days**
  - Potential exceedance of 60-degree beta angle constraint post undock if launch occurs on June 16<sup>th</sup> through June 20<sup>th</sup>.

# Deviations, Exceedances and Anomalies

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## Deviation / Exceedances

- **A Contingency Abort Black Zone (CABZ) assessment is not required.**
  - Mass properties do not meet the CABZ assessment criteria of liftoff weight greater than 259,000 lbm and Xcg aft of 1115.0 in.
  - FRR cycle liftoff weight = 264,163 lbs. and Xcg = 1111.0 in.

## Previous Mission Anomalies (STS-119 and STS-126/OV-105)

- **During STS-119 Entry, all 3 TACANs temporarily lost lock on Bearing measurements.**
  - OV-105 is equipped with 3-string GPS and has no TACAN receivers
  - Not an issue for this flight.
- **During STS-126 (OV-105) undock, Ku Radar provided corrupted, unusable data (IFA 003668)**
  - Confirmed hardware issue
  - Unit has been replaced

# Exceptions and Standard Open Work

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- **Exceptions**

- None

- **Standard Open Work**

- All open work is scheduled to be completed per standard flight template
- Open work table in backup pages

- **Non-standard Open Work**

- ECO/EMCC Operator certification 05/13/09
- DOL Flight Derived Dispersions and DOLILU S9 Rule Implementation 05/25/09
- Rendezvous Class: R/PO PRF ADV 41069 06/07/09
  - The standard Rendezvous training classes will be completed very early for this mission (5/22/09) with respect to the June launch date
  - This non-standard class is required to comply with the L-2 week Proficiency requirement.
  - No issues with STS-127 crew readiness



# Rescue Mission Status

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- **STS-128 has been designated as the LON flight for STS-127**
- **STS-128 will be ready to launch on 8/06/09, if required, with the cargo element installed**
- **All rescue mission-specific analyses will be performed after call-up**

# Flight Design and Dynamics Readiness Accountability Statement

- ☑ **Software** : FDD discipline software used to create mission products meets generic and mission-specific Program requirements and is maintained under configuration control in accordance with the appropriate 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 and instructors are or will be trained, certified and current prior to supporting mission related activities. All flight-specific rendezvous crew training will be completed prior to launch.

*The FDD Flight Readiness Review Process Plan (USA009229) and the Flight Operations Flight Preparation and Readiness Plan (USA008977; Appendix D) which define 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-127.**

<b>Flight Design and Dynamics</b>	<b>S. A. Anderson Director</b>	<i>Original signed by S. A. Anderson</i> <small>Signature</small>	<i>04/28/09</i> <small>Date</small>
<b>Ascent/Descent Flight Design</b>	<b>D. J. Brockway Manager</b>	<i>Original signed by D. J. Brockway</i> <small>Signature</small>	<i>04/28/09</i> <small>Date</small>
<b>Orbit Flight Design</b>	<b>R. M. Hill Manager</b>	<i>Original signed by R. M. Hill</i> <small>Signature</small>	<i>04/28/09</i> <small>Date</small>
<b>Navigation &amp; Flight Design Integration</b>	<b>G. E. Schrage Manager</b>	<i>Original signed by G. E. Schrage</i> <small>signature</small>	<i>04/28/09</i> <small>date</small>

# Flight Design and Dynamics Declaration of Compliance with CoFR Endorsement Requirements for STS-127 Flight Readiness

- ☑ **Software** : FDD discipline software used to create mission products meets generic and mission-specific Program requirements and is maintained under configuration control in accordance with the appropriate 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 and instructors are or will be trained, certified and current prior to supporting mission related activities. All flight-specific rendezvous crew training will be completed prior to launch.

**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.

<u>DOCUMENT</u>	<u>VERSION</u>	<u>DATE</u>
Flight Implementation Data Pack (FIDP) - Generic	GEN-KY	04/22/09
Flight Implementation Data Pack (FIDP) - Flight Specific	127-BASE-AD	04/23/09

## Waivers & Exceptions:

None

*The FDD Flight Readiness Review Process Plan (USA009229) and the Flight Operations Flight Preparation and Readiness Plan (USA008977; Appendix D) which define the processes and products required for a successful flight have been executed and the applicable Program CoFR requirements satisfied.*

*Pending completion of open work and closure of noted exceptions, if applicable, Flight Design & Dynamics is ready to support STS-127.*

*Original signed by S.A. Anderson* 5/01/09  
**Director** **Date**  
**Flight Design & Dynamics**

# DM Flight Design and Dynamics (Trajectory Operations)

## Significant Mission Firsts and Unique Items

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- **ISS Phasing Strategy**
  - Use Progress mid ring thrusters with Progress on the nadir
  - Max phasing capability is 0.5 mps
  - Reboost placeholder on 6/3 (Currently targeted as 0 m/s)
  - Currently there is no reboost required
  - Consecutive launch opportunities with FD3 Rendezvous: 9 days (June 13-21)
- **There is no JURE capability**
- **Jettison of JEM Thermal Covers (4-6) on EVA 1 through 3.**
  - TOPO jettison analysis shows safe long term relative motion with ISS
  - Covers expected to be far in front by undock
  - Jettison on EVA 5 or within two days of undocking prohibited by Flight Rule
  - EVA 2 jettisons (2) will only occur if time limited for bagging them during the EVA

# Significant Mission Firsts and Unique Items

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- **ANDE-2 Deploy**

- Deployed at least 5.3 nm (10 km) below ISS – No recontact issues with ISS
- Separates into 5 components after deploy
- Separation delta-v from Space Shuttle is 0.7 fps (Castor Cylinder) to 4.4 fps (Pollux cylinder)
- Minimum velocity is 0.6 fps assuming 1 spring failure
- Deploy will be performed in an attitude to provide a retrograde sep
- Will perform a burn after deploy to bring sep rate to at least 1 fps opening. Burn TIG selected at optimal time for combination with orbit adjust if required

- **DRAGONSAT Deploy**

- Deployed at least 5.3 nm (10 km) below ISS – No recontact issues with ISS
- Separates into 2 components after deploy
- Separation delta-v from Space Shuttle is 6.8 fps to 7.9 fps
- Deploy will be performed in an attitude to provide at least 3 fps retrograde opening rate

# Significant Mission Firsts and Unique Items

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- **Payloads of Opportunity**

- MAUI
- SEITE
- SIMPLEX

- **2JA Stage ISS Visiting Vehicle Traffic**

- 33P Undock (DC1 Nadir) – July 17<sup>th</sup>
- 18S Relocate (SM Aft to DC1 Nadir) – July 20<sup>th</sup>
- 34P Docking (SM Aft) – July 26<sup>th</sup>

# Exceptions and Standard Open Work

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- **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

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- **Nominal Undock with OBSS unstowed:**

- 10 FPS Sep-2 burn required for subsequent deploy ops.
- OBSS will be unstowed, on the SRMS in the undock position
- Previous Analysis for up to 5.6 fps +X, ER verbally OK'd 10 and promised documentation
- Submitted CR to 2JA\_C2-50 Nominal Undock with OBSS Unstowed
- EA agreed on 10 fps, but wanted additional content added to the rule
- Safety has raised concerns with the thoroughness of the documentation of the analysis
- Currently re-structuring, attempting to make PCN1
- Fallback plan would be to execute 2 consecutive 5 fps burns separated by 1 minute

- **Soyuz Debris Avoidance Maneuver – 2JA Stage**

- Timeline is same as Progress without matching unit but additional flexibility on Time of Ignition (TIG) due to crew involvement
- OIP, Flight Rules, and Console Handbook updates submitted – waiting approval
- 4 to 7 day period between 33P Prop Purge and 18S Relocate where this capability would be prime for any debris avoidance maneuvers



# STS-127 Flight Design & Dynamics Division Readiness Statement

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The Flight Design and Dynamics Division has performed the reviews necessary to assess the flight readiness relating to flight design requirements definition, crew and flight controller rendezvous training, and trajectory operations. We have determined all applicable responsibilities acceptable for flight pending closure of the identified open work and issues.

*Original signed by B. A. Conte* *04/29/09*

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

*Original signed by R. D. Banfield* *04/29/09*

Robert D. Banfield  
Chief, Flight Design and Dynamics Division

As compiled by: FDM/J. Flinn  
FDO/R. Cutri-Kohart

# Back-Up

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- **Flight Readiness Open Work**
- **Propellant Summary**
- **Items listed below in separate file:**
  - Launch Window
  - Abort Regions Chart
  - Nominal ET Impact Area

## Flight Readiness Open Work

Item	Responsible	Due Date	Closed	Closure Rationale
<b>USA Flight Design Standard Open Work:</b>				
PROP37 SODB Volume II Amendment	PROP	05/01/09		
DATA43 FDD FRR Data Pack	FDM	05/07/09		
FSW Verification Test Results Review	ADFD	05/14/09		
FSW Verification Test Results Review	Orbit	05/14/09		
RNDZ/FDO Phasing Plan Meeting	Orbit	05/10/09		
ONOR29B RNDZ Launch Target Data	Orbit	05/13/09		
DATA45 FDD FSW PF Sign-off	FDM	05/15/09		
PROP06 OMRSD OMS/RCS	PROP	05/15/09		
PROP07 Abort Propellant Dump Tagup	PROP	05/16/09		
L-4 week LDO Database Freeze	ADFD	05/16/09		
RNDZ08 RNDZ Phasing Limits	Orbit	05/18/09		
PROP02 Mass Properties	PROP	05/20/09		
ONOR37B Daily Planar/Phase Windows	Orbit	05/20/09		
Prop Analyst & Flt Controller Tag-up	PROP	05/21/09		
NAVO16B GPO COTM Data Pack	Navigation	05/22/09		
NAVO18B GPO/ONAV Ops Memo	Navigation	05/22/09		

## Flight Readiness Open Work - Continued

Work Item	Responsible	Due Date	Closed	Closure Rationale
<b>USA Flight Design Standard Open Work - Continued:</b>				
ONOR27 Launch and Landing Data	Orbit	05/22/09		
ASCT04 Uplink APM	ADFD	05/23/09		
LDO: L-3 week LDO Checkout/TCDT Sim	ADFD	05/25/09		
ASCT44 DOL Uplink I-loads	ADFD	05/29/09		
ONOR29C RNDZ Launch Target Data	Orbit	06/03/09		
Dial Down Decision FIDP	FDM	06/05/09		
ONOR37C Daily Planar/Phase Windows	Orbit	06/05/09		
RNDZ02 Target Drag Characteristics	Orbit	06/05/09		
DSCT17 Landing Site Tables	ADFD	06/06/09		
PERA Pre-Flight Product	ADFD	06/06/09		
C-Band tracking Scheduling Message	Navigation	06/06/09		
ASCT99 OMS Assist - ATO Update	ADFD	06/07/09		
PROP00A PROP/Ascent Aborts Tagup	PROP	06/08/09		
RNDZ09 Rendezvous COLA Plans	Orbit	06/08/09		
PROP02A DOL Mass Properties Updates	PROP	06/08/09		
Pre-Launch Mass Properties Request	PROP	06/08/09		

## Flight Readiness Open Work - Continued

Work Item	Responsible	Due Date	Closed	Closure Rationale
<b>USA Flight Design Standard Open Work - Continued:</b>				
PROP31 ARD Data	PROP	06/08/09		
PROP33 Ferry Data Package	PROP	06/08/09		
PROP34 MCC Data	PROP	06/08/09		
SRB & ET RTLS Impact Point Update Memo	ADFD	06/10/09		
ASCT42 Collision Avoidance Data	ADFD	06/10/09		
ASCT47 Final MCC Trajectory Inputs	ADFD	06/10/09		
DSCT66 Real-Time Support Files	ADFD	06/10/09		
Range Safety Launch Window Cutout	ADFD	06/10/09		
Flight Annex	Navigation	06/10/09		
ASAB32B AME MCC Support Tables	ADFD	06/11/09		
L-2 day DOLILU System Checkout	ADFD	06/11/09		
DSCT05 Maximum Crossrange Capability	ADFD	06/11/09		
ASAB25 ARD Bias Tables	ADFD	06/12/09		

## Flight Readiness Open Work - Continued

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Work Item	Responsible	Due Date	Closed	Closure Rationale
<b>USA Flight Design Non-Standard Open Work:</b>				
ECO/EMCC Operator certification	ADFD	05/13/09		
DOL Flight Derived Dispersions/S9 Rule Updates	ADFD	05/25/09		

## Flight Readiness Open Work - Continued

Item	Responsible	Due Date	Closed	Closure Rationale/Status
<b>Trajectory Operations Standard Open Work</b>				
Close to Launch Trajectory Data	OFDO	05/09/09		
Successful Completion of RNDZ Training	RNDZ Instructor	05/22/09		
TCDT Checkout in Ops Cert Mode	AE GPO	05/28/09		
DOD Support Readiness	LSO	05/29/09		
Flight Load Checklist Complete	Nav	05/29/09		
Flight Load Checklist Complete	DOLILU	05/29/09		
Flight Load Checklist Complete	Entry Support	05/29/09		
Flight Load Checklist Complete	Orbit-RNDZ	05/29/09		
Flight Load Checklist Complete	RGPO	06/07/09		
Flight Load Checklist Complete	AE FDO	06/07/09		
Flight Load Checklist Complete	AE GPO	06/07/09		
Flight Load Checklist Complete	LSO	06/07/09		
Flight Load Checklist Complete	OFDO	06/07/09		

## Flight Readiness Open Work - Continued

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Item	Responsible	Due Date	Closed	Closure Rationale/Status
<b>Trajectory Operations Non-Standard Work:</b>				
Flight rule documenting undock with OBSS unstowed	FDO	06/01/09		
RNDZ Training Class: R/PO PRF ADV 41069	RNDZ Instructor	06/07/09		



# Flight Readiness Open Work - Concluded

Item	Responsible	Due Date	Closed	Closure Rationale/Status
<b>DM Standard Open Work:</b>				
Orbiter Readiness Statement	FDRIB	05/24/09		
Range Safety Readiness Statement	FDRIB	05/28/09		

The Flight Design and Dynamics Division has performed a final review and determined all Division and USA FDD open work and/or actions for this mission are closed or acceptable rationale is provided for proceeding with the flight.

\_\_\_\_\_  
 Flight Design Manager  
 Date\_\_\_\_\_

\_\_\_\_\_  
 Chief, Flight Design Requirements and Integration Branch  
 Date\_\_\_\_\_

\_\_\_\_\_  
 Director, Flight Design and Dynamics Department  
 Date\_\_\_\_\_

\_\_\_\_\_  
 Chief, Flight Design and Dynamics Division  
 Date\_\_\_\_\_

# Propellant Summary

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**FRCS = 2175 lbm**

**ARCS = 4970 lbm**

**OMS = 22761 lbm**

**FRR Design Propellant Margins**

**ARCS/OMS = 32 lbm**

**FRCS = 561 lbm**

**FRR Design Assumptions: STS-127 ATL, FRR Cycle Trajectory Inputs - 122 nm RNDZ, 61 sec OMS Assist, 1 mated water dumps**