STS-106 Flight Readiness Review

August 29, 2000

Agenda

- Program Integration - Flight Manager — Nat Hardee
  - Key Mission Considerations *
  - Payload & System Safety
  - Orbital Debris Status
  - Payload In-Flight Anomalies * — - No Issues
  - Launch Commit Criteria *
- Special Topic - Targeted Launch Times for ISS Missions * — Linda Ham
- USA Program Integration — Bob White
  - Systems and Cargo Integration Flight Preparation *
- BRSS Integration
  - Program Anomalies * — - No Issues
  - Waivers to Vol X — - No Issues
- System Integration TMR — Don Noah
- Flight Readiness Statement

* Backup Material Included

Key Mission Considerations

- STS-106 (2A.2b) is 2nd offspring of STS-101 (2A.2) with STS-101 (2A.2a) the 1st
  - 4 month turnaround from STS-101
  - Basically same integrated vehicle configuration and mission integrated products
  - Same basic Flight IPT

Key Mission Considerations

- **Energy Dependent Day / Launch Day Opportunity Strategy**
  - Placarded FD3 rendezvous launch opportunities
  - 204 lbs O_2 / 41 lbs H_2 margin for 11 day flight
  - 12th day (6 ingress days) required to provide margin for full 11 day timeline and opportunity to complete ISSP's baselined / get ahead tasks
  - Need 70 lbs / 95 lbs O_2 buybacks for on time launch / 24 hr scrub to extend to 12 day flight
    - Buybacks identified *
  - Expect FD3 rendezvous opportunities for 9/8, 9/9, 9/11, 9/12
  - O_2 and H_2 require reservice and buybacks for 9/11 or 9/12 attempts to extend to 12 day flight
  - 48 hr duel commodity reservice being evaluated (72 hour standard)
  - Therefore, energy dependent day achievable for 9/8 or 9/9 launch but have to reservice both O_2 and H_2 for 9/11 or 9/12 launch attempts
  - With O_2 reservice on 2nd day, FD3 rendezvous opportunities on day 1 & 3 support a 12 day flight with 70 lbs of O_2 buybacks
  - If FD4 rendezvous launch required, baselined FDRD 11 day Flight Plan (5 ingress days) supportable with 51 lbs of O_2 buybacks

* Backup Material Included

Payload and System Safety

- Integrated hazards assessment is complete
- Payload environmental impact assessment complete
- Toxicology process
  - Verification 1: Complete
  - Verification 2: Standard open work for late load items
- Payload safety review process is complete except for ICC SHOSS Box Safety Data Pack
  - Reopened for late addition of MicroWIS recorders (4) and SAAMD's (2)
  - Expect no problems since same configuration as STS-101
  - ECD: 08/30/00

STS-106 Orbital Debris Status

- **Orbital Debris / Micrometeoroid Risk Is Acceptable**

Criteria	Risk	Guideline
Critical Penetration	1 in 602	1 in 200
Radiator Tube Penetration	1 in 511	1 in 60
Window Replacements	66%	N/A

STS-106 Launch Commit Criteria

- **Generic Maximum Allowable Ground Winds (LCN 977)**
  - **Deletes GSE-FG03 for mission specific maximum allowable ground winds and updates GSE-024 with generic Vol X wind limits since RSRM aft segment stiffener hardware now certified to Vol X limits**
    - **ECD: 09/01/00**

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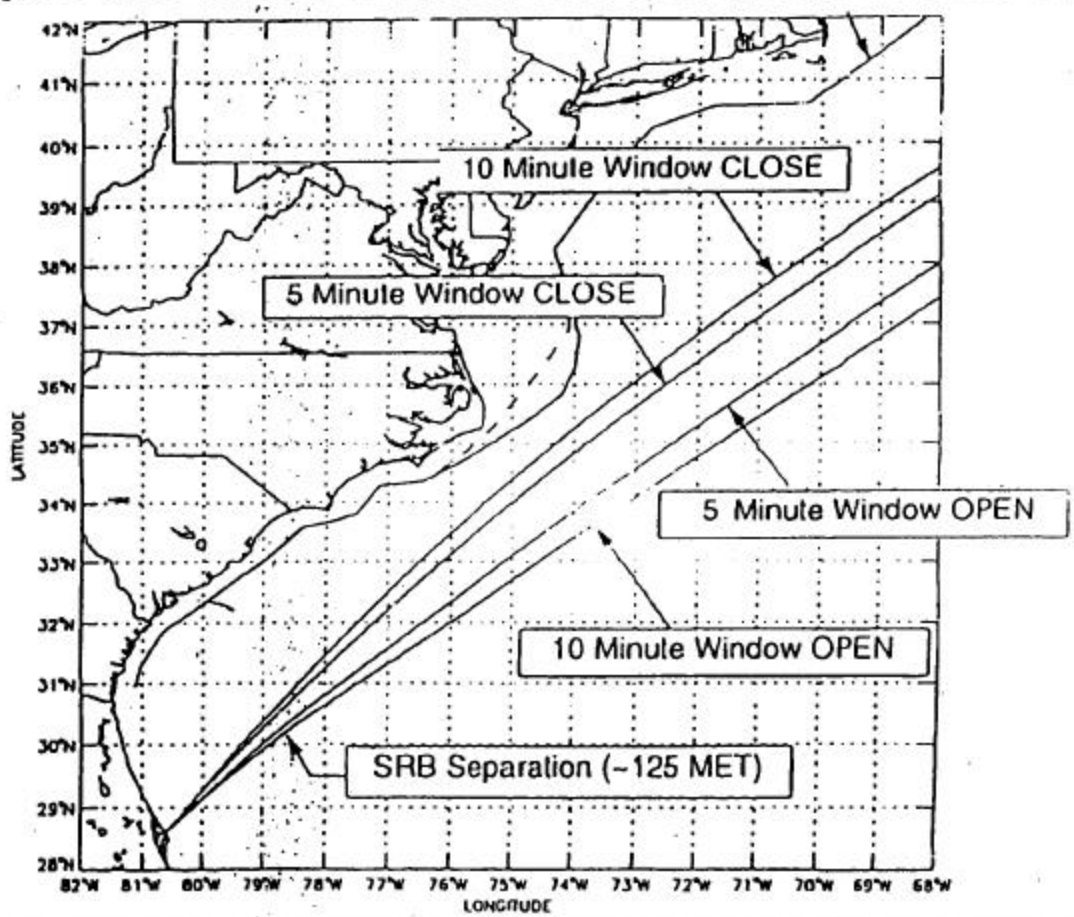
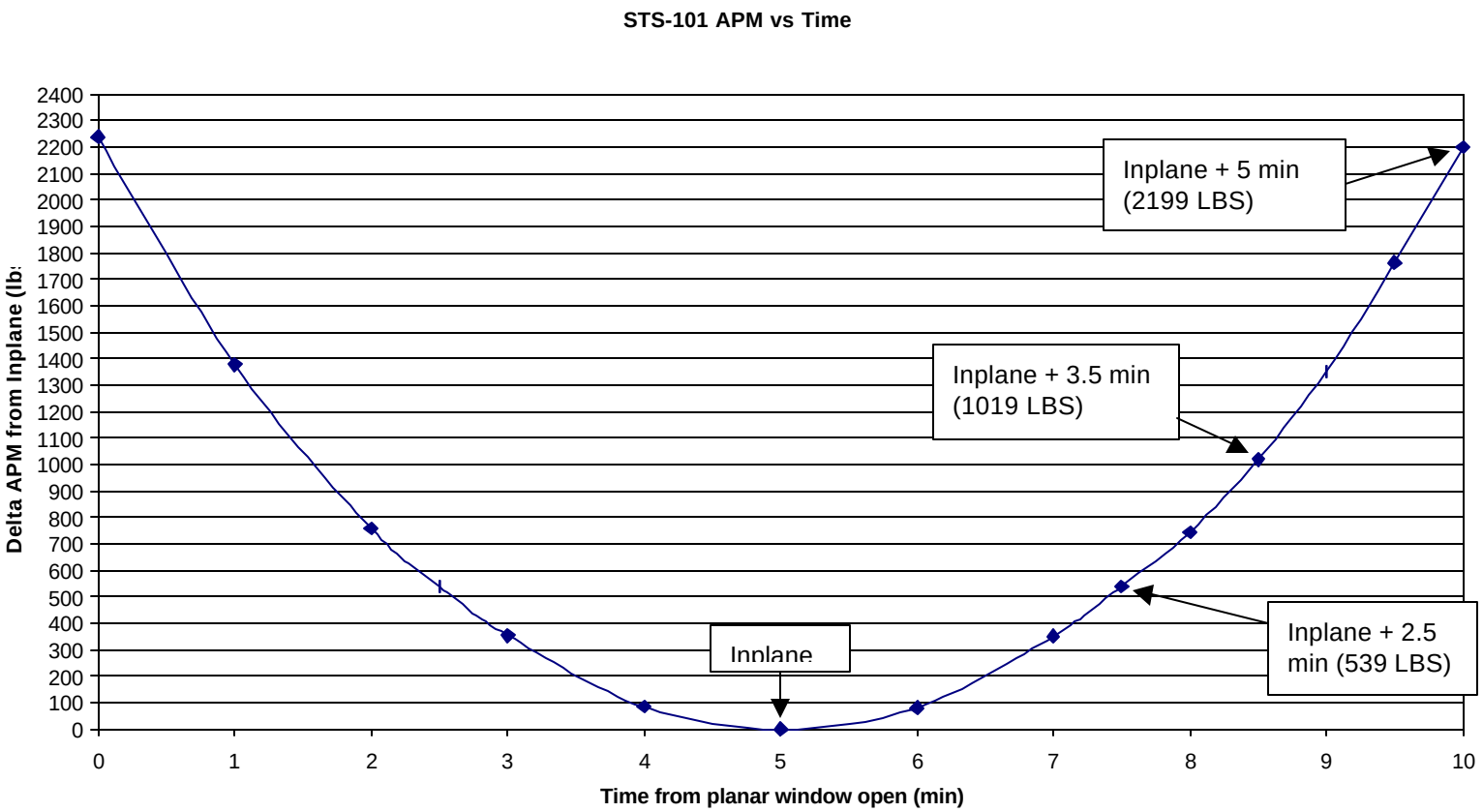
Launch Window Groundtrack

Open and Close Window Groundtracks of 51.6 deg



Ascent Performance Margin vs. Time

Presenter	Linda Ham	
Date	08/29/2000	Page 10



Launch Window Mission Design Considerations

- Flight design I-loads protect full 10-minute window (ET cert constraint)
- RNDZ profile designed to maximize launch window to 10 minutes
- SSP manifests to 5-minute window (near in-plane ± 2.5 minutes)
  - Protects 700 lb Ascent Performance Margin (APM) above 5-minute window for DOL dispersions
- OMS assist timer adjusted ~L-5 days to carry additional OMS to orbit
  - Protects 900 lb APM above 5-minute window (near in-plane ± 2.5 minutes)

Two Separate but Related Issues

1. **Preferred Launch Time**: Disregarding window duration, what is the preferred launch time - open, "optimum" (near in-plane), close, or somewhere in between?

   Trades: Intact abort mode, ascent performance margin, FD3 vs FD4 RNDZ, OMS to orbit, East Coast Abort Landing (ECAL) site coverage, mission recovery capability for one SSME failure, drainback hold time

2. **Launch Window Duration**
   - Risks associated with launch scrub/24-hour turnaround
   - LCC preplanned contingency procedures
   - Launch hold history

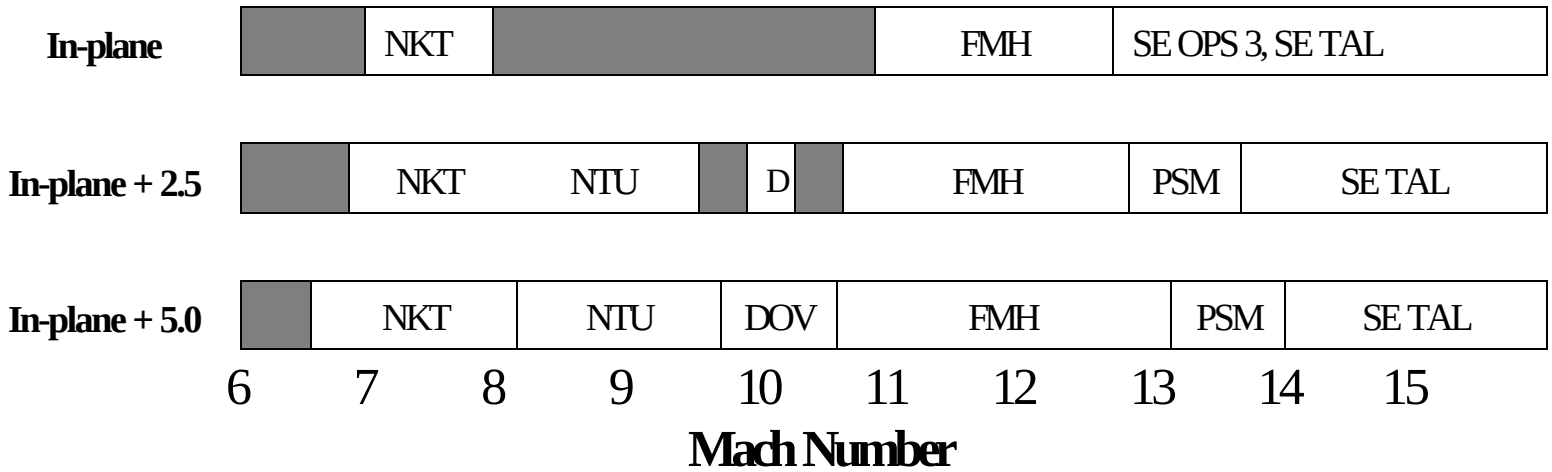
Options

- There are numerous options, but fundamentally, two approaches
  - Choose preferred launch time, and launch window duration will fall out, or
  - Choose minimum launch window duration, then prioritize other trades
- Old rules prioritized as follows: 5-minute window, FD3 RNDZ (as long as 1 minute of FD3 is available), maximize APM
- SSP (including KSC-PH, FCOD, MOD, SRQA) agreed to
  - Choose preferred launch time based on safety and mission success (mission success equates to safety by avoiding additional launch)
  - Accept resulting launch window

SSME Probabilities

- SSME probabilities from Rocketdyne with MSFC/SSME Project Office concurrence
  - Assumes Block IIA SSME's
  - Anchor to SSME demonstrated reliability for Block I configuration
- Probability of a noncatastrophic SSME failure during 8:30 ascent: 1 in 255 flights [failure rate: 3.9e-3; 0.996 reliability]
- Probability of catastrophic SSME failure during 8:30 ascent: 1 in 390 flights [failure rate: 2.56e-3; 0.99 reliability]
- Probability of second noncatastrophic SSME failure during 8:30 ascent: 1 in 195,000 flights [failure rate: 5.13e-6; 0.999995 reliability]
- Probability of 2 SSME's noncatastrophic failures during the timeframe where additional 2 engine out ECAL sites are available: 1 in 1,023,250 flights [failure rate: 9.77e-7; 0.999999 reliability]
  - First SSME fail between two eng TAL and PTA
  - Second SSME between Mach 8 - Mach 11 (129-sec window)

ECAL Coverage for 2 SSME Out Simo



	Bailout	D, DOV	Dover
NKT	Cherry Point	FMH	Otis
NTU	Oceana	PSM	Pease

Ascent Performance Anomaly Probability

- Historical data indicates 2 of 98 launch attempts experienced anomalies with major impacts to ascent performance
  - STS-93 SSME nozzle leak (hurt) and high performing SSME due to ac short (helped) resulted in ~2500 lbs APM hit
  - STS-78 SSME pressure transducer icing (longer SSME burn time) and LH2 underload resulted in ~4000 lbs APM hit

Safety Priorities

- Launching at any time in the launch window is safe
- Optimize for the most likely failure case - maximize APM for unforeseen problems
  - Could be safety or mission success trade depending upon significance of performance lost
  - History of needing maximum APM: 1 in 49
- Protect for 2nd most likely failure – one SSME benign shutdown
  - Regardless of where in the launch window we launch, intact abort capability exists for one SSME failed
  - However, earliest two eng TAL and PTA occurs at window open
- Maximize mission success to minimize chance of an additional launch to complete mission objectives
  - Ascent is clearly the riskiest mission phase
  - Probability of catastrophic SSME failure during ascent: 1 in 390 flights

Safety Priorities (cont'd)

- Maximize chance of mission success by
  - Launch with FD3 RNDZ capability (increasingly important)
  - Maximum OMS propellant to orbit (adjust OMS assist) to provide margin for
    - Provide for contingency re-rendezvous
    - Reboost ISS
    - Additional STS attitude control of docked stack
    - Use OMS for phasing (opens launch window, change FD4 to FD3 RNDZ)
  - Provide earliest mission success for single SSME failure (safety trade)
- Maximize ECAL coverage for second and third SSME failures
  - Probability of failures during the timeframe where additional 2 engine out ECAL sites are available: 1 in 1,023,250 flights
  - ECAL coverage does not imply safe landing (uncertified)
    - ET sep, no factor of safety on Nz/Qbar, thermal, etc.
    - Landing weather

Launch Window Trades

Trade	Open (-5 min)	Optimum (near in-plane)	Close (5 min)	Probability of Occurrence	Survivability
Max MPS performance (safety and mission success)	-2440 lbs (110 fps)	MAX	-2160 lbs (21 fps)	1 in 49	Hi
Earliest "preferred" 1 SSME fail abort mode • TAL • PTA	Earliest Earliest	5 sec later than Open 8 sec later than Open	11 sec later than Open 25 sec later than Open	1 in 255	Hi
Max chance of mission success • FD3 vs FD4 RNDZ • Max OMS to orbit • Earliest mission success with 1 SSME failed	MAX FD3 RNDZ 26 sec later than Opt	MAX Earliest	9 sec later than Opt	1 in 1,445	Hi
Max ECAL coverage • 2nd SSME fail coverage (SIMO) • 2nd SSME fail coverage (SEQ) First EO at 6K, abort ZZA • 3rd SSME fail coverage (SIMO)	No capability No capability 68 sec of capability	54 sec of capability 22 sec of capability 109 sec of capability	MAX 145 sec of capability 167 sec of capability 191 sec of capability	<<1 in 1,023,250 1 in 1,023,250 <<1 in 1,023,250	Near None Lo Near None
Max launch window	MAX Min. scrub risk			19% of delays <5 min	Hi
Max LOX drainback hold time	MAX Min. scrub risk	41 sec < open	5 min < open		Hi

Launch Window Duration

- **Launch delay history indicates**

~10 percent of delays were:	delay < 2.5 minutes
~ 9 percent of delays were:	2.5 < delay < 5.0 minutes
~ 4 percent of delays were:	5.0 < delay < 10 minutes

- **Majority of LCC preplanned contingency procedures built to complete in 5 minutes**
  - 65 percent cannot be accomplished in 3 minutes or less
  - 48 percent cannot be accomplished in 5 minutes
    - Landing weather

Launch Window Duration (cont'd)

- Risk of launch scrub/24-hr turnaround has not been quantified
  - One single point failure identified, GVA jackscrew failure while arm retract or reextend postscrub
    - Annual preventive maintenance is performed to preclude this failure
- Importance of launch window
  - Duration of launch slip due to scrub can be significant due to range conflicts, etc. (e.g., STS-101)
  - Launch slips can become crucial to ISS assembly
  - Historical data indicates ~19 percent of delays between 0 and 5 minutes
  - LCC preplanned contingency procedures built to complete in < 5 minutes

Conclusion

- To maximize safety and mission success: Launch at optimum and accept resulting window duration
  - Maximizes APM
  - Maximizes OMS to orbit
  - Typically provides FD3 RNDZ
  - Earliest (within 1 sec) mission success with one failed SSME
  - Lose 5 sec TAL and 8 sec PTA over open for 10 minute window
  - Some improvement in ECAL site coverage over previous philosophy, however, lose some ECAL coverage for 2 and 3 SSME failures compared to window close
- Continue to adjust OMS assist timer at L-5 days protecting 900 lb APM above 5-minute window
  - If DOL APM gains ~750 lb, window duration is 5 minutes
  - If DOL APM has no gains or losses, window duration is ~4 minutes
  - Loss 700 lbs APM, window duration is 3 minutes
  - Loss 900 lbs APM, window duration is 2.5 minutes
- This philosophy will be used for STS-106 and subsequent flights

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SYSTEMS & CARGO INTEGRATION ANALYSES & REQUIREMENTS

Presenter:
Bob White

Organization/Date:
Program Integ/08-29-2000

- **STS-106 has been evaluated for compatibility with all generically certified systems requirements - no issues**
  - Includes dynamic clearances, loads, thermal, IGN&C, etc.
  - Verified by comparison of generic cert databases to mission mass properties, trajectory data & I-loads
- **Mission specific Systems and Cargo Integration analyses have been completed except for standard planned work - no issues**
  - Verification of as-designed vs as-installed TOP's at L-2 days
  - GN&C ATO dump uplink I-load verification at L-8 days
  - Complete OMS assist uplink I-load verification at L-2 days
- **STS-106 flight elements and cargo configuration requirements have been developed and released in appropriate documents and engineering drawings - no issues**

SYSTEMS AND CARGO VERIFICATION

Presenter:
Bob White

Organization/Date:
Program Integ/08-29-2000

- **Have verified that STS-106 ascent design criteria operates within the PE certification limits for all critical parameters - no issues**
- **Supported the testing and verification for DOSS - no issues**
  - Verified new work station operating system (O/S) with component level tests and O/S regression tests
  - Verified update to SSME influence coefficients
  - Standard planned work remaining - L-2 day verification testing
- **Payload Integration hardware reconfiguration and Interface Verification Tests (IVT's) have been completed except for standard planned work - no issues**
  - Middeck experiment installation and IVT at L-1 day

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STS-106 NASA System Integration TMR Flight Readiness

- Insight, audit and surveillance requirements complete
- No out-of-family problems have been identified for impact to safety of flight, or planned flight operations
- Approved Program requirements changes have been implemented and verified
  - ICD, OMRS, LCC
  - Vehicle configuration
  - DOSS configuration
  - NSTS 07700, Volume X
  - Joint requirements
- All Joint Shuttle / International Space Station on-orbit Systems Integration analyses have been completed and compatibility verified for STS-106 2A.2b
- System Integration is ready for flight pending the completion of remaining open work

SPACE SHUTTLE PROGRAM
Space Shuttle Program Integration
NASA Johnson Space Center, Houston, Texas

STS-106 Flight Readiness Statement

Presenter	
Date 08/29/2000	Page 28

THIS CERTIFIES THAT ALL MISSION REQUIREMENTS HAVE BEEN MET AND SPACE SHUTTLE INTEGRATION IS READY FOR FLIGHT, PENDING COMPLETION OF THE DEFINED OPEN WORK

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STS-106 Flight Readiness Review

Backup Charts

Cryo Buybacks (lbs of O_2) For 12th Day

38.7	Programs agreed "easy" items (18.0/14.7 EVA on additional day, 1.9 no EMU recharge after additional EVA, 18.8 Circ Pump mgmt)
15.6	Ku-band mgmt (save 8.0 lbs with early stow after undocking)
20.0	CGBA
8.3	Delete SOAR PGSC (2) ops except for 8 hr minimum
4.7	Delete one of two SOAR PGSC ops
2.0	Delete OSVS ops
5.4	Delete Spacelab Crew support ops
16.7	Power down FF2, FF4, & FA4 MDM's for docked period
22.0	Delete O_2 Repress above 14.7
42.0	Connect RACU Y-Jumper/delete docked APCU ops

Cryo Buybacks (lbs of O_2) For 12th Day

On-time Launch
Need 70 lbs of Savings

38.7	Program Agreed Easy Items
8.0	Ku-Band Early Stow
22.0	O_2 Repress
1.3	Reduced SOAR PGSC Ops as Required
70.0 lbs	Savings

24 Hour Scrub (2nd Launch Attempt)
Need 95 lbs of Savings

38.7	Program Agreed Easy Items
8.0	Ku-Band Early Stow
22.0	O_2 Repress
20.0	CGBA
6.3	Reduced SOAR PGSC Ops as Required
95.0 lbs	Savings

FD4 Rndz Launch
Need 51 lbs of Savings

38.7	Program Agreed Easy Items
8.0	Ku Early Stow
4.3	Reduced SOAR PGSC Ops or Reduced O_2 Repress
51.0 lbs	Savings

Note: (1) RACU Y-Jumper (up to 42 lbs) can be used for any option if available
(2) H_2 margins support 3 consecutive launch attempts

Closed Payload In-Flight Anomalies Affecting STS-106

- AP-17 XFER SOAR OCA Files w/Floppy (STS-101-PLD-01)
  - Files on the SIGI PGSC were outdated due to launch scrub
  - When MS1 attempted to load the SOAR file updates to the SIGI PGSC, a DOS “File not Found” error message associated with the update task occurred
  - The experiment required a new almanac (for warm starts) and six new files to support the first XPOP attitudes
  - Spacehab provided update to SOAR AP-17 procedure to ensure all the files were transferred
    - Update was sent as MSG 15A and MS3 performed this procedure
  - Later SOAR discovered that the data files had errors and needed additional updates
    - New files were uplinked and revised AP1-7 was sent as MSG 23A
  - Execution of MSG 23A was successful
  - Crew procedures have been modified for STS-106 to clarify which files need to be transferred in addition to the batch file

Closed Payload In-Flight Anomalies Affecting STS-106

- SIGI PGSC Hard Disk Log and Flashcard Log Status (STS-101-PLD-02)
  - MS1, during PGSC check, reported that the fields for SIGI PGSC hard disk log and flashcard log were blank (nominal status is blue)
  - After a second check, MS1 reported that the fields were green
  - Recovery procedures from the POCC were unsuccessful
  - Spacehab believes that when MS1 cycled the “SIGI TEST” application, the anomaly was cleared
    - Ground indications show all good data
  - Anomaly traced to software bug in “SIGI TEST” application
  - Software has been updated

Closed Payload In-Flight Anomalies Affecting STS-106

- **Suboptimal Performance from Ball Star Tracker on SOAR (STS-101-PLD-03)**
  - **Telemetry from the BALL Star Tracker (ST) indicated that during daylight passes, the BALL ST was not properly computing attitude**
    - **Once into the night passes, the BALL ST was behaving as expected and properly computed attitude**
  - **The BALL ST is the primary truth source for attitude to verify the SIGI attitude**
    - **SOAR has two backups:**
      - **One is the CALCORP ST**
      - **The other is using the Orbiter attitude**
  - **After reviewing the data, it was determined that the CALCORP ST was having the same problems as the BALL ST, which means either stray light is entering both ST's from a common source, or both ST's are having difficulty rejecting stray light**
    - **There were no objects in the payload bay within the solar rejection angle of either ST**

Closed Payload In-Flight Anomalies Affecting STS-106

- **Suboptimal Performance from Ball Star Tracker on SOAR (STS-101-PLD-03) (cont'd)**
  - **Post flight analysis indicate that while in sunlight - small debris are illuminated causing the ST's to lose track of required Stars**
    - **The sun illuminated debris "floating" in front of the rendering it impossible for them to identify Stars and determine attitude**
  - **Per EM2 STS Contamination - the debris or dust particles seen during STS-101 can be attributed to the post OMDP of the vehicle**
  - **The video from STS-101 mission showed the much greater dust / debris being released from the payload bay as compared to STS-96, -99, and -103**
  - **Rationale for closure of this IFA is the released dust / debris is assumed post OMDP on STS-101, the normal pre-flight payload bay cleaning will be performed, and the Orbiter change in attitude to fly an attitude which would not illuminate the dust in the sun**

Closed Payload In-Flight Anomalies Affecting STS-106

- **Loss of SIGI Downlink Data (STS-101-PLD-04)**
  - At MET 02/08:20. 07/13:25, 07/16:13, 07/23:15, and 08/16:07 SOAR stopped receiving telemetry
  - Impact is potential loss of data since the ground could not confirm that SIGI PGSC was logging data
  - Telemetry was recovered following the first three occurrences after SOAR performed a soft reboot via ground command
  - Telemetry was recovered following the fourth and fifth occurrences by issuing a SIGI PGSC software “telemetry on” command
  - Spacehab Payload Processing Facility (SPPF) testing did not re-create problem seen on STS-101
    - Specific problem is unknown
  - Plan to fly on STS-106 as is and recovery will be via ground command - same as STS-101
  - Since problem could not be repeated during post-flight ground testing at the SPPF, the rationale for closing this IFA is to accept the anomaly if it reoccurs during STS-106, and plan to perform a ground commanded re-boot of the SIGI PGSC to prevent loss of payload data

Approved Mandatory Launch Commit Criteria for STS-106

- Minimum Equipment List (MEL) Mission Dependent
- EPDC AMEC Update
  - Reformats EPDC-09 to accommodate missions flying with the advanced master events controller (AMEC)
- Updates for the Advanced ADTA
  - Updates the applicable SSID's for the transition of the Shuttle fleet to an all advanced ADTA configuration
- Block II SSME Skin Temp & Fuel System Purge Changes
  - Updates the main fuel valve skin temp anomaly and fuel system purge system purge anomaly SSID's to include Block II SSME
- Block II SSME LPFTP Discharge Press LCC Changes
  - Updates the low pressure fuel turbopump discharge pressure engine ready anomaly and LPFTP discharge press qualification anomaly SSID's to include the Block II SSME

Approved Non-Mandatory Launch Commit Criteria for STS-106

- **Update of FCP Relief Nozzle Temperature Requirement**
  - Revises requirement for clarification of nozzle A & B temperatures during periods of rain
- **HYD Pressure Transients and C&W Updates**
  - Defines transient pressure periods and updates procedures to identify indication only failures
- **Deletion of PRSD OMRS Quantity References**
  - Updates to address the moving of quantity targets from the OMRS to the web based e-consumables system
- **Haz Gas Implementation**
  - Deletes implementation notes from HAZ-02 through HAZ-08 and moves them to HAZ-01

Launch Window Trades

Trade	Open (-2.5 min)	Optimum (near in-plane)	Close (+2.5 min)	Probability of Occurrence	Survivability
Max MPS performance (safety and mission success)	-620 lbs (28 fps)	MAX	-460 lbs (21 fps)	1 in 49	Hi
Earliest "preferred" 1 SSME fail abort mode • TAL • PTA	Earliest Earliest	2 sec later than Open 5 sec later than Open	5 sec later than Open 12 sec later than Open	1 in 255	Hi
Max chance of mission success • FD3 vs FD4 RNDZ • Max OMS to orbit • Earliest mission success with 1 SSME failed	MAX FD3 RNDZ 9 sec later than Opt	MAX Earliest	Same as Optimum	1 in 1,445	Hi
Max ECAL coverage • 2nd SSME fail coverage (SIMO) • 2nd SSME fail coverage (SEQ) First EO at 6K, abort ZZA • 3rd SSME fail coverage (SIMO)	15 sec of capability No capability 95 sec of capability	54 sec of capability 22 sec of capability 109 sec of capability	MAX 100 sec of capability 96 sec of capability 139 sec of capability	<<1 in 1,023,250 1 in 1,023,250 <<1 in 1,023,250	None Lo None
Max launch window	MAX Min. scrub risk			10% of delays <2.5 min	Hi
Max LOX drainback hold time	MAX Min. scrub risk	1 min 20 sec < Open	3 min 13 sec < Open		Hi

Recent Launch Delay History

- **STS-88:** One scrub - LOX drainback hold time of 3:42 expired (hyd. P alarm troubleshooting)
  On time launch
- **STS-96:** On time launch
- **STS-93:** Two scrubs - first due to haz gas at T-12 sec, second KSC weather
  Delayed 7 minutes on third attempt for MILA equipment
- **STS-103:** Three scrubs - One technical and two KSC weather
  On time launch
- **STS-99:** Two scrubs - first technical/weather and second weather
  Held 13:40 minutes to close out IPR's (hyd. circ pump)
- **STS-101:** Three scrubs for weather (KSC and TAL crosswind)
  On time launch

Launch Delay History (Short Delays)

Delay Time	Launch Window	STS-	Reason for Delay
10 sec	2 hr 30 min	58	Aircraft in the restricted area
22 sec	71 min 46 sec	57	Aircraft in the restricted area
48 sec	2 hr 30 min	46	Procedural error (APU isol valve not op in GLS window)
55 sec	2 hr 30 min	70	Range safety AGC fluctuation (hold at T-31 sec)
1 min 13 sec	2 hr 30 min	67	FES feedline heater verification
2 min 18 sec	3 hr 0 min	51-B	LPS lost GPC FEP (hold at T-4 min)
2 min 47 sec	2 hr 30 min	80	H2 haz gas (held at T-31 sec)
2 min 51 sec	2 hr 30 min	31	LOX O/B fill/drain valve failed to auto close
3 min 0 sec	3 hr 45 min	73	Range safety command problems
3 min 1 sec	54 min	51-I	Ship in recovery area plus clouds over launch pad
3 min 40 sec	27 min	34	TAL reconfig (rain at Ben Guerir – go at ZZA)
3 min 43 sec	1 hr 2 min	66	TAL weather (3 sites no-go, Ben winds decreased)
4 min 45 sec	2 hr 30 min	37	Range safety ceiling, “blast” prediction
5 min 23 sec	2 hr 30 min	50	Cirrus Anvil in area
6 min 50 sec	14 min	41-DR	Two private planes in restricted area
7 min	1 hr 56 min	93	MILA equipment troubleshooting
7 min 30 sec	2 hr 30 min	54	LSEAT loads waiver processing
12 min 15 sec	2 hr 17 min	41	RTLS rainshowers (T-9), WSB 2 mask in GLS (T-5), PL purge out of limits (T-31 sec for 1 min 22 sec)
13 min 0 sec	1 hr 57 min	44	LOX replenish valve leak
13 min 40 sec	2 hr 30 min	45	RTLS ceiling violation
13 min 40 sec	2 hr 10 min	99	Clear IPR list

Assumptions for Launch Window Trades

- MPS Performance - Used 22 lb / fps rule of thumb
- Earliest two eng TAL boundary - STS-96 flight cycle data
- Drainback hold time - STS-101 flight cycle data, 200 lb APM above window open
- ECAL capability - STS-88 with current procedures

ECAL Coverage

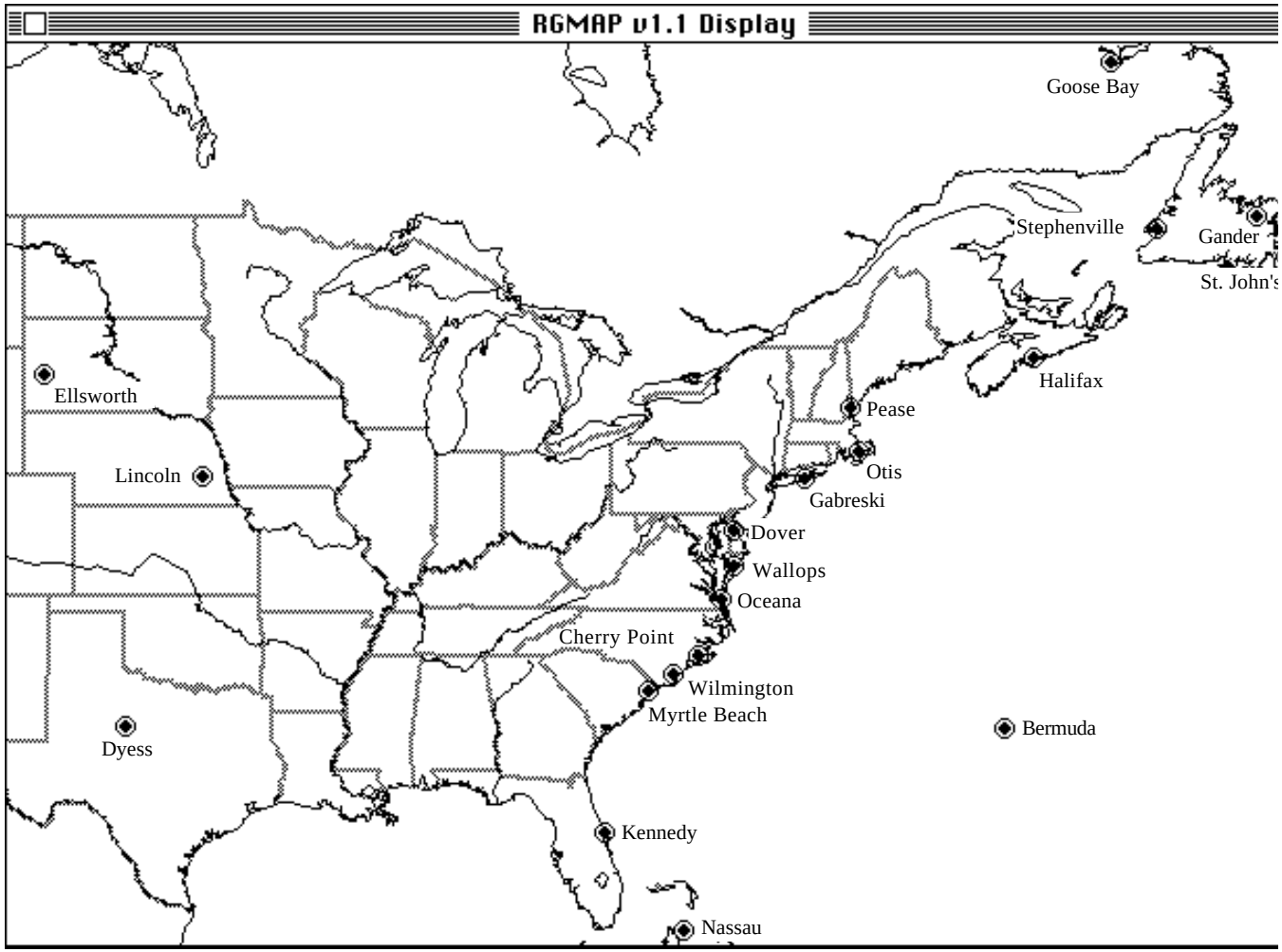
Max ECAL Coverage	In-plane – 5	In-plane – 2.5	In-plane/Opt.	In-plane + 2.5	In-plane +5
2nd SSME Fail Coverage(SIMO)	No capability	15-seconds capability	54-seconds capability	100-seconds capability	145-seconds capability
2nd SSME Fail Coverage (SEQ) First EO @ 6K, Abort ZZA	No capability	No capability	22-seconds capability	96-seconds capability	167-seconds capability
3rd SSME Fail Coverage(SIMO)	68-seconds capability. Starts at VI~15.2 kfps	95-seconds capability. Starts at VI~13.5 kfps	109-seconds capability. Starts at VI~12.7 kfps	139-seconds capability. Starts at VI~8.2 kfps	191-seconds capability. Starts at VI~7.6 kfps

Data gathered from STS-88 generic 2 and 3 EO contingency abort analysis with current procedures.

Note:
2nd SSME Fail Coverage capability times provided up to Single Engine OPS 3 boundary since we won't go ECAL after Single Engine OPS 3.
3rd SSME Fail Coverage capability times provided up to total loss of ECAL capability since there is no other choice.

DM43/Glenn E. Pogue
6/23/00

RGMAP v1.1 Display



CLOSED STS-101 PROGRAM IN-FLIGHT ANOMALY

Presenter:
Bob White

Organization/Date:
Program Integ/08-29-2000

- **Out-of-family SRB / MLP holddown post loads recorded during STS-101 launch (STS-101-I-01)**
  - Unusual 60 Hz response in strain gage data from HDP's #2 and #4
  - Investigation isolated root cause to MLP-1 electrical power system short, inducing EME on measurement system
  - IFA Closed at 08/10/00 PRCB
  - STS-106 Flight Rationale
    - STS-106 MLP-2 electrical system integrity verification completed 08/11/0, prior to roll from VAB
    - KSC analysis of critical MLP systems EME susceptibility identified no issues for mission operations
    - Reconstruction of integrated system performance verified dynamics and loading conditions are well within certification and experience base