Sounding Rocket Working Group

SRPO Summary

June 29, 2006

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Presentation Outline

- Mission Results Summary (since last meeting)
- FY06-FY08 Manifest
- Anomaly Investigation Status
- Poker Status (Libby West)
- Accomplishments
- Foreign Missions
- Student Flight Opportunities/Concepts
- Technology Update (John Hickman)
- Findings from January SRWG Meeting

Mission Results Since Last SRWG

- 11 Total Missions
  - 2 Science
    - Kankelborg - WSMR (success)
    - Rabin - WSMR (success)
  - 1 Educational
    - SubSEM (success)
  - 2 Technology
    - Terrain Relative Guidance Demo / Velocity Vector ACS Demo (success)
    - Celestial ACS (success in that we learned about issues with the system)
  - 6 Reimbursable
    - Target missions (success)
    - Army Infrasound missions (success)

FY06 Launch Schedule

		FY 2006	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
#	Vehicle Type	Mission												
		WALLOPS ISLAND												
1	Test Vehicle	HICKMAN/NASA			▲									
2	Test Vehicle	HICKMAN/NASA											△	
3	Orion	JUSTIS/NASA									▲			
4	Black Brant IX	EARLE/UNIV. OF TEXAS-DALLAS												△
5	Terrier Orion	PLAYER/LARC												△
		WSMR												
6	Black Brant IX	KANKELBORG/MONTANA ST. UNIV.					▲							
7	Terrier Orion	SEYBOLD/JPL						▲						
8	Black Brant IX	RABIN/GSFC							▲					
9	Test Vehicle	COSTELLO/NASA-NSROC								▲				
10	Black Brant IX	MCCAMMON/UNIV. OF WISCONSIN											△	
11	Black Brant IX	CASH/UNIVERSITY OF COLORADO												△
		NORWAY												
12	Terrier Orion	WHEELER/PENN STATE UNIVERSITY										△		
		REIMBURSABLE MISSIONS												
13	Terrier Oriole	WINSTEAD/NAWC (HAWAII)		▲										
14	Orion	WINSTEAD/NAWC (WSMR)		▲										
15	Terrier Orion	WINSTEAD/NAWC (WSMR)		▲										
16	Terrier Orion	WINSTEAD/NAWC (WSMR)		▲										
17	Orion	WINSTEAD/NAWC (WSMR)						▲						
18	Orion	WINSTEAD/NAWC (WSMR)						▲						
19	Terrier Orion	WINSTEAD/NAWC (HAWAII)									▲			
20	Terrier Orion	WINSTEAD/NAWC (HAWAII)										▲		
21	Terrier Orion	WINSTEAD/NAWC (WSMR)									▲			
22	Terrier Orion	WINSTEAD/NAWC (WSMR)									▲			
23	Terrier Orion	WINSTEAD/ARAV (WSMRI)	TBD											
24	Terrier Orion	WINSTEAD/ARAV (WSMR)	TBD											
25	Orion	WINSTEAD (WSMR)	TBD											
26	Orion	WINSTEAD (WSMR)	TBD											
27	Black Brant IX	AUDENAERT/THAAD (WSMR)										△		
28	Black Brant IX	AUDENAERT/THAAD (WSMR)										△		

FY07 Manifest

	Mission	Launch Date	Site	PI	Comments
1	36.219	Oct	WSMR	Hassler	
2	36.233	Oct	WSMR	Woods	
3	36.236	Oct	WSMR	Judge	MIC – Feb 9, 2006
4	36.207	Nov	WSMR	Cruddance	Prefers to wait for new NSROC Celestial ACS
5	12.059	Nov	WSMR	Costello	
6	36.220	Nov	WSMR	McCandliss	Prefers to wait for new NSROC Celestial ACS
7	36.225	Jan	WSMR	Chakrabarti	Planet Imaging – Unique ACS requirement
8	35.038	Jan	PFRR	Lessard	Rocket assisted ejectable sub-payloads
9	21.138	Jan	PFRR	Larsen	JOULE 2
10	36.234	Jan	PFRR	Larsen	JOULE 2
11	41.064	Jan	PFRR	Larsen	JOULE 2
12	41.065	Jan	PFRR	Larsen	JOULE 2
13	35.037	Feb	PFRR	Craven	Tailored Trajectory
14	41.061	Feb	PFRR	Craven	TMA – Location Aid Needed
15	41.062	Feb	PFRR	Craven	TMA – Location Aid Needed
16	41.063	Feb	PFRR	Craven	TMA – Location Aid Needed
17	40.019	Feb	PFRR	LaBelle	CHARM
18	36.226	May	WSMR	Bock	
19	41.XXX	May	WFF	Hickman	Technology
20	41.069	June	Andoya	Robertson	
21	41.070	June	Andoya	Robertson	
22	36.221	TBD	WSMR	Moses	

FY08 Manifest

	Mission	Launch Date	Site	PI	Comments
1	36.XXX	Nov	WSMR	McCammon	
2	35.036	Dec	Andoya	Kletzing	
3	40.018	Dec	Andoya	Kletzing	
4	40.021	Jan	Andoya	Kintner	
5	41.XXX	TBD	WSMR	Erdman	Air Sampler refly?
6	41.XXX	TBD	WSMR	Erdman	Air Sampler refly?
7	36.235	June	WSMR	Harris	New PL
8	36..213	June	WSMR	Porter	
9					
10					
11					
12					
13					
14					
	36.173	TBD	WSMR	Nordsieck	PI objected to being dropped from manifest. Intends to eventually fly…

Active Mishap Investigation Boards (MIB)

Failure	AIB lead	Status
BBXII Vehicle Failure – 40.017 (Poker 2005)	NASA (Nelson)	Closed -
Celestial ACS Test Flight (12.058)	NSROC	Star Tracker reboot occurred at Orion burnout. ACS flight computer failed to handle reboot recovery and communication to the tracker was lost.
Parachute Anomaly (36.203/Rabin)	NSROC	Parachute functioned, but there was a deployment sequencing anomaly

Poker Campaign Status

Campaign Manager (CM) Libby West
Deputy Campaign Manager (DCM) Brian Hall

Scheduled Campaign Window: January, February, March (BU) 2007

Larsen Mission Summary and Status

- Multiple Scale Study of High Latitude Joule Heating During a Substorm event (JOULE II)
- Mission DR held March 16, 2006
- Delta DR June 14, 2006 (NSROC inhouse).
- 21.138 and 36.234 Payload Status
  - Mechanical and Electrical Designs: 100% Complete
  - Mechanical Fabrication: 50% Complete
  - Electrical Fabrication: 5% Complete
- 41.064 and 41.065 Payload Status
  - Mechanical Design: 100% Complete
  - Mechanical Fabrication: 90% Complete
  - Electrical Design: 98% Complete (working final details with students on the beacon experiment)
  - Electrical Fabrication: 10% Complete
- 21.138 is using the MK1 version of the BB. Return to Flight of BB MK1 scheduled for September, 2006. – Note: This is the only vehicle utilizing the BB MK1 for the Poker Campaign, this vehicle is a single stage BB V MK1(ground launched).
- 41.064 and 41.065 are TMA payloads, require location device, system selected NSROC – working with vendor to assess options.
- On schedule for Integration in early September.

Lessard Mission Summary and Status

- Rocket Observations of Pulsating Aurora (ROPA)
- 40.020 DR Complete March 9, 2006
- 40.020 Payload Status
  - Mechanical and Electrical Designs: 100% Complete
  - Mechanical Fabrication: 40% Complete
  - Electrical Fabrication: 45% Complete
- Fly Away Detector (FAD) motors (STAR3) require re-cert at ATK. NSROC working re-cert and static fire with ATK. Working towards July Static Burn. Motors transferred from JPL (used on Mars Landers).
- On schedule for Integration in early October.

Craven Mission Summary and Status

- Investigations of Mesoscale Drivers for Vertical and Horizontal Winds in the High-Latitude Lower Thermosphere (HEX 2)
- Mission DR Complete February 28, 2006
- 35.037 Payload Status
  - Mechanical and Electrical Designs: 100% Complete
  - Mechanical Fabrication: 25% Complete
  - Electrical Fabrication: 60% Complete
- 41.061, 41.062, and 41.063 Payload Status
  - Mechanical and Electrical Designs: 100% Complete
  - Mechanical Fabrication: 25% Complete
  - Electrical Fabrication: 60% Complete
- 35.037 – Will Require a waiver of the redundant TTS requirement. Request to fly current configuration (100 + successful flights).
- 35.037, 41.061, 41.062, and 41.063 are TMA payloads, require location device, system selected NSROC – working with vendor to assess options.
- On schedule for Integration in late October.

LaBelle Mission Summary and Status

- Correlations of High Frequencies and Auroral Roar Measurements (CHARM)
- 40.019 DR held March 14, 2006
- Delta DR held on May 17, 2006 (NSROC inhouse)
- 40.019 Payload Status
  - Mechanical and Electrical Designs: 100% Complete
  - TM Mechanical Fabrication: 100% Complete
  - Other Mechanical Fabrication: Started
  - Electrical Fabrication: Started
- Integration on schedule for early October.

NENS Mobile Equipment Summary and Status

- Equipment Status
  - TM Super Van - Green
  - 7M1 – Acceptance Testing for new ACU ongoing
  - 7M2 – New Gear Boxes installed this week
  - Radar 8 Van - Green
  - Radar 8 - Green
  - MRCS2 – Anomaly with DQ processing velocity – ended up a time stamp issue (real time vs sim tape) – Issue Resolved – System Green.
- Testing Status
  - Slaving testing has begun – Radar Sim tape went bad. Radar Sim tape being recreated, then testing will resume.
  - Sims will begin once all systems undergo final testing.
- Shipping on schedule for July 30, 2006

Issues and Risks

ISSUES

- Research Range Funding: Verbal commitment from HQ on 4M of the 7M overguide request. – Not closed

RISKS

- Flight Termination System Waivers: Redundant FTS, Secure FTS – Will be required.
- Poker Database Update: Update population and town sizes. Update sizes of buildings at the Range. Safety working with Poker
- Poker Risk Criteria: Some criteria more stringent than WFF. Preliminary analysis suggests Poker Waivers may be required for Terrier Orion vehicles and Lessard. – Safety working with Poker
- Recovery Beacon for TMA: Beacon identified. NSROC working out details with vendor.
- PSI Overload: NENS PSI working several projects. One major project offloaded and assistant PSI support identified – Closed
- Clear Radar Site: Known RF issue from previous Conde mission. Coordination efforts with Site personnel will begin early.

Upcoming Plans

- Preparation for upcoming BB Mk1 RTF in September.
- Continue with Monthly team meetings.
- NENS – Integrate the two 7M systems to Supervan, work with Safety on Ver/Val of mobile systems, Shipping vans by end of July.
- NASA/NSROC team set up and load test Super HAD at WFF – ongoing.
- NSROC installation of launcher on Pad 5 at Poker in late July.
- NSROC continue with Payload Fabrication and Wiring.
- Poker to begin site preparations for mobile equipment deployment.
- SRPO/Poker Annual meeting scheduled for July 18, 2006.

Accomplishments - Flights

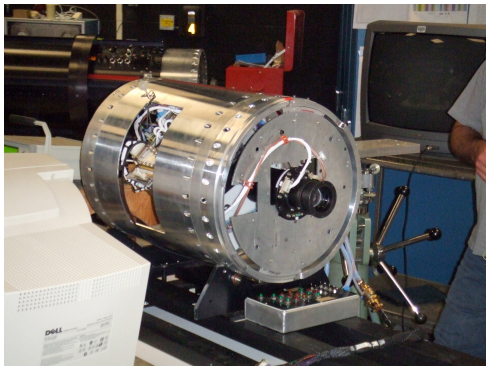
- Kankelborg
  - WSMR: Feb 8, 2006
  - Mission Successful
  - Landed in ordinance hazard zone
- Rabin
  - WSMR: April 12, 2006
  - Mission Successful
  - Multiple field deployments required
- Seybold
  - WSMR: April 5, 2006
  - Terrain Relative Navigation technology test
  - Velocity Vector ACS demo
    - System functioned well
- Celestial ACS Test Flight
  - WSMR: May 22, 2006
  - Partially successful
- SubSEM
- Multiple reimbursable flights

Removal of payload from ordinance zone

Kankelborg payload on the ground

Accomplishments - Subsystems

- Celestial ACS
  - GLN-MAC functioned nominally
  - Experienced an in-flight reboot of the ST-5K star tracker
  - System recovered, but proper communication between ACS and the tracker was never reestablished
  - Cause of reboot being investigated
  - Software to be modified to better handle reboot and other in-flight occurrences
  - *Details will be provided in the afternoon session*



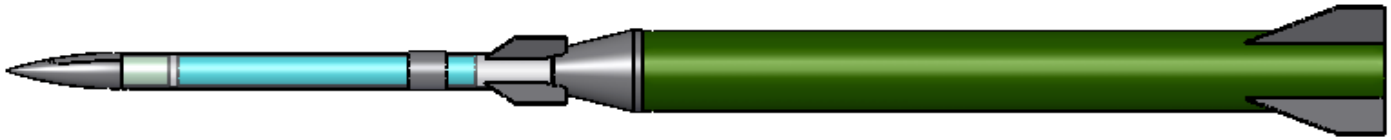
Accomplishments - Subsystems

- First two S-19L have been delivered
  - Use the LN-200 gyro
  - Retrofit funded using reimbursable funding
  - First two flights will be on reimbursable missions from WSMR
    - August time frame
  - The NSRP will retain ownership of units after the flights
- Velocity Vector ACS
  - Inertial system with GPS
  - Tracked the velocity vector well

Accomplishments - Vehicles

- MLRS motors being de-armed at WSMR for eventual delivery to WFF
- Design underway
- Optimization study in progress to determine the configuration of the aerodynamic surfaces

- *NSROC will provide details in the afternoon session*



Accomplishments – Grd Instrumentation

- Dynasonde construction has started
- Located near the WFF main gate using space what "was" the WFF softball fields
- Will support the upcoming Earle mission

Upcoming Foreign Missions

- Norway (Wheeler)
  - June 27- July 3
  - Collaborative student mission (USA/Norway)
- Norway (Robertson)
  - June/July 2007
  - Collaborative mission with ARR and German/Norwegian ECOMA rocket campaign
  - Under-flight for AIM satellite
- Norway (Kletzing)
  - Slipped to Dec 2007 (FY08)
  - Norwegian mission from Svalbard scheduled for same period
    - ARR says personnel should not be an issue
    - NASA launcher needed to resolve conflict

Student Flight Opportunities

- Sub-SEM
  - 14 experiments
  - 13 schools
  - June 8, 2006 flight was successful
- SERI
  - Low-cost means to give students at small universities hands-on aerospace experience
    - Salisbury University
    - University of Md Eastern Shore

SubSEM Students

SU Rocket Team

Future Student Flight Concepts

- **Sub-SEM**
  - Likely to be discontinued due to limited funding
  - WFF is seeking external funding
  - K-12 student flight projects are low priority
  - Could be shifted to university level flight opportunity
    - Shift to Terrier-Orion
    - Potential to replace existing dedicated flight opportunities
    - Custom forward end w/ standardized aft end (SubSEM module)

- **FreeSPACE Experiment Module**
  - Short skin section containing 4 FreeSPACE boxes
  - Self-contained (no electrical interface to PL, no umbilical)
  - Weight estimated to be ~10 pounds
  - Flown on all Black Brant missions at WSMR?
  - Estimate 10-15 pounds additional weight (worst case)
    - Replace ORSA adapter ring
    - Could serve as ballast
    - Strategic placement of experiment boxes could assist with balance

Technology Development

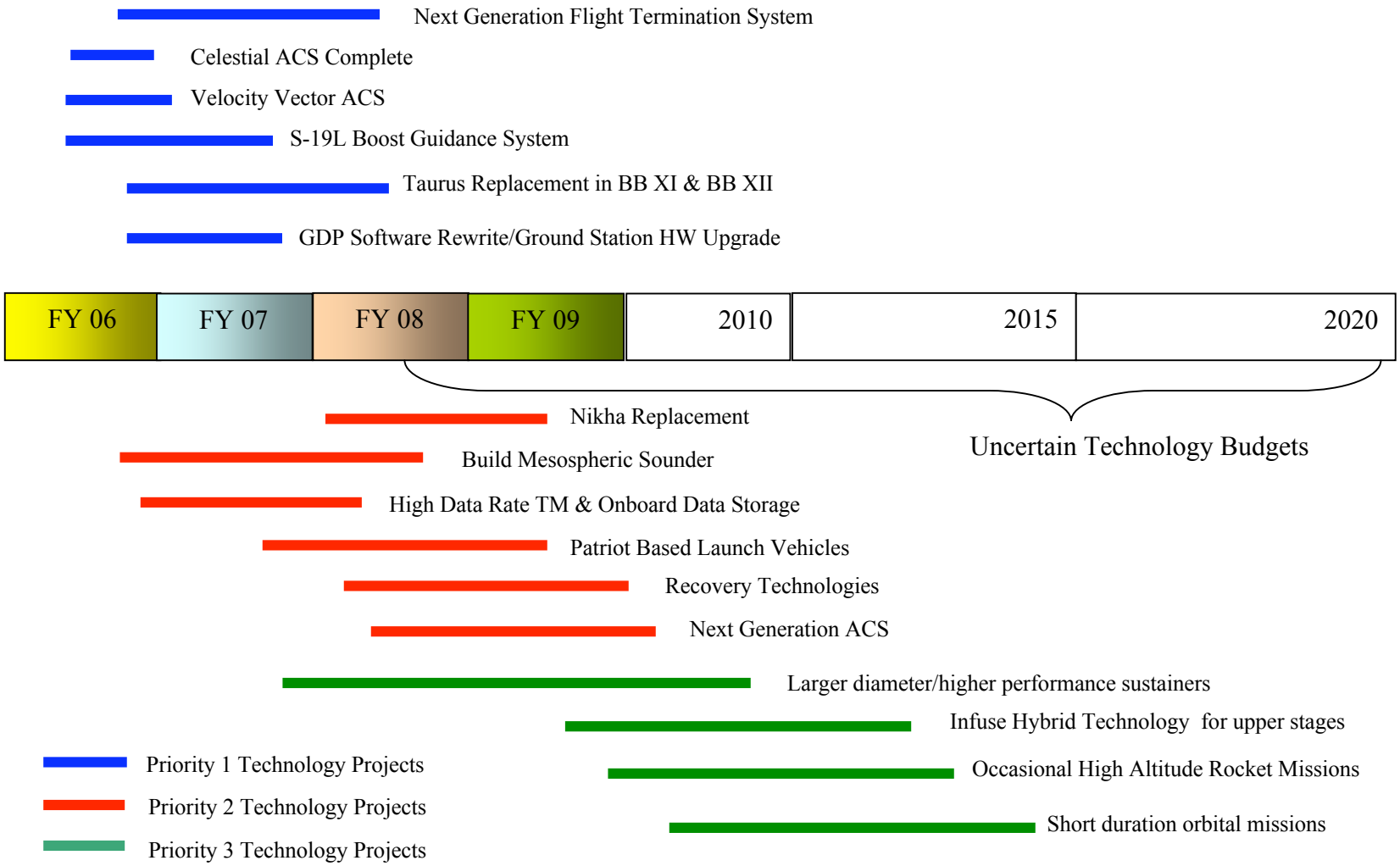
Technology Program Update

- Limited funding will impact technology program
  - SRPO will attempt to leverage DoD funding whenever possible
    - Talos-ASAS 28
    - High Data Rate TM
- Investments must be made strategically
  - Investing in an ACS with less jitter, small changes in telemetry data rate, advanced water recovery techniques will not lead to a higher flight rate
  - Mesospheric sounder, advanced surplus motor stacks, much higher TM data rates are investments that may lead to higher payoffs

Technology Program Update

- 3-tier technology project structure established to help set priorities
  - Priority 1 Technology Projects
    - Investments required to keep program viable
    - Flight termination system, S-19L, Celestial ACS,
  - Priority 2 Technology Projects
    - High priority investments focused on program needs and/or technologies that are likely to lead to new funding sources/higher flight rates
    - Nihka replacement, Mesospheric Sounder, high data rate TM
  - Priority 3 Technology Projects
    - Long term projects that may lead to new program capabilities
    - Larger diameter motors, hybrid technologies, HASR
- Reimbursable funding sources for technologies also help set priorities

Technology Roadmap



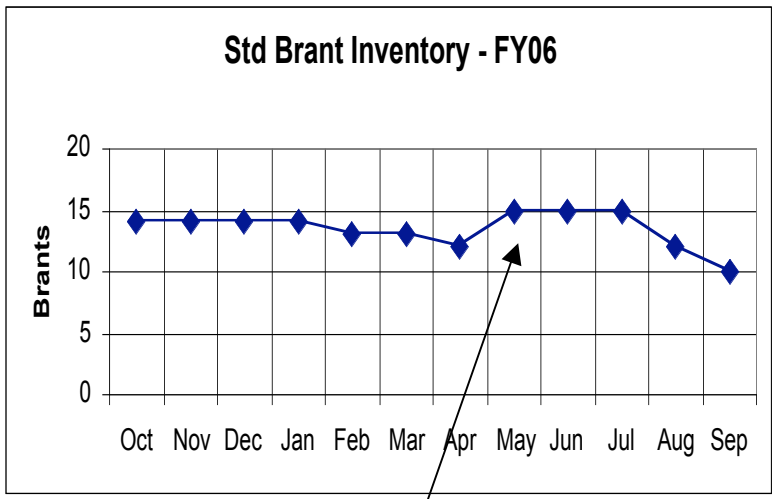
Findings from January 2006 SRWG

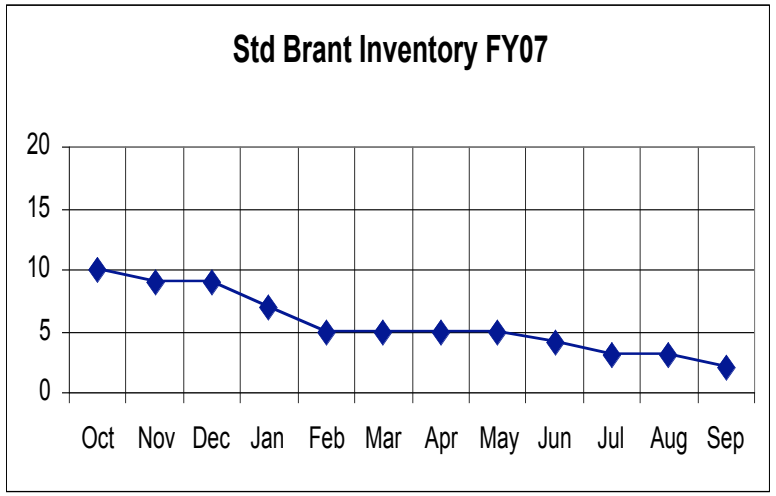
I. Black Brant Anomaly Report and Recovery Plan

- Release of the MIB report
  - Authorization given to distribute the report to the SRWG members

- Non-Advocate Review went well
- Panel felt the igniter design is now robust and should work at any pressure
- Panel suggested that a static firing be considered to validate all evolutionary changes that have occurred over last several years
- Static firing will be conducted, which will cause a few weeks delay in the flight test

Standard Brant Motor Inventory



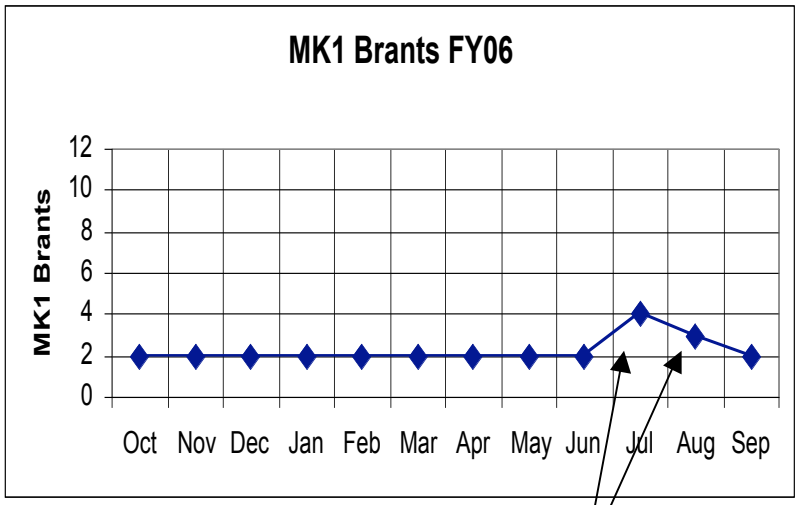


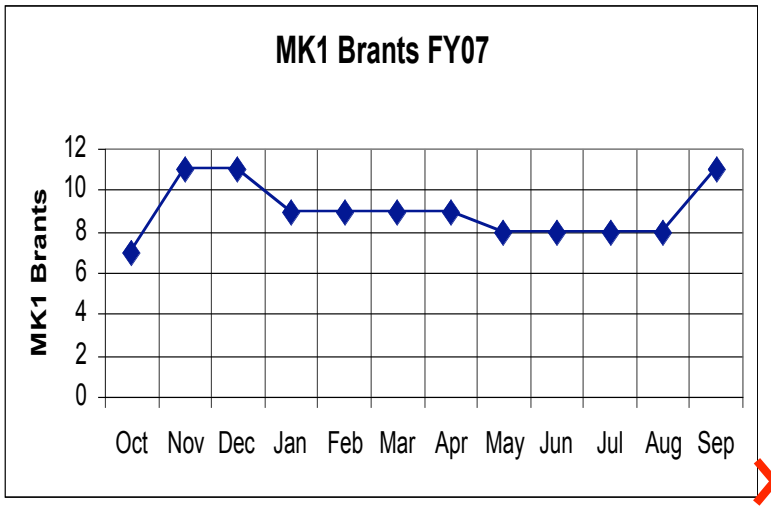
Obtained USAF Motors

MK1 Static Firing and test Flight

Standard Brant inventory will be depleted in the June 2007 time frame.

MK1 Brant Motor Inventory





Static Firing and Test Flight

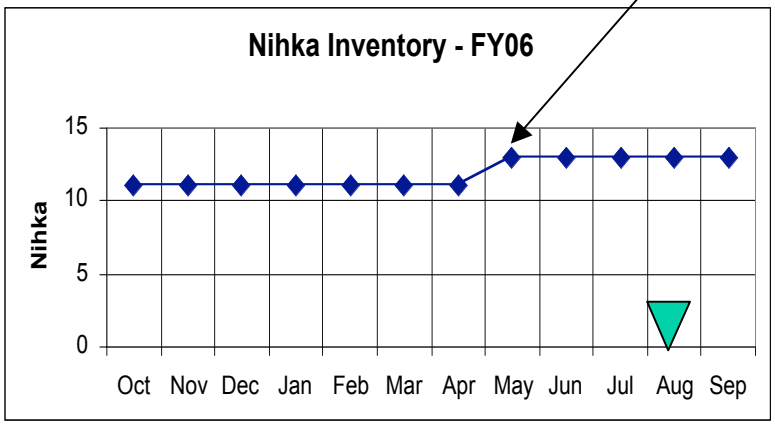
Depletion of Std. Brants

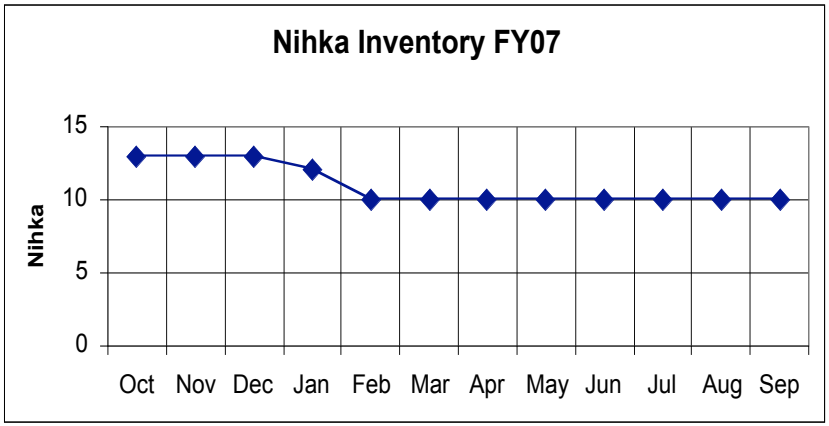
II. Alternate Sounding Rocket Motors

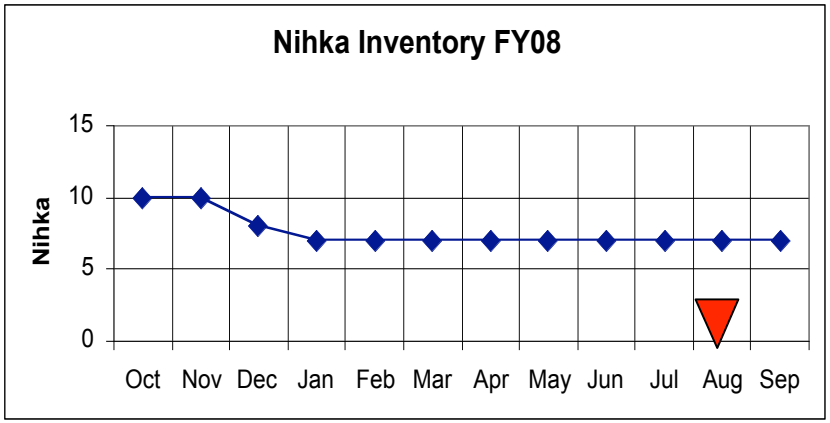
- Obtaining new surplus motors is proving more difficult than hoped
  - MLRS motors
    - 6 units at WFF
    - Navy is de-arming more units at WSMR
  - Patriot
    - Army's default position is to provide to NASA after recertification
      - Certification requires nozzle replacement & we must wait in the cue for nozzles
      - Nozzle replacement may not be required
      - SRPO trying to convince the Army that NASA will handle its own recertification (use process similar to Improved Orions)
- Nihka Replacement
  - SRPO & NSROC are moving forward (details in the following slides)

Nihka Motor Inventory

Obtained USAF Motors







Nihka Status

- Responses to RFI have been obtained
  - 2 vendors responded
  - Projected NRE anticipated to be between $1M and $3M
- RFQ expected to be released in July/Aug timeframe
- Assume 24 month delivery
  - Place order
  - Design, and fabricate 2 test units
  - Static firing & test flight
  - Deliver remaining 10 units
- Development effort would include one or more static firings
- SRPO will require one test flight from WFF before final delivery is accepted

III. Review of Vibration Specifications

- Continue to instrument payloads when opportunities emerge
- Sufficient data has been collected to establish new specs for Terrier-Improved Orions and BBIX
- A non-Advocate review will be conducted on data collection, analysis approach, and new specifications
  - Aug/Sept time frame
  - WFF engineering and possible support from Greenbelt experts
  - PI participation
- NSROC proposes to use new specs on select Poker missions

- *Details will be provided in the afternoon session*

IV. Integration of Solar Payloads

- SRPO still gets resistance when this is suggested at MIC's
- Unfortunately PI's are under very limited budgets
  - Travel budgets are very limited
- Compromise may be to have NSROC engineer and technician visit the PI's institution to verify the Experiment/TM interface prior to the field deployment

V. Progress with ACS Systems and Attitude Knowledge Systems

- There are precision issues with current celestial ACS
- NSROC is incorporating higher quality gyro into the celestial system
- Next Generation ACS will address these concerns as well

- *Details will be provided in the afternoon session*