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Executive Summary 1

Executive Summary

35.033 / PFAFF

Tracy Gibb
NSROC Mission Manager

1) Mission Overview

35.033 was a new mission, which launched from the SvalRak Launch Facility, NyAlesund, Norway on December 14, 2002. The Principle Investigator was Dr. Robert Pfaff (NASA/GSFC). CSOC and Norwegian resources provided the tracking and range support respectively. NSROC provided all instrumentation, ACS, as well as all vehicle systems. The overall objective of the investigation was to improve our understanding of the electrodynamics of the cusp and boundary layer, the associated plasma processes within this region, and their effect on energy and momentum coupling between the cusp ionosphere and the magnetosheath/solar wind.

2) Mission Success Criteria

Comprehensive Success Criteria:

1) Apogee of at least 750 km.

   Results: ACHIEVED (apogee of 772.2 km)

2) All electric field booms deployed and 80% of the DC and wave electric field data telemetered to the ground.

   Results: TBD. No science post-flight report received.

3) All energetic particle detectors (Aerospace Corp., University of Calgary, University of Maryland) deployed and successfully taking data with 80% of these data telemetered to the ground.

   Results: TBD. No science post-flight report received.

4) Good data obtained from the GSFC fluxgate magnetometer and Langmuir probe with 80% successfully telemetered to the ground.

   Results: TBD. No science post-flight report received.

5) Data obtained from the French search coil and current loops with 80% successfully telemetered to the ground.

   Results: TBD. No science post-flight report received.

6) Pointing of the payload to within 5° of the magnetic field direction throughout at least 50% of the flight time above 250km.

   Results: ACHIEVED

   On the upleg the coning half angle opened up to around 4 to 5 degrees, and was reasonably well centered on target. Simultaneously, the magnetic field line (the target) slowly moved off, but not sufficiently to trigger an ACS dead band firing. Both the gyro and the ACS magnetometer showed the magnetic aspect (of the primary axis) to follow a sinusoidal motion with the overwhelming portion being well within 5 degrees. {at this point, we are not immediately able to provide a percentage, but it is well over 50%) Again, the gyro and magnetometer confirm this statement. In fact, there is an excellent agreement between these two instruments (well within one degree).

On the downleg, after the apogee update, the magnetic aspect never exceeds 5 degrees until 800+ seconds, and then only for short arcs of the coning cycle The coning half angle on the downleg was kept less than two degrees.

7) No ACS firing for at least 80% of the time spent above 250km.

Results: ACHIEVED

Only two firings, initial alignment and apogee update.

8) Good trajectory data (determined to within 5 km) obtained. Good attitude knowledge data (within 1° RMS/revolution) obtained throughout 80% of the time spent above 250km.

Results: ACHIEVED

GPS trajectory typically far exceeds this criterion, unless the number of satellites becomes an issue. Every indication was positive for this mission. The agreement between the gyro solution and the Magnetometer trace confirmed an excellent Attitude track. These two sensors, after correcting the gyro measurements for known drift, agreed within one degree, and hence, we feel quite confident that attitude knowledge within 1 degree RMS was achieved. The attitude solution also matched theory and had very high precision and minimal noise.

9) Rocket launched while the ground photometers are taking data and while the upstream solar wind parameters are being monitored.

Results: Results: TBD. No science post-flight report received.

Minimum Success Criteria:

1) Apogee of at least 700 km.

   Results: ACHIEVED (apogee of 772.2 km)

2) At least one pair of electric field booms deployed with usable DC and wave electric field data gathered and telemetered to the ground during at least 50% of the time above 250km.

   Results: TBD. No science post-flight report received.

3) Good data obtained from the GSFC Fluxgate magnetometer and Langmuir probe successfully telemetered to the ground during at least 50% of the time above 250 km.

   Results: TBD. No science post-flight report received.

4) At least one ion and one electron energetic particle detector gathering good data and successfully telemetered to the ground during at least 50% of the time above 250 km.

   Results: TBD. No science post-flight report received.

5) Pointing of the payload to within 5° of the magnetic field direction throughout at least 50% of the flight time above 250 km or good attitude data (within 3° RMS/revolution) obtained throughout at least 50% of the time spent above 250 km.

   Results: ACHIEVED (Please see CSC #6 & CSC #8 above)

6) Usable trajectory data (determined to within 10 km) obtained.

   Results: ACHIEVED

3) Mission Initiation Conference

The MIC was held on March 1, 2000, in the second floor conference room of building E-106, located at Wallops Flight Facility, Wallops Island, Virginia. Final milestone schedule to include:

a.) Requirements Definition Meeting	04/11/00
b.) Design Review	10/10/01
c.) Integration @ WFF	08/26/02
d.) Mission Readiness Review	10/29/02
e.) Field Operations	11/16/02 to 12/1602
f.) Launch	12/14/02

The following individuals were in attendance:

Name	Organization	Name	Organization
Dr. Rob Pfaff	GSFC/696	Thad Sterling	NSROC
Dr. Jim Clemmons	Aerospace Corp.	Charlie Kupelian	NSROC
Dr. Dave Knudsen	U of Calgary	Mark Simko	NSROC
Dr. Jack Moore	U of Maryland	Steve Barthelson	NSROC
Bobby Flowers	NASA/810	Bob Shendock	NSROC
John Briton	NASA/810	Alfred Halter	NSROC
William Johnson	NASA/810	Chris Bradley	NSROC
Frank Lau	NASA/810	Randy Carrier	NSROC
Emmett Ransone	NASA/810	Tim Bowser	NSROC
Tracy Gibb	NSROC	Ben Robbins	NASA/803
Charles Lankford	NSROC	Tony Kawano	CSC
Gordon Marsh	NSROC		

Actions:

NSROC, in conjunction with the appropriate safety organizations, will investigate the feasibility of launching the proposed mission along a southern azimuth as desired by the PI. They will investigate the ramifications of utilizing a MK-70 Terrier motor in the Black Brant X configuration. They will provide Dr. Clemmons with information regarding maximum cable sizing for a Holex 2801 cutter to be utilized in the Energetic Particle Detector deployment mechanism. A larger cable than previously used for this mechanism is desirable to compensate for the historical potential of Nihka motors developing spin rates at burnout in excess of the predicted 4 Hz. They will also take the lead for coordination of any actions required to conduct operations utilizing the proposed Black Brant X vehicle with the existing launcher and shelter complex at NyAlesund, Svalbard.

The PI will coordinate mission requirements with all co-investigators and refine the success criteria, in conjunction with the assigned NSROC payload team, to be consistent with the capabilities of the flight hardware systems available to support the mission.

4) Requirements Definition Meeting

The Requirements Definition Meeting was held for the subject mission on April 11, 2000 at Wallops Flight Facility. The Principal Investigator was Dr. Robert Pfaff of the Goddard Space Flight Center.

The following people were in attendance:

Name	Organization	Name	Organization
Frank Lau	NASA/SRPO	Thad Sterling	NSROC
Dr. Rob Pfaff	NASA/GSFC**	Charles Kupelian	NSROC
Bill Koselka	NSROC/Program	Alfred Halter	NSROC
Royce Cutler	NSROC	Giovanni Rosanova	NSROC
David Krause	NSROC	Randy Carrier	NSROC
Jay Scott	NSROC	Steve Barthelson	NSROC
Tracy Gibb	NSROC	Patrick McPhail	NSROC
Rob Maddox	NSROC	Mark Simko	NSROC
Robert Shendock	NSROC	Don Grant	CSC
Jim Deihl	NSROC		

** Attended via teleconference.

RDM Action Item #1

Revise the comprehensive requirements matrix to reflect the correct success criteria.

Response:

Dr. Pfaff's memorandum, detailing the success criteria for this mission, was received on the day of the Requirements Definition Meeting. The success criteria, as defined in Dr. Pfaff's memorandum dated 4/11/00, were different from that which had been previously defined in the MIC documentation. Due to the late arrival of the signed success criteria memorandum the success criteria, as defined therein, were not reflected in the RDM package. The signed success criteria memorandum was included as part of the RDM package. The comprehensive requirement matrix was revised to reflect the newer success criteria, along with the appropriate process/approach for each.

Recommendation

It was recommended that NASA/SRPO, along with the Norwegian Space Center, should compile a Joint Implementation Plan" (JIP) in which the responsibilities of all entities involved would be clearly defined. Furthermore, it was recommended that these responsibilities should include those of NASA, NSC, CSOC, NSROC and all other agencies, or countries involved. A JIP was utilized on the previous mission to Svalbard in 1997, and was instrumental in the clear definition of responsibilities and effort that was required in support of that mission.

5) Design Review

The Design Review (DR) for the Pfaff/35.033 mission occurred on October 10, 2001 at Wallops Flight Facility, VA. The Project Team was comprised of a multinational Science Team, NSROC and Wallops Flight/Ground Safety. The DR included members of the science community along with NSROC, NASA Ground Safety and SRPO.

Project Team Members:

Principal Investigator	Dr. Robert Pfaff
Mission Manager	Tracy Gibb
Electrical Systems	Gordon Marsh/Charles Kupelian
Telemetry Systems	Thad Sterling
Mechanical Systems	Giovanni Rosanova
Performance Engineer	Brent Edwards
ACS	Charlie Kupelian/SVC
Vehicle Sys Engineer	Kevin Mackey
Ground Safety	Ben Robbins
Flight Safety	Jim Gladding

Review Panel Members:

Chairman	Dave Krause
Electrical Systems	Eric Johnson
Telemetry	Charles Lankford
Mechanical Systems	Rob Maddox
Flight Performance	Mark Simko
GNC	Ron Kiefer
Vehicle Systems	Chris Bradley
Mission Operations	Bruce Scott
Ground Safety	Don Grant

The following items were presented and discussed.

Introduction	Scientific Objectives
Team Listing	Flight Performance
Success Criteria	Mechanical Systems
RDM Action Items	Power
Payload Description	Telemetry
Timeline	ACS
Requirements matrix	Vehicle Systems
Schedule	Ground Safety

Discussions regarding the ground collection occurred with a CSOC representative present. The plan for data collection was not completely resolved although significant progress in defining the assets that could be used appeared to have been completed. The decision between the 20-foot versus the 7-meter system was made following the receipt of the 20-foot system, which at that time was undergoing a refurbishment. The 20-foot system with its current capability did not provide adequate G/T figure of merit and resulted in an unacceptable signal-to-noise ratio at maximum slant range

Action Items

1. Provide the results of the structural analysis (FE modeling) for the Forward Experiment structure.

   A the time of the Design Review, the forward experiment structure consisted of 4 decks held together by a set of staggered longeron's; i.e., the longeron's were not continuous from the top deck to the bottom deck. See Figure 1.

   This design approach was re-evaluated to ensure that the structure would be as rigid as possible. The components were re-oriented such that a continuous set of longerons could be accommodated. Normally, longerons are oriented 90^{o} apart, but in order to achieve a continuous structure on this payload, the longerons were oriented in a rectangular pattern with angular spacing of 75^{o} and 105^{o}. Furthermore, the longeron's themselves were designed with a stiff cross-section: 2" x 1" x 1/8" channel. See Figure 2.

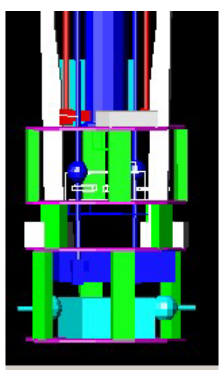

Figure 1 - DR version of FWD Exp.

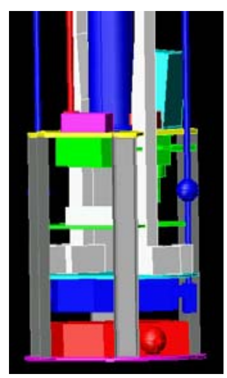

Figure 2 - As built FWD Exp.

A Finite Element Model of the continuous longer on structure was created to verify its integrity under expected loading. The load cases applied consisted of the following.

- Load Case 1: 500 lb. longitudinal load on center of the top deck to simulate FEOS.
- Load Cases 2 though 5: 100 lateral load on each longeron to simulate lateral acceleration.
- Load Cases 6 through 9: 100 lb. on each of an adjoining pair of longerons also to simulate lateral acceleration.

Figure 3 shows the model. Table 1 on the next page summarizes the results.

Load Case #1 resulted in a maximum deflection of 0.018 in. in the center of the top deck and a maximum stress of 7.4 ksi., also in the top deck.

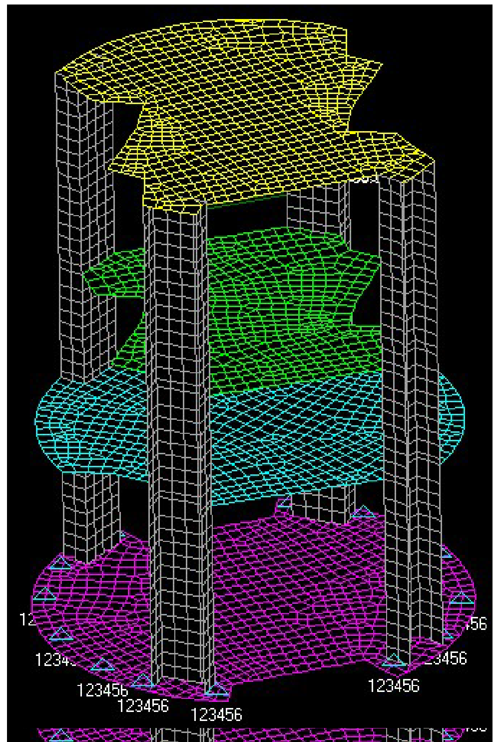

Figure 3 - Finite Element Model

Of the remaining load cases, the worst deflection and stress resulted from Load Case #6, which represented an applied load of 100 lb. on each of two adjoining longeron's (200 lb. total), which were 75^{o} apart. In this case, the maximum lateral deflection was 0.070 in. at the top deck and a maximum stress of 12.1 ksi. This load case could be related to a flight scenario by considering worst-case lateral acceleration. NSROC Flight Performance determined that the maximum predicted lateral acceleration during flight would be 1.25 g. The total weight of the forward experiment structure and components was estimated at 85 lb., and the CG was estimated to be just above the top deck. Therefore, Load Cases 2 through 9 were good representations of the resultant load expected on the structure during flight. Consequently, a 1g lateral acceleration was equivalent to an 85 lb. lateral load at the top deck. Scaling down the deflection and stress from Load Case #6 to extract the effects of 1.25g lateral acceleration yielded a maximum lateral deflection of .037 in. at the top deck and 6.4 ksi. in the longeron's. The stress was well below the 35 ksi. yield limit of 6061-T6 Aluminum. This deflection at the top deck translates to 0.077 in. deflection of the tips of the stowed GSFC 8m booms, which were about 40 in. above the top deck. This deflection was minimal, but as a precaution, modifications to the boom retainer deck near the boom tips were made to allow these booms to fold farther inward toward the payload centerline.

Time permitting; a lateral load test would be conducted to verify the Finite Element Model.

Table 1 – Summary of Finite Element Analysis Results

Longeron	Total Load (lbs)	Max Stress (psi)	Location of Max Stress	Max Deflection (in)
A	100	8777	top of longeron A	0.0326
B	100	8838	top of longeron B	0.0332
C	100	8803	top of longeron C	0.0328
D	100	8784	top of longeron D	0.0332
A&B	200	12089	bottom of aft deck, under foot of longerons B&D	0.0697
C&D	200	11825	bottom of aft deck, under foot of longerons B&D	0.069
A&D	200	9116	bottom of aft deck, under foot of longeron C	0.0479
B&C	200	9505	bottom of aft deck, under foot of longeron C	0.0469

2. Resolve the ACS/IGN HSNG interface joint. Consider the mission implication for increased mass when deciding between adding an adaptor ring and remanufacturing the IGN HSNG skin.

   An adapter ring was considered at first, but the added weight of a male radax joint and a female manacle would have yielded an adapter weighing approximately 8 lb. This weight gain was significantly more than that of simply changing the forward joint of the Nihka Igniter housing. Although fabrication of an ignition skin is significantly more expensive than a simple adapter, the payload team decided that the weight savings was more critical to this particular mission than cost. Therefore, it was decided to make a custom Nihka ignition skin with a male radax forward joint.

3. Resolve the ACS roll control during the mission. Note that the PI prefers roll stabilization to 0.35 Hz following boom deployment and then DISABLE roll control for the remainder of the mission.

   The ACS roll control was resolved. The comprehensive mission timeline was revised to reflect and provided to the panel for review.

4. Coordinate the TM ground-tracking plan. Consider masking, LOS altitude, G/T and the assets assigned.

   The NSROC portion of the "TM ground-tracking plan" was already in the MTR. The latest MTR had been released on 8/19/02 and the revision was "G". The MTR was provided to the DR panel for review. As per the assigned TM engineer, "with no LOS altitude requirement there was nothing to consider for masking or LOS altitude".

5. Provide history of predicted and actual Nihka burnout times. Consider the implications of a long burn and early despin event.

   The historical predicted Nihka burn times versus actual Nihka burn times for 11 BBXII missions and 18 BBX missions were provided. The predicted Nihka burn time varied among older missions. At the time of the DR, the Nihka was predicted to burn for 18.6 seconds. The predicted Nihka burn times ranged from 17.8 seconds to 19.0 seconds. Using the referenced predicted burn times; the average Nihka burn time variation was 0.3 seconds. The longest burn observed was 1.6 seconds over a predicted of 18.1 seconds. Using the burn time predicted for the DR (18.6 seconds), the average Nihka burn time variation was -0.1 seconds. The longest burn observed was 1.1 seconds over the current predicted burn time of 18.6 seconds. The longest burn time occurred on mission 35.013, which there were not any anomalies documented. Disregarding this mission, the longest burn was 0.5 seconds over the current predicted burn time of 18.6 seconds.

Typically, Despin is predicted to occur 3 seconds after predicted Nihka burnout. The Despin event for this mission was predicted to occur 3.4 seconds after predicted Nihka burnout.

Historical data did not show implications of excessive burn times for the Nihka

6. Revisit the boom deployment scenario. Consider the variations in timers, boom deployment durations.

   The boom deployment sequence was revisited and revised accordingly. A revised comprehensive mission timeline was provided for the DR panels review.

7. Review the need for ACS commo lines /TM data fiber optic line between the launcher and the blockhouse. Coordinate shipment and installation of any required hardware.

   There was no TM data fiber optic requirement between the launcher and the blockhouse. There was no fiber line between the launcher and the blockhouse. The previous mission to Svalbard did not utilize this either. This being the case, no TM data will be sent to the blockhouse.

   ACS Commo lines were required between the ACS computer (in blockhouse) and the pad box (at launch pad). Two, 2 conductor twisted shielded pair (24 or 26 gage wire) were required to be run from the blockhouse to the launcher. The range advised via email that the cable they have was not shielded. They also stated that if we were to bring 100 meters of the required cable they would run for us once we arrived at the launch range. This is how it was done for the previous mission to Svalbard.

8. Provide the Flight Safety Design Review inputs.

   Flight Safety Design review inputs were provided for the DR panels review.

6) Mission Readiness Review

The Mission Readiness Review (MRR) for the Pfaff/35.033 GE mission occurred on October 29, 2002 at Wallops Flight Facility, VA. The MRR included the Science team, NSROC, NASA's Sounding Rocket Program Office and NASA Flight and Ground Safety. The Project Team was comprised of the NASA Goddard Science Team, a host of national and multinational science teams, NSROC and Wallops Ground Safety.

Project Team Members

Principal Investigator	Dr. Robert Pfaff
Mission Manager	Tracy Gibb
Performance	Brent Edwards
Mechanical	Giovanni Rosanova
Power Engineer	Charlie Kupelian
Telemetry Engineer	Thad Sterling
Vehicle Sys Engineer	Timothy Branch
Ground Safety	Ben Robbins

Review Panel Members

Chairman	Dave Krause
Electrical – TM	Charles Lankford
Electrical - Power	Eric Johnson
Mechanical Systems	Rob Maddox
Flight Performance	Mike Disbrow
ACS	Walter Costello
Vehicle Systems	Chris Bradley
Mission Operations	Jay Scott
Ground Safety	Greg Smith

The following items were presented and discussed.

Introduction
Science Overview
Flight Performance
Mechanical Systems
Power
Telemetry
ACS
Vehicle Systems
Ground Safety
Flight Safety

Action Items

1. Determine if the orientation between the 6m Goddard and the 6m Berkeley booms is adequate (<5˚.)

   Dr. Pfaff provided a sketch of the offset requirement to clarify the manner in which the booms should be offset. The sketch is attached, but, in summary, it specifies that there should be a 5° offset between the line-of-action of the two boom sets in order to achieve sphere alignment in the fully deployed state. It was then determined that the 35.033 team had indeed provided the required 5° offset.

   However, this 5° offset was based on layout and spin rate of the 35.018 mission. Since the layout and spin rate of the 35.033 mission will be different, the required offset will not be exactly 5°. When questioned about this, Dr. Pfaff agreed that 5° is close enough (email attached below). Therefore, no further modifications to the tailcan will be necessary

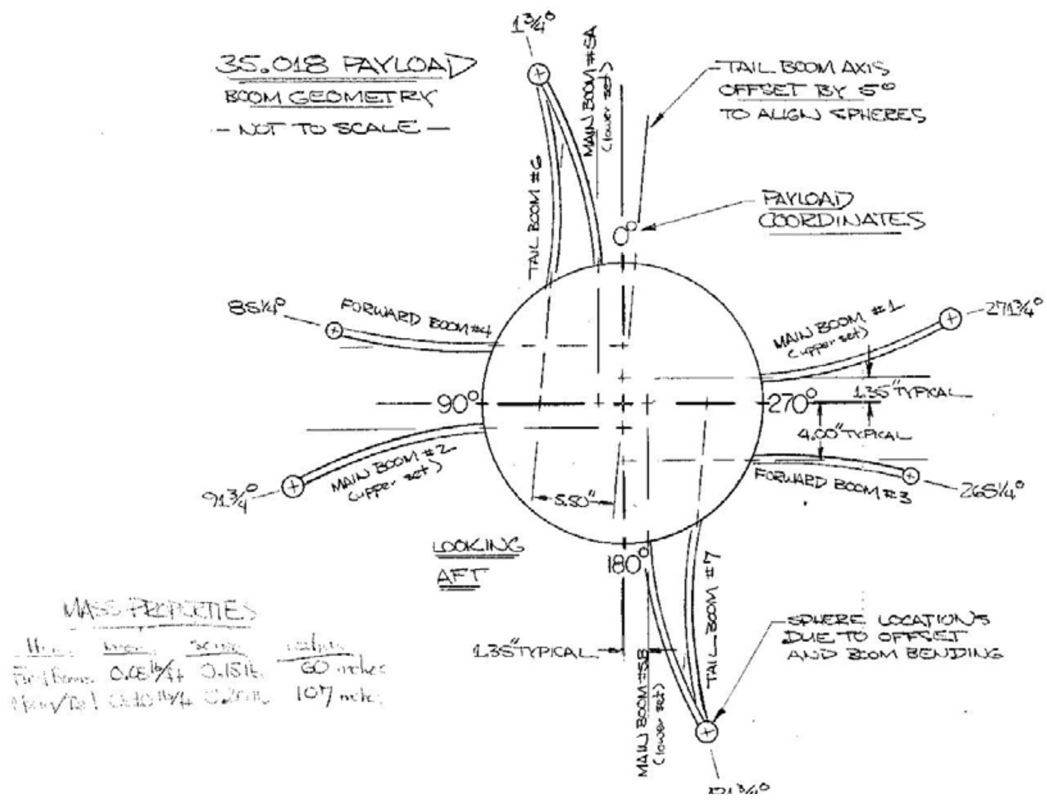

Figure 1 – Sketch of Boom Offset Requirement

Confirmation by email provided by Rob Pfaff:

From: 'Robert Pfaff'
Sent: Sunday, November 17, 2002 11:59 PM
To: Rosanova Giovanni
Subject: RE: Re: Question on tail can cant

Giovanni,

The 5-degree is close enough.

The different offset of the forward booms would change things somewhat, maybe a degree or so, but it is not a straightforward calculation and I would like to keep this at 5 degree.

Thanks,

Rob

2. Determine if the 2σ high roll rate of 5 Hz is acceptable for the Aerospace EED/EID booms.

   Confirmation by email provided by Jim Clemmons

   From: James H Clemmons [James.H.Clemmons@aero.org]
   Sent: Mon 11/4/2002 7:30 PM
   To: Rosanova Giovanni
   Subject: Re: 35.033 MRR Action item #2

   Hi Giovanni-

   Thanks for the message. I thought that I had mentioned that with the actual mass of the EED/EID, we could actually support a roll rate up to 6 Hz without getting concerned. I think our original request used a mass distribution that had some margin in it.

   Regards,
   Jim

3. Reinforce with the various science teams the need to securely attach all flight fasteners/hardware

   The above need was relayed to the science participants. They agreed to ensure that all flight fasteners/hardware would be securely fastened for flight. In addition, the payload was thoroughly inspected prior to final assembly.

4. Investigate the magnetic field change with the stowed French booms and the effect on the ACS maneuvers

   After discussions with NSROC payload team member sin the field, NSROC management at Wallops, the SRPO and SVC, it was determined to upload the new flight software that was provided to the payload team by SVC via email. The payload team uploaded the new software to the SVC MACS (software having been air-bearing tested at SVC on the Larsen MACS prior to being emailed). The payload team verified the proper sequence with the new software installed. The payload team performed this effort and provided an email detailing their effort and the verification thereof. The email can be located below.

>>>>>>>>>>>>>>>>>>>>>>>>>
Please send this to whoever needs it.

Well, it is afternoon in NyAlesund. We were able to load the new flight program.
The upload process went very smoothly. We saw all good checksum indications during the upload.

Pat did the Q-test and it reflected the new revision code:

36250d20	monitor software	4/11/02
35.033	ACS software	11/26/02
35.033r10flt	flight software	11/26/02

We had to wait for TM, but then we ran an ACS timeline. We reviewed the charts, and everything looks nominal.

ACS is ready for anything.

Regards,
Pat McPhail,
Charlie Kupelian
>>>>>>>>>>>>>>>>>>>>>>>>>>>

Recommendations

NO recommendations formally made.

Concerns

NO concerns formally identified.

7) Integration Overview

Testing Summary:

1.) 8/5/02 – 8/7/02
- Payload electrical checks.

2.) 8/8/02 – 8/16/02
- Payload TM checks.

3.) 8/19/02 – 3/23/02
- Sub-systems integration.

4.) 8/260/02 – 10/3/02
- All-systems integration.
- Pre-MRR Shipping Review (10/3/02)

5.) 10/1/02 – 10/10/02
- ACS post integration air bearing effort.

6.) 10/8/02
- NSROC hardware shipped.

7.) 10/21/02
- Mission Readiness Review

8.) 10/25/02
- All hardware required in Andoya.

9.) 10/31/02
- Sea Transport departed Andenes.

10.) 11/5/02
- Hardware arrived in NyAlesund.

11.) 11/16/02
- Project Team Departed

12.) 11/17/02
- Layover in Paris

13.) 11/18/02
- Depart Paris
- Arrive Oslo
- Layover in Oslo

14.) 11/19/02
- Departed Oslo.
- Arrived Longyearbyn
- Departed Longyearbyn
- Arrived NyAlesund
- Checked payload build-up and blockhouse with range personnel.
- Confirmed all equipment on site.

15.) 11/20/02
- Completed payload inventory.
- Completed vehicle inventory.
- Unpacked/Setup.
- Batteries charging
- Performed acceptable TM "turn-on".
- ACS Boost pump to pad.
- BBV & Nihka housing checked
- Setup offices, email & Internet access.

16.) 11/21/02
- Nitrogen delivered to assembly.
- Aircraft cancelled @ 1500 due to weather.
- Rented snow machine for team use.
- Conducted U of Calgary checks.
- ACS work at launch pad.
- Vehicle systems work at launch pad.
- Checked out hand held radios.

17.) 11/22/02
- Aircraft cancelled because of weather.
- Flew stranded team members from Longyearbyn to NyAlesund via SAR helicopter (Elborn, Slocum, Gross, Stiegies and two French science team members).
- More launch umbilical work completed.
- Motor prep work continued.

18.) 11/23/02
- Begin TM checks.
- Fiber installed by ARR from TM van to payload assembly.
- PC problems reading email files. Couldn't log into network profile.
- Terrier fins installed.

19.) 11/24/02
- U of MD checks completed.
- French instrument checks completed.
- U of Calgary checks completed

- BBV fins set.
- GPS system test completed.
- Installed GSFC 8m booms.

20.) 11/25/02
- GSFC checks begin.
- Pfaff & Clemmons arrived.
- Aerospace instruments arrived.

21.) 11/26/02
- Aerospace checks completed.
- Terrier & BBV staged.
- GSFC checks continue.
- Sequence testing completed.

22.) 11/27/02
- Playbacks from sequence testing.
- GSFC calibrations.
- Sphere painting.

23.) 11/28/02
- Tailcan installation.
- Experiment checks.

24.) 11/29/02
- Experiment checks continue.
- French component changed out.
- Installed nosecone.
- Payload build-up for flight.
- Payload transported to vehicle assembly.
- Staged payload to the Nihka motor.

25.) 11/30/02
- Armed LEO.
- Payload transported to the launcher.
- Staged payload/Nihka to BBV

26.) 12/01/02
- Umbilicals rigged.
- Armed 2nd & 3rd stages.
- Bagged and boxed payload.
- Range meeting.
- Practice count.
- Problem with wind-weighting GPS ground station.

27.) 12/02/02
- Wind weighting station operational.
- Cheyenne contacted re launch.
- Weather report.
- Vertical payload checks.
- Scrubbed @ 1039UT.

28.) 12/03/02
- Weather report.
- Scrubbed.

29.) 12/04/02
- Weather report.
- Scrubbed

30.) 12/05/02
- ACS leak discovered during horizontals.
- Launch op cancelled because of leak.
- Begin working on leak problem.
- ACS system removed. Problem with the quick-disconnect.
- Bad O-ring.
- Quick-disconnect repaired.
- Pressure checks performed. Failed.
- Valve re-built.
- Pressure checks performed again. Passed.
- ACS reinstalled to payload.

31.) 12/06/02
- Weather report.
- Scrubbed.

32.) 12/07/02
- Weather report.
- Scrubbed.

33.) 12/08/02
- Weather report.
- Vertical payload checks.
- Scrubbed.

34.) 12/09/02
- Weather report (Promising).
- Verticals payload checks.
- Armed.
- Scrubbed (no science).

35.) 12/10/02
- Weather report.
- Winds were in.
- Vertical payload checks.
- Scrubbed (no science).

36.) 12/11/02
- Weather report (Promising)
- Contacted NORAD.
- Went to T-3 minutes.
- Set final launcher settings.
- Went back to T-6 minutes.
- Scrubbed (no science)

37.) 12/12/02
- Weather report.
- Winds in, science is out.
- Worked on contingency plan.
- Scrubbed.

38.) 12/13/02
- Weather report.
- Winds out, science out.
- Scrubbed.

39.) 12/14/02
- Weather report.
- Unable to launch balloons because of wind.
- Went to T-3 minutes.
- Requested extension to the window (FAA approved).
- Launched @ 1116+47UT
- Nominal flight, or so it appeared.
- Packed up for return shipment home.

40.) 12/15/02
- Checked out from Kings Bay.
- Departed NyAlesund.
- Arrived Longyearbyn.
- Departed Longyearbyn.
- Arrived Oslo.
- Lay over in Oslo.

41.) 12/16/02

- Depart Oslo.
- Arrive Philly.
- Depart Philly.
- Arrive home.

8) Anomalies & Discrepancies

Please see section 8 of this MCR for complete disposition of each and every anomaly realized during this mission's lifecycle.

Project Team 2

TEAM CUSP: 35.033 GE / Pfaff - Svalbard (WFF)

Responsibility	Team	Phone	E-Mail	FAX
NSROC – Mission Manager	Tracy Gibb	757-824-1757	Gibb_Tracy@nsroc.net	413-451-6795
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NSROC – Mechanical Engineer	Andrew Groves	757-824-2217	Groves_Andrew@nsroc.net	757-824-2271
NSROC – Payload Technician (ET)	Herbert Haugh	757-824-1789	Haugh_Herbie@nsroc.net	757-824-2411
NSROC – Payload Technician (GNC)	Patrick McPhail	757-824-2384	McPhail_Patrick@prc.com	757-824-2411
NSROC – Payload Technician (MT)	Brian Tucker	757-824-1253	Tucker_Brian@nsroc.net	757-824-2411
NSROC – Flight Performance Engineer	Brent Edwards	757-824-1993	Edwards_Brent@nsroc.net	757-824-2411
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NSROC – Vehicle Technician	Curt Thomas	757-824-2387	Thomas_Curt@nsroc.net	757-824-2551
NSROC – Safety, Quality & Assurance	Jim Deaton	757-824-2014	Deaton_Jim@nsroc.net	-
WFF - Flight Safety	James Gladding	757-824-1450	James.E.Gladding.1@gsfc.nasa.gov	757-824-1518
WFF- Ground Safety	Ben Robbins	757-824-2097	Ben.C.Robbins.2@gsfc.nasa.gov	757-824-1518

TEAM CUSP: 35.033 GE / Pfaff - Svalbard (SCIENCE)

Responsibility	Team	Phone	E-Mail	FAX
Principal Investigator – NASA/GSFC	Dr. Rob Pfaff	301-286-6328	Rob.pfaff@gsfc.nasa.gov	301-286-1648
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Co-I – NASA/GSFC (E-Fields, Langmuir)	Dr. Christian Steigies	301-286-0448	Christian.Steigies@gsfc.nasa.gov	301-286-1648
Project Engineer (E-Fields)	David Sohl	-	-	-
Project Engineer (E-Fields)	Charlie Rogers	-	-	-
Project Engineer (Magnetometer)	John Scheifele	-	-	-
Project Technician (E-Fields)	Glen Gardner	301-286-5736	Ggardner@pop900.gsfc.nasa.gov	301-286-1648
Co-I – Aerospace Corp. (Particle Detector)	Dr. Jim Clemmons	310-336-2428	James.H.Clemmons@aero.org	310-563-3049
Aerospace Corp – Project EE	Dr. Penny Slocum	310-336-8158	Penny.L.Slocum@aero.org	310-336-1636
Co-I – UMD (Proton Detector)	Prof. Mike Coplan	301-405-4858	Coplan@glue.umd.edu	301-314-9363
Co-I – UMD (Proton Detector)	Prof. John Moore	301-405-1867	Jm89@umail.umd.edu	301-314-9121
Project Engineer – UMD (Proton Detector)	Alex Gross	410-615-3864	songdrgn@comcast.net	-
Co-I – University of CA. at Berkley	Dr. Gregory Delory	510-643-1991	gdelory@ssl.berkeley.edu	510-643-8302
Co-I – University of Oslo (HF Waves)	Prof. Jan Holtet	+47 2285 5672	j.a.holtet@fys.uio.no	+47 2285 5671
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Co-I – University of Calgary (SEI/SII)	Prof. David Knudsen	403-220-8651	Knudsen@phys.ucalgary.ca	403-282-5016
Engineer – University of Calgary (SEI/SII)	Peter King	-	-	-
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Engineer (CETP) - Magnetic Current/Coils	Dr. Abdel Bouabdellah	+33 1 39 25 48 57	Abdel.Bouabdellah@cetp.ipsl.fr	+33 139 25 49 22
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Collaborator (CETP) - Ground-Based, EISCAT	Dr. Dominique Fontaine	+33 139 254 917	Dominique.Fontaine@cetp.ipsl.fr	-
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Collaborator – University of Leicester	Dr. Timothy Yeoman	0116 252 3564	yxo@ion.le.ac.uk	0116 252 3555
Collaborator – University of Leicester	Dr. Steve Milan	-	-	-
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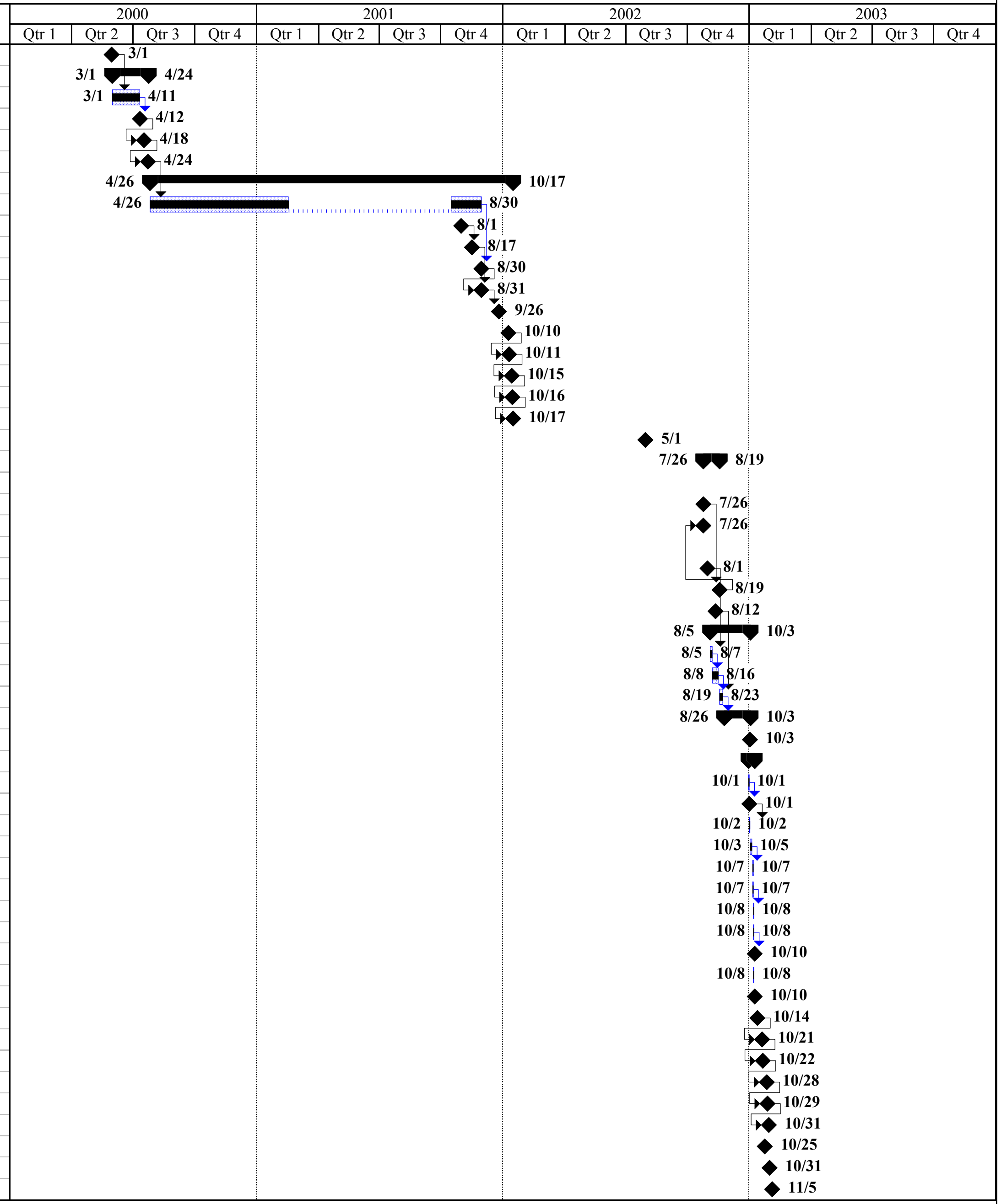
Final Mission Schedule 3

35.033 (CUSP) SvalRak

ID		Task Name	Start	Finish
1	✓	Mission Initiation Conference	Wed 3/1/00	Wed 3/1/00
2	✓	Requirements Definition Process	Wed 3/1/00	Mon 4/24/00
3	✓	Define Requirements	Wed 3/1/00	Tue 4/11/00
4	✓	RDM	Wed 4/12/00	Wed 4/12/00
5	✓	RDMM Due	Tue 4/18/00	Tue 4/18/00
6	✓	NASA Task Order Received	Mon 4/24/00	Mon 4/24/00
7	✓	Design Process	Wed 4/26/00	Wed 10/17/01
8	✓	Design effort	Wed 4/26/00	Thu 8/30/01
9	✓	Science Interface Inputs to NSROC	Wed 8/1/01	Wed 8/1/01
10	✓	Pre-DR Team meeting #1	Fri 8/17/01	Fri 8/17/01
11	✓	DR Inputs to MM by	Thu 8/30/01	Thu 8/30/01
12	✓	Pre-DR Team Meeting #2	Fri 8/31/01	Fri 8/31/01
13	✓	Notice to COTR/Team	Wed 9/26/01	Wed 9/26/01
14	✓	DR	Wed 10/10/01	Wed 10/10/01
15	✓	DRAI's Due	Thu 10/11/01	Thu 10/11/01
16	✓	Response to DRAI's	Mon 10/15/01	Mon 10/15/01
17	✓	DRAI's Closed Out	Tue 10/16/01	Tue 10/16/01
18	✓	DRMM to COTR	Wed 10/17/01	Wed 10/17/01
19	✓	Motors Ship	Wed 5/1/02	Wed 5/1/02
20	✓	Fabrication and Assembly Process	Fri 7/26/02	Mon 8/19/02
21	✓	Mechanical Fabrication	Fri 7/26/02	Fri 7/26/02
22	✓	FWD Exp Completed & Delivered BY	Fri 7/26/02	Fri 7/26/02
23	✓	AFT Exp Completed & Delivered BY	Fri 7/26/02	Fri 7/26/02
24	✓	Electrical Fabrication		
25	✓	TM Wired & Delivered BY	Thu 8/1/02	Thu 8/1/02
26	✓	EXP Structures Wired & Delivered BY	Mon 8/19/02	Mon 8/19/02
27	✓	SVC Hardware Delivery BY	Mon 8/12/02	Mon 8/12/02
28	✓	Test and Integration Process	Mon 8/5/02	Thu 10/3/02
29	✓	Electrical Checks	Mon 8/5/02	Wed 8/7/02
30	✓	Telemetry Checks	Thu 8/8/02	Fri 8/16/02
31	✓	Sub-System Integration	Mon 8/19/02	Fri 8/23/02
32	✓	All Systems Integration	Mon 8/26/02	Thu 10/3/02
76	✓ (note)	Pre-MRR Shipping Review	Thu 10/3/02	Thu 10/3/02
77	✓	ACS Post-T&E Air Bearing Effort	Tue 10/1/02	Thu 10/10/02
78	✓ (note)	ACS To SVC For Final Air Bearing	Tue 10/1/02	Tue 10/1/02
79	✓	McPhail Travels To SVC	Tue 10/1/02	Tue 10/1/02
80	✓	ACS Arrives @ SVC	Wed 10/2/02	Wed 10/2/02
81	✓	Air Bearing/Associated Testing	Thu 10/3/02	Sat 10/5/02
82	✓	Mcphail Travels Back To WFF	Mon 10/7/02	Mon 10/7/02
83	✓ (note)	ACS To WFF For Final Shipment	Mon 10/7/02	Mon 10/7/02
84	✓	ACS Arrives @ WFF	Tue 10/8/02	Tue 10/8/02
85	✓	ACS Functional Checks	Tue 10/8/02	Tue 10/8/02
86	✓ (note)	ACS & Associated Hardware Ship To ADRR	Thu 10/10/02	Thu 10/10/02
87	✓	ALL NSROC Hardware Ship Date	Tue 10/8/02	Tue 10/8/02
88	✓	MRR Inputs to MM By	Thu 10/10/02	Thu 10/10/02
89	✓	Notice/Package to COTR/Team	Mon 10/14/02	Mon 10/14/02
90	✓	MRR	Mon 10/21/02	Mon 10/21/02
91	✓	MRRAI's Due	Tue 10/22/02	Tue 10/22/02
92	✓	MRRM to COTR By	Mon 10/28/02	Mon 10/28/02
93	✓	Response to MRRAI's	Tue 10/29/02	Tue 10/29/02
94	✓	MRRAI's Closed Out	Thu 10/31/02	Thu 10/31/02
95	✓	Hardware @ Andoya Rocket Range BY	Fri 10/25/02	Fri 10/25/02
96	✓	Sea Transport Departs Andenes	Thu 10/31/02	Thu 10/31/02
97	✓	Hardware Arrival at Ny Alesund	Tue 11/5/02	Tue 11/5/02

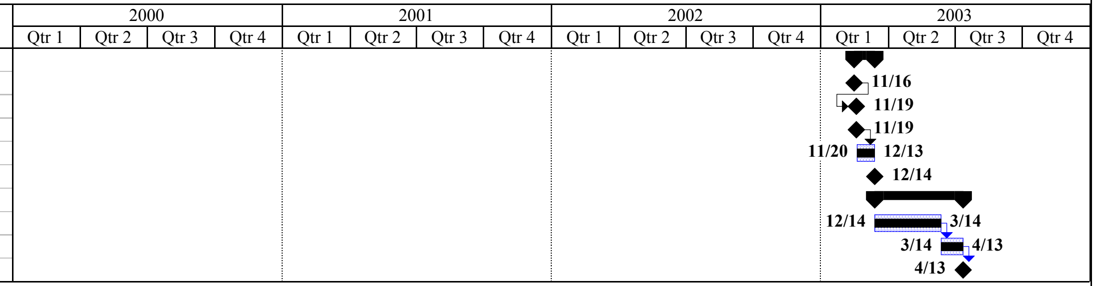


Wed 7/9/03
Revision 22
Tracy Gibb

Task		Milestone		Rolled Up Task		Rolled Up Progress		External Tasks		External Milestone	
Progress		Summary		Rolled Up Milestone		Split		Project Summary		Deadline	

35.033 (CUSP) SvalRak

ID		Task Name	Start	Finish
98	✓	Launch Operations Process	Sat 11/16/02	Sat 12/14/02
99	✓	Project Team Travel	Sat 11/16/02	Sat 11/16/02
100	✓	Arrive NyAlesund	Tue 11/19/02	Tue 11/19/02
101	✓	Check-In/Familiarize	Tue 11/19/02	Tue 11/19/02
102	✓	Launch Preparations	Wed 11/20/02	Fri 12/13/02
103	✓	Launch	Sat 12/14/02	Sat 12/14/02
104	✓	Mission Closeout Process	Sat 12/14/02	Sun 4/13/03
105	✓	Technical Mission Closeout (Extensive ACS Analysis)	Sat 12/14/02	Fri 3/14/03
106	✓	Financial Mission Closeout	Fri 3/14/03	Sun 4/13/03
107	✓	MCR Due	Sun 4/13/03	Sun 4/13/03



Wed 7/9/03
Revision 22
Tracy Gibb

Task		Milestone		Rolled Up Task		Rolled Up Progress		External Tasks		External Milestone	
Progress		Summary		Rolled Up Milestone		Split		Project Summary		Deadline	

16 Nov	Saturday Departed Chincoteague 1330, departed SBY 1530 on time. Exchange in Philadelphia would not take AE
17 Nov	Sunday Arrived Paris on time, bus + taxi to Hotel
18 Nov	●Tour of CETP ●Lunch with CEPT ●Departed hotel 1730 (paid bus for all) ●Departed Paris 2005 ●Arrived Oslo 2220 ●Arrived Hotel SAS 2300
19 Nov 8+3	●Departed Hotel 0800 ●Departed Oslo 1025 ●Arrived Longyearbyne 1450 ●Departed Longyearbyne 1730 ●Arrived Ny-Alesund 1815 ●Arrived Hotel 1900 ●Checked payload build-up and new blockhouse with Thomas and Kjell. ●Appears that all equipment is here. ●Email download 9.6 kbaud (impossible to use) ●Report of shipment coming from L.A. (Aerospace?
20 Nov 8+2.5	●Payload Inventory complete ●Vehicle Inventory complete ●Payload team unpacked, set up payload assembly ●Battery charging, TM turn-on good ●ACS boost pump delivered to launch pad ●BBV and Nihka housings checked ●Computer IIP addresses started ●Phone number list started ●set up hotmail account ●set up office in Polar Institute ●0800-1930
21 Nov 8+3.5	●Nitrogen delivered to Payload assembly hall ●Aircraft canceled at 1500 hours due to weather. ●Rented snowmobile ●Conducted U of Calgary checks ●ACS work at Launch Pad ●Vehicle Systems work at Launch Pad ●Checked hand held radios ●0800-2030

22 Nov	●Aircraft again cancelled due to weather ●Flew team members from Longyearbyne by SAR Helo, arrived approximately 1700 hours. Elborn, Slocum, Gross, Stegis, and 2 French experimenters. ●Team completed more launch umbilical work. ●Motor prep work continued.
23 Nov(Sat)	●Shelby started TM checks, running into problems with documentation being different than payload. ●Having fiber installed by ARR from TM van to payload build-up. ●PC problems reading email files. Cannot log into network profile. ●Fins installed on Terrier.
24 Nov(Sun)	●U of Md TM checks complete, ok. ●French instrument TM checks complete, some noise. ●U of Calgary TM checks complete, ok. ●Setting fins on BBV ●GPS system test performed. ●Installed GSFC 8m booms.
25 Nov	●GSFC TM checks ●Pfaff & Clemmons arrived in pm. ●Aerospace instruments arrived in pm ●GSFC worked all night until 0600 Tues. ●
26 Nov	●Aerospace TM checks ●Staged Terrier & BBV ●Cont GSFC TM checks ●Sequence tests completed
27 Nov	●Playbacks from sequence ●GSFC calibrations ●Sphere painting (until 0500 thurs) ●
28 Nov	●Tailcan installation ●Experiment checks
29 Nov	●Experiment checks ●Changed French component ●Installed nosecone ●Build-up of payload in payload assembly ●Transported payload to vehicle assembly ●Staged payload to Nihka

30 Nov (Sat) ●Armed LEO
●Transported payload to launcher (high winds, blowing snow)
●Stage payload/Nihka to BBV, some difficulties with the wide rail of the Mann launcher.
●Stopped work at 1630 for Thanksgiving dinner and break.

1 Dec (Sun) ●Rigged umbilicals until noon
●Armed 2nd and 3rd stages
●Bagged and boxed payload until 1700
●Range meeting at 1400
●Practice count at 1700
●Practice count end at 1830, good practice.
●Problem with windweighting GPS ground station, called Schmidlin then Printise Moore for assistance.

2 Dec ●On station at 0500 local till 1300
●Windweighting system operational, had to change both antennas at blockhouse windweighting system..
●Contacted Cheyenne 719-474-3422, Capt Snyker, Type 1 launch.
●T-2 hr weather report forecast, winds to 20 knots, light overcast, weather to be worse on Tuesday due to system to the west of Svalbard.
●Hold at T-40
●Pickup count at 0824UT (NO-GO on winds)
●Start Verticals at 0900UT
●End Verticals at 0911UT and "HOLD" for winds and science.
●Scrubbed launch at 1039UT due to winds.

3 Dec ●On station at 0500 local till 1300
●Winds 22 mph with gust to 45 mph, snowing.
●Scrubbed due to winds. Science was good.

4 Dec ●On station at 0500 local till 1300
●Scrubbed due to winds, rain, and lack of science.

5 Dec ●On station at 0500 local till
●ACS leak problem discovered during horizontals. Started pad work at 0615 working on this problem. Leak is in the flight hardware. Launch opportunity "OUT" due to head winds.
●ACS system removed by 0730, problem with the "quick disconnect". Appears to be bad o-ring inside the quick-disconnect.
●"Quick disconnect" repaired by 1100, and re-installed by 1130.
●Performing pressure checks by 1145
●Failed again, rebuilding again.
●1500 Performing pressure tests again, OK so far.
●1600 Performed 5k test, worked ok.

	●1900 System and payload back on launcher ready to go
6 Dec	●On station at 0500 local till 1300 ●Scrubbed due to winds, rain, and lack of science.
7 Dec (Sat)	●On station at 0500 local till 1100 ●Scrubbed due to winds, rain, good science.
8 Dec (Sun)	●On station at 0500 local till 1100 ●Scrubbed due to winds, rain, and lack of science. ●Had clear skies at beginning of window, looked promising, but winds increased and started snowing.
9 Dec	●On station at 0500 local till 1300 ●Winds are in for the first time, light snow ●0800 L, T-50, elevating ●0827 L elevated, armed, pad clear ●0840 L verticals complete ●0900 L T-6 and holding ●1100 l, no science, cancelled for the day ●Sent 3 boxes to Aerospace
10 Dec	●On station at 0500 local till 1300 ●Winds are "in" for 83.3 @ 205 ●No science, cancelled for the day
11 Dec	●On station at 0500 local till 1300 ●Possible activity report at 0950 UT ●Contacted NORAD at 0950 UT ●Going to T-3 at 1006 UT ●launcher settings 81.6 @ 188.8 for 82.5 @ 193.0 ●Going back to T-6 at 1036 UT ●Cancelled at 1100 UT
12 Dec	●On station at 0500 local till 1300 ●Winds in, science out. ●Working on contingency plan ●Telcon with Eberspeaker
13 Dec(Fri)	●On station at 0500 local till 1300 ●Winds out, science out.
14 Dec(Sat)	●On station at 0500 local till 1700 ●Winds 15mps, gust to 23mps, cannot launch balloons ●went to T-3 at 1044UT ●Requested extention to window, approved by FAA

	●Nominal 82.5 EL 200 AZ
	●Launcher settings 84.8 EL 185.3 AZ
	●Nominal flight 83 EL 200 AZ
	●Launch Time 1116+47 UT
	● +690 secs still good lock
	● +750 secs 31 EL 213 AZ
	● 1130+30 20 EL 213.5 AZ
	● +893 secs LOS NASA TM Ny-Alesund
	● +924 secs LOS NASA Andoya
15 Dec Sun	●Start at 1100 Kings Bays checkout
	●1230 departed Ny-Alesund
	●1300 Arrived Longyearbyen
	●1540 Departed Longyearbyen
	●Arrived Oslo 2100
16 Dec Mon	●0630 Depart SAS Hotel Oslo
	●Arrived Philadelphia
	●1730 Arrived Salisbury airport
	●1900Arrived residence

Final Launch Countdown 4

ANDØYA ROCKET RANGE

COUNTDOWN PROCEDURE

35.033 Pfaff (CUSP)

SvalRak / December 2002

"T" MINUS HH-MM-SS	ITEM #	FROM	TO	CHECK	OPERATION
03-00-00	1	LC		✓	Launch weather balloon and track to maximum altitude.
	2	LC		✓	Inform KB about intention to launch.
	3	LC		✓	Inform Bodø ATCC and Longyear ATC about intention to launch
	4		ALL	✓	Payload Personnel On Station.
02-30-00	5	LC		✓	Conduct Station Checks (Acknowledge) LC - Launch Control TPS - TPS Control PAS, VS - Pad Supervisor / Vehicle Systems PC - Payload Control ACS - Attitude Control System PTM - Payload TM NASA TM - NASA TM NO TM - Norwegian TM PS - Project Scientist PM - Project Manager
	6	LC		✓	RADIO SILENCE
	7	LC	PAS, VS	✓	Commence final vehicle systems arming.
	8	LC	PAS, VS	✓	Verify final vehicle systems arming complete. Verify RED TAGS removed.
	9	LC	PAS	✓	Verify Pad clear
	10	LC		✓	RADIO SILENCE LIFTED
02-15-00	11	LC	PM	✓	Permission to conduct Horizontal Payload checks.
[redacted]	12	LC		✓	Reset countdown clock to T-6 minutes. LC announce that countdown clock has been set to T-6 minutes for Horizontal payload checks.
[redacted]	13		PLC	✓	All systems on External Power
[redacted]	14		ACS	✓	ACS on External Power
[redacted]	15		PTM	✓	Start chart recorders
[redacted]	16		NASA TM	✓	Start magnetic tapes.
[redacted]	17		PC	✓	Spin up Gyro.

"T" MINUS HH-MM-SS	ITEM #	FROM	TO	CHECK	OPERATION
	18		PTM	✓	Verify clean PCM lock.
	19		NASA TM	✓	Record Transmitter parameters. Actual Nominal TM Sig Str ______dB >30 dB C/N Deviation ______kHz KHz
	20		GPS	✓	Verify GPS data (Turn on Rerad if needed)
	21		PC	✓	Verify Gyro spin-up.
00-03-00	22		PC	✓	Uncage Gyro and "Confirm".
	23		PLC	✓	Switch all systems to Internal Power
	24		PTM	✓	Verify clean PCM lock.
00-02-30	25		PTM	✓	Verify data within limits.
00-02-00	26		PTM	✓	Verify data on GPS.
	27		PC	✓	Cage Gyro and "Confirm".
	28		PC	✓	Switch to External Power.
	29		PC	✓	Switch all systems OFF. "GPS to remain ON"
	30		NASA TM	✓	Stop mag tapes.
	31		PTM	✓	Stop chart recorders.
	32		PM	✓	Verify Horizontal Payload checks complete.
02-00-00	33	LC	ALL	✓	Reset countdown clock to 02-00-00 hours and counting
01-45-00	34	LC	PAS	✓	Launch weather balloon
	35		PS	✓	Contact EISCAT and SuperDARN
	36	PS	ALL	✓	Science Report
00-40-00	37	LC	ALL	✓	HOLD for SCIENCE
	38	LC	ATC	✓	Clearance from Bodø ATCC and Longyear ATC to launch
	39	LC	ALL	✓	RADIO SILENCE
	40	LC	PAS	✓	Commence Terrier final arming.
	41	LC	PAS	✓	Verify Terrier final arming complete. Verify RED TAGS removed.
	42	LC	PAS	✓	Remove Shelter.
	43	LC	PAS	✓	Elevate launcher to nominal settings: AZ = 193° EL = 82.5°
	44	LC	PAS	✓	Take Vertical Photos

"T" MINUS HH-MM-SS	ITEM #	FROM	TO	CHECK	OPERATION
	45	LC	PAS	✓	Close road to Launch Area (put up road barrier and "No Admittance" sign)
	46	LC		✓	Conduct Station Checks (Acknowledge) LC - Launch Control TPS - TPS Control PAS, VS - Pad Supervisor / Vehicle Systems PC - Payload Control ACS - Attitude Control System PTM - Payload TM NASA TM - NASA TM NO TM - Norwegian TM PS - Project Scientist PM - Project Manager
	47	LC	PAS	✓	Verify Pad clear.
	48	LC	ALL	✓	RADIO SILENCE LIFTED
00-20-00	49	LC	PM	✓	Permission to conduct Vertical Payload checks.
	50	LC	ALL	✓	Reset countdown clock to T-6 minutes. LC announce that countdown clock has been set to T-6 minutes for Vertical payload checks.
00-06-00	51		PC	✓	All systems on External Power
	52		ACS	✓	ACS on External Power
	53		PTM	✓	Start chart recorders
	54		NASA TM	✓	Start magnetic tapes.
	55		PC	✓	Spin up Gyro.
	56		PTM	✓	Verify clean PCM lock.
	57		NASA TM	✓	Record Transmitter parameters. TM Sig Str ______dB >30 dB C/N (TM Recorded) Deviation ______kHz KHz
	58		GPS	✓	Verify GPS data
	59		PC	✓	Verify Gyro spin-up
00-03-00	60		PC	✓	Uncage Gyro and "confirm".

"T" MINUS HH-MM-SS	ITEM #	FROM	TO	CHECK	OPERATION
	61		PC	✓	Switch all systems to Internal Power
	62		VS	✓	ARM 2nd & 3rd Stage Igniter Housings
	63		PTM	✓	Verify clean PCM lock.
00-02-30	64		PTM	✓	Verify data within limits.
00-02-00	65		PTM	✓	Verify data on GPS.
	66		VS	✓	SAFE 2nd & 3rd Stage Igniter Housings.
	67		PC	✓	Switch to External Power.
	68		PAS,PTM	✓	Perform ACS "BOX" Test.
	69		PAS	✓	Launcher at POS 1 EL=82.5 AZ=193
	70		PAS	✓	Set Launcher to POS 2 EL=72.5 AZ=193
	71		PAS	✓	Set Launcher to POS 3 EL=72.5 AZ=203
	72		PAS	✓	Set Launcher to POS 4 EL=82.5 AZ=203
	73		PAS	✓	Set Launcher to POS 1 EL=82.5 AZ=193
	74		NASA TM	✓	Stop mag tapes.
	75		PTM	✓	Stop chart recorders.
	76		PM	✓	Verify Vertical Payload checks complete.
	77	LC		✓	Confirm final launcher settings ACTUAL EL= 84.8 / NOMINAL EL= 83.5 AZ= 200.0 / AZ = 193.0
	78	LC	ALL	✓	Reset countdown clock to 00-06-00 minutes. LC announce that countdown clock has been set to T-6 minutes for Real Countdown
	79	PS	LC	✓	IF HOLD IS NOT NEEDED, SKIP TO STEP 86
00-06-00	80	PS	LC	✓	HOLD for SCIENCE (if needed)
	81		PC	✓	Cage Gyro and "Confirm".
	82		PC	✓	Switch all systems OFF. "GPS to remain ON"
	83	PS	LC	✓	Resume countdown
	84	LC	PC	✓	Switch payload systems to External Power.
	85	LC	PC	✓	Begin Gyro Spin-up.
	86	LC	LC	✓	Restrict All Vehicle Traffic.

"T" MINUS HH-MM-SS	ITEM #	FROM	TO	CHECK	OPERATION
	87	LC		☑	Turn off all sodium vapor lamps around Science Center.
	88	LC	PTM	☑	Start chart recorders.
00-05-00	89	LC	NASA TM	☑	Start magnetic tapes.
	90	LC	NO TM	☑	Start magnetic tapes
	91	LC	PTM	☑	Verify data in limits.
	92	LC	PTM	☑	Verify chart recorder channels are nominal.
	93	LC	NASA TM	☑	Record Transmitter parameters. Actual Nominal TM Sig Str NA dB >30 dB C/N Deviation ____ KHz ± 2240 KHz
00-03-00	94	LC	PC	☑	Switch all systems to Internal Power
	95		PC	☑	Verify Gyro spin-up
	96	LC	PAS,VS	☑	ARM 2nd and 3rd Stage Igniter Housings
	97	LC	PAS	☑	Confirm final launcher settings SET EFFECTIVE EL= 94.8 AZ= ____ EL= 200.0 AZ= ____
00-00-60	98	LC	ALL	☑	Time Count at ten second intervals to T-10 seconds
	99		NASA TM	☑	Final GO from NASA TM CONFIRM BY LIGHT
	100		NO TM	☑	Final GO from NO TM CONFIRM BY LIGHT
	101		PAS	☑	Final GO from PAS, VS CONFIRM BY LIGHT
	102		PC	☑	Final GO from PC CONFIRM BY LIGHT
	103		PTM	☑	Final GO from PTM CONFIRM BY LIGHT
	104		LC	☑	Announce Payload Status: GO or NO-GO CONFIRM BY LIGHT
	105		PC	☑	Cage/Uncage Gyro and "confirm".
00-00-10	106	LC	ALL	☑	Time Count at one-second intervals to T-0. On T+ time, count ten second intervals until ballistic impact (930 seconds)

"T" MINUS HH-MM-SS	ITEM #	FROM	TO	CHECK	OPERATION
00-00-00	107	"N"		✓	Booster ignites (vehicle and payload umbilicals disengage). Ignition Time is: 11 - 16 - 48 z 12/19/02 HR MIN SEC NOTE: All personnel must remain clear of the Launch Danger Area until the "ALL CLEAR" announcement is made by the LC
+ 0.6	108				Rail Exit
+ 6.2	109				Terrier burnout
+ 12	110		PTM	✓	BBV Ignition
+ 44	111				BBV Burnout
+ 55	112				E-Field Oslo sync signal
+ 62	113		PTM	✓	Nosecone Separation
+ 68	114		PTM	✓	BBV/Nihka Separation
+ 72	115		PTM	✓	Nihka Ignition
+ 90.6	116			✓	Nihka Burnout
+ 91	117		PTM	✓	EED/EID Door Deploy
+ 92	118		PTM	✓	Aft UCB Door Deploy
+ 94	119		PTM	✓	Despin to 1.1 cps
+ 96	120				Begin ACS Autobias # 1
+ 99	121				Begin Alignment to B Vector
+ 100	122				IMS HV ON
+ 101	123				ACS Enable Overide
+ 117	124				(Disable ACS) (Aft UCB Boom Deploy)
+ 118	125				Enable ACS roll control
+ 121	126		PTM	✓	(SEI/SII Booms Deploy) (EED/EID Deploy)
+ 122	127		PTM	✓	(GSFC 6m Booms Deploy) (GSFC 8m Booms Deploy)
+ 127	128		PTM	✓	French AC Search Coils Deploy

"T" MINUS HH-MM-SS	ITEM #	FROM	TO	CHECK	OPERATION
+ 128	129		PTM	☑	Stacer's Deploy
+ 137	130				Set Roll Control >0.35 rps
+ 140	131				Begin ACS Autobias # 2
+ 146	132				Begin Alignment to B Vector
+ 169	133				SEI/SII HV ON
+ 170	134				EED HV ON, EID HV ON
+ 230	135				500 km Upleg
+ 450	136				Apogee Update
+ 488	137			☑	Apogee
+ 746	138				500 km Downleg
+ 897	139				300 kft Downleg
+ 919	140				50 kft Downleg
+ 925	141				Ballistic Impact

Abbreviations

LC	Launch Control
ALL..........................	All Stations
ATC..........................	Air Traffic Control Authorities
EISCAT	EISCAT Radar
PAS	Pad Supervisor
ACS..........................	Attitude Control System
PC	Payload Control
PM	Project Manager
PTM..........................	Payload TM
NASA TM	NASA TM Van
READOUT..............	TM Chart Readout
VS..........................	Vehicle Systems
PS	Project Scientist

Support Documentation 5

Authorization To Launch

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Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099

Reply to Attn of: 810

November 26, 2002

TO: NSROC/Program Manager

FROM: 810/Chief, Sounding Rockets Program Office

SUBJECT: 35.033 GE/Pfaff/GSFC Proceed with Launch Operations

The Sounding Rockets Program Office (SRPO) personnel attended the Mission Readiness Review (MRR) for the subject mission and have reviewed the NASA Sounding Rockets Operations Contractors close out of the action items. We are in agreement that the MRR process has been successfully completed.

The Sounding Rockets Program Office authorizes NASA Sounding Rocket Operations Contract to proceed with the launch operations for the subject mission.

Philip J. Eberspeaker

cc:
218/Mr. J. Dolan
800/Mr. C. Purdy
810/Mr. E. Ransone
810/Mr. N. Schultz
NSROC/Mr. J. Scott
NSROC/Ms. M. Bitting
NSROC/Ms. G. Donovan
NSROC/Ms. D. Galeone

Flight Requirements Plan

Flight Requirements Plan

For

BLACK BRANT X (MOD 1) 35.033 GE
(Pfaff/Goddard Space Flight Center/ Svalbard)

NSROC
Wallops Flight Facility
P. O. Box 99
Wallops Island, Virginia 23337

APPROVALS

SUBMITTED:

____
Sylvia M. Onions Date
NSROC
Wallops Flight Facility

CONCUR:

____
Tracy A. Gibb Date
Mission Manager
NSROC
Wallops Flight Facility

CONCUR:

____
Michael S. Patterson Date
Range Safety Officer
NASA Goddard Space Flight Center
Wallops Flight Facility
Wallops Flight Facility

APPROVED:

____
Philip J.. Eberspeaker Date
Chief, Sounding Rockets Program Office
NASA Goddard Space Flight Center
Wallops Flight Facility

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FLIGHT REQUIREMENTS PLAN

FOR

BLACK BRANT X (MOD 1) 35.033 GE
(PFAFF/GSFC/NORWAY)

1.0 Mission Description

A Black Brant X (MOD 1) sounding rocket is scheduled for launch from Ny Alesund, Svalbard, Norway during December 2002. The overall objective of this investigation is to study the electrodynamics of the cusp and boundary layer, the associated plasma processes within this region, and their effect on energy and momentum coupling between the cusp ionosphere and the magnetosheath/solar wind. This investigation focuses on three scientific objectives:

- Cusp Pulsations – Determine the plasma, current, and electric field structure within the upper dayside cusp ionosphere during IMF B_z south conditions during a period when cusp pulsations are observed on the ground.

- Cusp/Boundary Layer Electrodynamics – Reveal the electrodynamics of the cusp/boundary layer in the upper ionosphere for the first time. In particular, characterize the transition from open to closed field lines, using energetic particle and plasma wave data to mark the transition.

- Acceleration Processes in the Cusp – Investigate the acceleration processes in the cusp region including the role of Alfven waves in accelerating low energy electrons.

An important part of this campaign is the ground collaborative program, which provides a unique set of data which is an essential element of the anticipated scientific return of the mission. The collaborative program consists of optical sites, magnetometers, the EISCAT and Svalbard radars, and the SuperDarn radar.

The Principal Investigator for this mission is Dr. Robert F. Pfaff, Jr., NASA/Goddard Space Flight Center, Greenbelt, Maryland. Collaborating Co-Investigators and other members of the mission team are listed below.

1.1 Project Personnel and Responsibilities

Name	Organization/Function
Dr. Robert Pfaff, Jr.	NASA/GSFC/Principal Investigator
Dr. Mario Acuna	NASA/GSFC/Co-Investigator

Name	Organization/Function
Dr. James H. Clemmons	Aerospace Corp./Co-Investigator
Prof. Michael Coplan	Univ. of Maryland/Co-Investigator
Prof. John Moore	Univ. of Maryland/Co-Investigator
Dr. Greg Delory	Univ. of Calif. At Berkeley/Co-Investigator
Prof. Alv Egeland	Univ. of Oslo/Co-Investigator
Prof. Jan Holtet	Univ. of Oslo/Co-Investigator
Prof. Per-Even Sandholt	Univ. of Oslo/Co-Investigator
Dr. Mark Lester	Univ. of Leicester, UK/Co-Investigator
Dr. Timothy Yeoman	Univ. of Leicester, UK/Co-Investigator
Dr. David Knudsen	Univ. of Calgary/Co-Investigator
Dr. Vladimir Krasnoselskikh	LPCT/Co-Investigator
Dr. Herve de Feraudy	CETP/Co-Investigator
Dr. J. Moen	UNIS/Co-Investigator
Prof. Stanley Cowley	Univ. of Leicester/Collaborator
Dr. Dominique Fontaine	CETP/Collaborator
Dr. Laurence Rezeau	CETP/Collaborator
Dr. Francois Lefeuvre	LPCT/Collaborator
Tracy Gibb	NSROC/Mission Manager
Charles Kupelian	NSROC/GNC/Power Engineer
Thad Sterling	NSROC/Instrumentation Engineer
Giovanni Rosanova	NSROC/Mechanical Engineer
Brent Edwards	NSROC/Flight Performance Engineer
Herbert Haugh	NSROC/Payload Technician (ET)
Brian Tucker	NSROC/Payload Technician (MT)
Alfred Halter	NSROC/Vehicle Systems Engineer
James Gladding	CSC/GSFC.WFF/Flight Safety
Ben Robbins	NASA/GSFC,WFF/Ground Safety

1.2 Main Events Schedule

Date	Event
11/16/02	Mission team travels.
12/02/02	Launch window begins.
12/15/02	Launch window ends.

1.3 Launch Schedule

Launch Window: 12/02/02 through 12/15/02

Launch Time: TBD

2.0 Operations

2.1 Countdown

The countdown will be provided at the Preflight Conference.

2.2 Nominal Flight Trajectory and Payload Events

a. Altitude vs. Time, see Figure 1.

b. Altitude vs. Range, see Figure 2.

c. Norway Range Map, see Figure 3.

d. Payload Sequence of Events, see Table 1.

2.3 Recovery

There will be no recovery.

2.4 Launch Criteria

a. Clear sky, moon down and the presence of a dayside auroral break-up.

b. Monitor auroral geomagnetic effects in order to determine acceptable launch conditions.

c. Analyze the ionospheric convection velocity vector, perpendicular to the Earth's magnetic field, in order to determine acceptable launch conditions.

d. The latitudinal location of the emissions as well as the morphological, spectral, and dynamical characteristics of the cusp aurora will be used as indicators for appropriate launch conditions as well as providing important background information for data analysis.

e. Operation of all-sky and scanning photometers in Ny Alesun in support of launch as well as ground-based magnetometers.

f. Real-time solar wind data from either the ACE or other appropriate satellite.

2.5 Comprehensive Mission Success Criteria

a. Apogee of at least 790 km.

b. All electric field booms deployed and 80% of the DC and wave electric field data telemetered to the ground.

c. All energetic particle detectors (Aerospace Corp., University of Calgary, University of Maryland) deployed and successfully taking data with 80% of these data telemetered to the ground.

d. Good data obtained from the GSFC fluxgate magnetometer and Langmuir probe with 80% successfully telemetered to the ground.

e. Data obtained from French search coil and current loops with 80% successfully telemetered to the ground.

f. Pointing of the payload to within 5^{o} of the magnetic field direction throughout at least 50% of the flight time above 250 km. No ACS firing for at least 80% of the time spent above 250 km.

g. Good attitude knowledge data (within 1^{o} RMS/revolution) obtained throughout 80% of the time spent above 250 km.

h. Good trajectory data (determined to within 5 km) obtained.

i. Rocket launched while the ground photometers and radars are taking data and while the upstream solar wind parameters are being monitored.

2.6 Minimum Mission Success Criteria

a. Apogee of at least 700 km.

b. At least one pair of electric field booms deployed with usable DC and wave field data gathered and telemetered to the ground during at least 50% of the time above 250 km.

c. Good data obtained from the magnetometer and Langmuir probe successfully telemetered to the ground during at least 50% of the time above 250 km.

d. At least one ion and one electron energetic particle detector gathering good data and successfully telemetered to the ground during at least 50% of the time above 250 km.

e. Pointing of the payload to within 5^o of the magnetic field direction throughout at least 50% of the flight time above 250 km or good attitude data (within 3^o RMS/revolution) obtained throughout at least 50% of the time spent above 250 km.

f. Usable trajectory data (determined to within 10 km) obtained.

2.7 GO/NO-GO Launch Criteria

a. All systems must be fully operational and so designated by responsible personnel for a GO condition.

b. All range support on a GO status for launch.

c. All geophysical conditions in GO status as determined by Principal Investigator.

2.8 Special Requirements in Event of a Scrubbed Mission

a. Request that the launch be rescheduled as soon as possible.

b. See Launch Postponement or Cancellation Procedures (SOP 803-WI-8072.1.4) in the Ground Safety Plan published under a separate cover.

2.9 Radioactive Sources

None.

BBX (MOD1) 35.033 GE/Pfaff
206.5/184.7 kg P/L, 82.0^o QE, 193^o AZ, MAN, SVALBARD

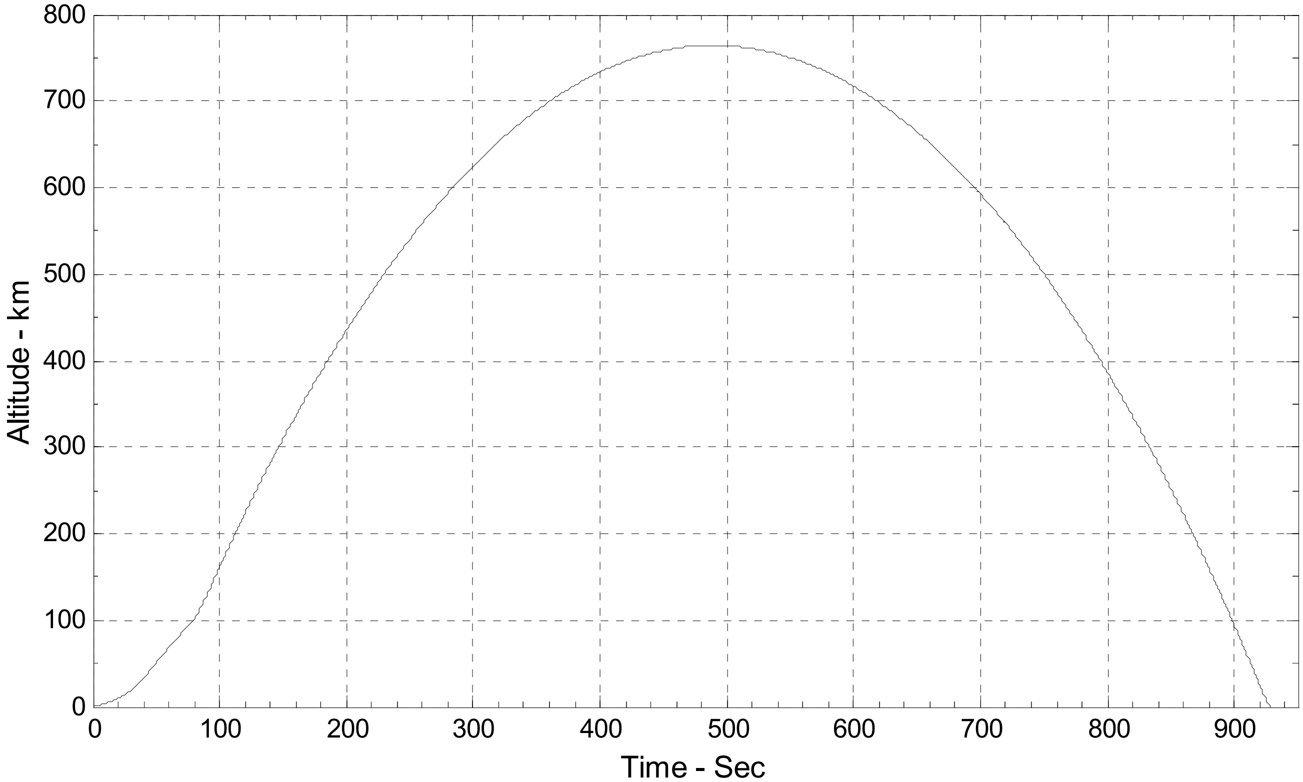

Figure 1. Altitude vs Time

BBX (MOD1) 35.033 GE/Pfaff
206.5/184.7 kg P/L, 82.0^o QE, 193^o AZ, MAN, SVALBARD

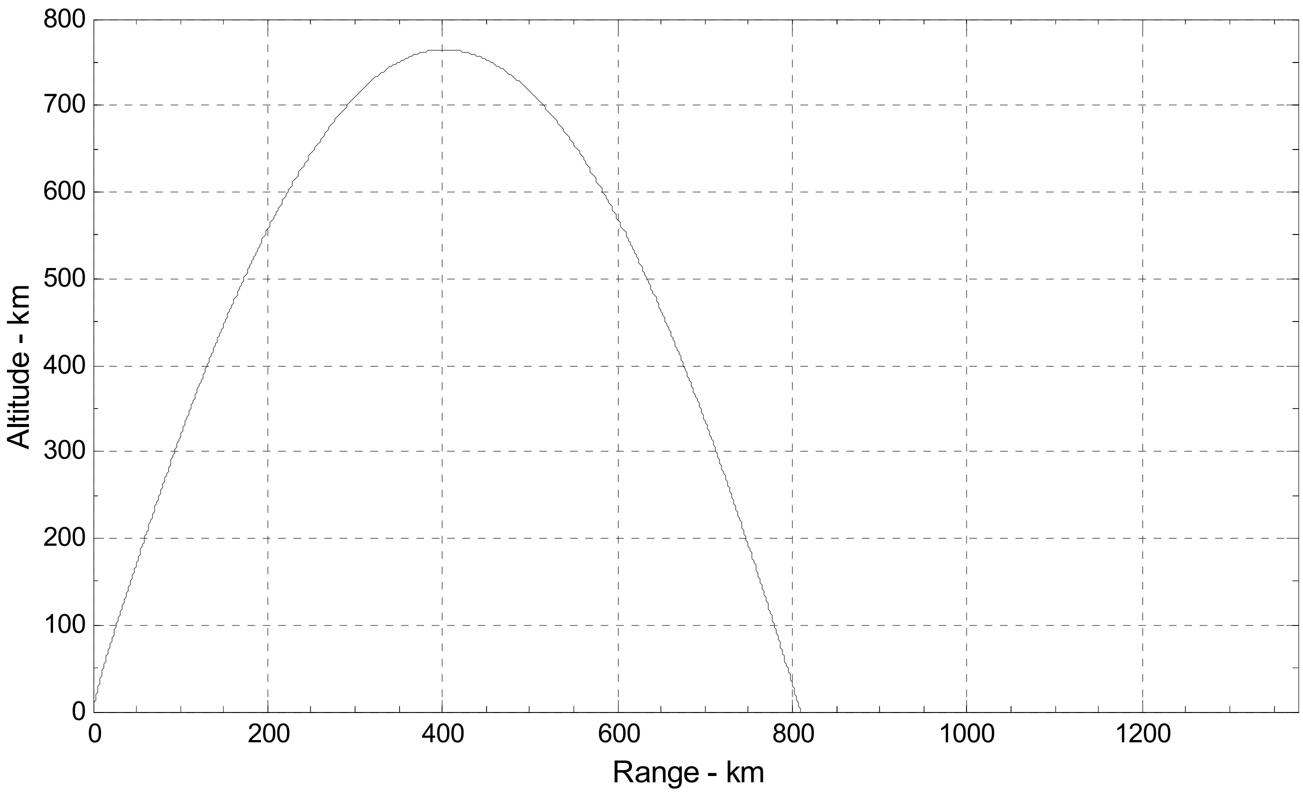

Figure 2. Altitude vs Range

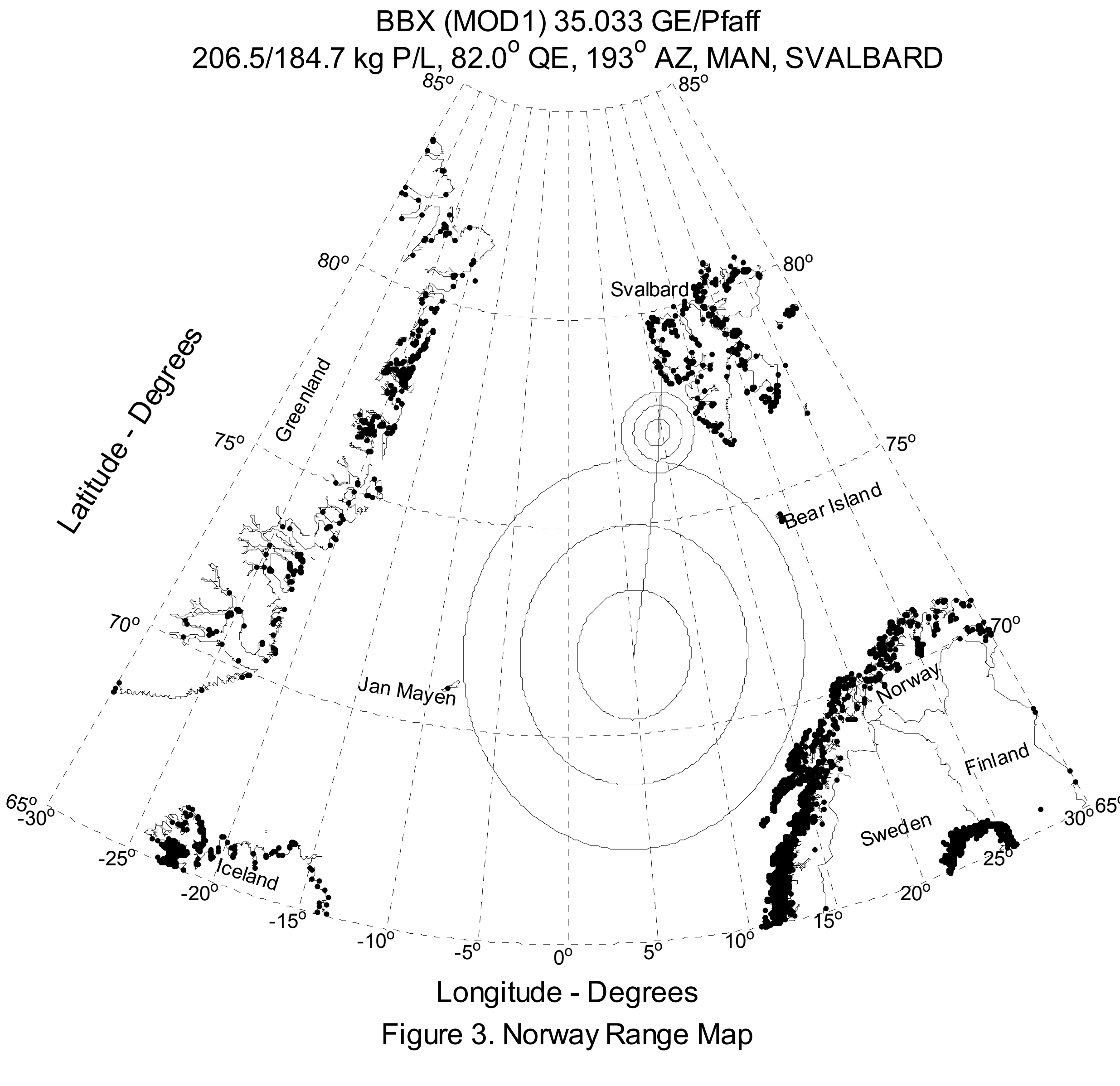

Figure 3. Norway Range Map

Table 1. Black Brant X 35.033 GE Nominal Sequence of Events

206.5/184.7 kg p/l, 82.0^o QE, 193.0^o AZ, SVALBARD

Event	Time (sec)	Altitude (km)	Range (km)	Velocity (mps)
Rail Exit	0.6	0.1	0.0	37.9
E-Field Lift-Off	1.0	0.1	0.0	70.9
Oslo Sync Signal	5.0	1.2	0.2	477.2
Terrier MK70 Burnout	6.2	1.8	0.3	554.5
Black Brant Ignition	12.0	4.7	0.8	462.5
50 kFt Upleg	27.2	15.2	3.2	1017.3
Black Brant Burnout	44.4	40.1	9.6	1912.7
Nose Cone Eject	62.0	71.0	18.4	1747.8
LEO Slug Eject	64.5	75.1	19.6	1724.8
Black Brant Separation	68.0	80.9	21.4	1692.7
Nihka Ignition	72.0	87.3	23.4	1656.1
Nihka Burnout	90.6	131.2	37.3	3438.6
EED/EID Doors Deploy	91.0	132.4	37.6	3435.4
UCB Boom Door Deploy	92.0	135.6	38.7	3426.5
Despin	93.0	138.9	39.7	3417.5
Begin ACS Autobias #1	95.0	145.4	41.8	3399.6
150 km Upleg	96.4	150.0	43.2	3386.8
ACS Autobias Finish; Begin Align to –B	98.0	155.0	44.8	3372.8
Aligned with –B	116.0	211.2	63.2	3214.3
Enable ACS Roll Control; UCB Booms Deploy	117.0	214.3	64.2	3205.6
SEI/SII Boom Deploy; EED/EID Deploy	119.0	220.3	66.2	3188.2
6m Booms Deploy; 8m Booms Deploy	121.0	226.3	68.2	3170.9
SEI/SII Booms Deployed	124.0	235.3	71.2	3145.0

Table 1. Black Brant X 35.033 GE Nominal Sequence of Events (continued)

206.5/184.7 kg p/l, 82.0^o QE, 193.0^o AZ, SVALBARD

Event	Time (sec)	Altitude (km)	Range (km)	Velocity (mps)
8m Stacer's Deploy; UCB Booms Deployed; French AC Coils Deploy; 8m Booms Deployed; EED/EID Booms Deployed	127.0	244.1	74.3	3119.1
6m Booms Deployed; French AC Coils Deploy	128.0	247.1	75.3	3110.5
8m Stacer's Deployed	135.0	267.4	82.2	3050.6
Begin ACS Autobias #2	136.0	270.3	83.2	3042.1
ACS Autobias Finish; Begin Align to –B#2	141.0	284.5	88.2	2999.7
Align to –B	151.0	312.2	98.0	2915.6
Open ACS Deadband	168.0	357.3	114.6	2774.9
SEI/SII High Voltage On; EED High Voltage On; EID High Voltage On; IMS High Voltage On	169.0	359.9	115.6	2766.7
500 km Upleg	229.6	500.0	173.0	2288.4
Apogee	489.8	764.5	403.3	965.9
500 km Downleg	750.1	500.0	633.7	2288.8
300 kFt Downleg	900.9	91.4	781.8	3546.8
50 kFt Downleg	922.9	15.2	804.9	3509.6
Ballistic Impact	928.3	0.0	809.4	2197.7

3.0 Payload Information

3.1 General Description

This payload (Figure 4) consists of a forward ejecting nose cone under which is contained the forward experiment structure and components, followed by an aft experiment section, a telemetry section, a magnetic attitude control system, and a standard Nihka motor ignition section. The Nihka tail will house a pair of experiment booms. The instruments to be flown on this payload and responsible organizations are listed below.

Organization	Responsibility
NASA/GSFC	Payload instrument design, Langmuir probe, fluxgate magnetometers.
Aerospace Corp.	Energetic ion and electron detectors.
Univ. of Maryland	Ion mass spectrograph, magnetic circuit for magnetic spectrograph instrument.
Univ. of California at Berkeley	Aft boom sensors.
Univ. of Oslo, Norway	Norwegian wave instrument.
CETP, France	Current density probe.
Univ. of Calgary	Calgary suprathermal particle imager.
LPCT, France	Search coil magnetometer.

3.2 Instrument Descriptions

a. DC and AC Electric Field Probes:

The DC and AC vector electric fields will be measured using the standard double probe technique. Spherical sensors with embedded pre-amps will be extended to distances of 6 and 8.8 meters on Weitzmann-type booms in the spin plane. The dual boom lengths (6 m and 8.8 m) will be used to verify the accuracy of DC electric fields near apogee where the plasma density is low. A third set of 6 m booms will be situated in the tail can section of the Nihka motor. The vector instrument will completely parametrize the DC and wave electric fields expected to be encountered in the cusp region.

b. Wave Processor:

The wave detector electronics will capture “snapshots” of the data at regular intervals with a frequency response of 4 MHz.

c. Fluxgate Magnetometer:

This instrument will provide triaxial measurements to a resolution of 2 nT and an absolute accuracy of approximately 10-15 nT for total field magnitude.

d. Current Density Probe:

This probe consists of a large number of wire turns on a torus made of high permeability material. An AC current passing through the surface of the torus induces an AC magnetic field in the torus and, therefore, an e.m.f. in the winding. The winding is made in such a way as to make the coil insensitive to DC and AC magnetic field along its axis. It allows the measurement of current fluctuations up to several KHz.

e. AC Search Coils:

Each sensor consists of a high-permeability core embedded in two solenoids. The main winding has a very large number of turns. Each sensor is connected to its own pre-amplifier.

f. Langmuir Probe:

This probe will extend on the main fiberglass mast. The probe will be swept in voltage approximately every 20 seconds for one second to provide absolute plasma density and temperature data as well as plasma potential.

g. Suprathermal Electron Imager:

The primary job of the Suprathermal Electron Imager (SEI) is to image Suprathermal electron distributions in the energy range 2-200 eV in order to characterize this component of cusp electron precipitation and its relation to local plasma energization. A second job is to search for signatures of electron acceleration by plasma waves in the cusp.

h. Energetic Ion and Electron Detectors:

These two analyzers make up the plasma instrumentation. Particles are admitted to the analyzer and then deflected by an electrostatic field produced by maintaining a potential difference across a gap between two concentric hemispherical plates. Particles in the correct energy range are able to traverse the gap to be detected by a microchannel plate detector positioned at the end of the gap.

i. Fast Ion Magnetic Spectrograph:

The Ion spectrograph will make high time resolution measurements (one complete spectrum every 5 ms) of the energy distributions of protons over a range of 100 eV to 10 keV with a resolution of 25% and alpha particles over a range of 50 eV to 5 keV with the same resolution.

3.3 Telemetry System

The telemetry system contains a single downlink S-band system. The System includes a Global Positioning System (GPS) for trajectory data. The TM downlink utilizes PCM/FM modulation and randomized NRZ-L code. A PSL Model WFF-93 PCM encoder is used for this link. System parameters are:

a. RF System:

Modulation Type:	PCM/FM
Carrier Frequency:	2215.5 MHz
Carrier Deviation:	$\pm$2240 MHz

b. PCM Encoder System:

Bit Rate:	6.4 Mbits/second
PCM Output Code:	RNRZ-L
Word Size:	10 bits/word

c. GPS System:

GPS Carrier:	1575.42 MHz
Solution Rate:	1 Hz
Baud Rate:	9.6 Kbaud

3.4 Attitude Control System

A Space Vector Magnetic Attitude Control System (ACS), Model 16471 will be flown.

> NOTE: Pressurizing and depressurizing the pressure vessels of the ACS system shall be performed in accordance with NASA/GSFC,WFF Code 571 Test Procedures TP 841.3 dated 7/27/88 and 7/29/88.

3.5 Power Systems

The payload consists of two instrumentation power systems. One system is a instrumentation gyro system and the other system supports the transmitter, GPS, and associated hardware.

The payload consists of two experiment power systems. One system is ±18 volts and the other is +9 volts. All systems are powered by Nickel Cadmium batteries.

3.6 Nihka Ignition System

The Nihka Ignition System is a standard module provided by Bristol Aerospace. The Nihka motor tail can will be modified to include a pair of deployable booms. Blow-off doors will be incorporated into the tail can skin.

3.7 Nose Cone

A Bristol 3:1 ogive nose cone will incorporate the FEOS and LEOS. The nose cone will be deployed before Nihka ignition.

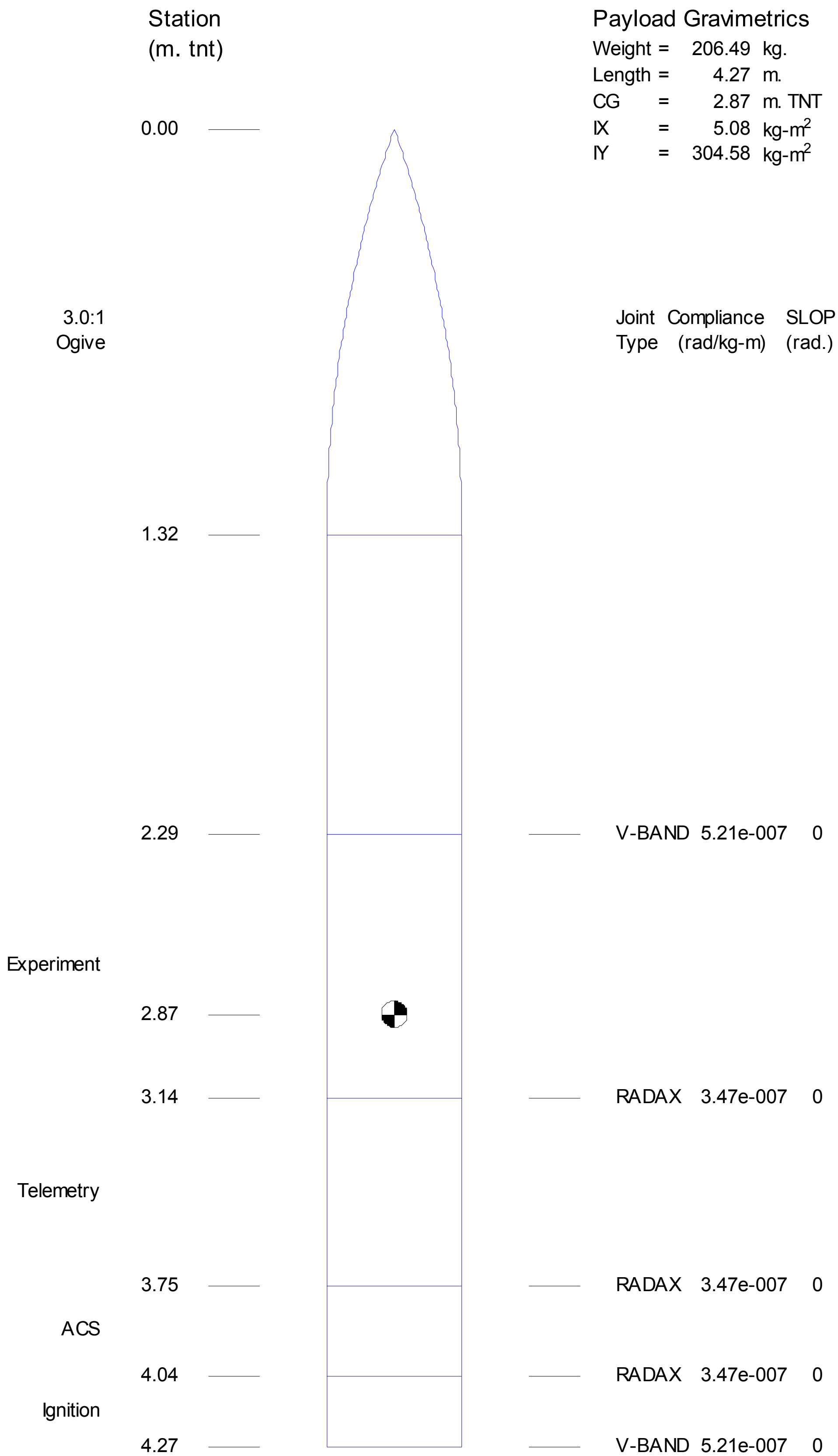

Figure 4. BBX (MOD1) 35.033 GE/Pfaff, Payload Configuration

4.0 Launch Vehicle

The Black Brant X sounding rocket is a three stage, solid propellant, rail launched, unguided vehicle. The first two stages are fin-stabilized using four fins in a cruciform configuration. The third stage is spin-stabilized. The first stage is drag separated from the second stage after first stage burnout. Second stage/third stage rocket motor separation is initiated by two Holex 3702 pressure cartridges and spring assembly located in the second stage igniter housing. The second and third stage rocket motors contain independent ignition systems, which will be monitored and controlled prior to first stage ignition. See Figure 4, Vehicle Configuration.

4.1 Launcher

Black Brant X (MOD 1) 35.033 GE is scheduled to be launched from the MAN launcher (31.7 ft rail travel).

4.2 Motors

4.2.1 Terrier Motor

The first stage booster has four fins with a fin-cant setting of 60 minutes to obtain a first stage burnout roll rate of 2.4 Hz. Burn time for the Terrier motor is approximately 6.2 seconds.

4.2.2 Black Brant VC Motor

The second stage sustainer has four fins with a fin-cant setting of 21.9 minutes to obtain a second stage burnout roll rate of 3.5 Hz. Burn time for the Black Brant motor is approximately 32.5 seconds.

4.2.3 Nihka Motor

The third stage sustainer has no fins; however, roll rate should increase to approximately 4.0 Hz at third stage burnout. Burn time for the Nihka motor is approximately 18.6 seconds.

4.3 Igniters

4.3.1 Terrier Igniter

The Terrier motor uses an electrically initiated ground-fired igniter, P/N MK 200 Mod 0. A manual safe/arm device is incorporated into the igniter. This igniter uses two S.D.I. ignition cartridges to initiate the Terrier igniter firing.

4.3.2 Black Brant VC Igniter

The Black Brant VC motor uses a Bristol high altitude igniter assembly, P/N 600-04862-3, for this flight. This igniter uses two Holex 9293-1 ignition cartridges to initiate the Black Brant motor igniter firing.

4.3.3 Nihka Igniter

The Nihka motor uses a Bristol high altitude igniter assembly, P/N 600-03840-1. This igniter uses two Holex 9293-1 ignition cartridges to initiate the Nihka motor igniter firing.

4.4 Igniter Housings

4.4.1 Black Brant VC Igniter Housing

This Bristol capacitor-discharge igniter housing assembly, P/N 600-020-12, is used for boosted vehicle applications. It contains the logic, pyrotechnic circuitry and mechanisms for performing the following functions:

a. Second stage sustainer motor ignition.

b. Second/third stage motor separation.

After manacle ring release, stage separation occurs via a separation system mounted on the forward end of the Black Brant igniter housing. The separation system is actuated when the two deployment guns sever four screws holding the manacle ring. The electrical power for pyrotechnic initiation is derived from four battery packs. Each battery pack consists of 21 silver-oxide S41 cells to provide a nominal 31.5 Vdc battery pack.

4.4.2 Nihka Igniter Housing

The Nihka capacitor-discharge igniter housing system, Bristol P/N 600-000451-31, is used for boosted vehicle applications. It contains logic, pyrotechnic circuitry and mechanisms for performing the following functions:

a. Third stage sustainer motor ignition.

b. Nihka rocket motor/payload separation.

c. Yo-yo despin payload.

The electrical power for pyrotechnic initiation is derived from four battery packs. Each battery pack consists of 21 silver-oxide S41 cells to provide a nominal 31.5 Vdc battery pack.

4.5 Vehicle and Payload Ordnance Data

Black Brant X (MOD 1) 35.033 GE sounding rocket will contain the following ordnance and pyrotechnic devices:

Item	Function
Terrier igniter	Terrier motor ignition.
S.D.I. Ignition Cartridge (103377-119)	Initiate Terrier igniter.
BBV Igniter, P/N 600-04862-3	Black Brant motor ignition.
Ignition Cartridge, Holex 9293-1	Initiate BBV motor igniter.
Pressure Cartridge, Holex 3702	Second/third stage separation.
Nihka Igniter, P/N 600-03840-1	Third stage Nihka ignition.
Ignition Cartridge, Holex 9293-1	Initiate Nihka motor igniter.
Pressure Cartridge, Holex 3702	Nose cone deployment.
Guillotine, Holex 5801	Initiate payload yo-yo despin.
Pressure Cartridge, Holex 6104	Payload/Nihka separation.
Holex 2801	EED/EID deployment.
1MTT18CC	Weitzmann booms deployment.
Holex 2801	E-field booms deployment.
Holex 2801	Aft UCB tail can doors deployment.
Holex 2801	SEI/SII booms deployment.

Item	Function
Holex 2801	EED/EID doors deployment.
Holex 2801	French search coil boom deployment.

NOTE: The Ground Safety Plan for this vehicle will be published under a separate cover.

4.6 Temperature Restraints

Following are the lower and upper storage and operating temperatures for the aforementioned components:

Component	Storage Temperatures ($^oC/^oF$) (Lower)	(Upper)	Operating Temperatures ($^oC/^oF$) (Lower)	(Upper)
Terrier Igniter	-28/-20	48/120	-28/-20	48/120
Terrier Motor	-12/+10	54/130	+07/+45	35/95
BBV Motor	-23/-10	51/125	-23/-10	51/125
BBV Igniter	-23/-10	51/125	-23/-10	51/125
Nihka Motor	-23/-10	51/125	-23/-10	51/125

All motors will be monitored via the Romotemp remote temperature system. This system will be installed at the launch range during field operations. The system consists of a laptop computer, a tattle tale J box, and miscellaneous cables. The system is completely portable and is capable of monitoring up to six temperatures per motor.

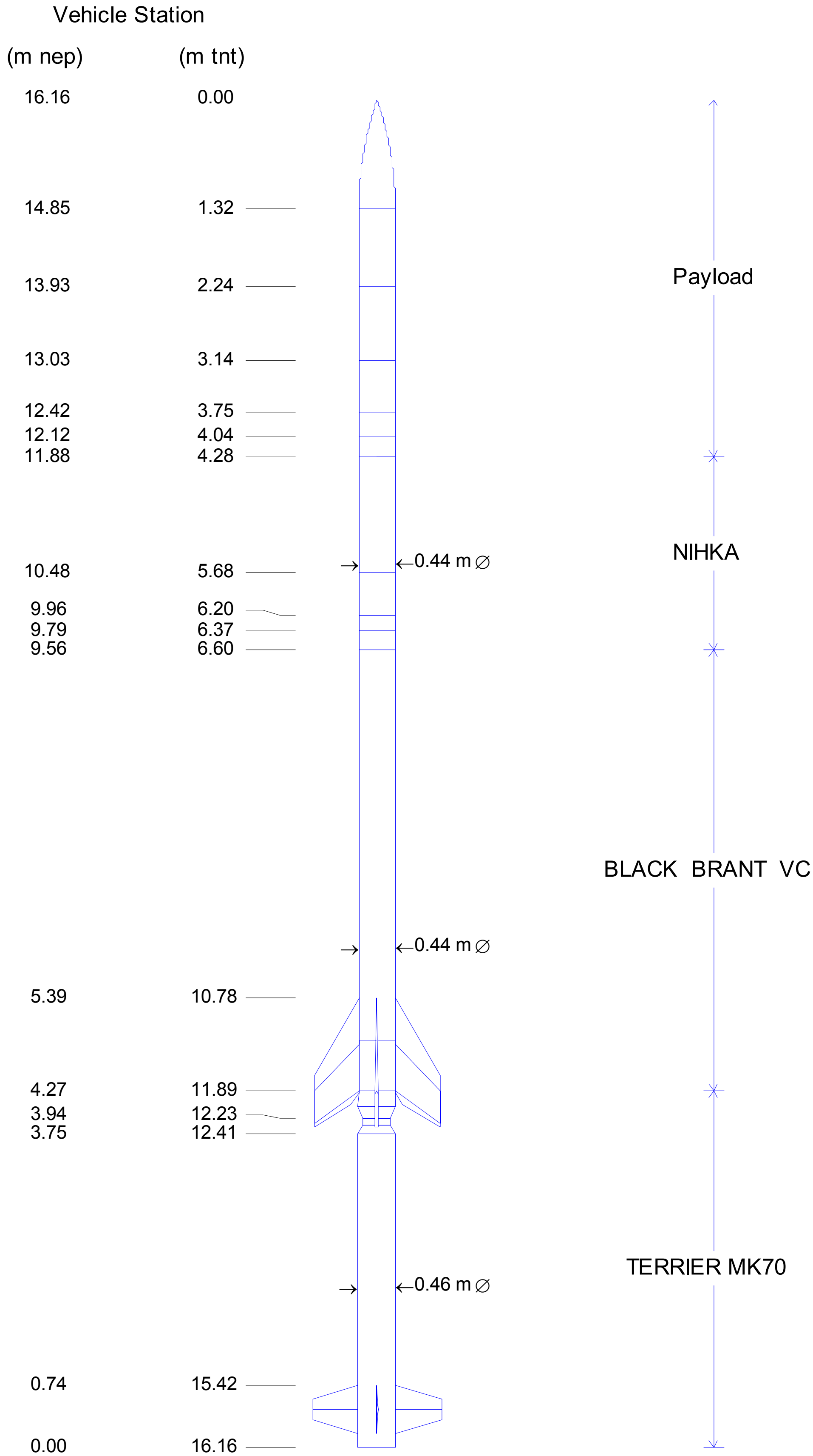

Figure 5. BBX (MOD1) 35.033 GE/Pfaff, Vehicle Configuration

5.0 Experimenter's Range Support Requirements

a. Dry nitrogen for payload purging.

b. EISCAT Svalbard radar, a new second radar dish and the mainland EISCAT radar.

c. Normal payload buildup and checkout facilities with environmental protection for the payload during build-up.

d. Provide a suitable telemetry tracking and alternate telemetry tracking station at the launch range and near the launch range.

e. Request the payload be enclosed in a styrofoam box.

f. Provide suitable wind weighting services and range safety services.

g. Provide suitable equipment for the transport of the rocket motors and payload to the launch pad.

h. Provide suitable storage facilities for the three rocket motors.

i. Provide necessary phone lines, with Internet and e-mail access.

j. The IMAGE (International Monitor for Auroral Geomagnetic Effects) digital magnetometer network which stretches from southern Finland to northern Svalbard.

k. Optical measurements operated by the University of Oslo's multi-channel scanning photometers in Ny Alesund, Svalbard, and Danmarkhavn on the east coast of Greenland.

l. Effective communication between all observation sites is paramount and a countdown allowing limited duration holds will be provided.

m. Ensure magnetically clean payload environment.

n. Clean entire payload of flux, debris, fingerprints, etc. with alcohol and acetone.

o. The CUTLASS HF phased-array radars, located in Iceland and Finland. CUTLASS forms the easternmost part of the SuperDARN Network. The entire SuperDARN network will provide data for the campaign to provide a truly global context.

p. Deliver the following to the experimenter in a timely fashion after launch:

(1) Telemetered data on standard data medium.
(2) Trajectory information accurate to 100 m or better.
(3) Attitude information accurate to one degree or better.

6.0 Technical Support

6.1 Global Positioning System (GPS)

A NASA GPS receiver will be used to provide tracking data. The GPS receiver has two serial ports. One will be configured to output position information at a constant rate and will connect to the PCM encoder. The second port will interface to ground support equipment.

6.2 Telemetry

Redundant tape recorders will be the prime data for this launch. Detailed telemetry requirements and system parameters will be further delineated at the Preflight Conference.

Recorder formats that will be used for real time flight data and for pre-launch payload checks are contained in the attachment.

6.3 Normal Range Launch Support

The Range will be required to support this launch in the following areas:

6.3.1 Rocket Lift-off Pulse

Rocket lift-off pulse is to be unambiguously superimposed on the timing signals distributed to all stations.

6.3.2 Communications

On-range communications via intercom and telephone will be required.

6.3.3 Meteorology

Daily forecasts including expected surface winds and winds aloft to 60 K-ft ad general weather conditions at the Range.

6.3.4 Wind Weighting

Normal wind weighting support for determination of launcher settings is required. In addition, records of pre- and post-launch ballistic wind data are also required. Input parameters for the configuration will be supplied by Wallops Flight Facility.

NOTE: Azimuth and elevation to provide the highest possible altitude consistent with Range Safety.

6.4 **Technical Personnel Services**

Services of pad personnel are required for assembly of the vehicle, installing and mating the payload to the vehicle, and completing launch operations. Preparation and assembly of the rocket vehicle are to be performed in accordance with NSROC/WFF Standard Procedures.

7.0 General Support

7.1 Blockhouse and Assembly Area

It is requested that the Range provide the following facilities for rocket preparation and firing operations:

a. Laboratory and assembly space (temperature and humidity controlled) with two work benches, 115 V at 60 Hz power, and voice communications in hazardous assembly area.

b. A small area in the blockhouse for payload control equipment to be used during the countdown. This area should have 115 V, 60 Hz, 20 amp AC power and access to the payload umbilical circuits.

7.2 Ground Support Equipment

The Range is requested to provide dollies and hoists for use in vehicle buildup. Suitable transport of the rocket motors to the launch pad is also required. The Range is also expected to provide suitable firing circuits and associated support equipment.

7.3 Consumables

The following consumable is requested to be supplied by the Range:

Item Description	Use	Cylinder Size	Qty
Nitrogen, dry	Payload purge	A	6
Nitrogen	ACS		20

7.4 Data Collection, Reduction, and Distribution

7.4.1 Quick Look (to Mission Manager)

Exact time of lift-off.
Apogee altitude and time.
Payload impact range, azimuth, and time.

7.4.2 Postflight Data Processing (to Mission Manager)

a. The following in-flight data should be supplied as soon as possible after launch:

(1) Absolute time of lift-off.
(2) Burnout time, velocity and altitude.
(3) Peak time and altitude.
(4) Impact coordinates of payload (if possible).
(5) Actual and effective launcher elevation and azimuth angles.

b. Two copies of the pre- and post-launch ballistic wind data are required.

c. Three copies of the smoothed radar data are required.

7.4.3 Final Data Report

One copy of all radar and wind weighting data should be provided to the Mission Manager, prior to his departure, for transport to GSFC/WFF. All other data should be forwarded to:

Ms. Deborah J. Stanley
GHG, Wallops Flight Facility
Building E-106
Wallops Island, VA 23337

Comprehensive
Mission Requirements Matrix

Requirements Matrix

35.033 GE

NASA Goddard Space Flight Center

Change History Log

Revision	Effective Date	Description of Change
Baseline	4/12/00	Original document presented at RDM
A	9/13/01	Requirements matrix format changed to the new standard format. This has resulted in requirement number changes. Several requirements modified. All changed data has been "~~struck-through~~" and all new data is in *blue italics*.
B	10/1/01	Changed PR 46 at PI request. All changed data has been "~~struck-through~~" and all new data is in *red italics*.
C	10/25/02	Changed PR37 to reflect new CSC apogee requirement. Numerous other changes to bring the requirements up-to-date. All new data is in *green italics*.

Payload Requirements: Pfaff 35.033

Category	Ref. #	Requirement	Process/Approach
Payload Hardware	PR 1.	Science related instrumentation.	This is a new mission. The science hardware will be supplied by an international team. Dr. Rob Pfaff is the Principal Investigator. This mission ~~will have~~ *has* similar resemblances to the Geodesic mission that was recently launched from the PFRR, Alaska.
	PR 2.	Forward structure to house science related instrumentation.	NSROC will provide the structure, which will house the science instrumentation. This will include all decks *(4)* and *C-channel* longerons.
	PR 3.	*Aft structure to house science related instrumentation.*	*NSROC will provide the 17.26” dia., 33.5” long structure, which will house the Aerospace and GSFC science instrumentation. This will include the skin, two decks, blow-off doors (Aerospace) and C-channel longerons.*
	PR 4.	Forward ejecting nosecone and skirt to expose the forward mounted science instrumentation.	NSROC will provide a*n Aluminum, 0.062” thick, 17.26” dia., 3:1 ogive,* FEOS-LEO *(with extension tube to clear Langmuir probe)* nosecone ~~with extended skirt~~ approximately ~~100"~~ *90”* in length. *The nosecone ~~will have~~ has an internal fiberglass liner for a skirt.*

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
	PR 5.	Provide necessary instrumentation to meet all science requirements and ensure adequate collection, encoding and transmission of all pertinent data.	NSROC will provide a *17.26" dia., 24" long* ~~standard~~ telemetry section consisting of *the skin*, 2 decks, *C-channel longerons*, wrap-around S-band and L-band antennae, TM transmitter, WFF-93 encoder and other miscellaneous TM hardware.
	PR 6.	Provide necessary attitude control system to provide pointing of the payload to within 5° of the magnetic field direction.	NSROC subcontractor Space Vector will provide *the 17.26" dia., 11.56"* long magnetic ACS. *Two remote nozzles will be mounted in the Forward Exp Section on the longerons between deck three and four. This results in a moment arm on the order of ~~63"~~ 4.97', which is acceptable for this mission.*
	PR 7.	Provide the necessary vehicle systems to ensure ignition and Despin.	*The necessary hardware will be supplied by NSROC to ensure this requirement is met. Standard Bristol 17.26" dia., 8.9" long Nihka ignition system will be supplied. The Nihka tail can will be modified to include a pair of deployable booms for UCB. Despin will be made to 1.1cps.*
	PR 8.	Provide the necessary vehicle configuration to ensure the greatest possibility of achieving the defined success criteria.	Based on launch range and science requirements, ~~it is felt that~~ A BB X *(Mod 1) vehicle configuration* will meet the pre-defined science objectives. *See PR 9.*

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Flight Trajectory / Dynamics	PR 9.	Desired apogee of ~~800~~ *790* km.	~~Preliminary analysis~~ *FP* has determined a BBX *(Mod 1)* vehicle would carry this payload ~~(455 lbs.)~~ ~~*455.2 lbs*~~ *472.63 lbs* to a nominal apogee of ~~798 km~~ ~~*790.3 km*~~ *760.6 km*. A two sigma low apogee of ~~733 km~~ ~~*742.9 km*~~ *705.4 km*. Both assume an *82.5* ~~84~~ degree QE.
	PR 10.	Position determination.	GPS will be provided to meet this requirement. Additionally, Doppler ranging would be utilized provided Norwegian support can be arranged through NASA JIP.
	PR 11.	Maximum burnout roll rate of 4 Hz.	~~Preliminary analysis indicates no interaction between pitching frequency and roll rate.~~ Fin cant will be adjusted accordingly to prevent burnout roll rates in excess of 4 rps. *2^{nd} stage burnout roll rate of 3.5 rps with a target nominal Nihka burnout roll rate of 4.0 Hz. With a 2-sigma high burnout roll rate of 5.0 Hz. The current boom deployment sequence can withstand either 2-Sigma low or 2-Sigma high vehicle performance.*
	PR 12.	Maximum roll rate for boom deployment 1.5 hz.	This will be accomplished by NSROC provided yo-yo despin. *A Sigma high roll rate would yield a maximum roll rate at boom deployment of ~~1.23~~ 1.38 rps as analyzed.*
	PR 13.	Residual roll rate, after boom deployment, of .2 - .5 Hz with .35 Hz preferred.	~~SVC MAG system will activate and remove any residual rates down to .2eps to .5eps with a target of .35eps.~~ *The ACS will be programmed such that as the booms deploy, and the roll rate decreases from the Despin roll rate of 1.1 rps, when the roll rate tries to go lower than ~~0.35~~ 0.5 rps the ACS will activate and maintain ~~0.35~~ 0.5 rps. After boom deployment lower roll control threshold will be set at 0.35 rps.*

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Flight Trajectory / Dynamics	*PR 14.*	*Ensure vehicle stability is within acceptable limitations*	*All performance related factors are well within acceptable minimum limitations. See ~~DR~~ MRR Section 3.0 Flight Performance for more detail. Vehicle stability is considered acceptable for this mission.*
	PR 15.	*Ensure impact dispersion is within acceptable limitations.*	*The impact dispersion is considered acceptable for this mission. See ~~DR~~ MRR Section 3.0 Flight Performance.*
	PR 16.	*Ensure predicted flight trajectory is within acceptable limitations.*	*Utilizing a Black Brant X (Mod 1) vehicle configuration launched from the Ny Alesund launch facility with a QE of ~~84.0~~ 82.5° and an AZ of ~~215.0~~ 193.0°, with a ~~455.2~~ 472.6-lb payload configuration will achieve a nominal apogee of ~~790.3~~ 760.6 km with a nominal impact downrange of ~~624.7~~ 756 km. Although a more Southerly trajectory is desired this particular trajectory meets all science requirements and is considered acceptable for this mission. More analysis will be completed in an effort to obtain a more Southerly trajectory of 82.0° QE with an AZ of 193.0°. Multiple trajectories have been approved by WFF Flight Safety and are currently pending Norwegian approval: #1 QE = 82.5, AZ = 193.0, Apogee = 760.6 km; 2-Sigma Low = 705.4 km, #2 QE = 82.5, AZ = 200.0, Apogee = 760.2 km; 2-Sigma Low = 705.0 km, #3 QE = 82.5, AZ = 205.0, Apogee = 760.0 km; 2-Sigma Low = 704.8 km, #4 QE = 83.0, AZ = 210.0 Apogee = 765.8 k; 2-Sigma Low = 710.2 km, #5 QE = 84.0, AZ = 215.0, Apogee = 776.7 km; 2-Sigma Low = 720.3 k. All meet ALL success criteria.*

Payload Requirements: Pfaff 35.033

Category	Ref. #	Requirement	Process/Approach
GNC	PR 17.	Align payload to magnetic field.	A SVC Model 16471 ACS will be programmed to *initially* align the payload to within ~~5~~ ±*2*° of the magnetic field. *Booms will then deploy and re-alignment to ±1.5° of the magnetic field will take place. Dead-band will be established at ±10°-deg (hysterisis), an apogee update will occur at T+450 after which the Dead-band will be re-established @ ±10°-deg (hysterisis).* ~~After alignment,~~ ~~*the ACS will correct whenever the total mis-alignment is >5°.*~~ ~~The system will be shut off and then restarted for realignment at apogee. It is believed that this process will minimize coning effects.~~
	PR 18.	Coning.	
	PR 19.	Attitude determination to within 1° (RMS/revolution) accuracy.	~~SVC Magnetic ACS rate sensors will be utilized, along with four solar aspect sensors, to determine attitude data to one degree accuracy. Additionally, magnetometer will provide roll rate and relative attitude data.~~ *SVC magnetic ACS, with TM gyro, provides attitude knowledge to better than 3° accuracy.*

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Power	PR 20.	TM System	~~Standard~~ *NSROC provided TM* + 28 V battery pack (24 ~~"C" NiCads~~ *"4/3FAU" NiMH's*).
	PR 21.	Pyrotechnic System	~~Standard~~ *NSROC provided* Pyro battery pack (16 ~~"A" NiCad's~~ *"5/4AAAU" NiMH's*).
	PR 22.	*Gyro System*	*NSROC provided Gyro battery pack (24 "5/4AAAU" NiMH's).*
	PR 23.	Experiment System #1	~~Standard~~ *NSROC provided experiment* +18 V battery pack (15 ~~"A" NiCad's~~ *"AU" NiMH's*)
	PR 24.	Experiment System #2	~~Standard~~ *NSROC provided experiment* -18 V battery pack (15 ~~"A" NiCad's~~ *"AU" NiMH's).*
	PR 25.	Experiment System #3	~~Standard~~ *NSROC provided experiment* +9 V battery pack (8 ~~"C" NiCad's~~ *"AAU" NiMH's).*
	PR 26.	Provide the necessary flight events as required.	A Multifunction Timer (MFT) will control all flight events.
	PR 27.	Provide the necessary electrical inhibits for all associated hazardous systems.	Altitude switches and a safe/arm plug for two of the experiments will be utilized.

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Telemetry	PR 28.	Transmission of all housekeeping data from all science instruments, and all NSROC housekeeping data including GPS, magnetometer, and associated deployment monitors.	A single Aydin-Vector T610 (possibly a T410 based on availability) 10 watt S-Band transmitter, a single WFF-93 ~~5~~ *6.4* MBPS encoder will be utilized to provide adequate down linking of the required data.
	PR 29.	PCM science data downlink channels as required.	The NSROC TM engineer will coordinate this effort based on input from the science team.
	PR 30.	Real time decommutation, D/A conversion and strip chart recording of selected PCM signals.	
	PR 31.	D/A conversion and strip chart recording of all PCM telemetry is required after each pre-launch check and post flights.	
	PR 32.	At least one 8-channel strip chart recorder required, by Aerospace Corp, for payload checkout and pre-launch diagnostics. Also require a parallel interface from a TDP decom/DAC unit for this purpose.	

Payload Requirements: Pfaff 35.033

Category	Ref. #	Requirement	Process/Approach
Flight Data Products	PR 33.	TM Data	Dr. Pfaff, and each Co-PI, will each receive a copy of the PCM TM link data in PTP format on CD no later than 30 calendar days after launch.
	PR 34.	Attitude Data	NSROC GNC will perform the necessary attitude determination, down to ~~one~~ *3°* degree (RMS/revolution) *or better* and will provide this data in an agreeable format with Dr. Pfaff. *See PR19.* ~~Solar aspect sensor data in ASCII format will be available on the Wallops FTP site no later than 30 calendar days after launch.~~
	PR 35.	Positional Data	GPS single point solution will be provided, in Excel format, on the Wallops FTP site no later than thirty days after launch. Doppler ranging, ~~if utilized, would~~ *will* be provided by Norwegian support efforts.
	PR 36.	Quick Look Data	Strip charts of flight data, will be supplied to the experimenters, as requested prior to launch, within 24 hours of launch. All subsequent requests will be delivered no later than ~~three days~~ *two weeks* after launch *following WFF play-backs.*

Payload Requirements: Pfaff 35.033

Category	Ref. #	Requirement	Process/Approach
Comprehensive Success Criteria	PR 37.	Apogee of at least ~~800~~ ~~*790*~~ *750* km.	~~Preliminary~~ Analysis has determined a BBX *(Mod 1)* vehicle would carry this payload ~~(455 lbs)~~ ~~*455.2*~~ *472.6 lbs* to a nominal apogee of ~~798~~ ~~*790.3*~~ *760.6* km. A two sigma low apogee of ~~733~~ ~~*742.9*~~ *705.4* km. Both assume an ~~84~~ *82.5*-degree QE (See PR~~7~~ *9 &16*). ~~This is a conservative weight estimation and preliminary weight reductions have already been taken into consideration in order to reduce payload weight further, thus increasing apogee.~~
	PR 38.	All electric field booms deployed and 80% of the DC and wave electric field data telemetered to the ground.	NSROC provided MFT will provide the deployment signal with the deployment monitor and gathered scientific data telemetered to ground by means of the TM system described in PR ~~21~~ ~~*28*~~ *26*.
	PR 39.	All energetic particle detectors (Aerospace Corp., University of Calgary, University of Maryland) deployed and successfully taking data with 80% of these data telemetered to the ground.	
	PR 40.	Good data obtained from the GSFC fluxgate magnetometer and Langmuir probe with 80% successfully telemetered to the ground.	Gathered science data will be encoded by the WFF-93, ~~5~~ *6.4* MBPS encoder and downlinked by a single 10 watt transmitter located in the TM section (see PR ~~21~~ *28*).
	PR 41.	Data obtained from the French search coil and current loops with 80% successfully telemetered to the ground.	

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Comprehensive Success Criteria	PR 42.	Pointing of the payload to within 5° of the magnetic field direction throughout at least 50% of the flight time above 250km.	A SVC Model 16471 ACS will be programmed to *initially* align the payload to within ~~5~~ *+2*° of the magnetic field. *Booms will then deploy and re-alignment to +1.5° of the magnetic field will take place. Dead-band will be established at +10°-deg (hysterisis), an apogee update will occur at T+450 after which the Dead-band will be re-established @ +10°-deg (hysterisis).* ~~After alignment,~~ ~~*the ACS will correct whenever the total mis-alignment is >5°.*~~ ~~The system will be shut off and then restarted for realignment at apogee. It is believed that this process will minimize coning effects.~~
	PR 43.	No ACS firing for at least 80% of the time spent above 250km.	The ACS will be programmed accordingly to ensure this requirement is met. ~~*The ACS will activate whenever the payload mis-alignment exceeds 5°.*~~ *See PR 42*
	PR 44.	Good trajectory data (determined to within 5 km) obtained. Good attitude knowledge data (within 1° RMS/revolution) obtained throughout 80% of the time spent above 250km.	GPS single point solution will *provide the accuracy necessary to meet the trajectory data requirement. See PR19 for attitude knowledge requirement.* ~~Accuracy to within 10 km. If need be, GPS differential solution will be used to provide trajectory data to within 5 km. SVC MAG Rate sensors, solar aspect sensors and magnetometer will provide attitude accuracy to 1 degree (RMS/revolution).~~
	PR 45.	Rocket launched while the ground photometers are taking data and while the upstream solar wind parameters are being monitored.	This effort will be coordinated between the NSROC-PM, range resources and science team.

Payload Requirements: Pfaff 35.033

Category	Ref. #	Requirement	Process/Approach
Minimum Success Criteria	PR 46.	Apogee of at least ~~650~~ ~~*740*~~ *700* km.	~~Preliminary~~ Analysis has determined a BBX *(Mod 1)* vehicle would carry this payload ~~(455 lbs.)~~ ~~*455.2*~~ *472.63-lbs* to a nominal apogee of ~~798~~ ~~*790.3*~~ *760.6* km. A two sigma low apogee of ~~733~~ ~~*742.9*~~ *705.4* km. Both assume an ~~84~~ *82.5*-degree QE (See PR~~7~~ *9*).
	PR 47.	At least one pair of electric field booms deployed with usable DC and wave electric field data gathered and telemetered to the ground during at least 50% of the time above 250km.	NSROC provided MFT will provide the deployment signal with the deployment monitor and gathered scientific data telemetered to ground by means of the TM system described in PR ~~21~~ ~~*28*~~ *26.*
	PR 48.	Good data obtained from the GSFC Fluxgate magnetometer and Langmuir probe successfully telemetered to the ground during at least 50% of the time above 250 km.	Gathered data will be encoded by means of the WFF-93 ~~5~~ *6.4* MBPS encoding system and downlinked by the 10 Watt transmitter located in the TM section (See PR ~~21~~ *28*).
	PR 49.	At least one ion and one electron energetic particle detector gathering good data and successfully telemetered to the ground during at least 50% of the time above 250 km.	
	PR 50.	Pointing of the payload to within 5° of the magnetic field direction throughout at least 50% of the flight time above 250 km or good attitude data (within 3° RMS/revolution) obtained throughout at least 50% of the time spent above 250 km.	SVC Magnetic ACS will provide alignment, to within 5 degree of the magnetic field throughout at least 50% of the flight time above 100 km. *See PR19 for attitude knowledge requirement.* ~~SVC MAG rate sensors, solar aspect sensors and magnetometer data will be utilized to resolve attitude data to 1-degree accuracy (RMS/revolution).~~
	PR 51.	Usable trajectory data (determined to within 10 km) obtained.	Single point solution GPS data will be utilized to adequately meet this requirement.

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Other	PR 52.	Outgassing, by electrical and mechanical components, should be minimized to protect instrument systems and enhance the value of scientific data.	Low outgassing materials will be utilized, as necessary; to ensure these criteria is adequately met.
	PR 53.	Ensure magnetically clean payload environment.	Non-Magnetic hardware will be utilized in the forward experiment section (under nosecone) to ensure magnetic cleanliness.
	PR 54.	Ensure reduced EMI.	Standard shielding practices will be utilized in an attempt to reduce any EMI. This will include twisted, shielded pair, as deemed necessary by the science team and will be fully identified by the Design Review.
	PR 55.	Clean entire payload of flux, debris, fingerprints, etc with an approved solvent.	Alcohol and Acetone will be provided for a thorough cleansing of the payload throughout the course of this mission.
	PR 56.	Use clean bare aluminum skin	Clean, bare aluminum skins will be utilized.
	PR 57.	No anodization on the payload exterior parts or parts which might reach high temperatures (gold iridite acceptable).	No anodization will be required.

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Other	PR 58.	Magnetic calibration required.	Magnetic calibration will take place at *Wallops Flight Facility.* ~~Goddard Space Flight Center, as requested by Dr. Pfaff.~~
	PR 59.	Ensure prompt shipment, of sea-transported items, in order to avoid associated transportation route freeze based on time of year.	~~The Hazardous systems, along with, associated CSOC, and NASA TM ground support equipment, will need to be shipped at least four months prior to the anticipated freeze of the shipping routes. Previously, NASA handled all shipping.~~ *All hazardous systems have been shipped and are in Norway.*
	PR 60.	Composition of a Joint Implementation Plan (JIP) between NASA/WFF/SRPO and the Norwegian Space Center (NSC), as before.	~~This plan will need to be devised in order to clearly define the requirements placed on NASA, NSROC and NSC. The plan utilized previously was comprehensive and clearly defined the requirements placed on each entity. This effort needs to be completed again. This should be NASA SRPO and NSROC's joint responsibility.~~ *The JIP has been completed and delivered to all pertinent parties.*
	PR 61.	Provide the necessary hardware for launch operations, subject to fulfillment of required export licensing procedures.	Since all hardware is ultimately in the possession of NASA, this should be arranged by NASA in order to ensure timely delivery of associated equipment. *All hardware/equipment has been arranged for, shipped and received by ARR.*

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Range Requirements	PR 62.	Launch Site	Ny Alesund, Svalbard
	PR 63.	Launch Window #1: ~~12/9/01 - 12/17/01~~ *12/1/02 – 12/16/02*	This will be considered the preferred launch window based on its closer proximity to the solstice. ~~This window may adjust by one *several* days pending further review by Dr. Pfaff.~~
	PR 64.	Launch Window #2: 1/8/02 - 1/18/02	This will be considered the secondary launch window.
	PR 65.	Dry Nitrogen purge requested.	This requirement will be coordinated with range personnel.
	PR 66.	Payload to be enclosed in a Styrofoam box.	
	PR 67.	The necessary heaters to provide heated air into the aft end of the Styrofoam box.	
	PR 68.	Provide a suitable telemetry tracking station to be installed by NASA/contractor personnel at the launch range.	~~NSROC would like to propose a 7-meter mobile unit, with transportable readout van be located at Ny Alesund launch range.~~ *It is requested that a CSOC mobile telemetry van be sent to Ny Alesund and staffed by CSOC personnel. The CSOC mobile telemetry van should be responsible for TM antenna tracking, reception of TM link, recording of PCM data, and read-out displays on TDP's and strip chart recorders. A minimum of one CSOC mobile TM antenna is required. The CSOC provided TM antenna must have a G/T of at least 16.5 dB per degree K.*
	PR 69.	Provide a suitable alternate telemetry tracking station to be installed by NASA/contractor personnel near the launch range.	NSROC would like to propose a TOTS trailer to be located at Andennes launch facility. Additionally, *Longyearbyn 11M antennae could also provide support if NASA can arrange support.*
	PR 70.	Provide suitable wind weighting services and range safety services.	The NSROC mission manager, NASA SRPO and appropriate range resources will coordinate this effort. Norwegian Space Center should provide this, as per the JIP.
	PR 71.	Provide workshop space for payload testing and vehicle build-up.	NSC can only meet this requirement. Therefore, this effort should be clearly outlined in the JIP between NASA and NSC.

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Range Requirements	PR 72.	Provide suitable launcher, with launcher shelter, to accommodate one Black Brant X vehicle/payload configuration.	NSC can only meet these requirements. Therefore, this effort should be clearly outlined in the JIP between NASA and NSC. The NSROC PM will work closely with NSC resources, and the SRPO, to ensure that these requirements are met.
	PR 73.	Provide suitable equipment for the transport of the rocket motors and payload to the launch pad.	
	PR 74.	Provide suitable storage facilities for the three rocket motors required	
	PR 75.	Provide the necessary phone lines, with Internet and email access. This will allow the easy dissemination of scientific data be viewed prior to and during launch operations. This may require the assignment of IP addressed, as necessary.	
	PR 76.	Provide telemetry support on Svalbard with one ten-foot transportable telemetry system.	
	PR 77.	Provide launch services of the proposed sounding rocket and associated payload.	

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Range Requirements	PR 78.	Ensure the necessary communications, with the Norwegian Government, to obtain all clearances, licenses, and permits necessary for NASA to conduct this sounding rocket mission. This will include all necessary aviation and shipping clearances, radio frequency clearances, and clearances to possess, use and transport hazardous materials (i.e. rocket motors, batteries, pyros, etc)	NSC can only meet these requirements. Therefore, this effort should be clearly outlined in the JIP between NASA and NSC. The NSROC PM will work closely with NSC resources, and the SRPO, to ensure that these requirements are met.
	PR 79.	Ensure the necessary communications with other appropriate foreign agencies to ensure the understanding of the purpose, and intent, of this launch. This should be provided well in advance, in writing. This effort needs to be primarily directed to the U.S.S.R., as was for the Kintner launch 40.012 launch in January of 1999. This will prevent any recurrent misunderstandings between governments.	

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Launch Requirements	PR 80.	Clear sky, moon down and the presence of a dayside auroral break-up.	Dr.Pfaff will determine when scientific conditions are suitable for launch. Real time optical images as well as EISCAT and SuperDarn Radar data will be used. This effort will be coordinated by Dr. Pfaff and other associated resources.
	PR 81.	Monitor auroral geomagnetic effects in order to determine acceptable launch conditions.	We will utilize IMAGE (International Monitor for Auroral Geomagnetic Effects) digital magnetometer network, which stretches from southern Finland to northern Svalbard to meet this requirement. This effort will be coordinated by Dr. Pfaff and other associated resources.
	PR 82.	Analyze the ionospheric convection velocity vector, perpendicular to the Earth's magnetic field, in order to determine acceptable launch conditions.	We will utilize the CUTLASS HF phased-array radars, located in Iceland and in Finland. The use of the two radar's provides two line of sight velocity components, which will be utilized to meet this requirement. This effort will be coordinated by Dr. Pfaff and other associated resources.

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Launch Requirements	PR 83.	The latitudinal location of the emissions as well as the morphological, spectral, and dynamical characteristics of the cusp aurora will be used as indicators for appropriate launch conditions as well as providing important background information for data analysis.	The University of Oslo will operate multichannel channel scanning photometers in Ny Alesund, Svalbard, and Danmarkhavn on the east coast of Greenland. The photometers will measure light intensities, and auroral emission lines to be used in meeting this requirement. This effort will be coordinated by Dr. Pfaff and other associated resources.
	PR 84.	Operation of all-sky and scanning photometers in Ny Alesun in support of launch, as well as ground-based magnetometers.	The University of Oslo in support of this mission will furnish this. This will be coordinated by Dr. Pfaff and other associated resources.
	PR 85.	Real-time solar wind data from either the ACE or other appropriate satellite.	Dr. Pfaff will coordinate this effort through the appropriate NASA resources.

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
Launch Requirements	PR 86.	Measure the ion drift, ion temperature, electron temperature and electron density in the polar cap, in order to determine acceptable launch conditions.	The EISCAT Svalbard Radar (ESR), which is located in Longyearbyn, is a fully steerable monostatic incoherent scatter radar and will be utilized to analyze ion and electron activity. A new second radar dish will be available as well, one looking up the field line and one fully steerable, down to an elevation of 30 degrees. The mainland EISCAT system comprises a fully steerable tristatic UHF system and a monostatic VHF system which is steerable along a meridian, and which can also operate in a split beam configuration. These radar's will compliment the ESR in the local area as well as provide detailed information of the region just to the south of Svalbard. These radar units will work in conjunction with each other to determine the necessary ion, and electron activity required for launch. The science team will coordinate this effort.
	PR 87.	All systems operating nominally.	Necessary evaluations will be made real-time in an effort to ensure payload flight readiness.

Payload Requirements: Pfaff 35.033			
Category	**Ref. #**	**Requirement**	**Process/Approach**
	PR 88.	Ensure existing wind conditions, at and above the launch site, are within limitations.	WFF will provide a Flight Safety Package. This document will contain the same information typically included in a Flight Safety Plan, including wind limitations. Since Norwegian authorities have overall safety responsibility at their range, the flight safety package will serve as guidance for them. The Norwegians perform their own wind weighting and will provide an operational Go/No-Go for winds.
	PR 89.	*Integrated Launch Countdown procedures to be utilized during launch operations.*	*The NSROC Mission Manager will compile the integrated launch countdown procedure, utilizing inputs received from each team member, several weeks prior to launch. This comprehensive countdown will include all payload team members, range and other resources effort required in the launching of the mission. This procedure will be treated as a checklist and each step shall be checked off as the countdown progresses. This procedure will be strictly adhered to during launch operations with no deviations authorized unless approved by the Mission Manager.*

Success Criteria Memorandum

NASA/Goddard Space Flight Center

Space Sciences Directorate
Laboratory for Extraterrestrial Physics

Electrodynamics Branch – Code 696

DATE: **10/25/02** NUMBER OF PAGES: 3

TO: **Tracy Gibb**
PHONE#: ____________
FAX#: **413-451-6795**

FROM: Debbie Chipouras/NASA/Goddard Space Flight Center
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FAX#: (301) 286-1648
ADDRESS: Electrodynamics Branch, Code 696
Greenbelt, MD 20771

Signed re-re-revised Mission Success Criteria

October 25, 2002

TO: 810.0/T. Gibb/Mission Manager, Rocket 35.033

FROM: 696/R. F. Pfaff/Principal Investigator

SUBJECT: Mission Success Criteria

Enclosed is the re-re-revised Mission Success Criteria for Rocket 35.033.

Robert F. Pfaff, Jr.

Robert F. Pfaff, Jr.

Enclosure

cc: P. Eberspeaker/840

Cusp 2002 -- 35.033

Mission Success Criteria

October 25, 2002

Comprehensive Mission Success Criteria

Apogee of at least 750 km.

All electric field booms deployed and 80% of the DC and wave electric field data telemetered to the ground.

All energetic particle detectors (Aerospace Corp., University of Calgary, University of Maryland) deployed and successfully taking data with 80% of these data telemetered to the ground.

Good data obtained from the GSFC fluxgate magnetometer and Langmuir probe with 80% successfully telemetered to the ground.

Data obtained from French search coil and current loops with 80% successfully telemetered to the ground.

Pointing of the payload to within 5° of the magnetic field direction throughout at least 50% of the flight time above 250 km. No ACS firing for at least 80% of the time spent above 250 km.

Good attitude knowledge data (within 1° RMS/revolution) obtained throughout 80% of the time spent above 250 km.

Good trajectory data (determined to within 5 km) obtained.

Rocket launched while the ground photometers and radars are taking data and while the upstream solar wind parameters are being monitored.

Minimum Success Criteria

Apogee of at least 700 km.

At least one pair of electric field booms deployed with usable DC and wave electric field data gathered and telemetered to the ground during at least 50% of the time above 250 km.

Good data obtained from the magnetometer and Langmuir probe successfully telemetered to the ground during at least 50% of the time above 250 km.

At least one ion and one electron energetic particle detector gathering good data and successfully telemetered to the ground during at least 50% of the time above 250 km.

Pointing of the payload to within 5° of the magnetic field direction throughout at least 50% of the flight time above 250 km or good attitude data (within 3° RMS/revolution) obtained throughout at least 50% of the time spent above 250 km.

Usable trajectory data (determined to within 10 km) obtained.

Robert F. Pfaff, Jr.

Sequence of Events

Nominal Sequence of Events
Pfaff / 35.033

(Assuming 472.6/414.3 lb. payload and 82.5 deg. QE 193 deg. AZ - Svalbard)

10/11/2002

Rev. N

Event	Time (sec)	Altitude (km)	Range (km)	Q (psf)	Roll Rate (Hz) (after completion of event) Low RR	Nominal RR	High RR	Event Control	Timer Type	Dwell Time
Rail Exit	0.6	0.1	0	18.2	N/A	N/A	N/A	N/A	N/A	N/A
Terrier MK70 Burnout	6.2	1.8	0.3	3238.3	N/A	N/A	N/A	N/A	N/A	N/A
BBV Ignition	12.0	4.7	0.8	1636.5	N/A	N/A	N/A	BBV FDM	mechanical (120 sec.)	
50kft Upleg	27.2	15.2	3.0	1800.7	N/A	N/A	N/A	N/A	N/A	N/A
BBV Burnout	44.4	40.0	9.0	94.8	N/A	N/A	N/A	N/A	N/A	N/A
E-Field/Oslo Sync Signal	55.0	59.0	14.0	6.4	N/A	N/A	N/A	WFF TM	MFT	1
N/C Eject	62.0	71.0	17.3	1.2	N/A	N/A	N/A	WFF TM	MFT	1
LEO slug eject	64.5	75.1	18.4	0.7	N/A	N/A	N/A	LEO CDI	RC delay circuit	N/A
BBV Separation	68.0	80.8	20.0	0.3	N/A	N/A	N/A	BBV FDM	mechanical (120 sec.)	
Nihka Ignition	72.0	87.2	21.9	0.1	N/A	N/A	N/A	Nihka FDM	mechanical (120 sec.)	
Nihka Burnout	90.6	131.1	34.9	0.0	3.00	4.00	5.00	N/A	N/A	N/A
EED/EID Doors Deploy	91.0	132.3	35.3	0.0	N/A	N/A	N/A	WFF TM	MFT	1
Aft UCB Boom Doors Deploy	92.0	135.5	36.2	0.0	N/A	N/A	N/A	WFF TM	MFT	1
Despin to 1.1rps	94.0	142.0	38.2	0.0	0.83	1.10	1.38	Nihka FDM	mechanical (120 sec.)	
Begin ACS Autobias #1	96.0	148.5	40.1	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
150 Km Upleg	96.5	150.0	40.6	0.0	N/A	N/A	N/A	N/A	N/A	N/A

ACS Maneuver #1

Autobias #1 Complete/Enabled/Aligned to -b Vector	99.0	158.1	43.0	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Begin alignment to -B (@1.1rps)	99.0	158.1	43.0	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
IMS HV On	100.0	161.3	44.0	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
ACS Enable Override	101.0	164.5	44.9	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Disable ACS	117.0	214.0	60.2	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Aligned with -B	117.0	214.0	60.2	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Enable ACS Roll Control Lower Threshold ≥ 0.50 rps	118.0	217.1	61.1	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A

Boom Deployment Sequence

Aft 6m UCB Booms Deploy (0-3 Hz)	117.0	214.0	60.2	0.0	0.83	1.10	1.38	WFF TM	MFT	1
SEI/SII Booms Deploy (Nom: .75 +/-.25 Hz)	121.0	226.1	63.9	0.0	0.64	0.85	1.07	WFF TM	MFT	1
EED/EID Deploy (.5 - 1.0 Hz)	121.0	226.1	63.9	0.0	0.64	0.85	1.07	WFF TM	MFT	1
GSFC 6m Booms Deploy (0 - 3 Hz)	122.0	229.1	64.9	0.0	0.58	0.78	0.97	WFF TM	MFT	1
GSFC 8m Dual Sphere Booms Deploy (0 - 1 Hz)	122.0	229.1	64.9	0.0	0.58	0.78	0.97	WFF TM	MFT	1
SEI/SII Booms Deploy Complete	126.0	240.9	68.7	0.0	0.50	0.50	0.57	N/A	N/A	N/A
Aft 6m UCB Booms Deploy Complete	127.0	243.9	69.6	0.0	0.50	0.50	0.52	N/A	N/A	N/A
French AC Search Coils Deploy	127.0	243.9	69.6	0.0	0.50	0.50	0.52	WFF TM	MFT	1
GSFC 8m Dual Sphere Booms Deploy Complete	128.0	246.8	70.5	0.0	0.50	0.50	0.50	N/A	N/A	N/A
GSFC 8m Dual Sphere Boom - Stacer's Deploy (0 - 1 Hz)	128.0	246.8	70.5	0.0	0.50	0.50	0.50	WFF TM	MFT	1
French AC Search Coils Deploy Complete	128.0	246.8	70.5	0.0	0.50	0.50	0.50	N/A	N/A	N/A
EED/EID Deploy Complete	129.0	249.7	71.5	0.0	0.50	0.50	0.50	N/A	N/A	N/A
GSFC 6m Booms Deploy Complete	129.0	249.7	71.5	0.0	0.50	0.50	0.50	N/A	N/A	N/A
GSFC 8m Dual Sphere Boom Stacer's Deploy Complete	136.0	269.9	78.0	0.0	0.50	0.50	0.50	N/A	N/A	N/A

ACS Maneuver #2

Set Roll Control ≥ 0.35 rps (2.7 sec)	137.0	272.8	78.9	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Begin Autobias #2/Enabled/Realign to -b Vector	140.0	281.3	81.7	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
ACS Autobias #2 Complete	146.0	298.0	87.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Begin alignment to -B #2 (@~0.4rps)	146.0	298.0	87.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Aligned with -b/Maneuver Complete	155.0	322.6	95.5	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Open ACS Dead Band to +/- 10 degrees	169.0	359.3	108.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
SEI/SII High Voltage On	169.0	359.3	108.3	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
EED High Voltage On	170.0	361.9	109.2	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
EID High Voltage On	170.0	361.9	109.2	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
500km Upleg	230.1	500.0	162.6	0.0	N/A	N/A	N/A	N/A	N/A	N/A
Apogee Update	450.0	755.0	345.9	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Complete Apogee Update	465.0	758.6	358.0	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Open ACS Deadband +/- 10-Deg	465.0	758.6	358.0	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Apogee	488.0	760.6	376.7	0.0	N/A	N/A	N/A	N/A	N/A	N/A
500km Downleg	746.0	500.0	590.9	0.0	N/A	N/A	N/A	N/A	N/A	N/A
300kFt Downleg	897.4	91.4	730.1	0.2	N/A	N/A	N/A	N/A	N/A	N/A
50kFt Downleg	919.4	15.2	751.8	******	N/A	N/A	N/A	N/A	N/A	N/A
Ballistic Impact	924.7	0.0	756.0	******	N/A	N/A	N/A	N/A	N/A	N/A

2-Sigma Low Sequence of Events
Pfaff / 35.033

(Assuming 472.6/414.3 lb. payload and 82.5 deg. QE 193 deg. AZ - Svalbard)

Roll Rate (Hz) (after completion of event) — 10/11/2002 — Rev. N

Event	Time (sec)	Altitude (km)	Range (km)	Q (psf)	Low RR	Nominal RR	High RR	Event Control	Timer Type	Dwell Time
Rail Exit	0.6	0.1	0	18.2	N/A	N/A	N/A	N/A	N/A	N/A
Terrier MK70 Burnout	6.2	1.8	0.3	3238.3	N/A	N/A	N/A	N/A	N/A	N/A
BBV Ignition	12.0	4.7	0.8	1636.5	N/A	N/A	N/A	BBV FDM	mechanical (120 sec.)	
50kft Upleg	27.2	15.2	3.0	1800.7	N/A	N/A	N/A	N/A	N/A	N/A
BBV Burnout	44.4	40.0	9.0	94.8	N/A	N/A	N/A	N/A	N/A	N/A
E-Field/Oslo Sync Signal	55.0	59.0	14.0	6.4	N/A	N/A	N/A	WFF TM	MFT	1
N/C Eject	62.0	71.0	17.3	1.2	N/A	N/A	N/A	WFF TM	MFT	1
LEO slug eject	64.5	75.1	18.4	0.7	N/A	N/A	N/A	LEO CDI	RC delay circuit	N/A
BBV Separation	68.0	80.8	20.0	0.3	N/A	N/A	N/A	BBV FDM	mechanical (120 sec.)	
Nihka Ignition	72.0	87.2	21.9	0.1	N/A	N/A	N/A	Nihka FDM	mechanical (120 sec.)	
Nihka Burnout	90.6	130.1	34.7	0.0	3.00	4.00	5.00	N/A	N/A	N/A
EED/EID Doors Deploy	91.0	131.2	35.0	0.0	N/A	N/A	N/A	WFF TM	MFT	1
Aft UCB Boom Doors Deploy	92.0	134.4	35.9	0.0	N/A	N/A	N/A	WFF TM	MFT	1
Despin to 1.1rps	94.0	140.6	37.8	0.0	0.83	1.10	1.38	Nihka FDM	mechanical (120 sec.)	
Begin ACS Autobias #1	96.0	146.8	39.6	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
150 Km Upleg	97.0	150.0	40.6	0.0	N/A	N/A	N/A	N/A	N/A	N/A

ACS Maneuver #1

Autobias #1 Complete/Enabled/Aligned to -b Vector	99.0	156.0	42.4	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Begin alignment to -B (@1.1rps)	99.0	156.0	42.4	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
IMS HV On	100.0	159.1	43.4	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
ACS Enable Override	101.0	162.1	44.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Disable ACS	117.0	209.6	59.0	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Aligned with -B	117.0	209.6	59.0	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Enable ACS Roll Control Lower Threshold ≥ 0.50 rps	118.0	212.5	59.9	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A

Boom Deployment Sequence

Aft 6m UCB Booms Deploy (0-3 Hz)	117.0	209.6	59.0	0.0	0.83	1.10	1.38	WFF TM	MFT	1
SEI/SII Booms Deploy (Nom: .75 +/- .25Hz)	121.0	221.1	62.6	0.0	0.64	0.85	1.07	WFF TM	MFT	1
EED/EID Deploy (.5 - 1.0 Hz)	121.0	221.1	62.6	0.0	0.64	0.85	1.07	WFF TM	MFT	1
GSFC 6m Booms Deploy (0 - 3 Hz)	122.0	224.0	63.5	0.0	0.58	0.78	0.97	WFF TM	MFT	1
GSFC 8m Dual Sphere Booms Deploy (0 - 1 Hz)	122.0	224.0	63.5	0.0	0.58	0.78	0.97	WFF TM	MFT	1
SEI/SII Booms Deploy Complete	126.0	235.3	67.2	0.0	0.50	0.50	0.57	N/A	N/A	N/A
Aft 6m UCB Booms Deploy Complete	127.0	238.1	68.1	0.0	0.50	0.50	0.52	N/A	N/A	N/A
French AC Search Coils Deploy	127.0	238.1	68.1	0.0	0.50	0.50	0.52	WFF TM	MFT	1
GSFC 8m Dual Sphere Booms Deploy Complete	128.0	240.9	69.0	0.0	0.50	0.50	0.50	N/A	N/A	N/A
GSFC 8m Dual Sphere Boom - Stacer's Deploy (0 - 1 Hz)	128.0	240.9	69.0	0.0	0.50	0.50	0.50	WFF TM	MFT	1
French AC Search Coils Deploy Complete	128.0	240.9	69.0	0.0	0.50	0.50	0.50	N/A	N/A	N/A
EED/EID Deploy Complete	129.0	243.7	69.9	0.0	0.50	0.50	0.50	N/A	N/A	N/A
GSFC 6m Booms Deploy Complete	129.0	243.7	69.9	0.0	0.50	0.50	0.50	N/A	N/A	N/A
GSFC 8m Dual Sphere Boom Spacer's Deploy Complete	136.0	263.0	76.2	0.0	0.50	0.50	0.50	N/A	N/A	N/A

ACS Maneuver #2

Set Roll Control ≥ 0.35 rps (2.7 sec)	137.0	265.7	77.1	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Begin Autobias #2/Enabled/Realign to -b Vector	140.0	273.8	79.8	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
ACS Autobias #2 Complete	146.0	289.8	85.1	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Begin alignment to -B #2 (@~0.4rps)	146.0	289.8	85.1	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Aligned with -b/Maneuver Complete	155.0	313.2	93.1	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Open Servo Dead Band to +/- 10 degrees	169.0	348.1	105.5	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
SEI/SII High Voltage On	169.0	348.1	105.5	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
EED High Voltage On	170.0	350.5	106.3	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
EID High Voltage On	170.0	350.5	106.3	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
500km Upleg	240.4	500.0	166.7	0.0	N/A	N/A	N/A	N/A	N/A	N/A
Apogee Update	450.0	704.2	336.2	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Complete Apogee Update	465.0	705.4	348.1	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Open ACS Deadband +/- 10-Deg	465.0	705.4	348.1	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Apogee	467.9	705.4	350.4	0.0	N/A	N/A	N/A	N/A	N/A	N/A
500km Downleg	695.3	500.0	534.2	0.0	N/A	N/A	N/A	N/A	N/A	N/A
300kFt Downleg	857.2	91.4	677.5	0.2	N/A	N/A	N/A	N/A	N/A	N/A
50kFt Downleg	880.0	15.2	699.2	******	N/A	N/A	N/A	N/A	N/A	N/A
Ballistic Impact	885.4	0.0	703.4	******	N/A	N/A	N/A	N/A	N/A	N/A

2-Sigma High Sequence of Events
Pfaff / 35.033

(Assuming 472.6/414.3 lb. payload and 82.5 deg. QE 193 deg. AZ - Svalbard)

Roll Rate (Hz) 10/11/2002

(after completion of event) Rev. N

Event	Time (sec)	Altitude (km)	Range (km)	Q (psf)	Low RR	Nominal RR	High RR	Event Control	Timer Type	Dwell Time
Rail Exit	0.6	0.1	0	18.2	N/A	N/A	N/A	N/A	N/A	N/A
Terrier MK70 Burnout	6.2	1.8	0.3	3238.3	N/A	N/A	N/A	N/A	N/A	N/A
BBV Ignition	12.0	4.7	0.8	1636.5	N/A	N/A	N/A	BBV FDM	mechanical (120 sec.)	
50kft Upleg	27.2	15.2	3.0	1800.7	N/A	N/A	N/A	N/A	N/A	N/A
BBV Burnout	44.4	40.0	9.0	94.8	N/A	N/A	N/A	N/A	N/A	N/A
E-Field/Oslo Sync Signal	55.0	59.0	14.0	6.4	N/A	N/A	N/A	WFF TM	MFT	1
N/C Eject	62.0	71.0	17.3	1.2	N/A	N/A	N/A	WFF TM	MFT	1
LEO slug eject	64.5	75.1	18.4	0.7	N/A	N/A	N/A	LEO CDI	RC delay circuit	N/A
BBV Separation	68.0	80.8	20.0	0.3	N/A	N/A	N/A	BBV FDM	mechanical (120 sec.)	
Nihka Ignition	72.0	87.2	21.9	0.1	N/A	N/A	N/A	Nihka FDM	mechanical (120 sec.)	
Nihka Burnout	90.6	132.1	35.2	0.0	3.00	4.00	5.00	N/A	N/A	N/A
EED/EID Doors Deploy	91.0	133.3	35.5	0.0	N/A	N/A	N/A	WFF TM	MFT	1
Aft UCB Boom Doors Deploy	92.0	136.6	36.5	0.0	N/A	N/A	N/A	WFF TM	MFT	1
Despin to 1.1rps	94.0	143.4	38.5	0.0	0.83	1.10	1.38	Nihka FDM	mechanical (120 sec.)	
Begin ACS Autobias #1	96.0	150.0	40.5	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
150 Km Upleg	96.0	150.0	40.5	0.0	N/A	N/A	N/A	N/A	N/A	N/A

ACS Maneuver #1

Autobias #1 Complete/Enabled/Aligned to -b Vector	99.0	160.1	43.5	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Begin alignment to -B (@1.1rps)	99.0	160.1	43.5	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
IMS HV On	100.0	163.4	44.5	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
ACS Enable Override	101.0	166.7	45.5	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Disable ACS	117.0	218.2	61.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Aligned with -B	117.0	218.2	61.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Enable ACS Roll Control Lower Threshold ≥ 0.50 rps	118.0	221.4	62.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A

Boom Deployment Sequence

Aft 6m UCB Booms Deploy (0-3 Hz)	117.0	218.2	61.3	0.0	0.83	1.10	1.38	WFF TM	MFT	1
SEI/SII Booms Deploy (Nom: .75 +/- .25Hz)	121.0	230.7	65.2	0.0	0.64	0.85	1.07	WFF TM	MFT	1
EED/EID Deploy (.5 - 1.0 Hz)	121.0	230.7	65.2	0.0	0.64	0.85	1.07	WFF TM	MFT	1
GSFC 6m Booms Deploy (0 - 3 Hz)	122.0	233.8	66.2	0.0	0.58	0.78	0.97	WFF TM	MFT	1
GSFC 8m Dual Sphere Booms Deploy (0 - 1 Hz)	122.0	233.8	66.2	0.0	0.58	0.78	0.97	WFF TM	MFT	1
SEI/SII Booms Deploy Complete	126.0	246.2	70.0	0.0	0.50	0.50	0.57	N/A	N/A	N/A
Aft 6m UCB Booms Deploy Complete	127.0	249.2	71.0	0.0	0.50	0.50	0.52	N/A	N/A	N/A
French AC Search Coils Deploy	127.0	249.2	71.0	0.0	0.50	0.50	0.52	WFF TM	MFT	1
GSFC 8m Dual Sphere Booms Deploy Complete	128.0	252.3	72.0	0.0	0.50	0.50	0.50	N/A	N/A	N/A
GSFC 8m Dual Sphere Boom - Stacer's Deploy (0 - 1 Hz)	128.0	252.3	72.0	0.0	0.50	0.50	0.50	WFF TM	MFT	1
French AC Search Coils Deploy Complete	128.0	252.3	72.0	0.0	0.50	0.50	0.50	N/A	N/A	N/A
EED/EID Deploy Complete	129.0	255.3	73.0	0.0	0.50	0.50	0.50	N/A	N/A	N/A
GSFC 6m Booms Deploy Complete	129.0	255.3	73.0	0.0	0.50	0.50	0.50	N/A	N/A	N/A
GSFC 8m Dual Sphere Boom Spacer's Deploy Complete	136.0	276.4	79.7	0.0	0.50	0.50	0.50	N/A	N/A	N/A

ACS Maneuver #2

Set Roll Control ≥ 0.35 rps (2.7 sec)	137.0	279.4	80.7	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Begin Autobias #2/Enabled/Realign to -b Vector	140.0	288.3	83.5	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
ACS Autobias #2 Complete	146.0	305.8	89.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Begin alignment to -B #2 (@~0.4rps)	146.0	305.8	89.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Aligned with -b/Maneuver Complete	155.0	331.4	97.8	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Open ACS Dead Band to +/- 10 degrees	169.0	369.9	110.0	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
SEI/SII High Voltage On	169.0	369.9	110.0	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
EED High Voltage On	170.0	372.6	111.9	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
EID High Voltage On	170.0	372.6	111.9	0.0	N/A	N/A	N/A	WFF TM	MFT	0.5
500km Upleg	221.8	500.0	159.4	0.0	N/A	N/A	N/A	N/A	N/A	N/A
Apogee Update	450.0	803.1	354.9	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Complete Apogee Update	465.0	808.8	367.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Open ACS Deadband +/- 10-Deg	465.0	808.8	367.3	0.0	N/A	N/A	N/A	SVC ACS	Microprocessor	N/A
Apogee	506.2	810.4	426.3	0.0	N/A	N/A	N/A	N/A	N/A	N/A
500km Downleg	789.8	500.0	682.3	0.0	N/A	N/A	N/A	N/A	N/A	N/A
300kFt Downleg	933.6	91.4	827.6	0.3	N/A	N/A	N/A	N/A	N/A	N/A
50kFt Downleg	955.0	15.2	850.7	8672.9	N/A	N/A	N/A	N/A	N/A	N/A
Ballistic Impact	960.3	0.0	855.3	******	N/A	N/A	N/A	N/A	N/A	N/A

Change History Log

Revision	Effective Date	Description
Baseline	9/3/2001	Released to project team.
A	9/4/2001	Change Boom Events, BB Sep, Nihka event times, added FP events
B	9/6/2001	Added Rail exit, E-field lift off, IMS HV on and GSFC 8m spacer deploy events. Also changed EED/EID deployment time to 8 s and the autobias #2 from 3 s to 5 s.
C	9/6/2001	Changed Boom sequence based upon roll dispersion analysis to accommodate minimum and maximum boom roll characteristics
D	9/7/2001	Finalized. Performance characteristics added.
E	9/13/2001	Added Presented as part of the DR.
F	8/2/2002	Combined E-field Lift Off & Oslo Synch Signals, Enable ACS roll control lower threshold (.5Hz) @ T+117, Modified all ACS Maneuver #2 times.
G	8/5/2002	Moved E-field/Oslo signal to 55 sec, Revised all trajectories for 82 EL and 193 AZ
H	8/7/2002	Added ACS Enable Overide and ACS Disable events.
I	8/8/2002	Modified Despin, SEI/SII, EED/EID & ACS related event times.
J	8/9/2002	Highlighted changes previously submitted. Removed inertia column, revised roll rates.
K	8/15/2002	Changed GSFC 6m, 8m boom and stacer deploy and complete times, Changed EED/EID HV On times. Revised spin rates. Did this to prevent over-loading on the relays.
L	8/19/2002	Disable ACS Time "Type-O". Re-labeled correctly to occur at T+117 seconds.
M	10/7/2002	Reviced to reflect actual measured mass properties. Added ACS apogee update.
N	10/11/2002	Changed T+169 event (Open Deadband) from +/- 5 deg to +/-10 deg

Joint Implementation Plan

JOINT IMPLEMENTATION PLAN

Between the

NORWEGIAN SPACE CENTRE (NSC)
P. O. Box 113, Skoyen, 0212 Oslo, Norway
And its subsidiary
Andoya Rocket Range (ARR)
P. O. Box 54, N-8483 Andenes, Norway

and the

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)
Goddard Space Flight Center's (GSFC's)
Wallops Flight Facility (WFF)
Wallops Island, Virginia, USA, 23337-5099

For a Sounding Rocket Experiment to Explore Electrodynamic Coupling, Pulsations, and Acceleration Processes in the Cusp and Boundary Layer Interface

Project No: 35.033 GE
Dr. Robert F. Pfaff, NASA's GSFC

Project Overview

1. The Norwegian Space Centre (NSC), Andoya Rocket Range (ARR), and the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center's (GSFC's) Wallops Flight Facility (WFF) hereby agree to conduct a cooperative Sounding Rocket Experiment to Explore Electrodynamic Coupling, Pulsations, and Acceleration Processes in the Cusp and Boundary Layer Interface, from Ny-Alesund, Svalbard, Norway. This campaign will be conducted in the framework of the Agreement between the United States of America (USA) and the Kingdom of Norway for Cooperation in the Civil Uses of Outer Space, signed on October 20, 2000, by the USA and on November 14, 2001, by Norway.

2. The campaign is planned for December 2002. It will explore in detail the pulsations and acceleration processes in the northern hemisphere winter cusp, and how they are related to energy and momentum input from the solar wind. The experimental approach takes advantage of the low rocket velocity in order to linger in the cusp and interface region and thereby explore their associated physical processes in unprecedented detail.

3. Dr. Robert F. Pfaff is the principal investigator (PI) for the Sounding Rocket Experiment in the Cusp and the NASA Black Brant X rocket, 35.033 GE. European co-investigators/collaborators include: Professors Joran Moen, Alv Egeland, Jan A. Holtet, and Per-Even Sandholt, University of Oslo, Norway; Drs. Herve de Feraudy, Dominique Fontaine, and Laurence Rezeau, Centre d'etude des Environnements Terrestre et Planetaires, Velizy, France; Drs. Vladimir Krasnosselskikh, and Francois Lefeuvre, Laboratoire de Physique et Chimie de L'Environnement, Orleans, France; and Drs. Mark Lester, Timothy Yeoman, and Professor Stanley Cowley, University of Leicester, UK. United States and Canadian co-investigators/collaborators include: Dr. Mario Acuna, NASA GSFC, Greenbelt, Maryland; Dr. James H. Clemmons, Aerospace Corporation, California; Professors Michael Coplan and John Moore, University of Maryland; Dr. Greg Delory, University of California at Berkeley; and Professor David Knudsen, University of Calgary, Canada.

As the PI for this Sounding Rocket Experiment in the Cusp, Dr. Pfaff will be responsible for all aspects of the investigation including the project definition, the payload instrument design, launch operations, and the data analysis and publication of results. He will also be responsible for the DC and AC electric fields investigation and Langmuir probe, including the instrument definition, hardware fabrication, integration, and data analysis.

Professor Joran Moen will coordinate the ground-based measurements from Svalbard. Professor Alv Egeland will coordinate the Norwegian program and participate in the data analysis, particularly of the cusp optical aurora. Professor Jan A. Holtet will have responsibility for the Norwegian wave instrument and will assist in the data analysis from that instrument. Professor Per-Even Sandholt will be responsible for the coordinated ground-based optical observations from Svalbard and Northern Scandinavia. He will also lead the analysis effort of the optical data. Dr. Herve de Feraudy will provide the Current Density Probe and lead the French participation. Dr. Dominique Fontaine will be the lead French representative for EISCAT and will work with Dr. Yeoman with the EISCAT observations. Dr. Laurence Rezeau will assist with the design and analysis of the Current Density Probe. Dr. Vladimir Krasnosselskikh will provide the search coil magnetometer. Dr. Francois Lefeuvre will assist with the design and analysis of the search coils. Dr. Mark Lester will coordinate the SuperDarn radar observations and lead the analysis of these data. Dr. Timothy Yeoman will be responsible for the coordinated EISCAT and Svalbard incoherent scatter radar observations. He will lead the analysis effort on these data. Professor Stanley Cowley will help coordinate the radar observations and will provide theoretical guidance to the project design and data analysis.

Dr. Mario Acuna will be responsible for the design, fabrication and calibration of the fluxgate magnetometers. Dr. James Clemmons will lead the Aerospace effort to design, fabricate and test the energetic ion and electron detectors. He will be responsible for all facets of the project and will supervise the technical staff in its execution. He will also analyze the returned data. Professor Michael Coplan will supervise the construction of the ion mass spectrograph and will help evaluate the experimental data. Dr. Greg Delory will be responsible for overseeing the construction, testing, and implementation of the aft boom sensors for the sounding rocket experiment. He will also participate in the analysis of data obtained from these instruments during post-flight activities. Professor David Knudsen will be responsible for design, fabrication, test and integration of the Calgary suprathermal particle imager and will interpret and analyze the data.

4. The campaign will consist of one Black Brant X sounding rocket to be launched from Ny-Alesund, Svalbard, Norway. A minimum apogee of at least 700 km is required affording a flight time of 10 minutes above 175 km. The flight will utilize ground-based facilities at Ny-Alesund, Svalbard, and Northern Scandinavia, the EISCAT Svalbard Radar, mainland EISCAT Radar and Super DARN Radar, which will be arranged by the European Science teams.

5. The scientific objectives of this campaign are as follows:

    a. Explore pulsations and acceleration processes in the northern hemisphere winter cusp and how they are related to energy and momentum input from the solar wind.

b. Gather measurements across the cusp-boundary layer border in order to understand the electrodynamics and resulting particle acceleration associated with the open-closed field line interface.

I. NSC/ARR RESPONSIBILITIES AND TASKS

Consistent with the terms and conditions of the MOU, NSC will use reasonable efforts to carry out the following responsibilities:

A. Provide payload testing and vehicle launching facilities.

1. Provide suitable and secure storage facilities for the rocket motors.

2. Provide workshop space for payload testing and vehicle build-up.

3. Provide suitable equipment for the transport of the rocket motors and payload to the launch pad.

4. Provide a launcher for the Black Brant X launch vehicle.

5. Provide launch services for the rocket.

6. Provide wind weighting services and range safety services.

B. Provide tracking, data acquisition, and communications support.

1. Provide telemetry support from Svalbard and participate in the coordination of ground-based support from northern Scandinavia.

2. Provide means for access to the Internet or E-mail from Svalbard.

C. Serve as a liaison with the Norwegian Government to obtain all clearances, licenses, and permits necessary for NASA to conduct this joint sounding rocket campaign, including aviation and shipping clearances, radio frequency clearances, and clearances to possess, use, and transport hazardous materials (i.e., rocket motors, batteries).

D. Provide assistance as requested in shipping items from Andoya to Longyearbyen and the Svalbard launch site.

E. Provide assistance as requested in preparing items for return shipment to Wallops Flight Facility. (NASA will be responsible for the shipping costs of NASA equipment).

F. Provide scientific data and results to all collaborators as soon as possible following the campaign.

II. NASA RESPONSIBILITIES AND TASKS

Consistent with the terms and conditions of the MOU, NASA GSFC's WFF will use reasonable efforts to carry out the following responsibilities:

A. Provide supplemental instrumentation and other equipment necessary to augment existing radar and telemetry at Svalbard.

B. Provide the Black Brant X launch vehicle and associated payload subject to fulfillment of required export licensing procedures.

C. Provide shipping of NASA equipment to Andoya and make the arrangements for return shipment to WFF.

D. Provide all necessary personnel for the assembly and testing of the payload and vehicle systems.

E. Provide scientific data and results to all collaborators as soon as possible following the campaign.

F. Provide ARR with standard operational information and data on the launch vehicle in order to perform a safety assessment.

III. PROJECT MANAGEMENT

NASA

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Wallops Island, VA 23337-5099
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NSC/ARR

Kolbjorn Adolfsen, President
Andoya Rocket Range
P. O. Box 54
N-8483 Andenes, Norway

Telephone: 47-76-14 44 00
Facsimile: 47-76-14 44 01
E-mail: kolbjorn@rocketrange.no

IV. PROJECT COST

As stated in Article 4, Item 1 of the Agreement between the USA and the Kingdom of Norway, which provides the framework for this campaign, “The Parties shall be responsible for funding their respective activities under this Agreement, unless otherwise agreed.” Therefore, launch support and any on-site purchases by NASA of consumables and/or other unique support services associated with this campaign will be covered under a separate contract between NASA and NSC/ARR.

V. SIGNATURE

This Joint Project Implementation Plan shall enter into force upon signature of both parties and will remain in effect until April 30, 2003, unless terminated by either agency on 90 days notice.

________________________ < Signature/Date on file with NASA> __________
Norwegian Space Centre Date
Andoya Rocket Range

________________________ < Signature/Date on file with NASA> _______________
Wallops Flight Facility Date
Goddard Space Flight Center
National Aeronautics and Space Administration

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Post Flight Summaries 6

Post Flight Report

Flight Performance

POSTFLIGHT MISSION ANALYSIS
BLACK BRANT X (MOD 1) 35.033 GE
(PFAFF/NASA, GSFC/NORWAY)

Prepared for

National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia 23337

By

NSROC

Prepared by:

____
D. Brent Edwards
Mission Analyst
Flight Performance

Reviewed by:

____
Michael E. Disbrow
Engineer
Flight performance

Approved by:

____
Mark S. Simko
Principal Engineer
Flight Performance

ABSTRACT

Mission: Black Brant X (MOD 1) 35.033 GE

Principal Scientific Investigator: Dr. Robert Pfaff, NASA, Goddard Space Flight Center

Project Manager: Mr. Tracy Gibb and Mr. Bruce Scott

Mission Analysts: Mr. Brent Edwards

Launched: December 14, 2002

Launch Site: Svalbard, Norway

Launcher: MAN, Pad No. 1, 31.7 ft rail travel

Launcher Settings:

	QE	AZ
Effective:	83.0°	200.0°
Actual:	84.8°	185.3°

Corrections of 136.04 km Down Range; 148.5 km Cross Range

Guidance: None

ACS: Magnetic SVC

Payload Weight: 472.63 lbs

Dispersion:

	Predicted (km)	Actual (km)	Miss (km)	Miss (sigma)
Performance				
Apogee:	772.2	766.1	-6.1	-0.22
Down Range:	647.04	894.24	247.2	1.42
Cross Range:	0.0	122.11	122.11	0.81

	Predicted (cps)	Actual (cps)	Miss (cps)
Roll Rate			
First Stage Burnout Roll Rate:	2.4	2.1	-0.3
Second Stage Burnout Roll Rate:	3.5	3.9	+0.4
Third Stage Burnout Roll Rate:	4.0	4.1	+-.1
Despin	1.1	1.1	0.0

This was a successful mission.

POSTFLIGHT MISSION ANALYSIS

BLACK BRANT X (MOD 1) 35.033 GE

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(continued)

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SECTION 1 – INTRODUCTION

This report documents the results of a preliminary postflight analysis conducted by NSROC for NASA/GSFC, Wallops Flight Facility.

This analysis is presented in summary format as follows:

Name of Mission: Black Brant X (MOD 1) 35.033 GE

Location of Launch Site: Svalbard, Norway

Date of Launch: December 14, 2002

Principal Scientific Investigator: Dr. Robert Pfaff, NASA, Goddard Space Flight Center

Project Manager: Mr. Tracy Gibb and Mr. Bruce Scott

This summary includes the following:

- Payload Description
- Launch Vehicle Description
- Vehicle Performance
- Boost Guidance System Performance
- Re-entry
- Dispersion
- Lessons Learned

SECTION 2 – LAUNCH VEHICLE DESCRIPTION

2.1 VEHICLE CONFIGURATION

Launch Vehicle Description: Table 2-1

2.2 PAYLOAD DESCRIPTION

Payload Configuration with Measured Physical Properties: Figure 2-1

Payload Major Diameter: 17.26 inches

Nose Cone Description: FEOS/LEOS, 3:1 Ogive

Table 2-1. Black Brant X (MOD 1) 35.033 GE
Launch Vehicle Description

Description	Booster	First Sustainer	Second Sustainer
Vehicle Type	Terrier MK70	BBVC	Nihka
Vehicle S/N	0558	MV606	NIH-52
Weight (lbs)	2226.7 Measured	2799.8 Measured	978.8 Measured (with tailcan and crossbar separation)
C.G. (in NEP)	81.0 Measured	109.3 Measured	20.5 Measured (with tailcan and crossbar separation)
Fin Cant (min)	59.8	21.9	n/a
Number of Fins	4	4	n/a
Drag Separated Load Bearing	DS	DS	LB

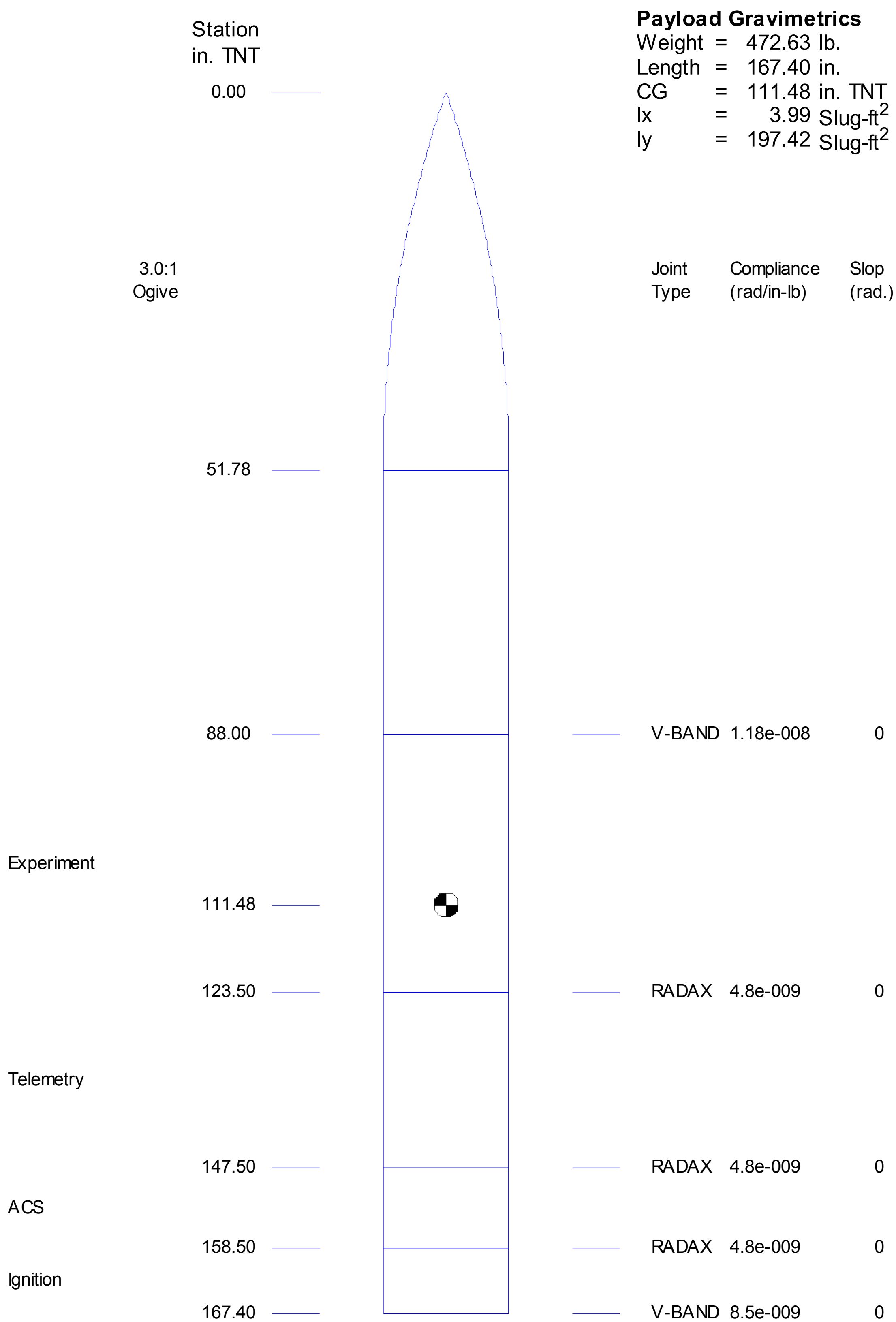


Figure 2-1. BBX (MOD1) 35.033 GE/Pfaff, Payload Configuration

SECTION 3 – VEHICLE PERFORMANCE

3.1 LAUNCH SPECIFICS

Launcher: MAN, Pad No. 1, 31.7 ft rail travel

Location: Latitude 78.9315°, Longitude 11.8504°, Height 112.0 ft MSL

Launcher Settings:

	QE	AZ
Effective:	83.0°	200.0°
Actual:	84.8°	185.3°

Corrections of 136.04 km Down Range; 148.5 km Cross Range

Payload Weight: 472.63 lbs

3.2 VEHICLE PERFORMANCE

There was no radar data available. GPS data dropped out from T+0 to T+18 seconds. The telemetry data had several dropouts during the motor burns. The Black Brant chamber pressure telemetry channel also had noisy data.

Apogee Altitude: 772.2 km predicted; 766.1 km actual

Impact Range: 645.70 km @ 206.3° predicted; 902.54 km @ 214.07° actual

Flight Data Event List: Table 3-1

Performance Comparisons: Figures 3-1 through 3-11

3.3 VEHICLE ROLL RATE

Roll Rate vs. Time: Figure 3-12

	Predicted (cps)	Actual (cps)	Miss (cps)
Roll Rate			
First Stage Burnout Roll Rate:	2.4	2.1	-0.3
Second Stage Burnout Roll Rate:	3.5	3.9	+0.4
Third Stage Burnout Roll Rate:	4.0	4.1	+0.1
Despin	1.1	1.1	0.0

3.4 NIHKA SEPARATION

Time: T+68.3 seconds

Angular Momentum: $(\Delta H) = \text{sqrt}\ [(7.4-13.25)^2 + (11.8-12.8)^2] = 5.94^o$

Lateral Rate: The delta lateral rate realized from the postflight data is between 1.7 and 1.9 deg/sec.

Pitch vs. Yaw: Figure 3-13

Table 3-1. Black Brant X (MOD 1) 35.033 GE
Flight Data Event List

Event	Time (sec) Predicted	Time (sec) Actual	Altitude (km) Predicted	Altitude (km) Actual	Range (km) Predicted	Range (km) Actual	Velocity (mps) Predicted	Velocity (mps) Actual	Flight Angle (deg) Predicted	Flight Angle (deg) Actual
Booster Flight Data (Terrier MK70)										
Ignition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84.8	84.8
Burnout	6.2	6.2*	1.7	N/A*	0.2	N/A*	552.8	N/A*	82.7	N/A*
First Sustainer Flight Data (BB VC)										
Ignition	12.0	12.0*	4.6	N/A*	0.6	N/A*	459.95	N/A*	81.9	N/A*
Burnout	44.4	44.0	40.2	37.2	7.6	9.8	1890.1	1860.6	77.8	73.0
Last Sustainer Flight Data (Nihka)										
Ignition	72.0	72.4	87.7	84.1	18.4	25.0	1639.5	1613.8	76.0	70.3
Burnout	90.7	92.1	132.0	129.5	29.4	40.9	3404.9	3476.1	75.7	70.2
Apogee	491.1	493.0	772.2	766.1	322.3	449.4	772.0	1080.0	0.0	0.0
Impact	930.7	932.7	0.0	0.0	647.0	904.4	2212.0	2221.7	-77.0	-71.9
Other Events										
GPS AOS	-	18.0	-	7.6	-	1.5	-	601.9	-	76.9
Nose Cone Separation	62.0	62.1	71.3	67.9	14.5	19.5	1732.7	1696.6	76.8	71.4
BBVC Separation	68.0	68.3	81.3	77.7	16.9	22.8	1676.9	1639.8	76.3	70.7
Despin	94.0	94.1	143.1	136.1	32.2	43.2	3374.5	3460.4	75.6	70.2
UCB Booms	117.0	117.1	215.8	208.5	50.9	69.0	3167.6	3261.8	74.8	69.1
SE/EED Booms	121.0	121.1	227.9	220.6	54.1	73.4	3132.4	3227.4	74.7	69.0
6m/8m Booms	122.0	122.2	231.0	223.9	54.9	74.6	3123.6	3218.9	74.6	68.9
French Booms	127.0	127.1	245.9	238.5	58.9	80.1	3080.8	3176.2	74.4	68.7
8m Stacers	128.0	128.2	248.9	241.8	59.7	811.3	3070.1	3167.7	74.3	68.6
GPS LOS	-	889.0	-	145.5	-	853.0	-	3437.0	-	-70.1

*N/A = Before GPS AOS

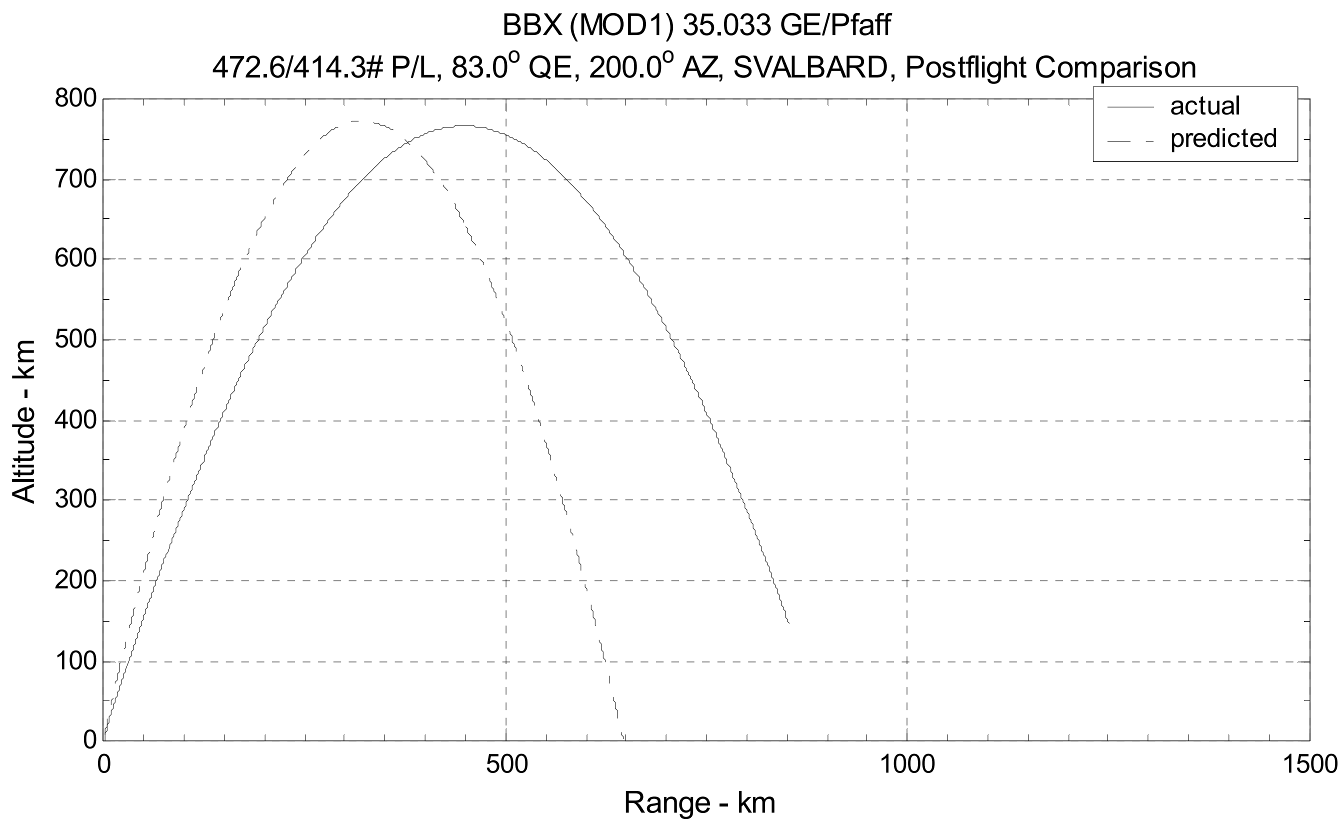


Figure 3-1. Altitude vs Range

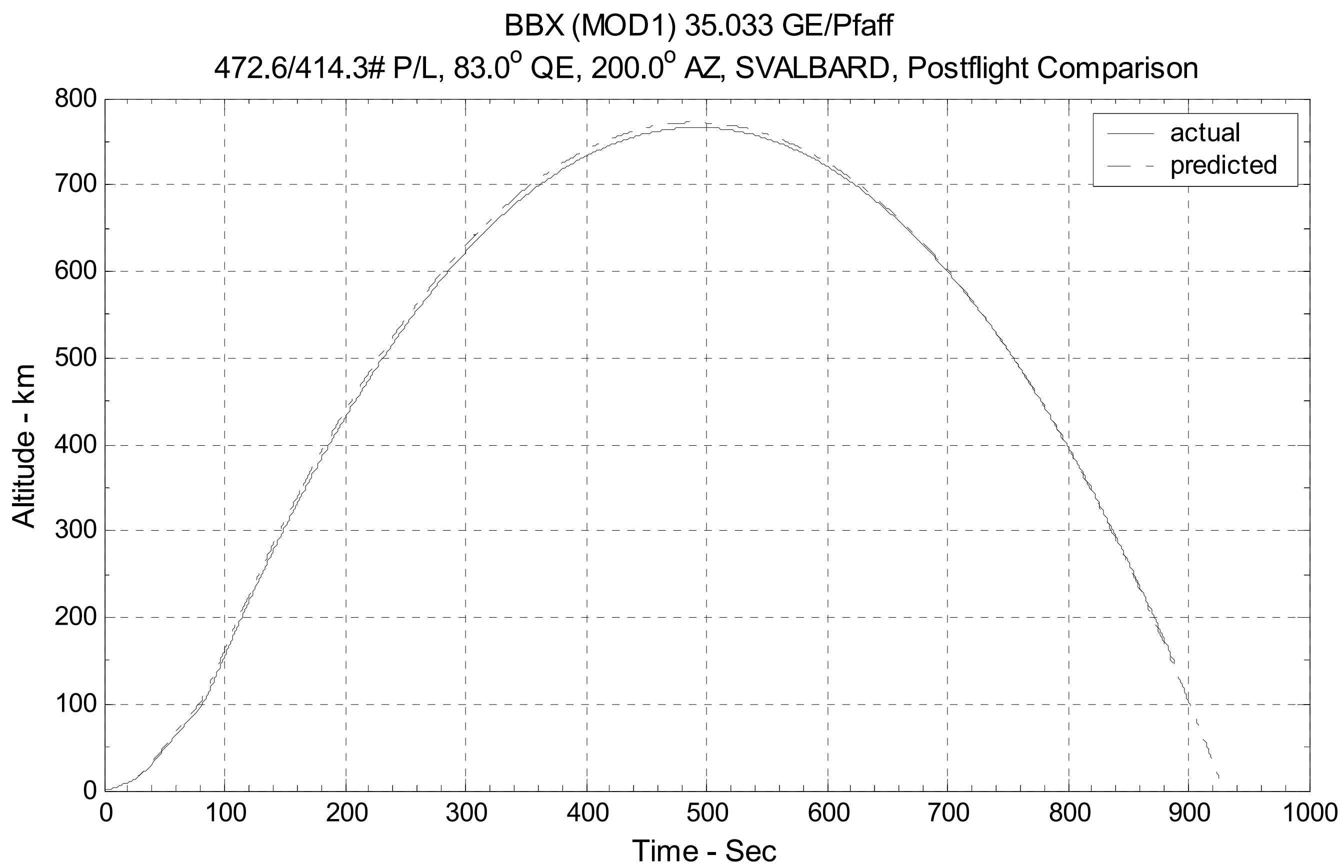


Figure 3-2. Altitude vs Time

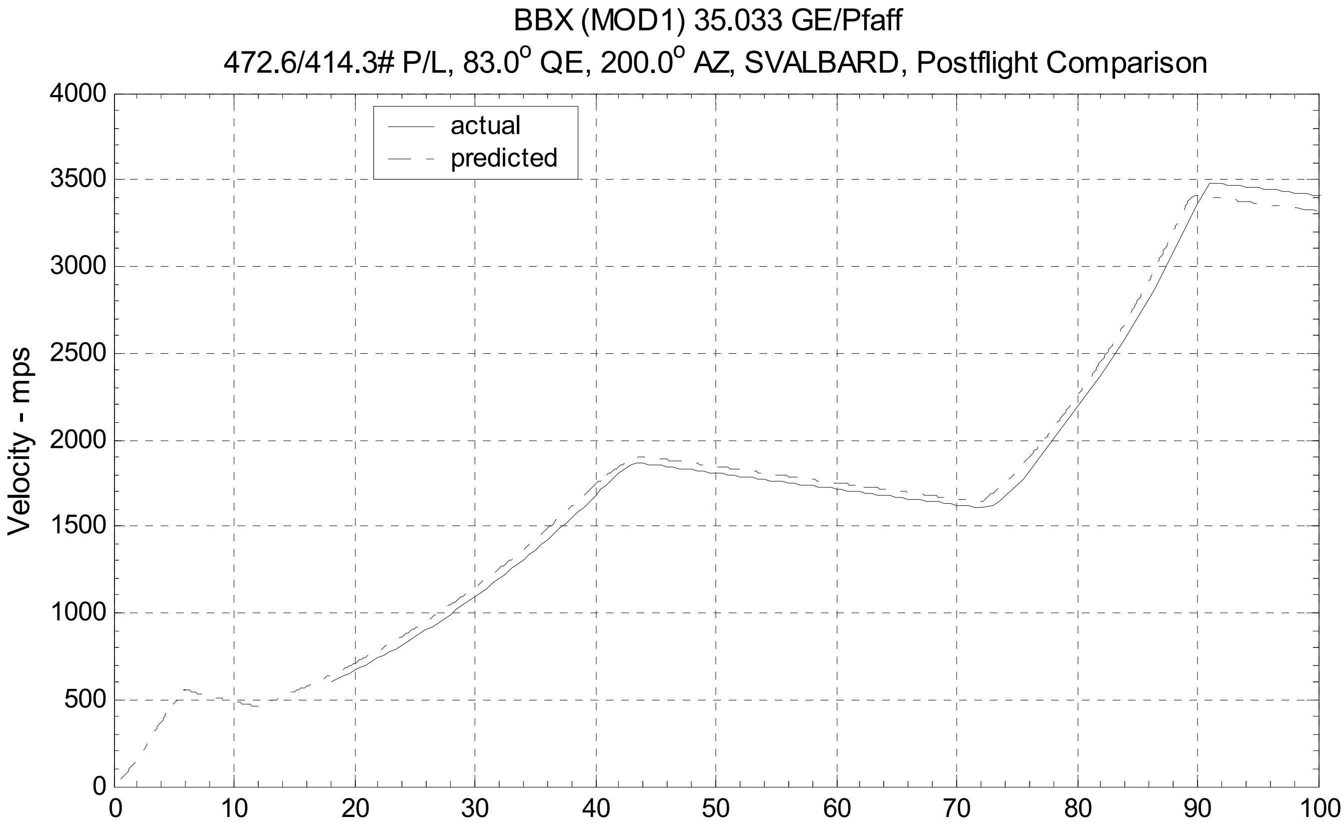


Figure 3-3(a). Velocity vs Time (0-100 sec)

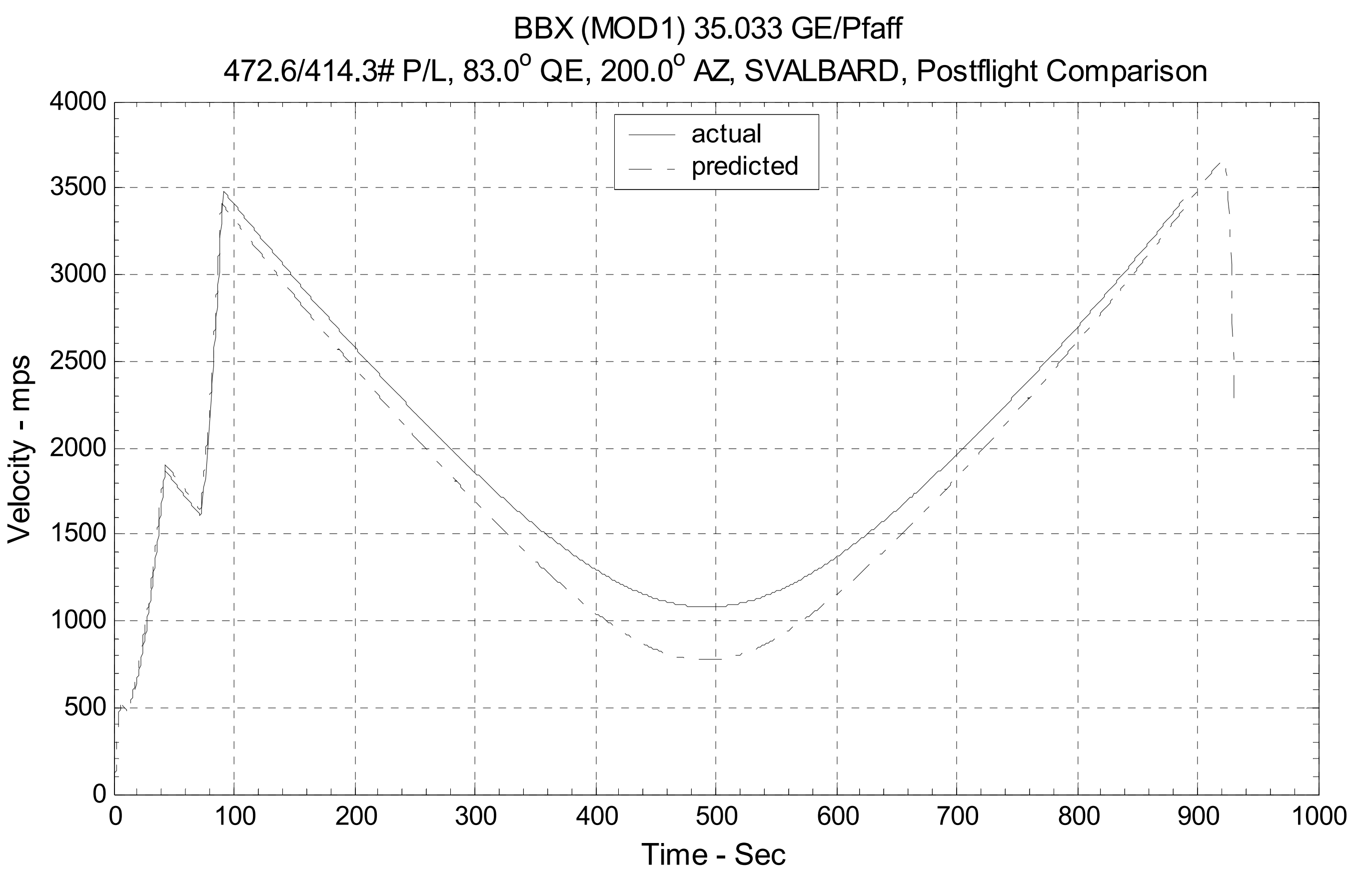


Figure 3-3(b). Velocity vs Time (Flight)

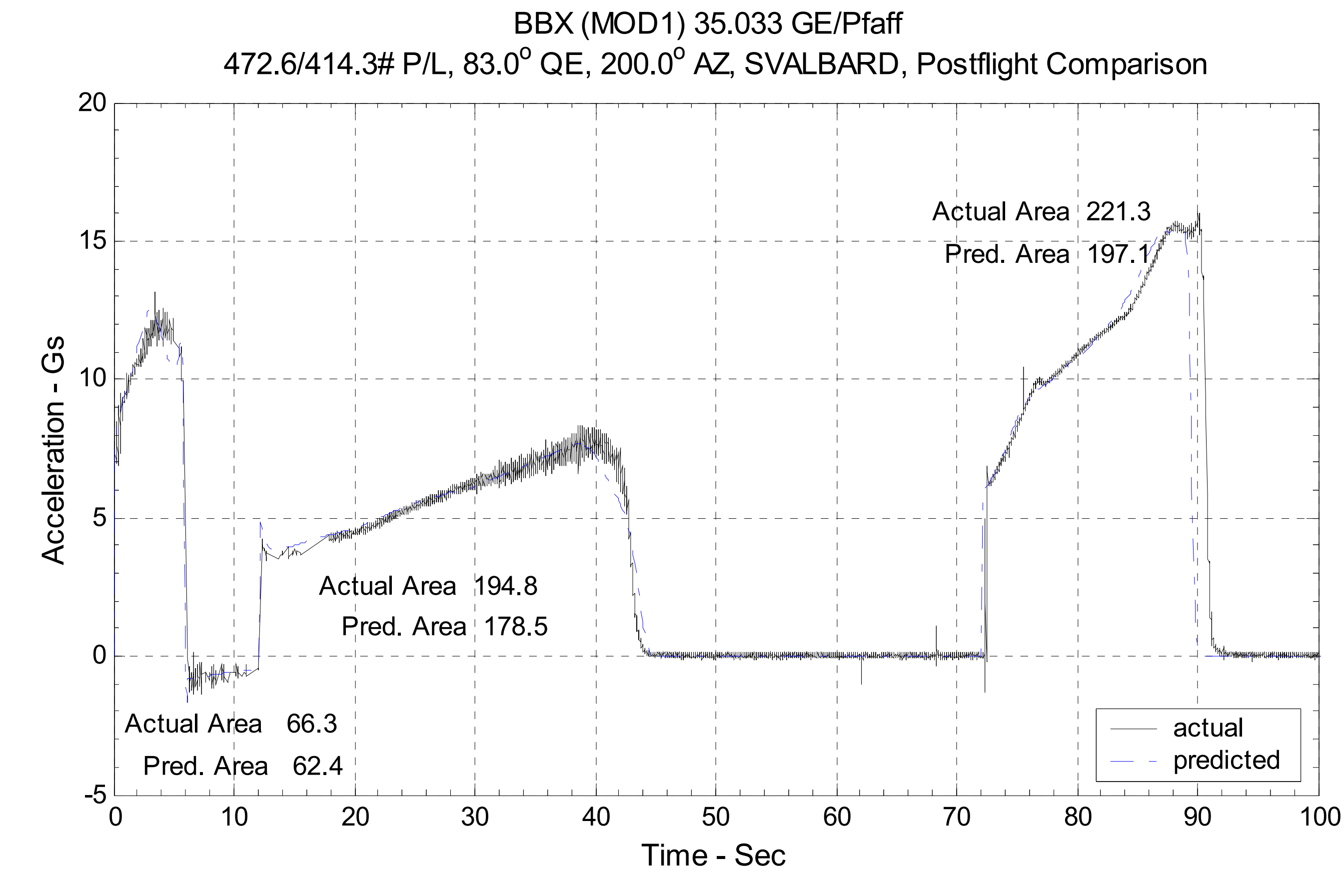


Figure 3-4. Acceleration vs Time

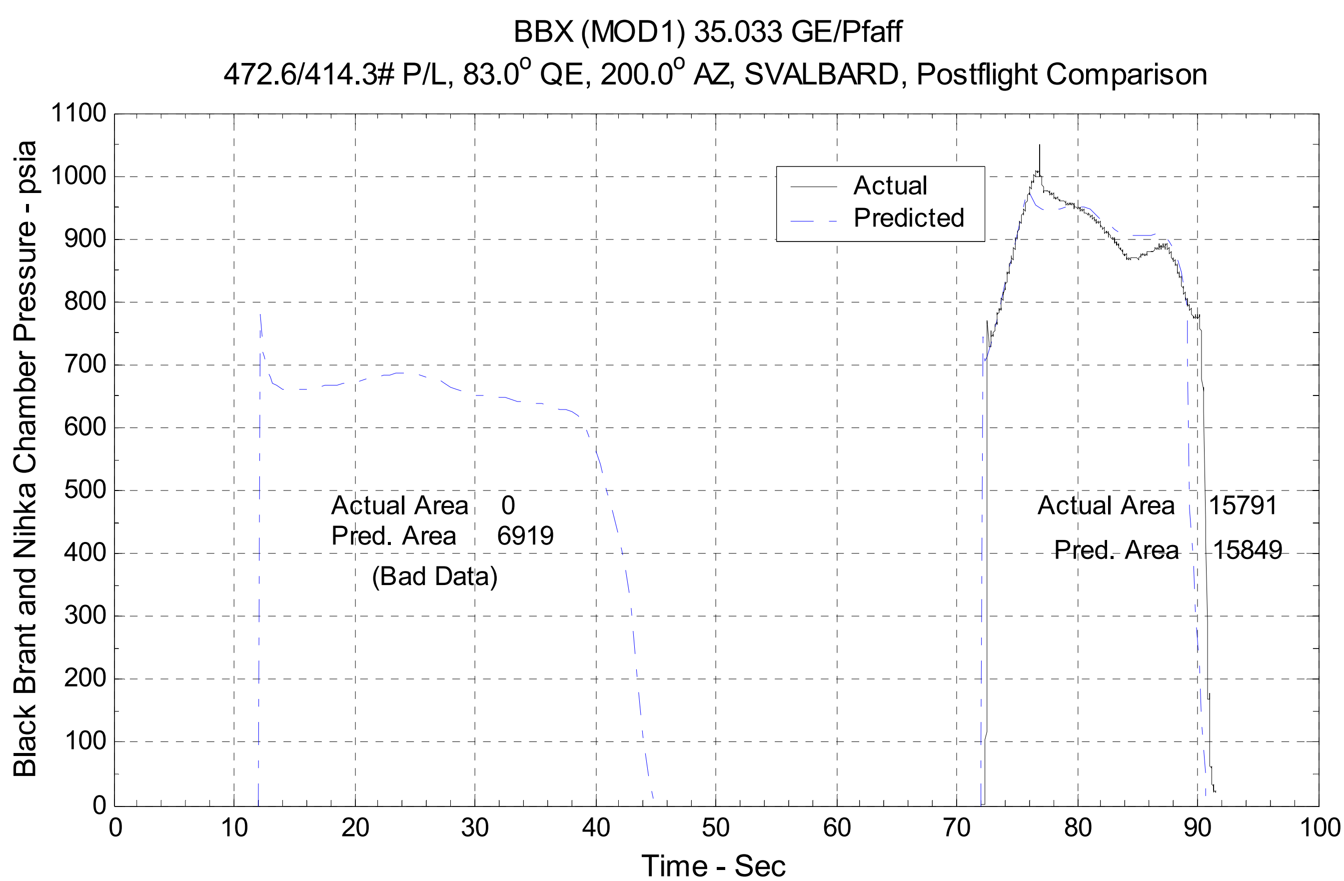


Figure 3-5. Black Brant and Nihka Chamber Pressure vs Time

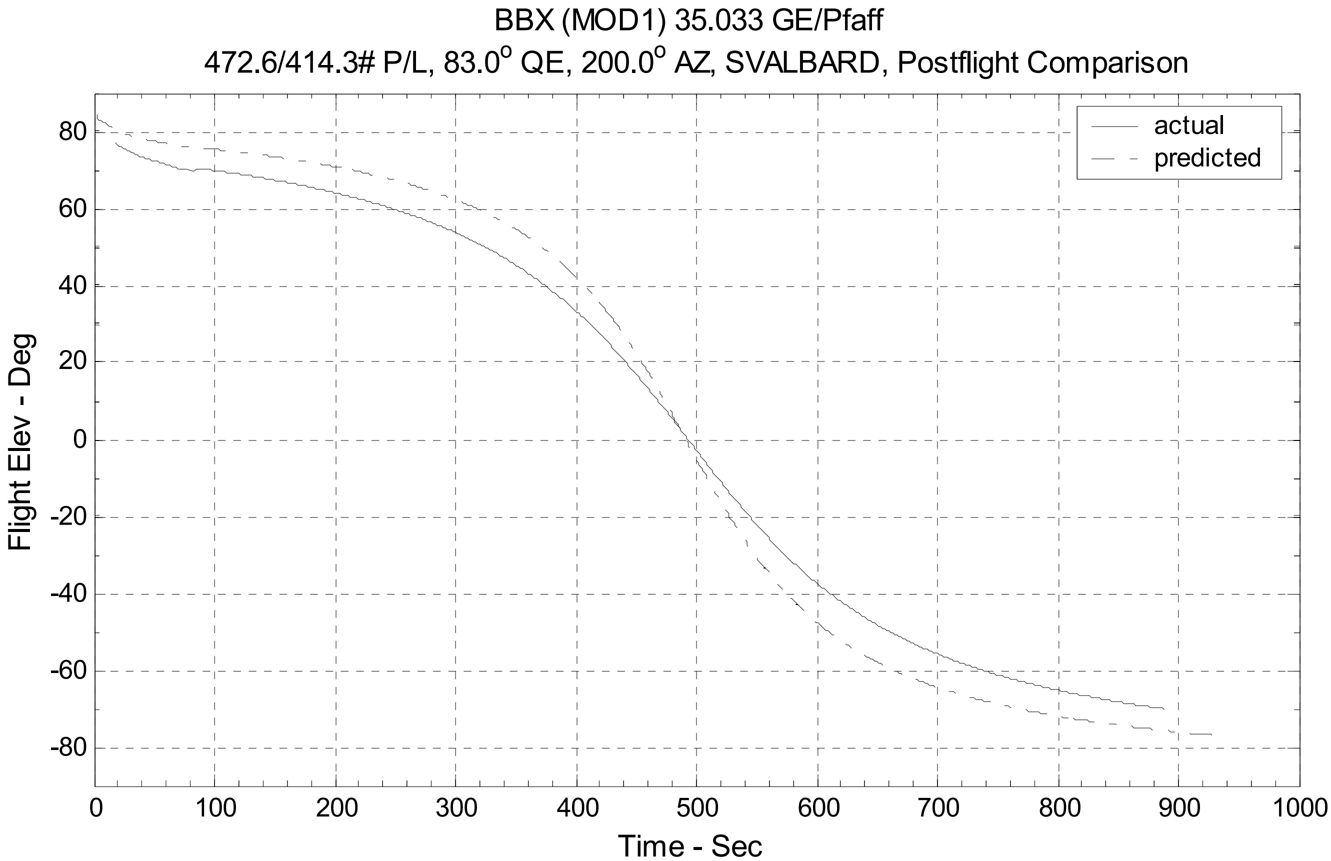


Figure 3-6(a). Flight El. vs Time

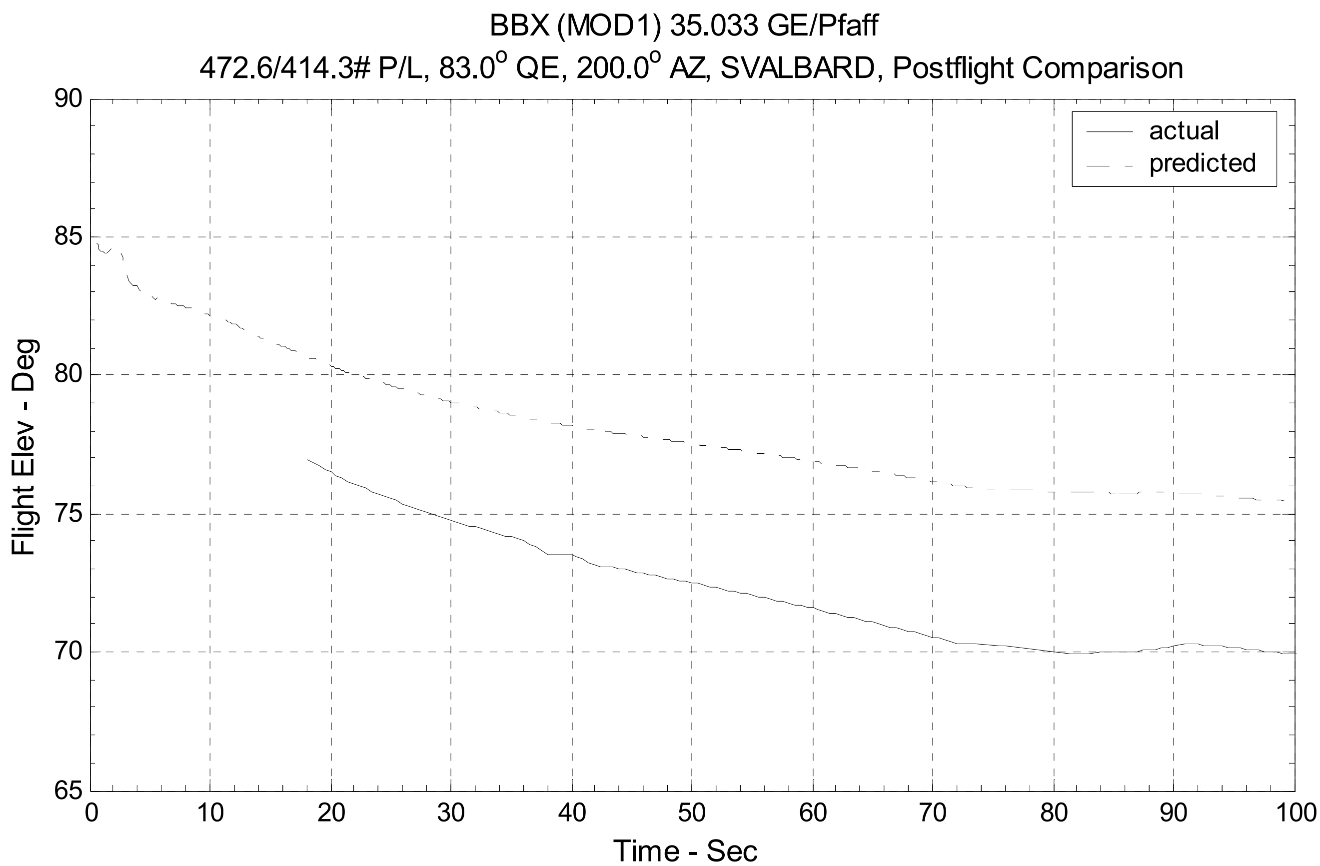


Figure 3-6(b). Flight El. vs Time

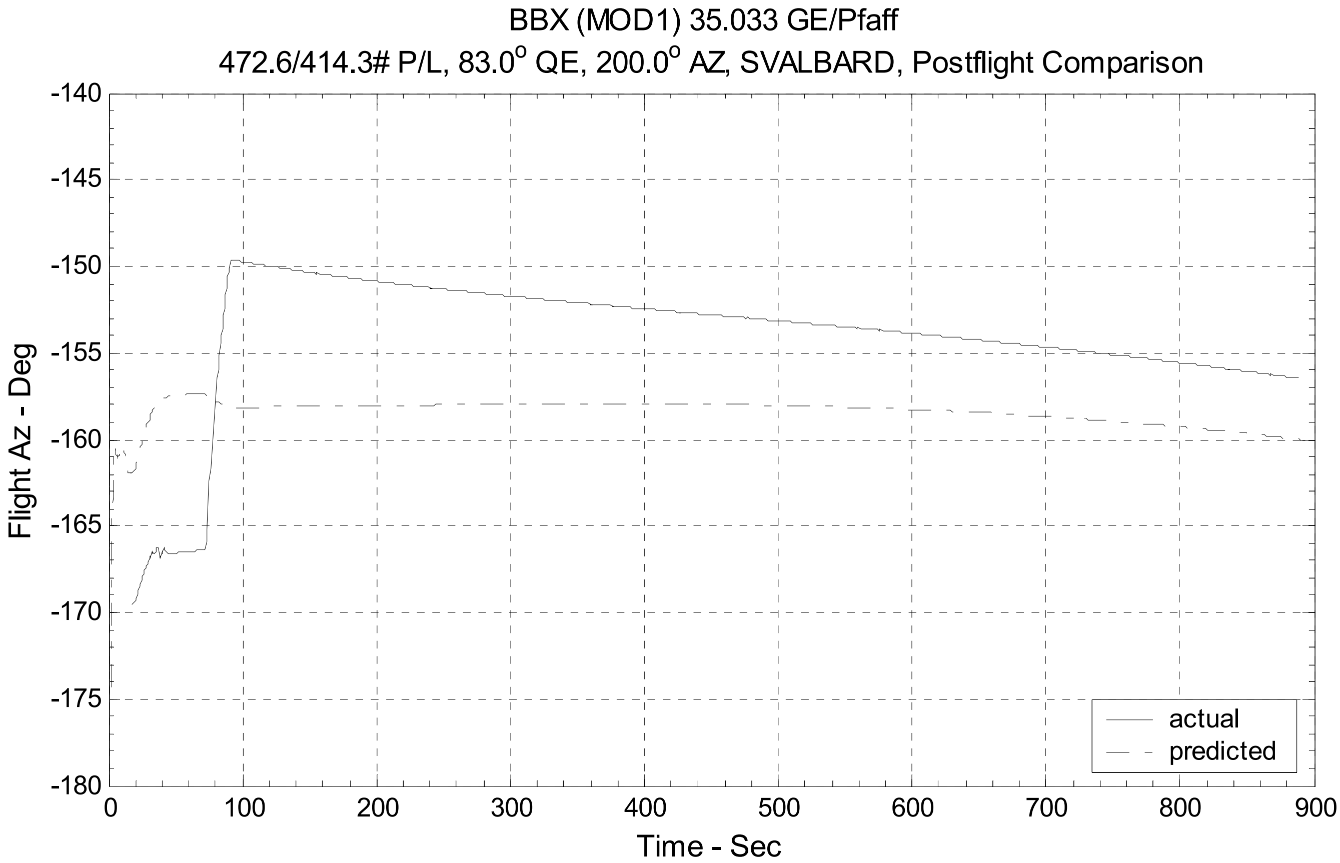


Figure 3-7. Flight Az. vs Time

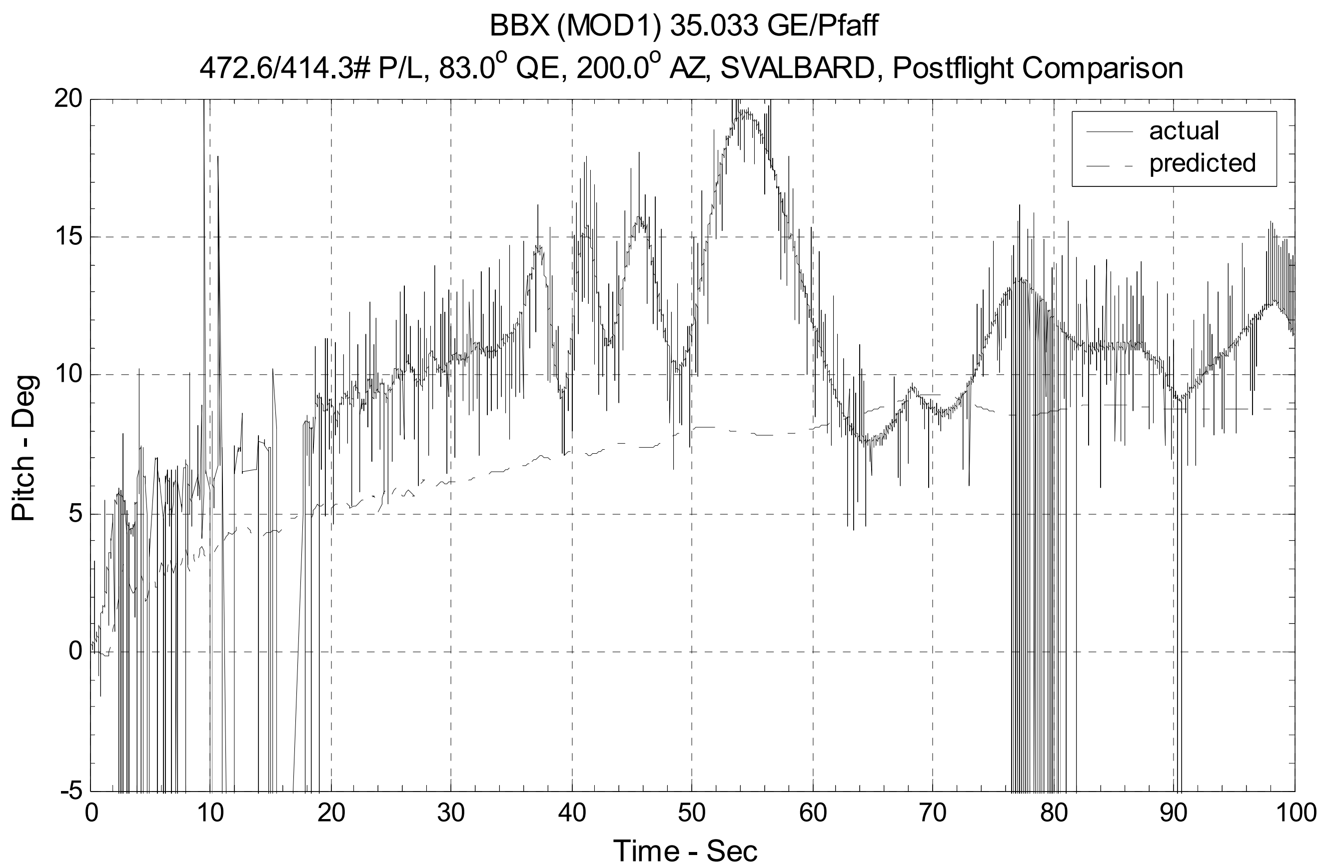


Figure 3-8. Pitch vs Time

BBX (MOD1) 35.033 GE/Pfaff
472.6/414.3# P/L, 83.0° QE, 200.0° AZ, SVALBARD, Postflight Comparison

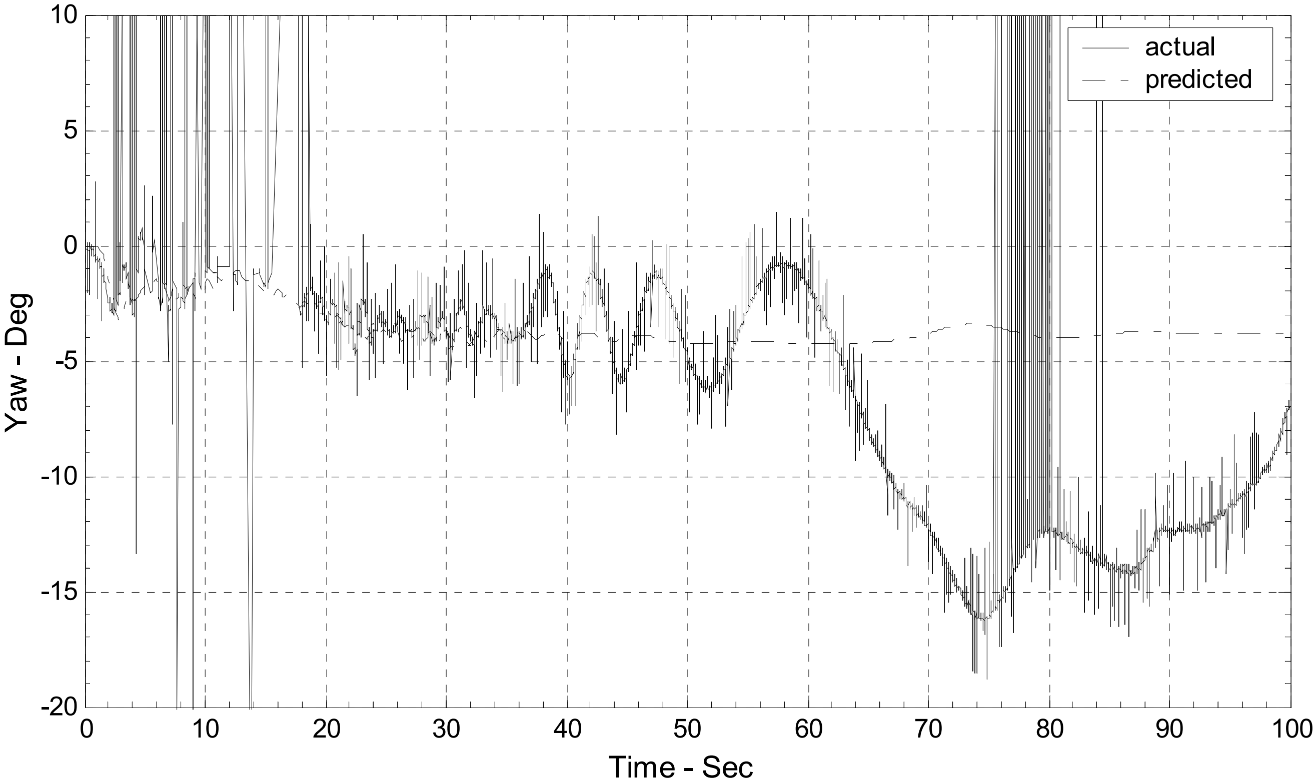


Figure 3-9. Yaw vs Time

BBX (MOD1) 35.033 GE/Pfaff
472.6/414.3# P/L, 83.0° QE, 200.0° AZ, SVALBARD, Postflight Comparison

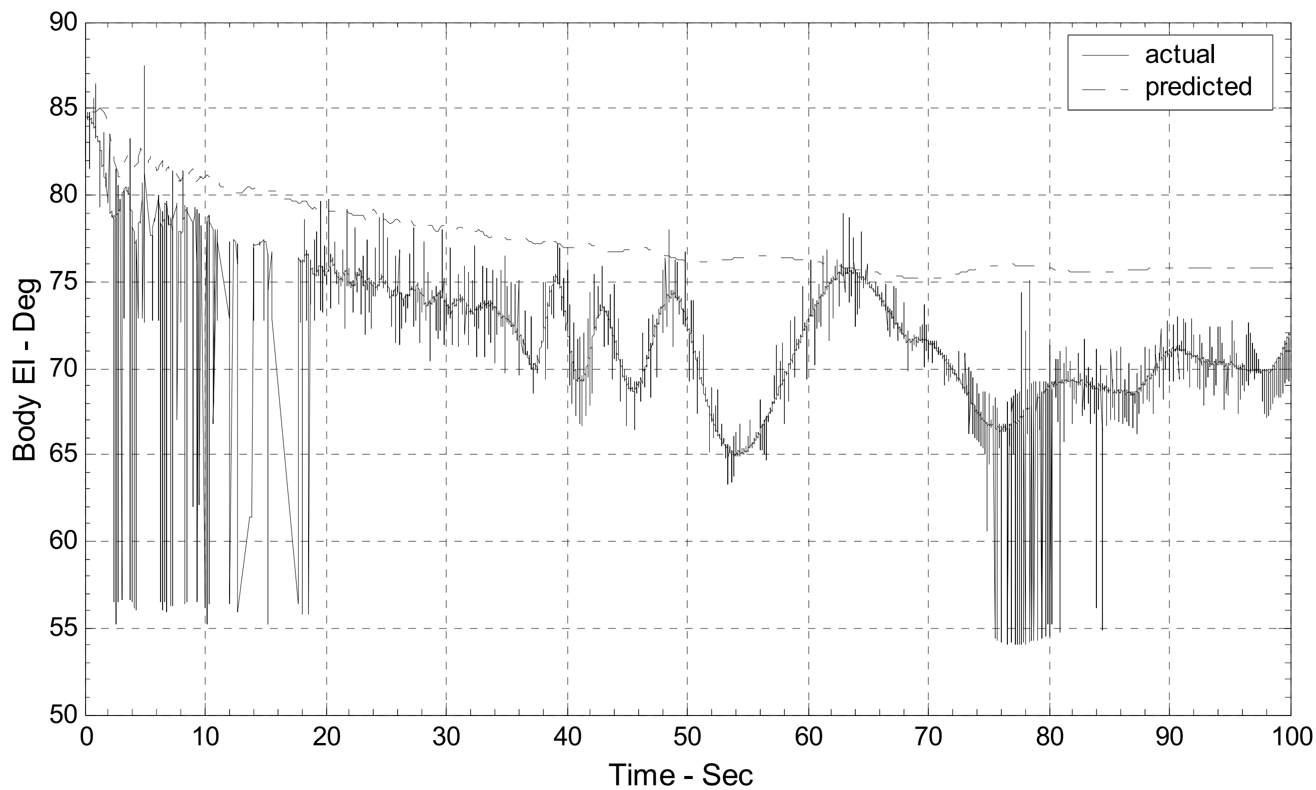


Figure 3-10. Body El. vs Time

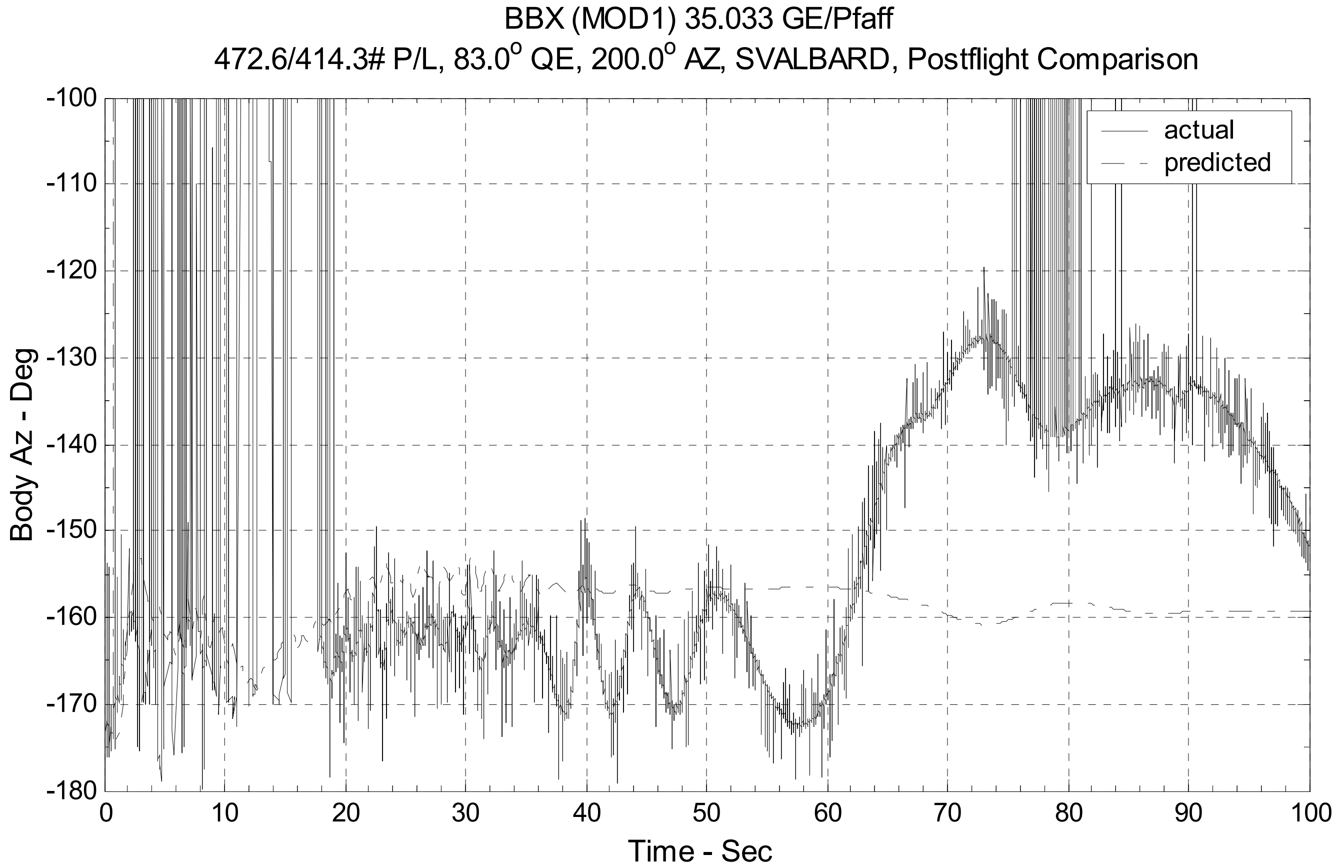


Figure 3-11. Body Az. vs Time

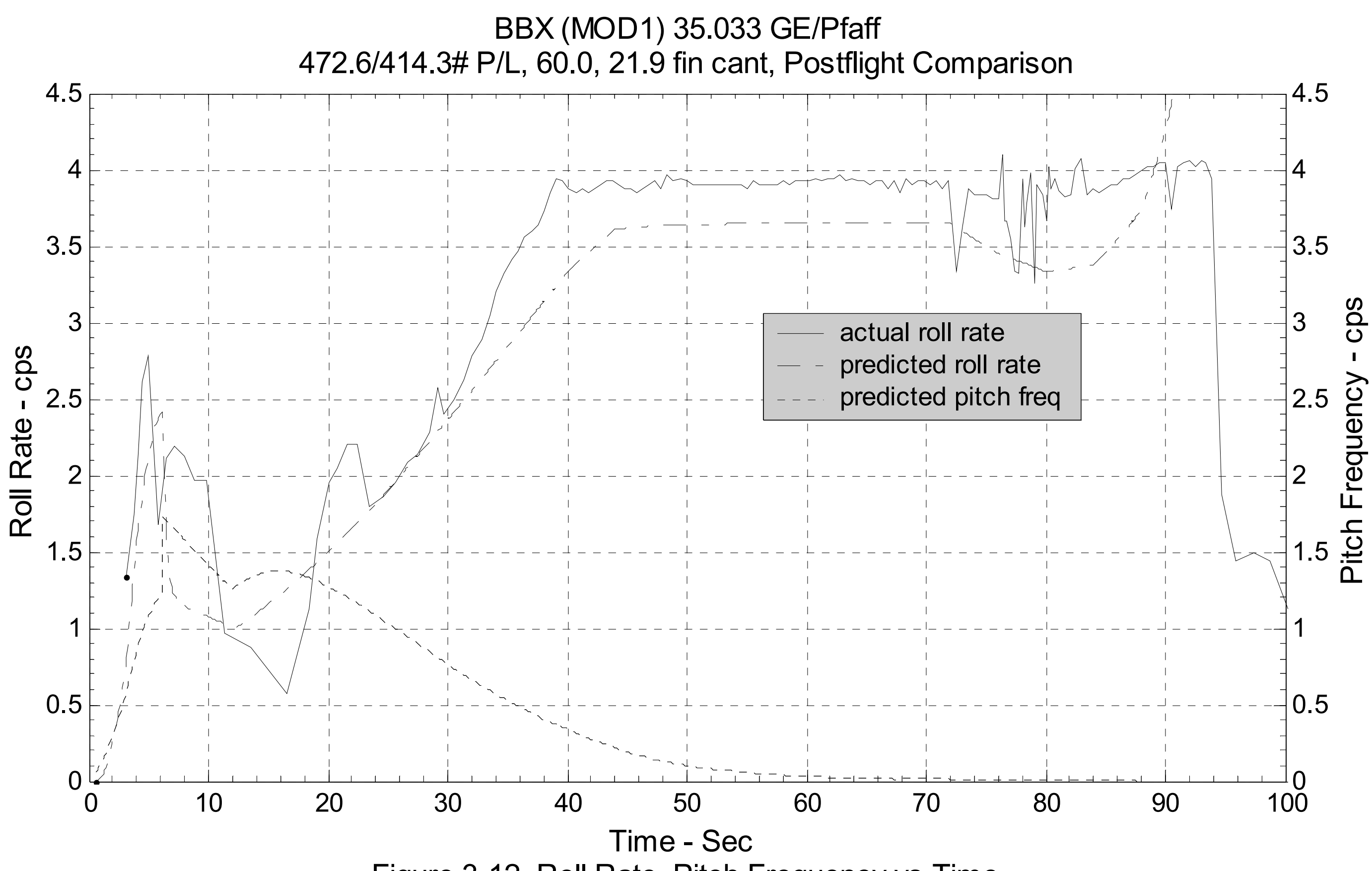


Figure 3-12. Roll Rate, Pitch Frequency vs Time

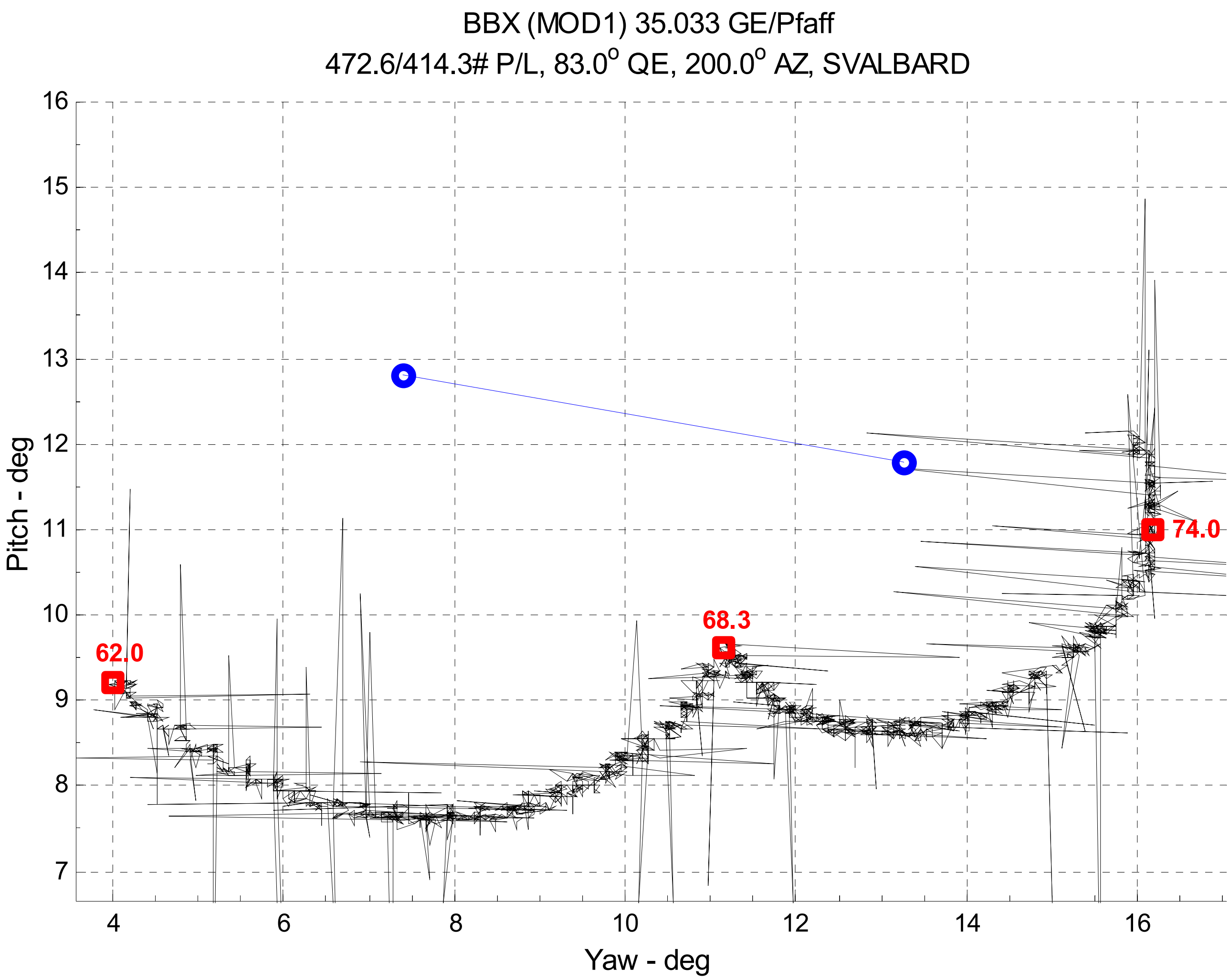


Figure 3-13. Pitch vs Yaw

SECTION 4 – BOOST GUIDANCE SYSTEM PERFORMANCE

There was no boost guidance system for this mission.

SECTION 5 – RE-ENTRY/RECOVERY

There was no re-entry/recovery for this mission.

SECTION 6 – VEHICLE DISPERSION

	Predicted (km)	Actual (km)	Miss (km)	Miss (sigma)
Performance				
Apogee:	772.2	766.1	-6.1	-0.22
Down Range:	647.0	894.2	247.2	1.42
Cross Range:	0.0	122.11	122.11	0.81

Down Range Impact Plot, Second Stage: Figure 6-1(a)

Down Range Impact Plot, Third Stage: Figure 6-1(b)

Norway Range Map, Second Stage: Figure 6-2(a)

Norway Range Map, Third Stage: Figure 6-2(b)

Altitude vs. Wind Speeds: Figure 6-3

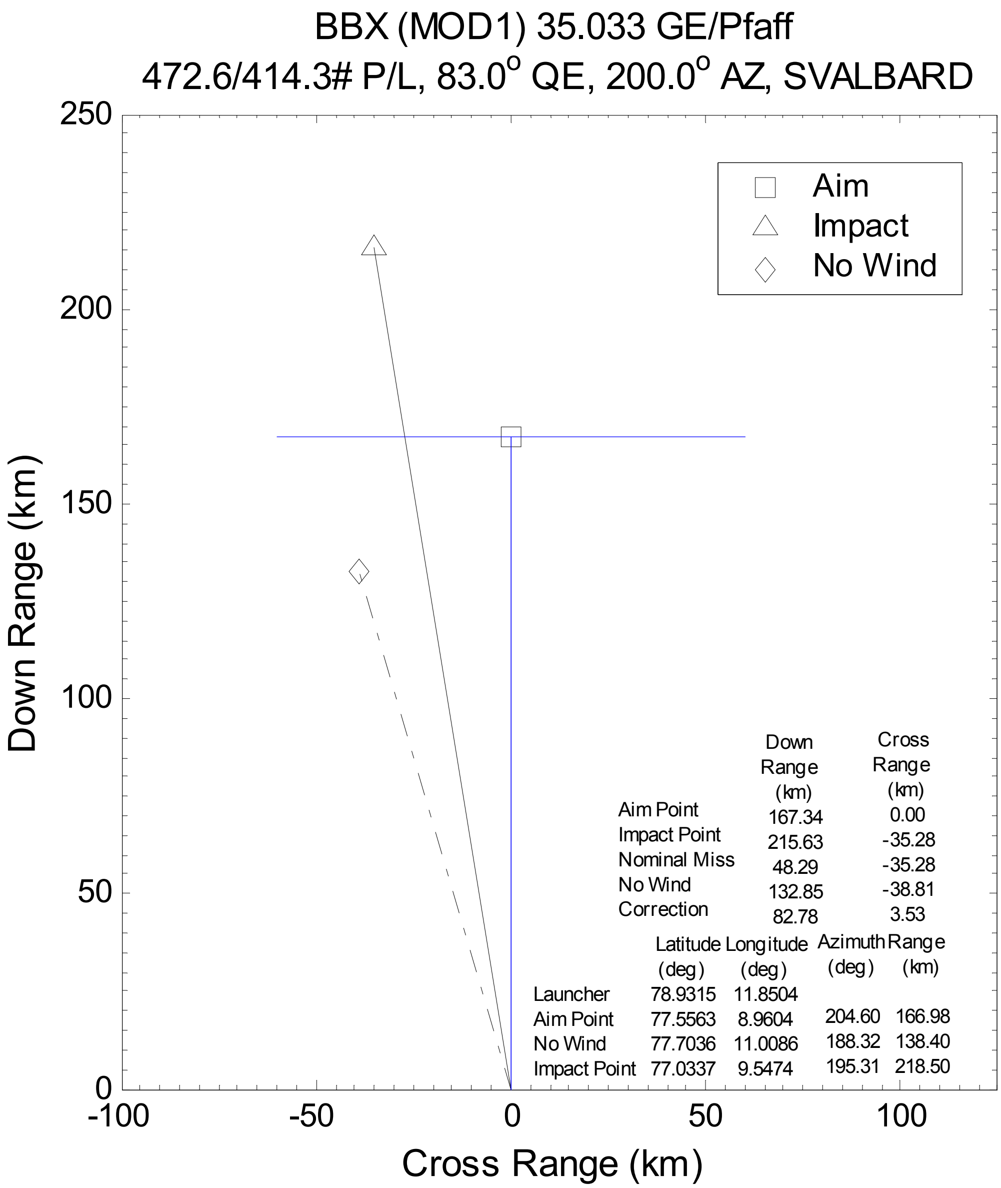


Figure 6-1(a). Down Range Impact Plot, Second Stage

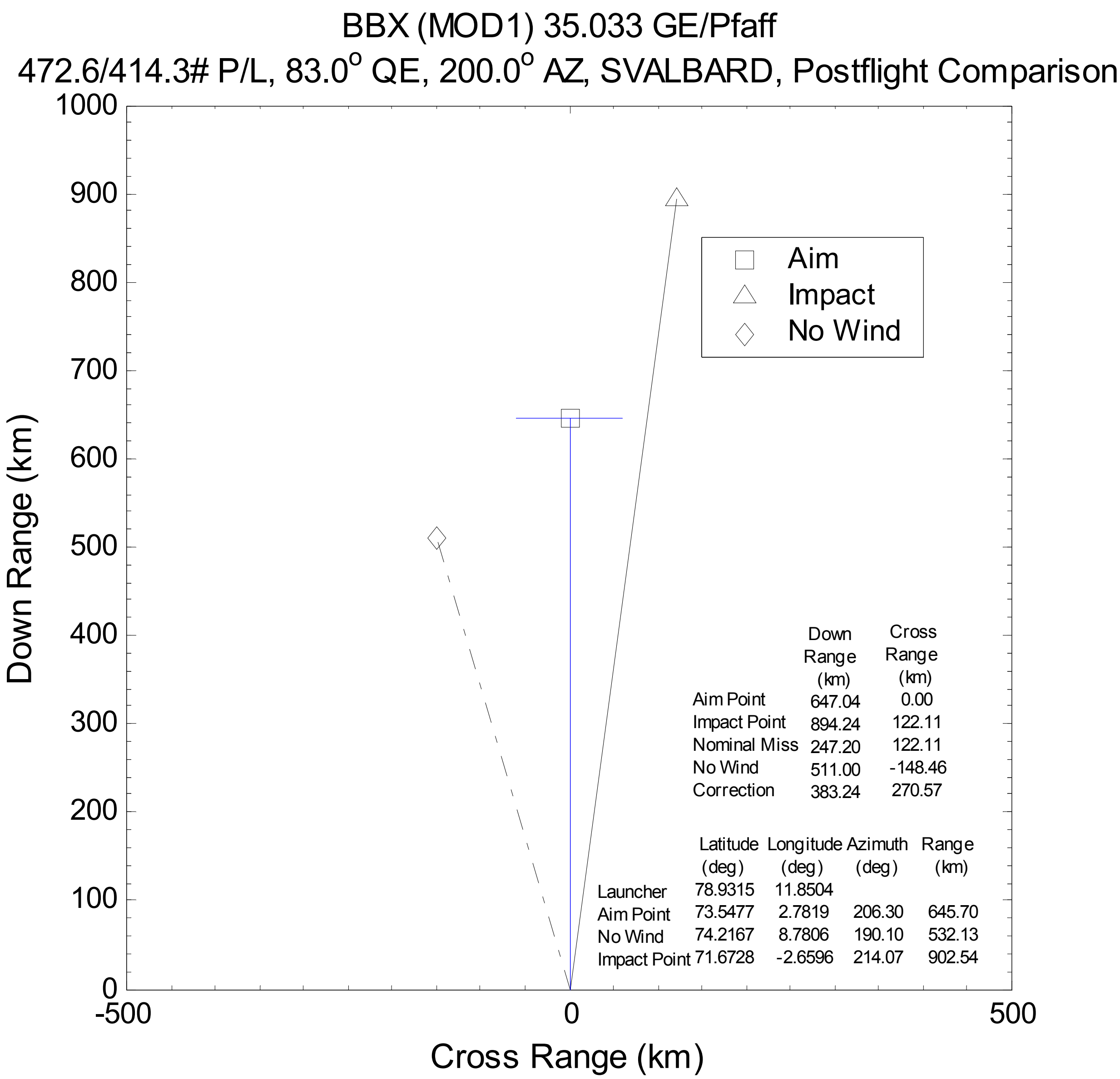


Figure 6-1(b). Down Range Impact Plot, Third Stage

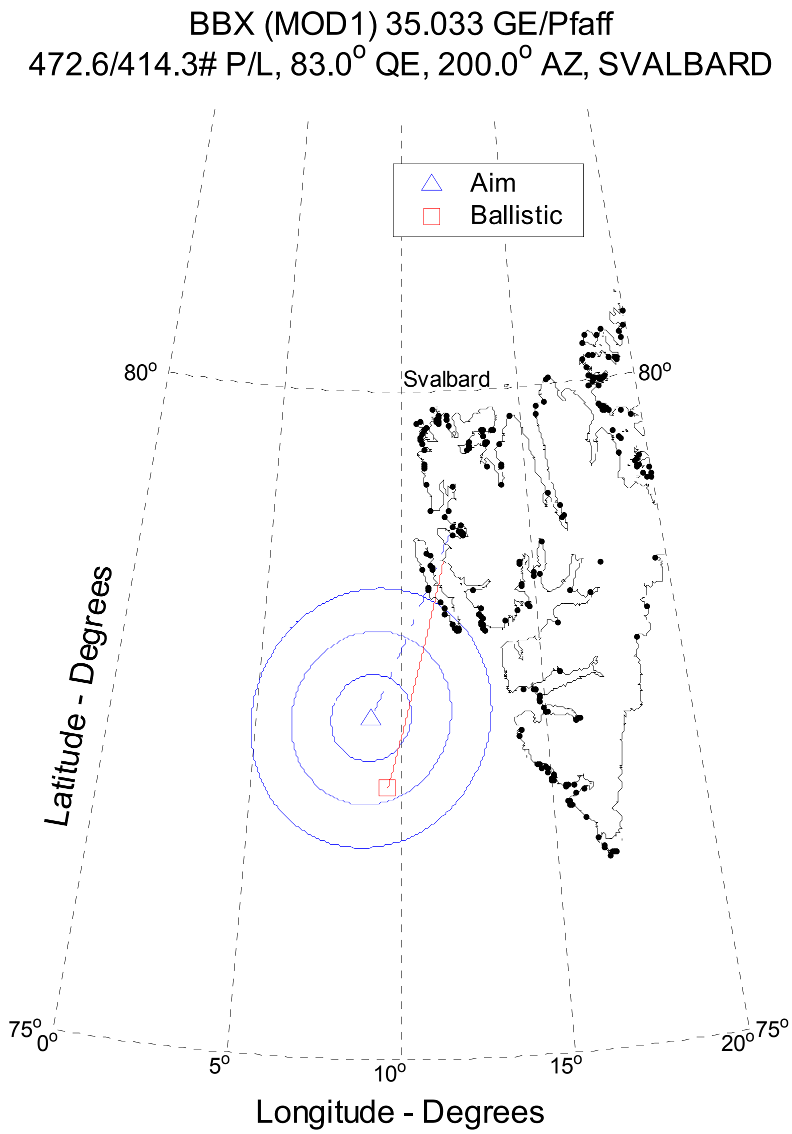


Figure 6-2(a). Norway Range Map, Second Stage

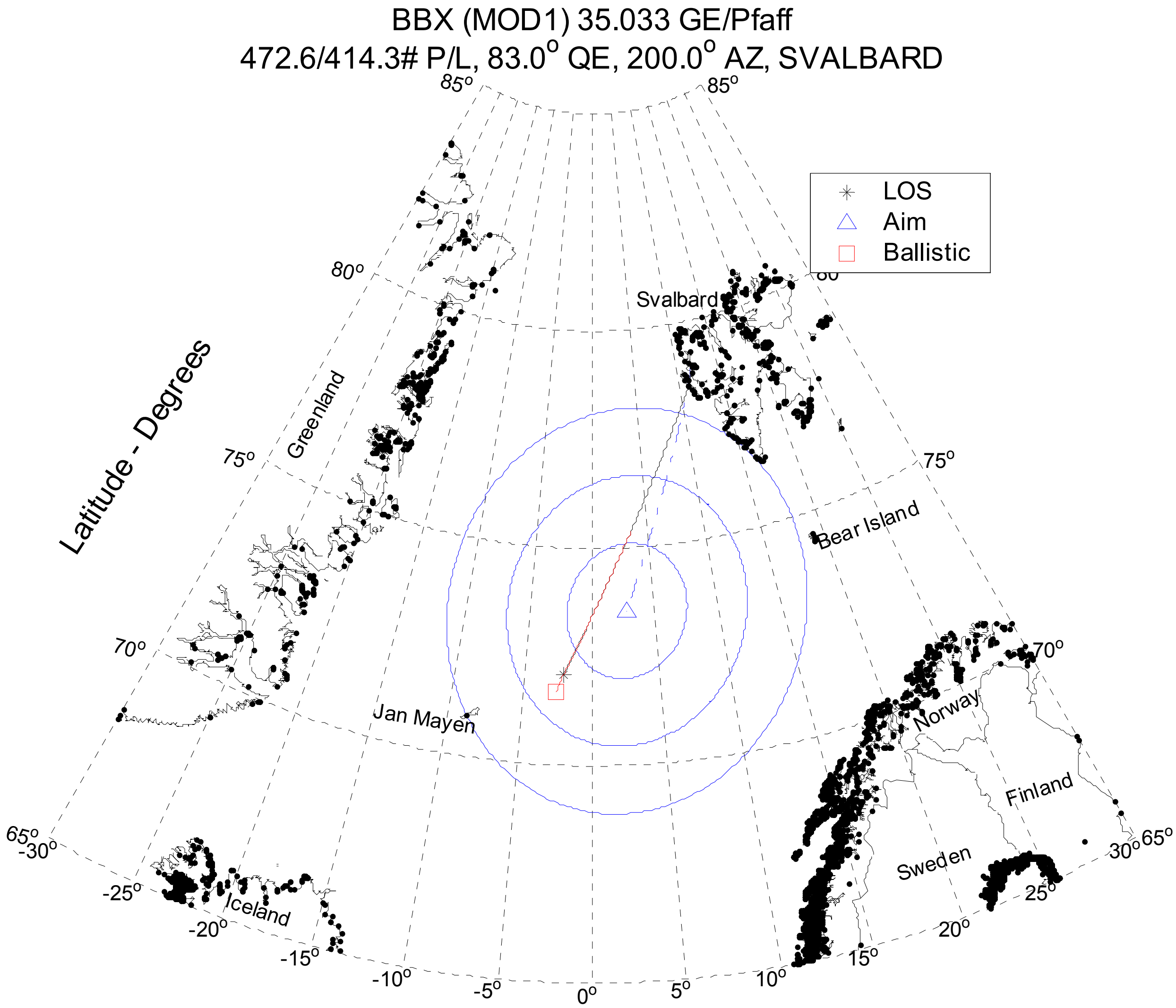


Figure 6-2(b). Norway Range Map, Third Stage

BBX (MOD1) 35.033 GE/Pfaff
472.6/414.3# P/L, 83.0° QE, 200.0° AZ, SVALBARD, Postflight Comparison

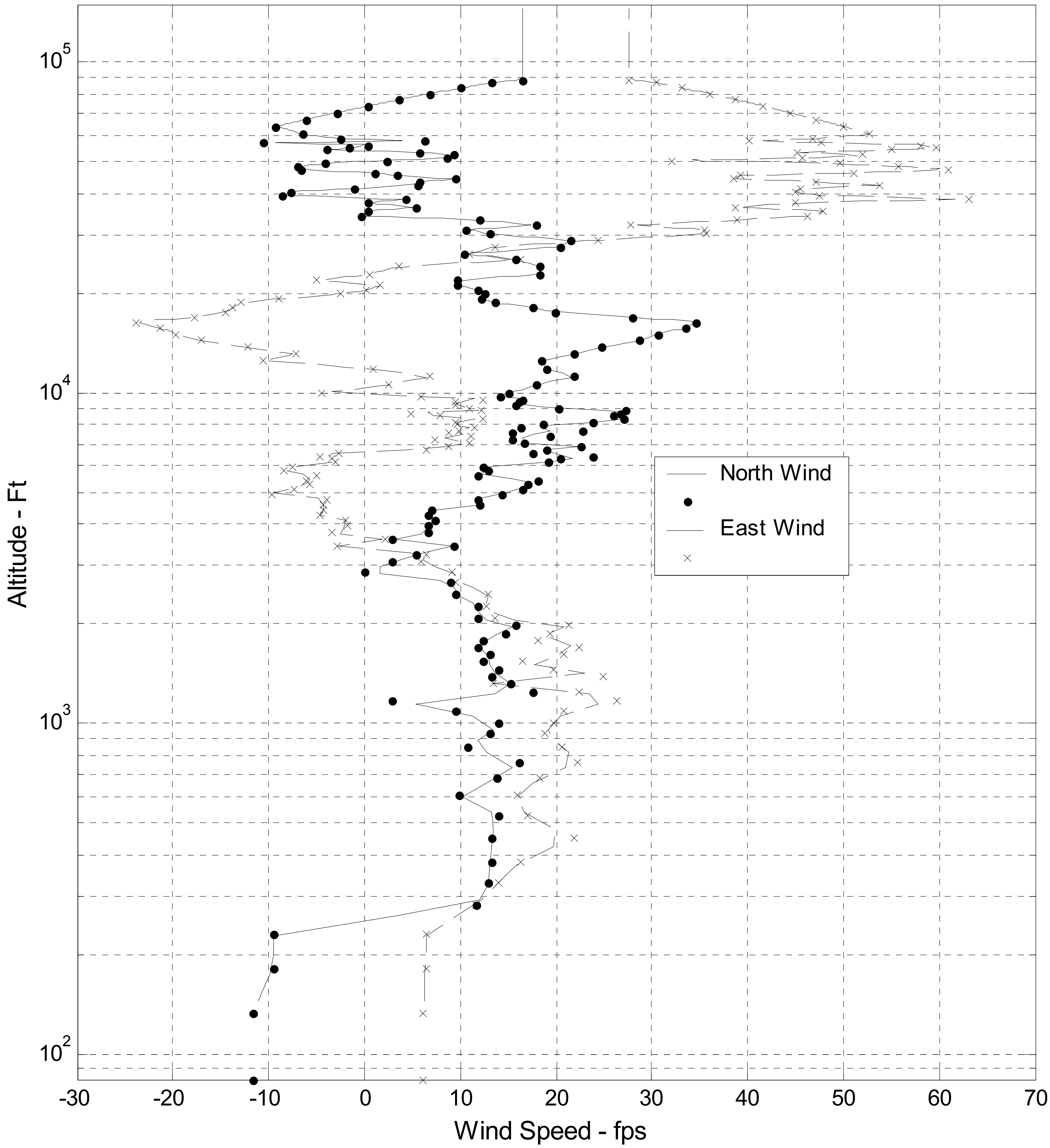


Figure 6-3. Altitude vs Wind Speeds

LESSONS LEARNED

PHASE: Mission Readiness Review

ISSUE: Possible payload coning during the boom deployment sequence with only a lower roll control programmed ACS system.

LESSON LEARNED:

(a) Inputs, outputs, and uses of the STRAN and FLEX6D analysis programs, including structural modeling of each set of booms for the STRAN program.

(b) Postflight data reduction indicates that the payload's coning angle peaked at 8^{o} at T+146 seconds. The coning reduces after this peak and appears to level out.

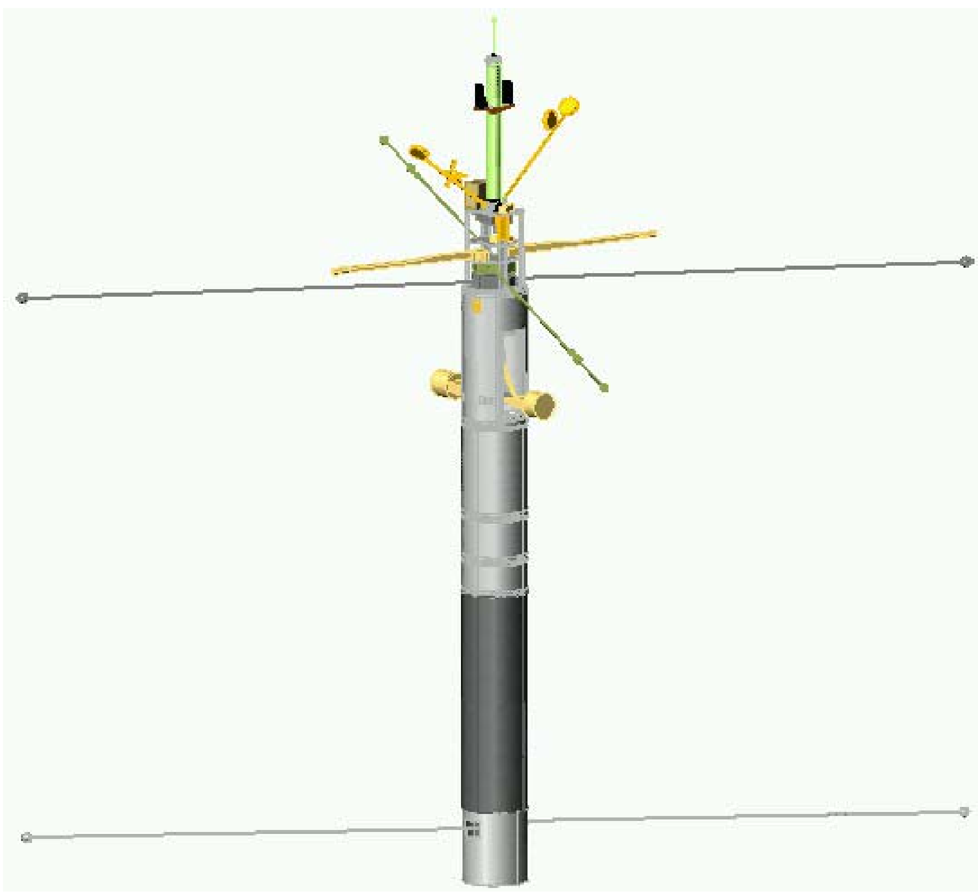
Post Flight Report

Mechanical Systems

MECHANICAL SYSTEMS
MISSION CLOSEOUT REPORT

FOR

35.033 GE/BLACK BRANT X
PFAFF/GODDARD SPACE FLIGHT CENTER
SVALBARD/DECEMBER, 2002



Giovanni Rosanova, Jr.
June 10, 2003

NSROC

1.0 Payload Mechanical System Description

The 35.033 payload was 17.26 in. in diameter, 167.40 in. long and weighed 472.63 lb. (including tail can booms). It consisted of an 88 in. long, forward ejecting nosecone under which is contained the forward experiment structure and components; this is followed by an aft experiment section, a telemetry section, a magnetic attitude control system, and a Nihka motor ignition section with a custom-built skin to adapt directly to the ACS. Furthermore, the Nihka tail can houses a pair of experiment booms. This payload went through integration and environmental testing at Wallops Flight Facility and was launched from Svalbard, Norway in December, 2002. A payload assembly drawing is attached.

2.0 Summary of Integration and Testing

The payload was fully assembled and tested at the Wallops Flight Facility. The environmental tests performed were static and dynamic balance of the nosecone alone and the booms stowed control configuration, bend, mass properties measurements, vibration, nosecone deployment, and blow-off door and fold-down boom deployments. See the 35.033 Mission Readiness Review Section 4.0 for a detailed sequence of events and summary of issues and resolutions regarding mechanical testing of this payload.

3.0 Summary of Flight Data and Anomalies

The experiment generally performed well with a few exceptions related to individual instrument performance. As of this writing, the experiment team is still investigating the causes of these anomalies. Mechanically, however, all systems performed nominally according to data obtained from Telemetry. The following is a summary of the specific mechanical events.

- The nosecone deployed properly and without any indication of interference with experiment structure ore instruments.
    - LEOS deployed properly as there was no indication of re-strike with the nosecone after Nihka ignition.
- Both sets of blow-off doors deployed.
- All fold down booms deployed.
    - “Stowed” monitors for the SEI/SII and EED/EID booms indicated successful deployment, but neither got positive confirmation from their “Deployed and locked” monitors. However, all indications from the experiment team conclude that these booms did fully deploy.
    - Search coil/current loop booms deployed and potentiometers showed full deployment.

  - GSFC fold-down booms had no monitors, but since they were spring loaded, there is no reason to believe that they did not deploy properly. Furthermore, the experimenter indicated good data from these instruments.
- All telescoping booms deployed properly.

4.0 Assessment of Damage to Payload

- The payload was not recovered, so a damage assessment was not possible.

5.0 Recommendations for Corrective Action

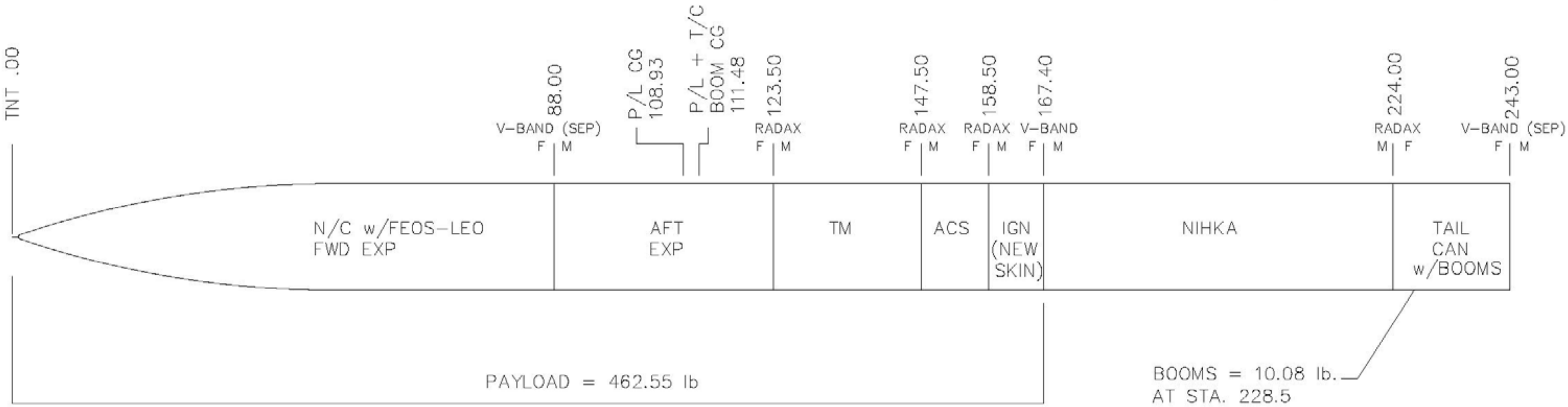
Many lessons were learned on this mission from a mechanical design and packaging standpoint. These points are summarized below.

- Leave ample clearance between back shells of interface connectors and components in adjacent sections, especially if the payload is wired with twisted and shielded harnesses.
- Allow for easy assembly and disassembly of experiment structures, taking into account the substantial wire harness that will accompany it. Consider interface connectors between sections that need to be taken apart several times during the mission life cycle.
- Many experiment screws came loose during vibration testing. It will be a challenge, but future payload teams need to encourage experimenters to torque their fasteners one last time before environmental testing.
- The orientation of tail can booms relative to the 6m booms on the forward end of the payload was supposed to be offset by 5^o in order to compensate for bending during deployment. This requirement was communicated late in the mission life cycle and thus caused significant re-work to correct. Since and NCR was written to capture this issue, it will serve as a good reference to future engineers who will have tail can booms on their payloads so that the offset can be designed in before hardware is built.
- Update ME43447 “Mechanical Field Assembly Procedure for Experiment Structures” to reflect lessons learned during final assembly in the field.
- Investigate possibility of designing future ACS modules with umbilical connectors farther away from 0^o. This will help to avoid tight fits under the launcher in Svalbard, which is wider than or conventional launchers.
- Recommend interface connector on Langmuir probe assembly rather than having it hard-wired. This will facilitate disassembly in the field for coating of the sphere.

- Obtain interface control drawings from Weitzman boom manufacturers earlier in design cycle. Kaleva design changes their mounting hole pattern, but I did not get their ICD until after their decks had been built.
- Design a better cooling approach for the Calgary booms. The cooling lines, which entered through the Telemetry section and were fed up to the boom tips, were removed and the entire payload was purged rather than just the SEI/SII sensors.
- Change the Nihka tail can modifications to include a door/cover for mounting the electrical interface connector. Having it hard mounted to the skin made it difficult to install in the field.

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. REMOVE BURRS AND BREAK SHARP EDGES .005 – .010 MAX.
2. INTERPRET DWG. PER ASME Y14.5M– 1994
3. SURFACE FINISH IS 125 √ UNLESS SHOWN OTHERWISE.

DATE	LET.	REVISION	ENG/DFT
10OCT2001	–	ORIGINAL RELEASE	MH
25OCT2002	A	REV PROPS & GRAV, SH2–REV BOOM LOCS	GR/RAP
5MAR2003	B	ADDED REFERENCE NUMBERS TO BOOMS ON SHT# 2.	AG/KW



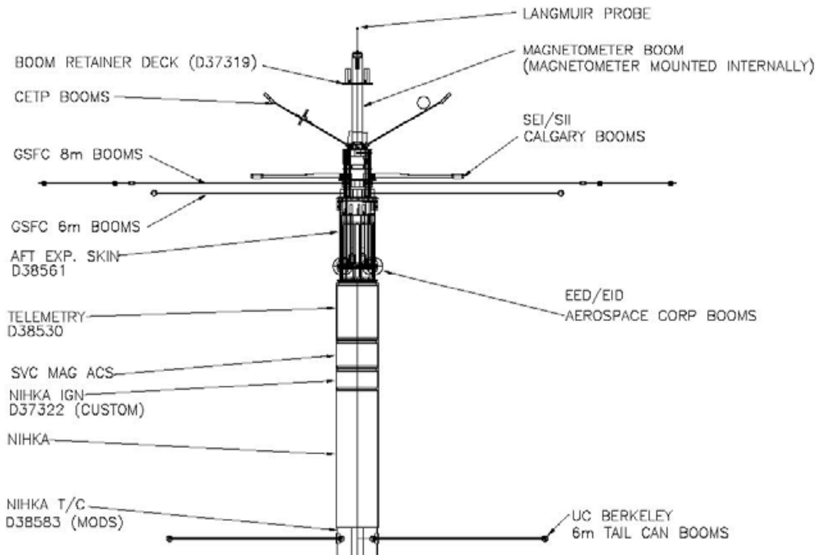
MEASURED CONFIGURATION PROPERTIES				
LAUNCH: OVERALL P/L AND TC BOOMS	472.63	111.48	3.99	197.42
NOSE OFF: OVERALL P/L AND SPENT NIHKA W/TC	620.17	150.16	5.47	370.68
ALL BOOMS DEPLOYED: OVERALL P/L AND SPENT NIHKA W/TC	620.17	150.70	21.24	370.38
	WT.	C.G.	I ROLL	I PITCH
	LBS.	INCHES	SLUG–FT2	SLUG–FT2

ESTIMATED SECTION PROPERTIES (** MEASURED)					
1	NOSECONE+SKIRT	57.50**	45.68**	0.603**	10.32**
2	EXP. COMP. AND STRUCTURE	151.98	92.51	0.707	84.771
3	UPPER BALANCE WEIGHTS	5.03**	62.63**	0.100	0.100
4	AFT EXPERIMENT SECTION	32.10	106.11	0.423	1.243
5	TELEMETRY	128.00**	135.50	0.924	1.654
6	ACS–SPACE VECTOR MAGNETIC	50.75	153.87	0.524	0.375
7	NIHKA IGN.	43.00	162.01	0.482	0.324
8	LOWER BALANCE WEIGHT	0.264**	163.46**	0.004	0.004
ITEM	DESCRIPTION	WT.	C.G.	I ROLL	I PITCH
		LBS.	INCHES TNT	SLUG–FT2	SLUG–FT2
GRAVIMETRICS INFORMATION					

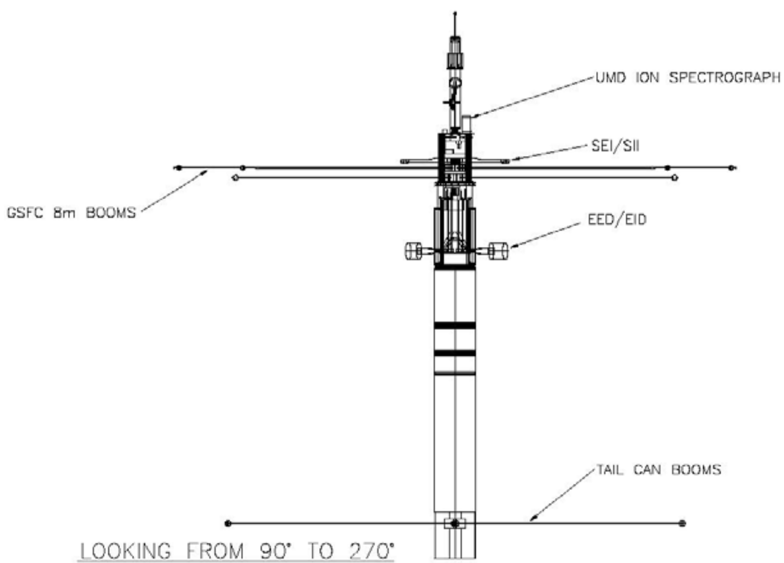
NEXT ASSEMBLY:	PROJECT: 35.033	SCALE: 1/10 DO NOT SCALE FROM DRAWING	**NSROC** GODDARD SPACE FLIGHT CENTER WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA 23337	DATE:	10 OCT 2001
				ENG.	G. ROSANOVA
MATERIAL: N/A		HEAT TREAT:		DES.	
				DFT.	M NOCK
UNLESS SHOWN OTHERWISE ALL DIMENSIONS IN INCHES TOLERANCE ON DIMENSIONS ANGULAR: ±0°15'	X.X ±.1 X.XX ±.02 X.XXX ±.005		TITLE: 35.033 CONFIGURATION AND PROPERTIES	CHK.	RM HYLBERT
				D37289 SHEET 1 OF 2	REV. B

NOTES: (UNLESS OTHERWISE SPECIFIED)
1. REMOVE BURRS AND BREAK SHARP EDGES .005 - .010 MAX.
2. INTERPRET DWG. PER ASME Y14.5M- 1994
3. SURFACE FINISH IS 125 √ UNLESS SHOWN OTHERWISE.

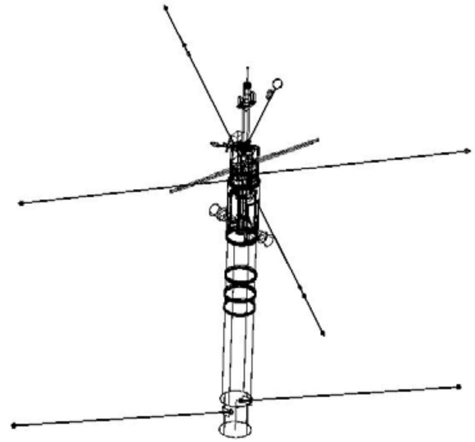
DATE	LET.	REVISION	ENG/DFT
10OCT2001	–	ORIGINAL RELEASE	MH
25OCT2002	A	UPDATE TO AS BUILT	GR/RAP
5MAR2003	B	ADDED REFERENCE NUMBERS TO BOOMS	AG/KW

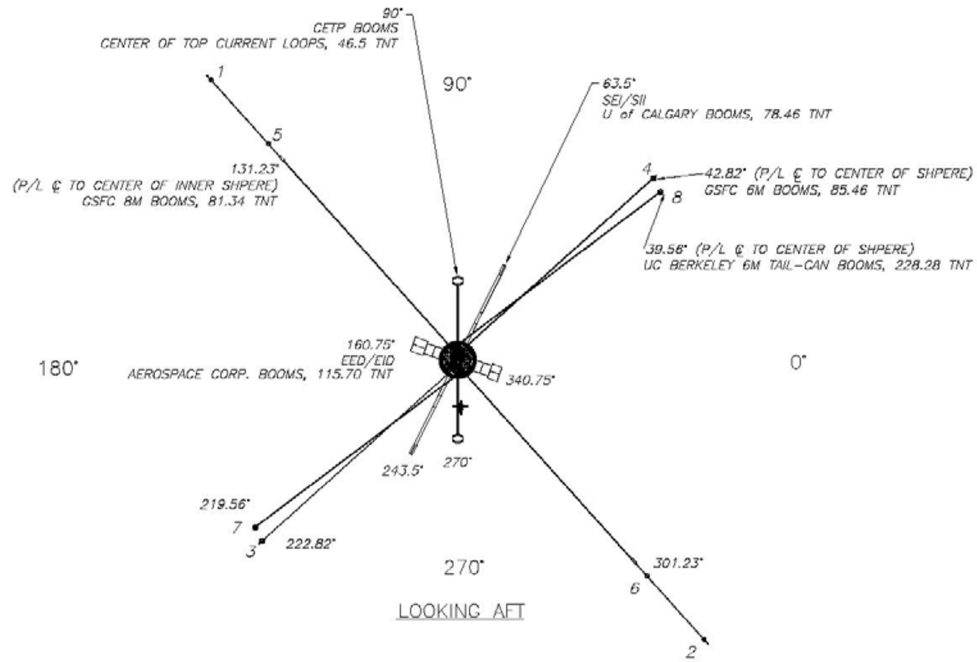


LOOKING FROM 0° TO 180°



LOOKING FROM 90° TO 270°





LOOKING AFT

NEXT ASSEMBLY:	PROJECT:	SCALE:	NSROC
–	35.033	VARIOUS DO NOT SCALE FROM DRAWING	GODDARD SPACE FLIGHT CENTER WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA 23337
MATERIAL: –		HEAT TREAT:	TITLE: 35.033 CONFIGURATION & PROPERTIES
UNLESS SHOWN OTHERWISE ALL DIMENSIONS IN INCHES TOLERANCE ON DIMENSIONS ANGULAR: ±0°15'	X.X ±.1 X.XX ±.02 X.XXX ±.005		

DATE:	10 OCT 2001
ENG.	C. ROSANOVA
DES.	
DFT.	KR WALTHALL
CHK.	RM HYLBERT
D37289 SHEET 2 OF 2	REV. B

Post Flight Report

Power

ELECTRICAL ENGINEERING
POWER SYSTEMS

POST FLIGHT SUMMARY

(EES-PF-0007-REV0)

FLIGHT	**35.033**
PRINCIPLE INVESTIGATOR	**Dr. Robert Pfaff**
LAUNCH SITE	**Ny Alesund, NO**
LAUNCH DATE	**14 Dec. 2002**
Date Prepared	**01/29/03**

LAST REVISION DATE 3/8/00

Mission Number	35.033
Principle Investigator	Dr. Robert Pfaff
Organization	GSFC
Co-Experimenters	James Clemmons, Penny Slocomb - Aerospace Corp.
	Mike Coplan, John Moore - U. of Md.
	Greg Delory - Berkely
	David Knudsen - U. of Calgary
	Jean-Louis Pincon - CETP
Launch Site	Ny Alesund, NO
Launch Date	14 Dec. 2002
Local T-0	11:16:48
Local LOS	11:31:40
Total Flight Time	0:14:52

PROJECT TEAM

Payload Manager	Tracy Gibb, Bruce Scott
Electrical Power Engineer	Charlie Kupelian
Electrical Telemetry Engineer	Thad Sterling, Shelby Elborn
Mechanical Engineer	Giovanni Rosanova, Andrew Groves
Electrical Technician	Herb Haugh
Mechanical Technician	Brian Tucker, Dana Morrison
Vehicle Technician	Alfred Halter
Ignition Systems Technician	Alfred Halter
ACS Personnel	Charlie Kupelian, Pat McPhail
S-19 Personnel	na

Airborne Power Systems

	1	2	3	4	5	6	7	8	9	10
System	TM	GYRO	PYRO	EXP +18	EXP -18	EXP +9				
Battery Type	24 'D'	24 'A'	16 'A'	15 'C'	15 'C'	8 'C'				
Nominal Voltage	+ 28	+ 28	+ 20	+ 18	- 18	+ 10				
System Load	3.6 A	0.70 A	na	1.10 A	0.80 A	2.09 A				
OCV Prior to Launch	na	na	na	na	na	na				
Voltage at T=0	30.5	31.49	22.3	19.81	-19.97	9.91				
Internal Time at T=0	3 min	3 min	3 min	3 min	3 min	3 min				
Voltage at LOS	28.48	29.87	22.13	18.09	-18.76	9.2				
Average Voltage	29.49	30.68	22.215	18.95	-19.365	9.555				

COMMENTS:
Voltages at LOS are based on Ny Alesund data, with an early LOS of 891 seconds. Open Circuit Voltages (OCV) were not noted prior to turn switching Internal.

IN-FLIGHT TIMING EVENTS

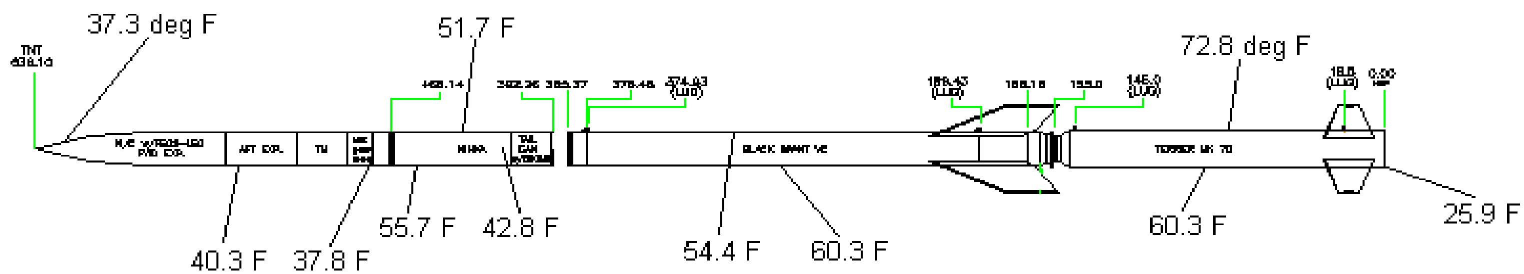
Event Timing System: 30 Channel Multi-function Timer

Timer Serial Number:

EVENTS	Nominal Time	Actual Time	Difference Nominal Actual	COMMENTS
E-Field Sync Signal	55.0	55.26	0.26	
N/C Eject	62.0	62.28	0.28	
EED/EID Doors Deploy	91.0	91.23	0.23	
Aft UCB Boom Doors Deploy	92.0	92.26	0.26	
IMS HV On	100.0	100.27	0.27	
Aft 6m UCB Booms Deploy (0-3 Hz)	117.0	117.27	0.27	
SEI/SII Booms Deploy (Nom: .75 +/-.25 I	121.0	121.26	0.26	
EED/EID Deploy (.5 - 1.0 Hz)	121.0	121.26	0.26	
GSFC 6m Booms Deploy (0 - 3 Hz)	122.0	122.26	0.26	
GSFC 8m Dual Sphere Booms Fold Dowı	122.0	122.26	0.26	
French AC Search Coils Deploy	127.0	127.26	0.26	
GSFC 8m Dual Sphere Boom Deploy	128.0	128.27	0.27	
SEI/SII High Voltage On	169.0	169.26	0.26	
EED\EID High Voltage On	170.0	170.25	0.25	

PAYLOAD PYROTECHNIC DATA SHEET

DEVICES	USE	SERIAL NUMBER	BRIDGE RESISTANCE
3702	Nose Cone deploy	72	1.01, 1.05
3702	Nose Cone deploy	74	1.22, 1.13
Weitzmann	6 Meter Extend	Boom #3	4.86, 5.00
Weitzmann	6 Meter Extend	Boom #4	4.62, 4.65
2801	8 Meter Fold Down	93	0.72, 0.70
Weitzmann	8 Meter Extend	Boom #1,5	5.02, 4.91
Weitzmann	8 Meter Extend	Boom #2,6	4.94, 4.53
2801	Search Coil Deploy	94	0.72, 0.70
2801	EED/ EID Booms Deploy	95	0.67, 0.73
2801	EED/ EID Doors Deploy	96	0.69, 0.67
2801	EED/ EID Doors Deploy	97	0.72, 0.70
2801	SEI/ SII Booms Deploy	98	0.71, 0.75
Weitzmann	Tail Can Booms Deploy	ALL parallel	2.71, 2.60
Weitzmann	Tail Can Booms Deploy	ALL parallel	2.71, 2.60
2801	Tail Can Doors Deploy	99	0.75, 0.74
2801	Tail Can Doors Deploy	100	0.71, 0.74



37.3 deg F
51.7 F
72.8 deg F
TNT
AFT EXP.
TM
378.48
274.03 (LUG)
BLACK BRANT VC
145.0 (LUG)
40.3 F
37.8 F
55.7 F
42.8 F
54.4 F
60.3 F
60.3 F
25.9 F

Experiment Integration including Pre-Vibration Test:

Changes after Post T & E Testing:

Pre-flight Testing and Launch operations:

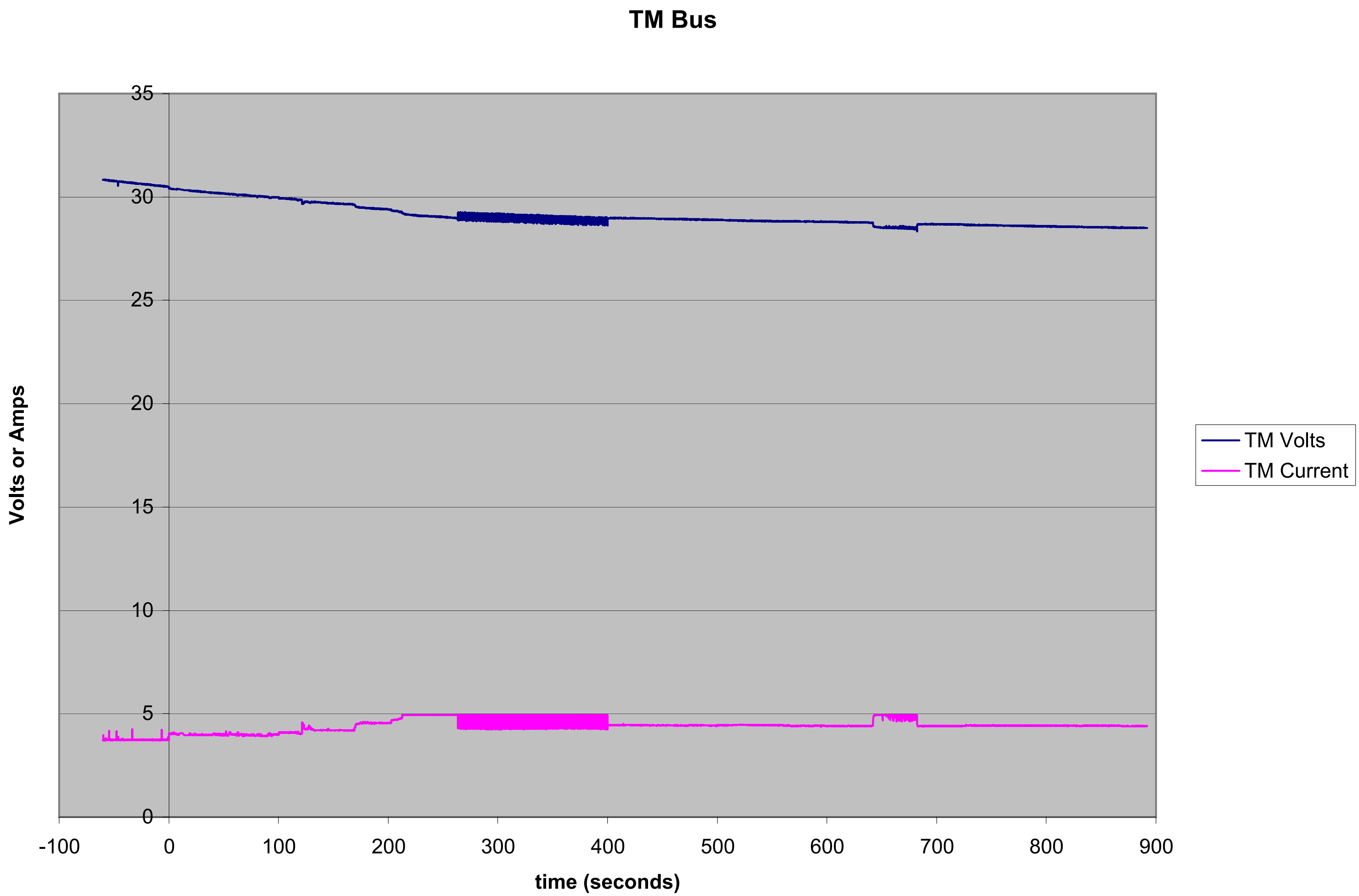
Romo-Temp worked pretty well. I look forward to the new software, though. The Norweigans built a foam box around the nose cone. They then wrapped the rest of the payload in plastic, the static proof kind, and blew hot air up inside the bag. The motors stayed warm when the rocket was vertical, but the payload got chilled. If there were critical temperature requirements for the payload, this scheme would not have worked. So, if you have critical temperature requirements, relay these to the Norweigans prior to field operations!

Summary (Success, Failure, any Flight Anomalies):

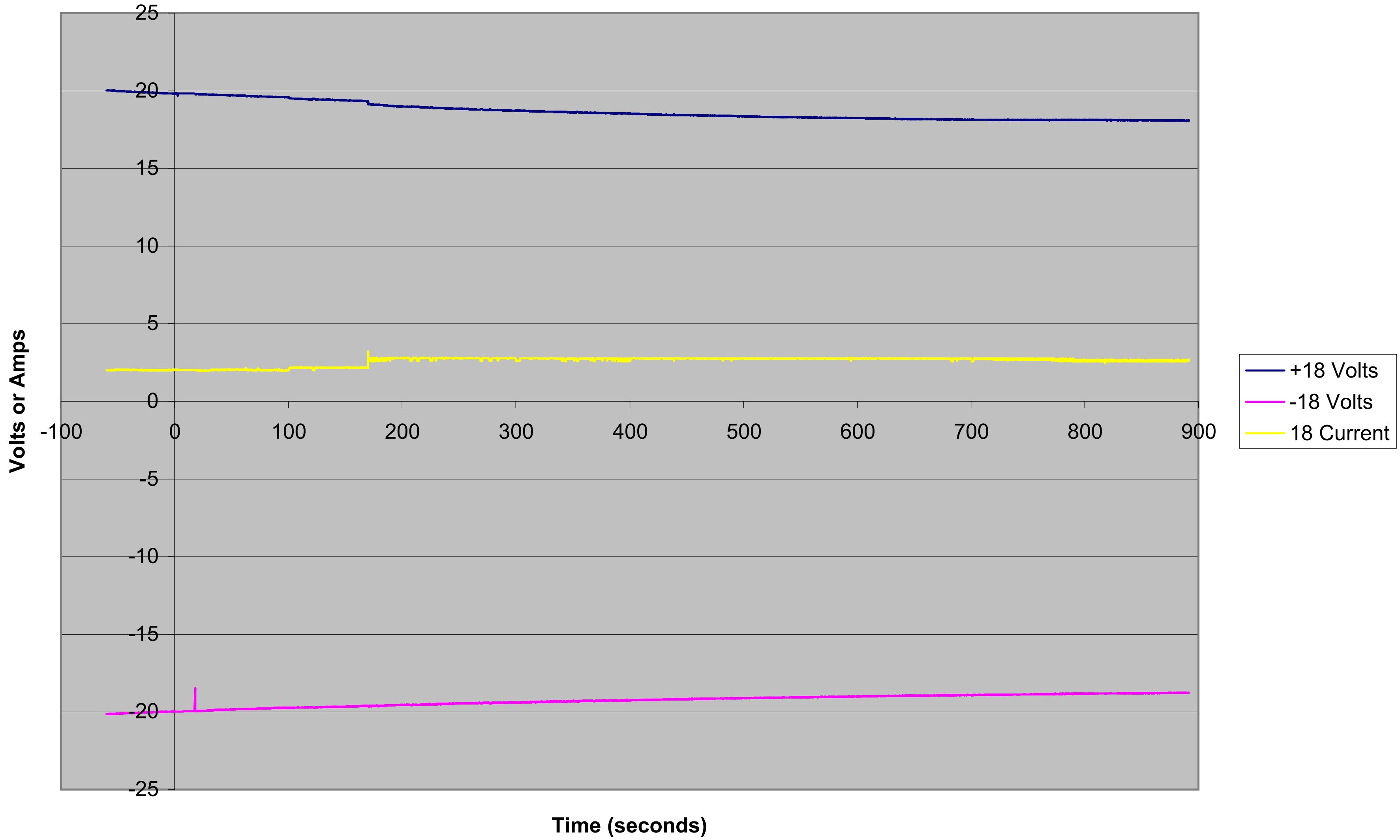
Attached is a plot of the various bus voltages for the flight. Notice the pyro short at 91 seconds. That was the EED / EID door deploy command. It fired the 4 bridge wires of two Holex 2801 guillotines. TM records indicate that both doors separated from the payload, so the short didn't prevent any events from happening. This is significant in that more than two pyro events should not be allowed to happen at the same time. If another had been triggered with t bus so low, it may not have occured. The +9 bus current increase at 125 seconds does not correspond to a timed event. The +18 Volt increase in current took place at 174 seconds, several seconds after High Voltages were turn on. There were two unexplained instances where the TM current increased. Please note that some of the experiment functions drew power from this bus. Otherwise, the power systems performed nominally.

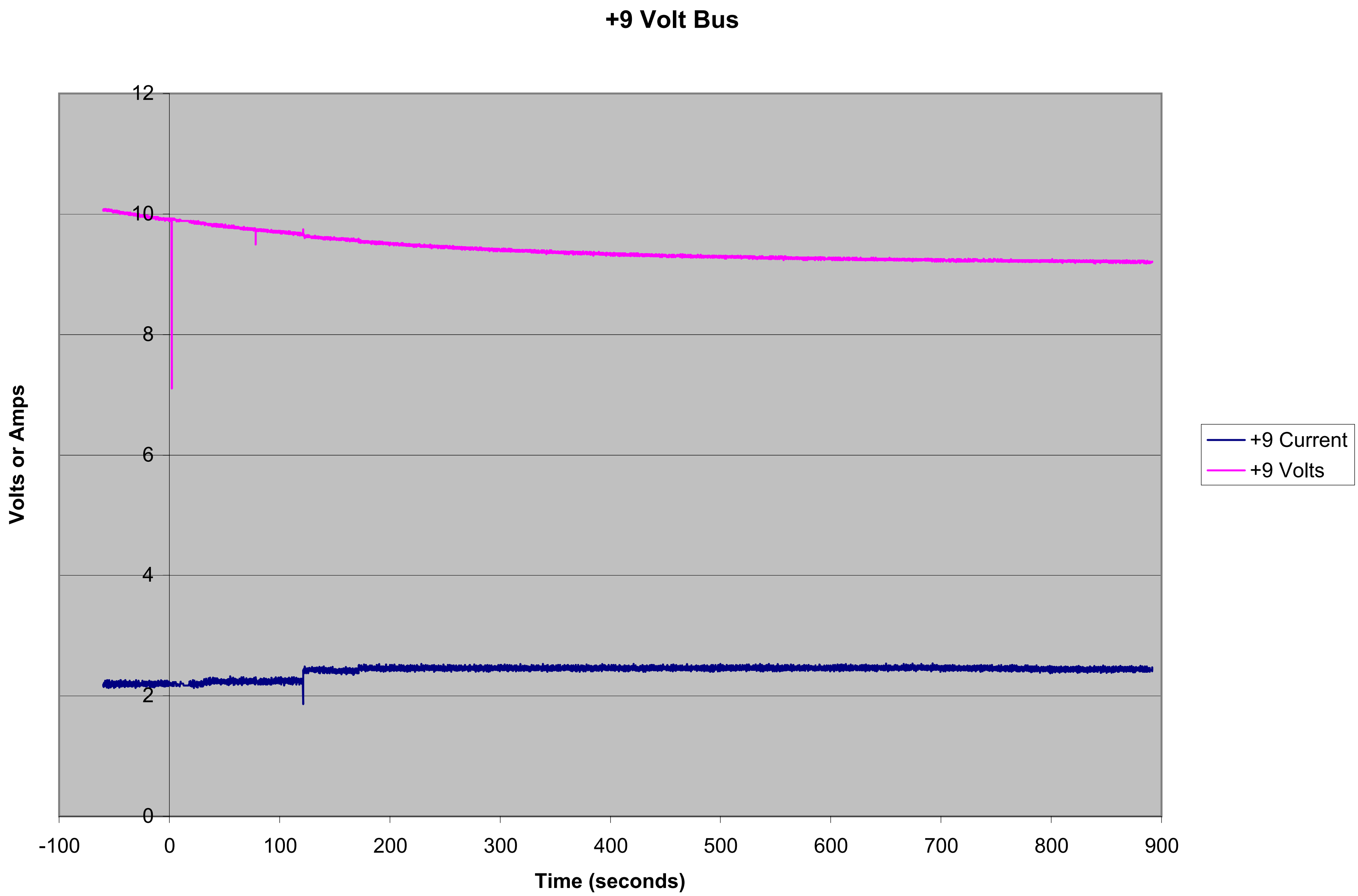
Recommendations for Improvements:

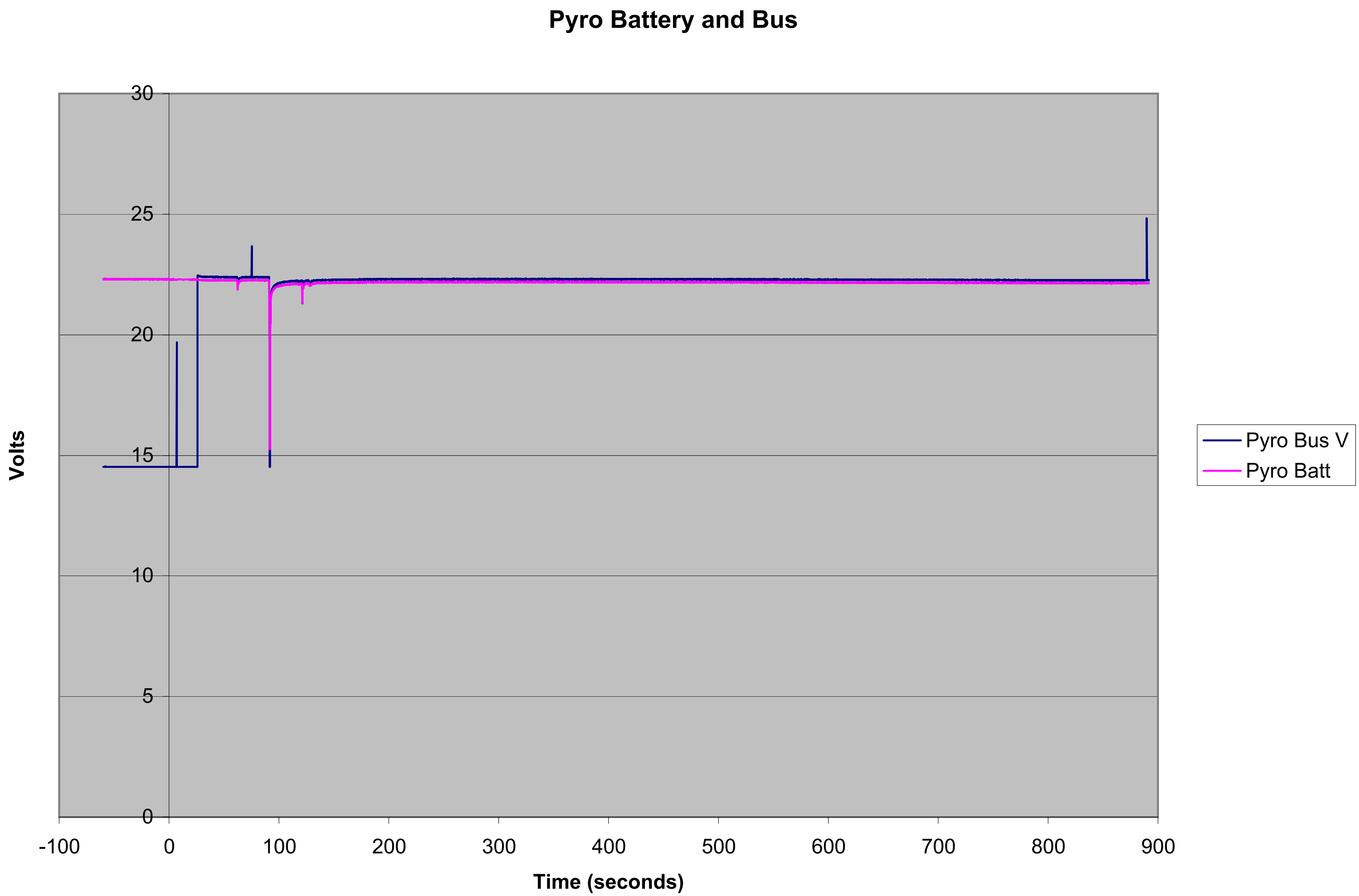
Add more grounds in the umbilical connectors, and follow them through to the suitcase. This would eliminate a lot the hassles of augmenting in the field. With 140ft of wire in the fireproof umbi, the losses were significant. Augmenting only helped a little. The facilities are good at Ny Alesund. There are only 200 available conductors in junction boxes, so keep that in mind when designing the next rocket to launch from there.


TM Bus
Volts or Amps
35
30
25
20
15
10
5
0
-100
0
100
200
300
400
500
600
700
800
900
time (seconds)
TM Volts
TM Current

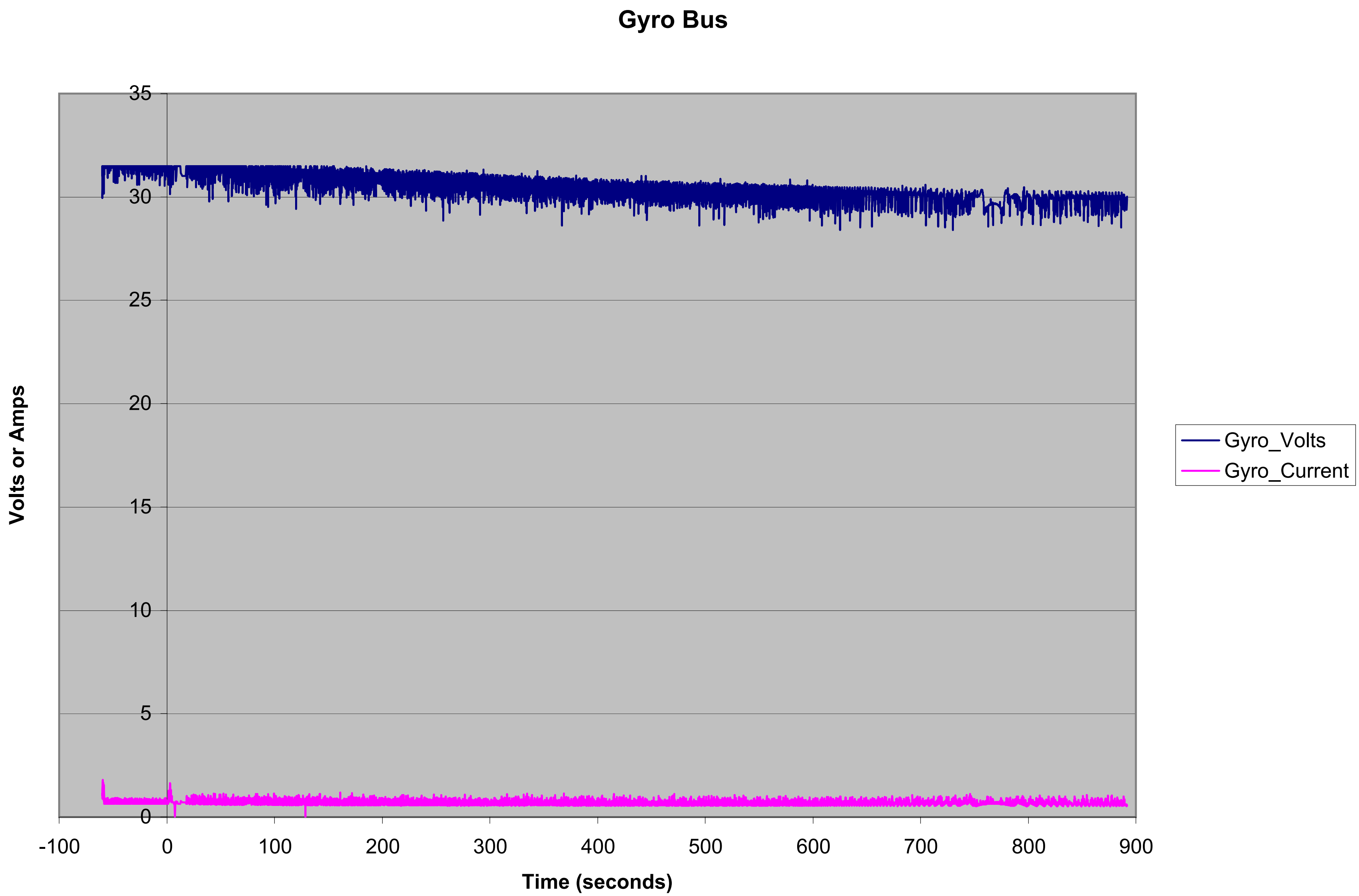
Experiment +/- 18 Volt Bus




+9 Volt Bus
Volts or Amps
Time (seconds)
12
10
8
6
4
2
0
-100
0
100
200
300
400
500
600
700
800
900
+9 Current
+9 Volts



Pyro Battery and Bus
Volts
30
25
20
15
10
5
0
-100
0
100
200
300
400
500
600
700
800
900
Time (seconds)
Pyro Bus V
Pyro Batt



Gyro Bus
Volts or Amps
35
30
25
20
15
10
5
0
-100
0
100
200
300
400
500
600
700
800
900
Time (seconds)
Gyro_Volts
Gyro_Current

Post Flight Report

Instrumentation

NSROC ELECTRICAL ENGINEERING
PO BOX 99, WFF
WALLOPS ISLAND, VA 23337-0099
757.824.1589
757.824.1954 Fax

Title	Electrical Engineering Flight Summary		
Doc. No.	EEPUB-35033-10		
Revision	-	**Release Date**	4/08/03
System	Telemetry		

Instrumentation Flight Summary

35.033
Pfaff / GSFC

Launched from
Svalbard
12/14/2002

Instrumentation Engineer: T. Sterling

Instrumentation
Flight Summary

Payload Number	35.033	Vehicle Type	BBX
Flight Date	12-14-2002	Launch Range	Svalbard, Norway
GMT-0	348:11:16:48	Project Number	S013
GMT LOS	348:11:32:09 (7M) 348:11:31:38 (A9)	GMT-0	348 Days 11 Hrs 16 Min 48 Sec
Recovery Required	No	Date & Local Time	N/A

Flight Summary: (Success/Failure/Partial/etc.)

Success

Instrumentation Systems (Airborne)

	TM 1						
Modulation	PCM/FM						
Bit Rate/ High VCO	6.4 Mbps RNRZ-L						
RF Freq (MHz)	2215.5						

Trajectory Data System (check systems used)

GPS Receiver X

Attitude Reference

Gyro Uncaged Reference	185.3	Degrees AZ	84.8	Degrees EL
Final Launcher Settings	185.3	Degrees AZ	84.8	Degrees EL

Key Personnel

Payload Mgr.	Tracy Gibb	ACS Engr.	Charlie Kupelian	P.I.	Dr. Robert F. Pfaff
Instr. Engr.	Thad Sterling/Shelby Elborn	Elec. Tech.	Brian Rose	Project Sci	Dr. Mario H. Acuna
Elec. Engr.	Charlie Kupelian	Mech. Tech.	Ed White	.	Dr. James H Clemons
Mech. Engr.	Giovanni Rosanova	.			Prof. Michael A. Coplan
Veh. Analyst	Brent Edwards				Prof. John H. Moore
					Dr. Gregory T. Delory
					Prof David J. Knudsen
					Dr. Herve de Feraudy
					Dr. Vladimir Krasnoselskikh

TM Systems Performance

Trajectory Data

Predicted Apogee	760.6	Km	Measured Apogee-RADAR	N/A	Km
Predicted Apogee Time	488	Sec	Measured Apogee-GPS	766.1	Km
Actual Apogee Time	493	Sec			

(Max/Min & average AGC and S/N levels measured in a 20 second window @ apogee)

Downlink AGC's (data from best antenna and receiver)

	TM 1
Sta./Ant.	A9 (20' Mobile)
Predicted S/N @ Apogee	-86.44 dBm
Max/Min S/N	-79 / <-101 dBm
Avg. S/N	-85 dBm

A9 was used in this case as it was the prime antenna and the analysis is useful for upcoming mission from this location.

Antenna Tracking Performance

Antenna Diameter	Antenna Name	Links Received From Antenna	Autotrack Time (if avail.)
24'	A9	1	+ LO Seconds
7m	7 Meter	1	+ 65 Seconds
			+ Seconds
			+ Seconds

Note any problems with any of the tracking antennas during the flight:

A9 did not track well off the pad. A9 lost the payload and then reacquired on a side band at approximately T+29 seconds.

A9 reaquired the main lobe at approximately T+133 seconds.

Number Of Data Drop Outs	TM 1	TM 2	TM 3	TM 4	TM 5	TM 6	TM 7
	< 2%						

(Number of dropouts from start of auto track until re-entry using best data source)
(If more than 10 dropouts are experienced record the dropouts as a % of the data period)

Mag Tape Data Quality

Note any problems with bad or intermittent data tracks (Data, Voice, Timing, etc.)

Direct time on tapes from both the 7 Meter and A9 had errors.

PRE-FLIGHT AND FLIGHT
PROBLEMS / ANOMALIES / RECOMMENDATIONS

PRE-FLIGHT PROBLEMS / ANOMALIES:

1. GPS sensitivity problem: Addressed in a separate document. This document was released to Engineering management, the assigned mission manager, and SQA.

IN-FLIGHT PROBLEMS / ANOMALIES:

1. Aerospace EID problem: Aerospace personnel indicated that the EID instrument failed to operate correctly. At approximately T+170.26 seconds the 18V bus current spiked from around 2.18 Amps to 3.22 Amps immediately falling to around 2.65 Amps. In the seconds following this event the current jumps up and down between 2.78 Amp and 2.58 Amp. This immediately follows the EED/EID HV event.

2. UMD Instrument: The UMD Instrument seems to have stopped outputting frame synch and counter data at approximately T+121.273 seconds. This time is approximately 7ms after the squib current monitors show the pyrotechnic devices firing for the deployment of the Calgary and Aerospace instruments. The UMD serial words and the squib current monitors are each sampled once every 6 ms. At T+121.267 the analog HV monitors show a drop from over 500 counts to less than 100. The analog monitors eventually return to a level a little higher than the level before the drop.

3. SEI/SII HV problem: The SEI/SII DC to DC converters experience problems that lead to a reduced HV output during two instances of fluctuation on TM 28V bus current. The current fluctuation occurs both times after a period of high current draw. The fluctuations ended with a period of lower current draw. The first fluctuation started from a high current condition around T+212 and lasted until approximately T+400. The second ran from approximately T+642 to T+682.

4. Black Brant Monitors: The monitors for the second stage motor did not show the expected values. It appears that these monitors, which include motor pressure and squib current monitors, were floating. This condition is indicative of an open circuit.

5. Pyro Bus Short: At approximately T+91.2 seconds the EED/EID door pyro events (2 Holex 2801) were fired. The pyro bus voltage dropped to below the minimum level that the TM system could detect during the entire dwell time for this event. This is indicative of a sustained short circuit condition in either one or both of the pyrotechnic devices.

FLIGHT EVENT TIMES

Event	Time (sec)	Pre Vibe	Post Vibe	Time	Comments	Event Control
First Movement	0	*	*	0.104	T=0 348:11:16:48	N/A
Terrier MK70 Burnout	6.2	*	*	6.23		N/A
BBV Ignition	12.0	12.5	12.4	12.4?	Very noisy data in this time period	BBV FDM
50kft Upleg	27.2	*	*	28.5	GPS 2 sps	N/A
BBV Burnout	44.4	*	*	44.35		N/A
E-Field Sync Signal	55.0	55.0	55.0	55.26	Off @ 56.27	WFF TM
N/C Eject	62.0	62.0	62.0	62.28		WFF TM
N/C Break wire				62.318		
BBV Separation	68.0	68.2	68.0	68.47?	From Accelerometer No SCM Activity	BBV FDM
Nihka Ignition	72.0	72.0	72.0	72.54		Nihka FDM
Nihka Burnout	90.6	*	*	91.72	Burnout roll rate 4 Hz	N/A
EED/EID Doors Deploy	91.0	91.0	91.0	91.23		WFF TM
EED/EID Door #1				91.275	Micro switch	
EED/EID Door #2				91.269	Micro switch	
Aft UCB Boom Doors Deploy	92.0	92.0	92.0	92.26		WFF TM
Aft Door #1				92.271	Micro switch	
Aft Door #2				92.271	Micro switch	
Despin to 1.1rps	94.0	94.0	94.0	94.14	approx 1.15 Hz	Nihka FDM
IMS HV On	100.0	100.0	100.0	100.27		WFF TM
Aft 6m UCB Booms Deploy (0-3 Hz)	117.0	117.0	117.0	117.27		WFF TM
Aft Boom 1 Fully Deployed				122.27	48 clicks	
Aft Boom 2 Fully Deployed				122.30	49 clicks	
SEI/SII Booms Deploy (Nom: .75 +/-.25 Hz)	121.0	121.0	121.0	121.26		WFF TM
SEI Retract uswitch				121.29		
SII Retract uswitch				121.29		
SEI Deployed uswitch				*	did not occur	
SII Deployed uswitch				*	did not occur	
EED/EID Deploy (.5 - 1.0 Hz)	121.0	121.0	121.0	121.26		WFF TM
EED/EID Retract uswitch				121.53		
EED/EID Deployed uswitch				*	did not occur	
GSFC 6m Booms Deploy (0 - 3 Hz)	122.0	122.0	122.0	122.26		WFF TM
6m Boom #1 Fully Deployed				128.01	48 clicks	
6m Boom #2 Fully Deployed				127.88	48 clicks	
GSFC 8m Dual Sphere Booms Fold Down	122.0	122.0	122.0	122.26		WFF TM
8m Boom #1 Fully Deployed				134.90	48 clicks	
8m Boom #2 Fully Deployed				134.85	48 clicks	
French AC Search Coils Deploy	127.0	127.0	127.0	127.26		WFF TM
French Boom #1 Fully Deployed				128.41		
French Boom #2 Fully Deployed				128.31		
GSFC 8m Dual Sphere Boom Deploy	128.0	128.0	128.0	128.27		WFF TM
SEI/SII High Voltage On	169.0	169.0	169.0	169.26		WFF TM
EED\EID High Voltage On	170.0	170.0	170.0	170.25		WFF TM
500km Upleg	229.6	*	*	231.5		N/A
Apogee	489.8	*	*	493	766.0996 Km	N/A
500km Downleg	750.1	*	*	754.5		N/A

INSTRUMENTATION FLIGHT COMPONENTS

35.033
Pfaff/GSFC

Item	Component Description	Manufacturer	Model No.	Serial No.	Comments
1	Magnetometer	Bartington	Mag-03MRN		
2	Accelerometer	Setra		865582/A050-39599	X
3	Accelerometer	Setra		865601/A0505-39600	Y
4	Accelerometer	Setra		865590/A4010-39615	Z
5	GPS Receiver	Ashtec/WFF	G12		
6	GPS Preamp	Trimble			
7	GPS Antenna	PSL			
8	Transmitter	L3	T610S		
9	S-Band Antennas	PSL			
10	Squib Current monitor box	WFF			
11	WFF93 Power deck	PSL		082	
12	WFF93 Analog deck	PSL		106	1-32
13	WFF93 Analog deck	PSL		113	33-64
14	WFF93 Analog deck	PSL		249	65-96
15	WFF93 Analog deck	PSL		265	97-128
16	WFF93 Control deck	PSL		185	
17	WFF93 Serial deck	PSL		32	
18	WFF93 Serial deck	PSL		86	
19	WFF93 Serial deck	PSL		06	
20	WFF93 Parallel deck	PSL		131	
21	WFF93 Parallel deck	PSL		134	
22	WFF93 Asynch deck	PSL		089	
23	WFF93 Counter deck	PSL		056	
24	WFF93 Time Event deck	PSL		063	
25	WFF93 Time Event deck	PSL		47	
26	WFF93 Time Event deck	PSL		52	
27	WFF93 Filter deck	PSL		119	
28	Current sensor	WFF			
29	Current sensor	WFF			
30	TM attitude gyro	Space Vector	20130-2	96-399 R4	

Serial numbers not provided by electrical technician.

PCM Matrix

35.033
Pfaff/GSFC

35.033 Pfaff/GSFC
PCM Format

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A65
2	SFID	S7	A50	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A66
3	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A68
4	SFID	S7	A51	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A70
5	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A61
6	SFID	S7	A71	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A65
7	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A67
8	SFID	S7	A72	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A69
9	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A43
10	SFID	S7	A73	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A61
11	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A65
12	SFID	S7	A74	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A66
13	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A68
14	SFID	S7	A75	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A70
15	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A61
16	SFID	S7	A76	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A65
17	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A67
18	SFID	S7	A77	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A69
19	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A99
20	SFID	S7	A115	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A61
21	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A65
22	SFID	S7	A116	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A66
23	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A68
24	SFID	S7	A78	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A70
25	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A61
26	SFID	S7	A79	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A65
27	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A67
28	SFID	S7	A80	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A69
29	SFID	S7	R1	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A39	A100
30	SFID	S7	M	A9	S2	A1	A2	S7	A7	A8	S2	A11	A12	S7	S5	S6	S7	S1	A18	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S7	A40	A61

35.033 Pfaff/GSFC
PCM Format

	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
1	A124	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-1H	S3-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
2	A59	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-3H	S3-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
3	A60	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-5H	S3-5L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
4	A62	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-1H	S4-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
5	A97	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-3H	S4-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
6	A98	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-1H	S3-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
7	A124	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-3H	S3-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
8	A123	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-5H	S3-5L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
9	P1	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-1H	S4-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
10	A63	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-3H	S4-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
11	A64	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-1H	S3-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
12	A96	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-3H	S3-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
13	A124	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-5H	S3-5L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
14	A101	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-1H	S4-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
15	A102	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-3H	S4-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
16	A103	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-1H	S3-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
17	A59	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-3H	S3-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
18	A60	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-5H	S3-5L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
19	A124	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-1H	S4-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
20	A97	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-3H	S4-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
21	A98	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-1H	S3-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
22	A104	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-3H	S3-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
23	A123	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-5H	S3-5L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
24	A105	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-1H	S4-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
25	A124	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-3H	S4-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
26	A106	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-1H	S3-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
27	A107	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-3H	S3-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
28	A108	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S3-5H	S3-5L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
29	A109	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-1H	S4-1L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38
30	A29	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A13	A14	S7	S5	S6	S7	S4-3H	S4-3L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A36	A37	A38

35.033 Pfaff/GSFC
PCM Format

	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
1	A41	S7	A95	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-2H	S3-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A49	S5	S6
2	A42	S7	S9-1	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-4H	S3-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-1	S5	S6
3	A41	S7	S9-2	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-6H	S3-6L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-2	S5	S6
4	A42	S7	S9-3	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-2H	S4-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A125	S5	S6
5	A41	S7	S9-4	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-4H	S4-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A126	S5	S6
6	A42	S7	S9-5	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-2H	S3-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A52	S5	S6
7	A41	S7	S9-6	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-4H	S3-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A127	S5	S6
8	A42	S7	S9-7	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-6H	S3-6L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A128	S5	S6
9	A41	S7	S9-8	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-2H	S4-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A110	S5	S6
10	A42	S7	S9-9	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-4H	S4-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A111	S5	S6
11	A41	S7	S9-10	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-2H	S3-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A53	S5	S6
12	A42	S7	S9-11	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-4H	S3-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-3	S5	S6
13	A41	S7	S9-12	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-6H	S3-6L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A112	S5	S6
14	A42	S7	S9-13	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-2H	S4-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A113	S5	S6
15	A41	S7	S9-14	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-4H	S4-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A114	S5	S6
16	A42	S7	A95	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-2H	S3-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A54	S5	S6
17	A41	S7	S9-15	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-4H	S3-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-4	S5	S6
18	A42	S7	S9-16	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-6H	S3-6L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-5	S5	S6
19	A41	S7	S9-17	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-2H	S4-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-6	S5	S6
20	A42	S7	S9-18	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-4H	S4-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-7	S5	S6
21	A41	S7	S9-19	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-2H	S3-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A55	S5	S6
22	A42	S7	S9-20	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-4H	S3-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-8	S5	S6
23	A41	S7	S9-21	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-6H	S3-6L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-9	S5	S6
24	A42	S7	S9-22	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-2H	S4-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	P2	S5	S6
25	A41	S7	K1L	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-4H	S4-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	P3	S5	S6
26	A42	S7	K1H	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-2H	S3-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	A56	S5	S6
27	A41	S7	TE1L	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-4H	S3-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	P4	S5	S6
28	A42	S7	TE1H	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S3-6H	S3-6L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-10	S5	S6
29	A41	S7	K2L	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-2H	S4-2L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-11	S5	S6
30	A42	S7	K2H	A9	S2	A1	A2	S7	A7	A8	S2	A16	A17	S7	S5	S6	S7	S4-4H	S4-4L	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	S10-12	S5	S6

	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
1	A27	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A21	A22	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
2	A28	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A23	A24	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
3	A81	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A25	A26	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
4	A82	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A30	A31	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
5	A83	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A32	A48	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
6	A27	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A21	A22	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
7	A28	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A23	A24	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
8	A84	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A25	A26	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
9	A85	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A30	A31	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
10	A86	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A32	A48	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
11	A27	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A21	A22	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
12	A28	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A23	A24	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
13	A87	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A25	A26	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
14	A88	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A30	A31	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
15	A89	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A32	A48	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
16	A27	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A21	A22	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
17	A28	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A23	A24	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
18	A90	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A25	A26	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
19	A91	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A30	A31	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
20	A92	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A32	A48	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
21	A27	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A21	A22	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
22	A28	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A23	A24	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
23	A93	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A25	A26	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
24	A94	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A30	A31	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
25	A44	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A32	A48	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
26	A27	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A21	A22	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
27	A28	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A23	A24	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
28	A45	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A25	A26	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
29	A46	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A30	A31	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3
30	A47	S7	S1	A9	S2	A1	A2	S7	A7	A8	S1	A19	A20	S7	S5	S6	A15	A32	A48	S7	S2	A3	A4	A5	A6	S7	A33	A34	A35	FS1	FS2	FS3

Calgary GSFC WFF
Aerospace Maryland French Synch and ID

PCM Code: RNRZ-L	Minor Frame Rate: 5000	FS1 = 1111101110	SFID: 00000CCCCC LSB
Bit Rate 6.4 Mbit	Parity: None	FS2 = 1001110100	SFID: Counts Up
Word Length: 10 Bits/Word	MSB First	FS3 = 1010010011	SFID: Word 1
Synch 33 bits FBA74A4C0			

Measurement List

35.033
Pfaff/GSFC

Format Label	Data Description	Organization	WD	WD INT	FM	FM INT	Sample Rate (SPS)
A1	VLF12	GSFC	6	32	1	1	20000.00
A2	VLF34	GSFC	7	32	1	1	20000.00
A3	VLF15	GSFC	22	32	1	1	20000.00
A4	VLF62	GSFC	23	32	1	1	20000.00
A5	VLF16	GSFC	24	32	1	1	20000.00
A6	VLF52	GSFC	25	32	1	1	20000.00
A7	VLF37	GSFC	9	32	1	1	20000.00
A8	VLF78	GSFC	10	32	1	1	20000.00
A9	VLF56	GSFC	4	32	1	1	20000.00
A10	VLF12LO	GSFC					0.00
A11	V12	GSFC	12	128	1	1	5000.00
A12	V34	GSFC	13	128	1	1	5000.00
A13	V15	GSFC	44	128	1	1	5000.00
A14	V62	GSFC	45	128	1	1	5000.00
A15	V78	GSFC	113	128	1	1	5000.00
A16	V37	GSFC	76	128	1	1	5000.00
A17	V48	GSFC	77	128	1	1	5000.00
A18	V56	GSFC	19	128	1	1	5000.00
A19	V16	GSFC	108	128	1	1	5000.00
A20	V52	GSFC	109	128	1	1	5000.00
A21	V1S	GSFC	114	128	1	5	1000.00
A22	V2S	GSFC	115	128	1	5	1000.00
A23	V3S	GSFC	114	128	2	5	1000.00
A24	V4S	GSFC	115	128	2	5	1000.00
A25	V7S	GSFC	114	128	3	5	1000.00
A26	V8S	GSFC	115	128	3	5	1000.00
A27	NI_LOW	GSFC	97	128	1	5	1000.00
A28	NI_HIGH	GSFC	97	128	2	5	1000.00
A29	HK Bias	GSFC	33	128	30	30	166.67
A30	V12L	GSFC	114	128	4	5	1000.00
A31	V34L	GSFC	115	128	4	5	1000.00
A32	V78L	GSFC	114	128	5	5	1000.00

Format Label	**Data Description**	**Organization**	**WD**	**WD INT**	**FM**	**FM INT**	**Sample Rate (SPS)**
A33	Coil X	France	27	32	1	1	20000.00
A34	Coil Y	France	28	32	1	1	20000.00
A35	Coil Z	France	29	32	1	1	20000.00
A36	Loop X	France	62	128	1	1	5000.00
A37	Loop Y	France	63	128	1	1	5000.00
A38	Loop Z	France	64	128	1	1	5000.00
A39	CA1	Calgary	31	128	1	2	2500.00
A40	CA2	Calgary	31	128	2	2	2500.00
A41	CA3	Calgary	65	128	1	2	2500.00
A42	CA4	Calgary	65	128	2	2	2500.00
A43	CA5	Calgary	32	128	9	30	166.67
A44	UMA1	UM	97	128	25	30	166.67
A45	UMA2	UM	97	128	28	30	166.67
A46	UMA3	UM	97	128	29	30	166.67
A47	UMA4	UM	97	128	30	30	166.67
A48	V37L	GSFC	115	128	5	5	1000.00
A49	V48L	GSFC	94	128	1	30	166.67
A50	French Boom #1 Pot	TM	3	128	2	30	166.67
A51	French Boom #2 Pot	TM	3	128	4	30	166.67
A52	Aft Can Temp	TM	94	128	6	30	166.67
A53	Shpere 3 Temp	GSFC	94	128	11	30	166.67
A54	Shpere 4 Temp	GSFC	94	128	16	30	166.67
A55	Shpere 7 Temp	GSFC	94	128	21	30	166.67
A56	Shpere 8 Temp	GSFC	94	128	26	30	166.67
A57	Not Programmed	Not Sampled					0.00
A58	Not Programmed	Not Sampled					0.00
A59	TM Gyro Yaw	TM	33	128	2	15	333.33
A60	TM Gyro Pitch	TM	33	128	3	15	333.33
A61	TM Gyro Roll	TM	32	128	5	5	1000.00
A62	TM Gyro Yaw Ref	TM	33	128	4	30	166.67
A63	TM Gyro Pitch Ref	TM	33	128	10	30	166.67
A64	TM Gyro Roll Ref	TM	33	128	11	30	166.67

Format Label	Data Description	Organization	WD	WD INT	FM	FM INT	Sample Rate (SPS)
A65	Thrust Accel	TM	32	128	1	5	1000.00
A66	X Accel	TM	32	128	2	10	500.00
A67	Y Accel	TM	32	128	7	10	500.00
A68	Z Mag	TM	32	128	3	10	500.00
A69	X Mag	TM	32	128	8	10	500.00
A70	Y Mag	TM	32	128	4	10	500.00
A71	GPS SV	GPS	3	128	6	30	166.67
A72	GPS RV	GPS	3	128	8	30	166.67
A73	Transmitter Temp	TM	3	128	10	30	166.67
A74	PCM Stack Temp	TM	3	128	12	30	166.67
A75	Skin Temp	TM	3	128	14	30	166.67
A76	TM 5V Mon	TM	3	128	16	30	166.67
A77	TM 28V Bus Mon	TM	3	128	18	30	166.67
A78	TM 28V Current	TM	3	128	24	30	166.67
A79	Exp + 18V Mon	TM	3	128	26	30	166.67
A80	Exp - 18V Mon	TM	3	128	28	30	166.67
A81	Exp +/-18V Current	TM	97	128	3	30	166.67
A82	Exp +9V Current	TM	97	128	4	30	166.67
A83	Exp +9V Bus Mon	TM	97	128	5	30	166.67
A84	Pryo Bus Mon	TM	97	128	8	30	166.67
A85	Nose Cone SCM	TM	97	128	9	30	166.67
A86	6 Meter Booms SCM	TM	97	128	10	30	166.67
A87	8 Meter Fold Down SCM	TM	97	128	13	30	166.67
A88	8 Meter Deploy SCM	TM	97	128	14	30	166.67
A89	Search Coil Boom SCM	TM	97	128	15	30	166.67
A90	EED/EID Deploy SCM	TM	97	128	18	30	166.67
A91	EED/EID Door SCM	TM	97	128	19	30	166.67
A92	Calgary Boom SCM	TM	97	128	20	30	166.67
A93	Tail Can Booms SCM	TM	97	128	23	30	166.67
A94	Tail Can Doors SCM	TM	97	128	24	30	166.67
A95	MFT Serial Data (110baud)	TM	67	128	1	15	333.33
A96	Pyro Batt Mon	TM	33	128	12	30	166.67

Format Label	Data Description	Organization	WD	WD INT	FM	FM INT	Sample Rate (SPS)
A97	Transposed Mag "X"	GNC	33	128	5	15	333.33
A98	Transposed Mag "Y"	GNC	33	128	6	15	333.33
A99	Transposed Mag "Z"	GNC	32	128	19	30	166.67
A100	Theta (Mag Field Error)	GNC	32	128	29	30	166.67
A101	Sinresl	GNC	33	128	14	30	166.67
A102	Cosresl	GNC	33	128	15	30	166.67
A103	Z Rate	GNC	33	128	16	30	166.67
A104	X Rate	GNC	33	128	22	30	166.67
A105	Adv Resolver	GNC	33	128	24	30	166.67
A106	Y Mag Hi_Res	GNC	33	128	26	30	166.67
A107	Z Mag Hi_Res	GNC	33	128	27	30	166.67
A108	X Mag Hi_Res -- R/MBIAS	GNC	33	128	28	30	166.67
A109	Impulse	GNC	33	128	29	30	166.67
A110	Discretes	GNC	94	128	9	30	166.67
A111	Nozzle Monitor	GNC	94	128	10	30	166.67
A112	BCD Time	GNC	94	128	13	30	166.67
A113	Tank Pressure	GNC	94	128	14	30	166.67
A114	ACS Battery Monitor	GNC	94	128	15	30	166.67
A115	Gyro +28V Bus Mon	TM	3	128	20	30	166.67
A116	Gyro +28V Current	TM	3	128	22	30	166.67
A117	Not Programmed	Not Sampled					0.00
A118	Not Programmed	Not Sampled					0.00
A119	Not Programmed	Not Sampled					0.00
A120	Not Programmed	Not Sampled					0.00
A121	Not Programmed	Not Sampled					0.00
A122	Not Programmed	Not Sampled					0.00
A123	Brant Motor Pressure	Vehicle Systems	33	128	8	15	333.33
A124	Nihka Motor Pressure	Vehicle Systems	33	128	1	6	833.33
A125	BBIDS 1	Vehicle Systems	94	128	4	30	166.67
A126	BBIDS 2	Vehicle Systems	94	128	5	30	166.67
A127	NIDS 1	Vehicle Systems	94	128	7	30	166.67
A128	NIDS 2	Vehicle Systems	94	128	8	30	166.67

Format Label	Data Description	Organization	WD	WD INT	FM	FM INT	Sample Rate (SPS)
S1	DSP	GSFC	18	n	1	1	25000.00
S2	HSBM	GSFC	5	n	1	1	50000.00
S3	LFAD	GSFC					
S3-1H			50	128	1	5	1000.00
S3-1L			51	128	1	5	1000.00
S3-2H			82	128	1	5	1000.00
S3-2L			83	128	1	5	1000.00
S3-3H			50	128	2	5	1000.00
S3-3L			51	128	2	5	1000.00
S3-4H			82	128	2	5	1000.00
S3-4L			83	128	2	5	1000.00
S3-5H			50	128	3	5	1000.00
S3-5L			51	128	3	5	1000.00
S3-6H			82	128	3	5	1000.00
S3-6L			83	128	3	5	1000.00
S4	Lang Probe	GSFC					
S4-1H			50	128	4	5	1000.00
S4-1L			51	128	4	5	1000.00
S4-2H			82	128	4	5	1000.00
S4-2L			83	128	4	5	1000.00
S4-3H			50	128	5	5	1000.00
S4-3L			51	128	5	5	1000.00
S4-4H			82	128	5	5	1000.00
S4-4L			83	128	5	5	1000.00
S5	EED	Aerospace	15	n	1	1	25000.00
S6	EID	Aerospace	16	n	1	1	25000.00
S7	SEI/SII	Calgary	2	n	1	1	120000.00
S8	HF Electronics	Notsampled					0.00

Format Label	Data Description	Organization	WD	WD INT	FM	FM INT	Sample Rate (SPS)
S9	Low Energy 22words	UMCP					
S9-1			67	128	2	30	166.67
S9-2			67	128	3	30	166.67
S9-3			67	128	4	30	166.67
S9-4			67	128	5	30	166.67
S9-5			67	128	6	30	166.67
S9-6			67	128	7	30	166.67
S9-7			67	128	8	30	166.67
S9-8			67	128	9	30	166.67
S9-9			67	128	10	30	166.67
S9-10			67	128	11	30	166.67
S9-11			67	128	12	30	166.67
S9-12			67	128	13	30	166.67
S9-13			67	128	14	30	166.67
S9-14			67	128	15	30	166.67
S9-15			67	128	17	30	166.67
S9-16			67	128	18	30	166.67
S9-17			67	128	19	30	166.67
S9-18			67	128	20	30	166.67
S9-19			67	128	21	30	166.67
S9-20			67	128	22	30	166.67
S9-21			67	128	23	30	166.67
S9-22			67	128	24	30	166.67
S10	High Energy 12words	UMCP					
S10-1			94	128	2	30	166.67
S10-2			94	128	3	30	166.67
S10-3			94	128	12	30	166.67
S10-4			94	128	17	30	166.67
S10-5			94	128	18	30	166.67
S10-6			94	128	19	30	166.67
S10-7			94	128	20	30	166.67
S10-8			94	128	22	30	166.67
S10-9			94	128	23	30	166.67
S10-10			94	128	28	30	166.67
S10-11			94	128	29	30	166.67
S10-12			94	128	30	30	166.67

Format Label	Data Description	Organization	WD	WD INT	FM	FM INT	Sample Rate (SPS)
R1	GPS SD	GPS	3	128	1	2	2500.00
TE1L	1 PPS	GPS	67	128	27	30	166.67
TE1H	1 PPS	GPS	67	128	28	30	166.67
K1L	Out1	Aerospace	67	128	25	30	166.67
K1H		Aerospace	67	128	26	30	166.67
K2L	Out2	Aerospace	67	128	29	30	166.67
K2H		Aerospace	67	128	30	30	166.67
P1	Science Digital monitor	Calgary/Aerospace	33	128	9	30	166.67
P2	NSROC Digital Mon 1	TM	94	128	24	30	166.67
P3	NSROC Digital Mon 2	TM	94	128	25	30	166.67
P4	NSROC Digital Mon 3	TM	94	128	27	30	166.67
FS1	1111101110	TM	126	128	1	1	5000.00
FS2	1001110100	TM	127	128	1	1	5000.00
FS3	1010010011	TM	128	128	1	1	5000.00
SFID	00000CCCCC	TM	1	128	1	1	5000.00
M	Frame Counter	TM	3	128	30	30	166.67
							6.40000
							6.400 Mbps

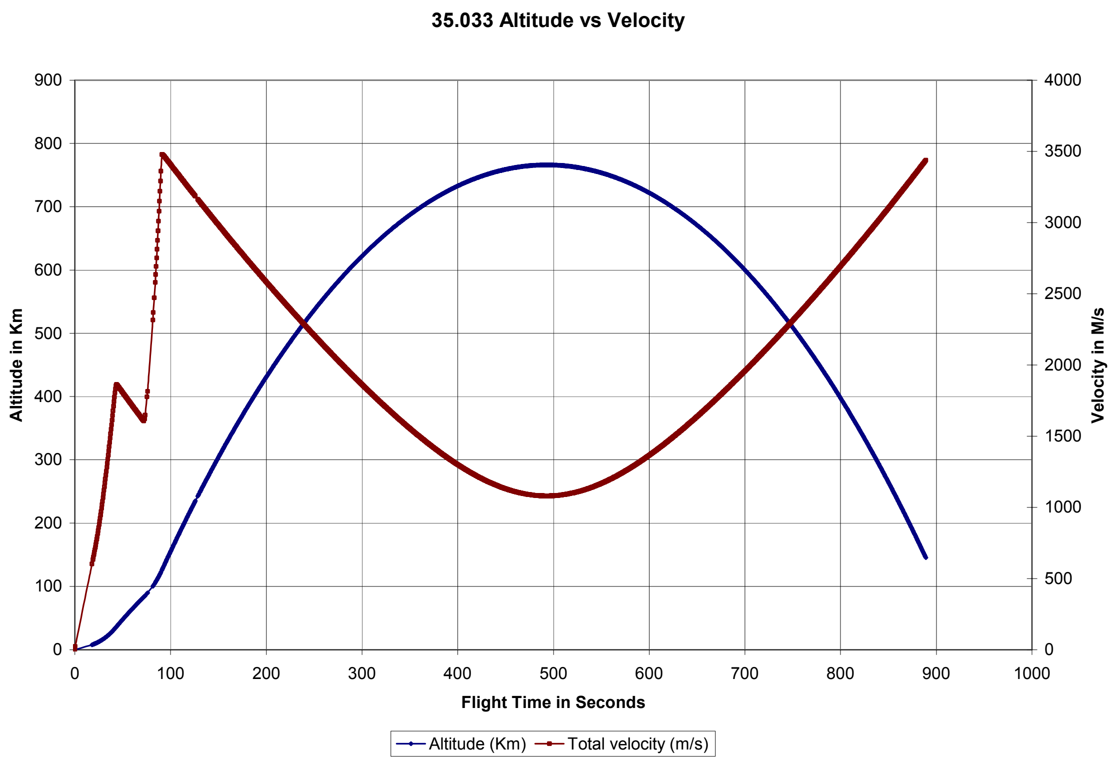
Format Label	Data Description	Organization	Words
Nonsymetrical channels			
S1		GSFC	18,35,43,99,107
S2		GSFC	5,11,21,37,53,69,75,85,101,117
S5		Aerospace	15,47,79,95,111
S6		Aerospace	16,48,80,96,112
S7		Calgary	2,8,14,17,20,26,30,34,40,46,49,52,58 66,72,78,81,84,90,98,104,110,116,122

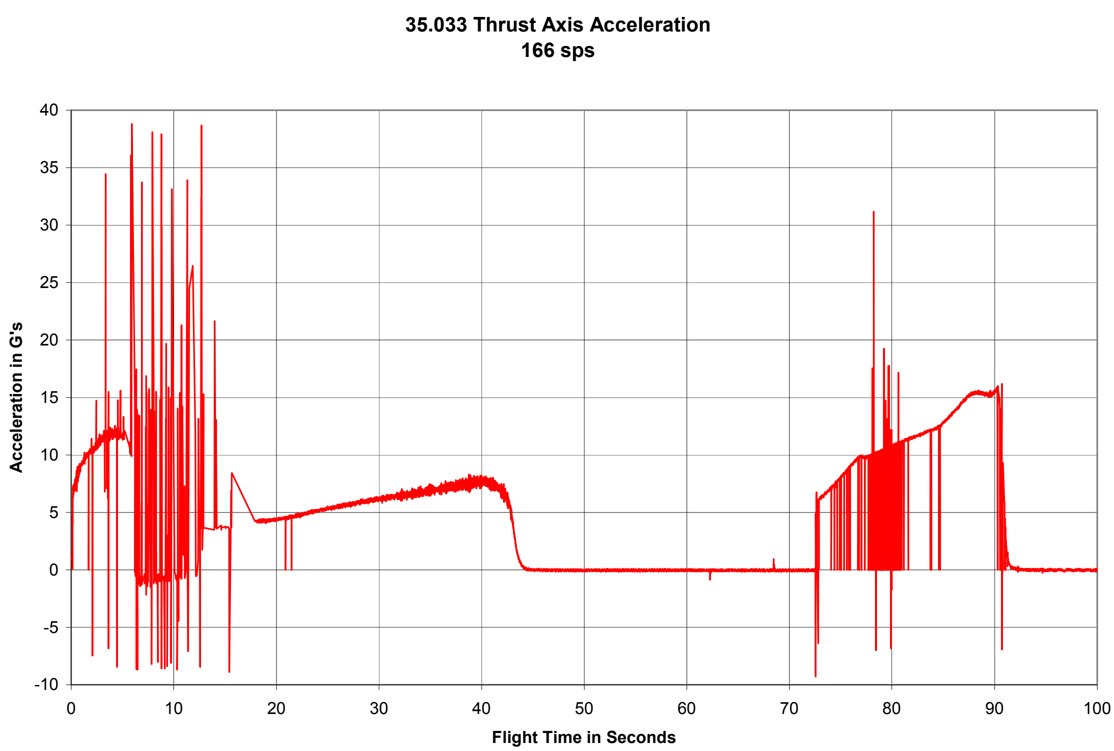
Format Label	Data Description	Organization
P1-1	LA0	Calgary
P1-2	LA1	Calgary
P1-3	LA2	Calgary
P1-4	LA3	Calgary
P1-5	EED Retracted	Aerospace
P1-6	EED Deployed	Aerospace
P1-7	Aft Boom 1	TM
P1-8	Aft Boom 2	TM
P1-9	Not Used	
P1-10	Not Used	
P2-1	Lanyard #1	TM
P2-2	Seperation	TM
P2-3	Nose Cone Deploy	TM
P2-4	EED/EID On/Off	TM
P2-5	GSFC Dual Sphere Boom #1	TM
P2-6	GSFC Dual Sphere Boom #2	TM
P2-7	EED/EID Door #1 Mon	TM
P2-8	EED/EID Door #2 Mon	TM
P2-9	GPS Int/Ext	TM
P2-10	IMS On/Off	TM
P3-1	Lanyard #2	TM
P3-2	EED/EID HV	TM
P3-3	IMS HV	TM
P3-4	GSFC 6m Boom #1	TM
P3-5	GSFC 6m Boom #2	TM
P3-6	GSFC/NOR On/Off	TM
P3-7	SEI/SII On/Off	TM
P3-8	+/-18V INT/EXT	TM
P3-9	+9V INT/EXT	TM
P3-10	CIT On/off	TM
P4-1	Lift Off Relay	TM
P4-2	SEI/SII HV	TM
P4-3	Aft Door #1 Mon	TM
P4-4	Aft Door #2 Mon	TM
P4-5	SEI Deployed Mon	TM
P4-6	SII Deployed Mon	TM
P4-7	SII Retracted Mon	TM
P4-8	SEI Retracted Mon	TM
P4-9	Gyro INT/EXT	TM
P4-10	Not Used	

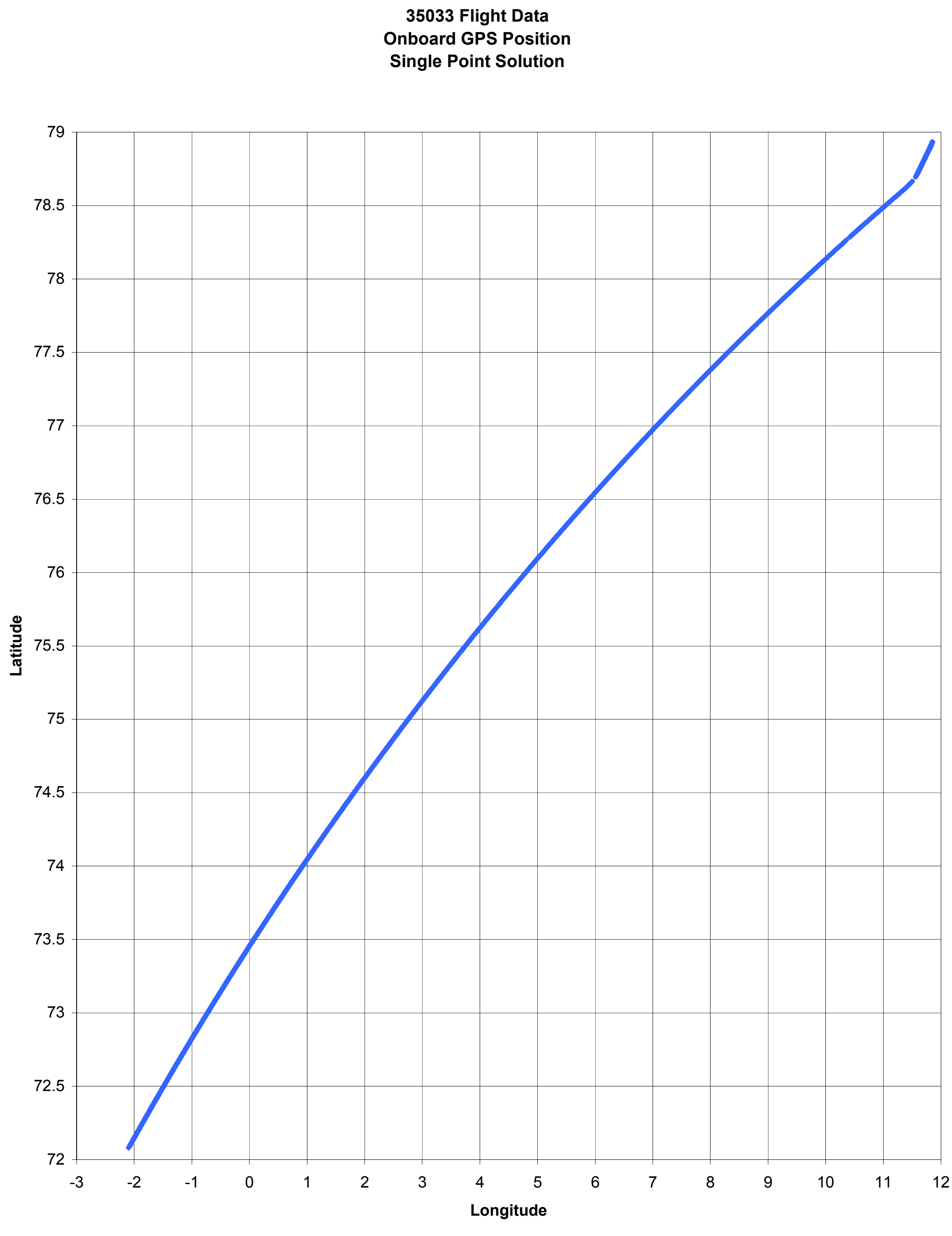
LIST OF DATA PLOTS

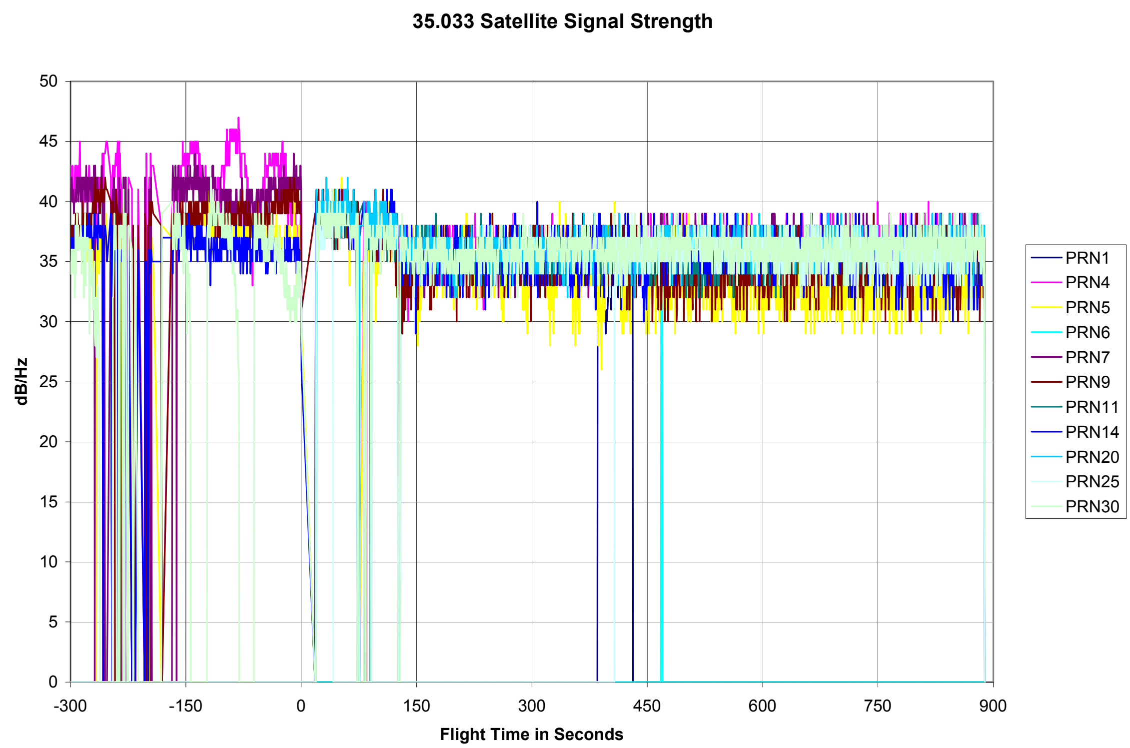
35.033

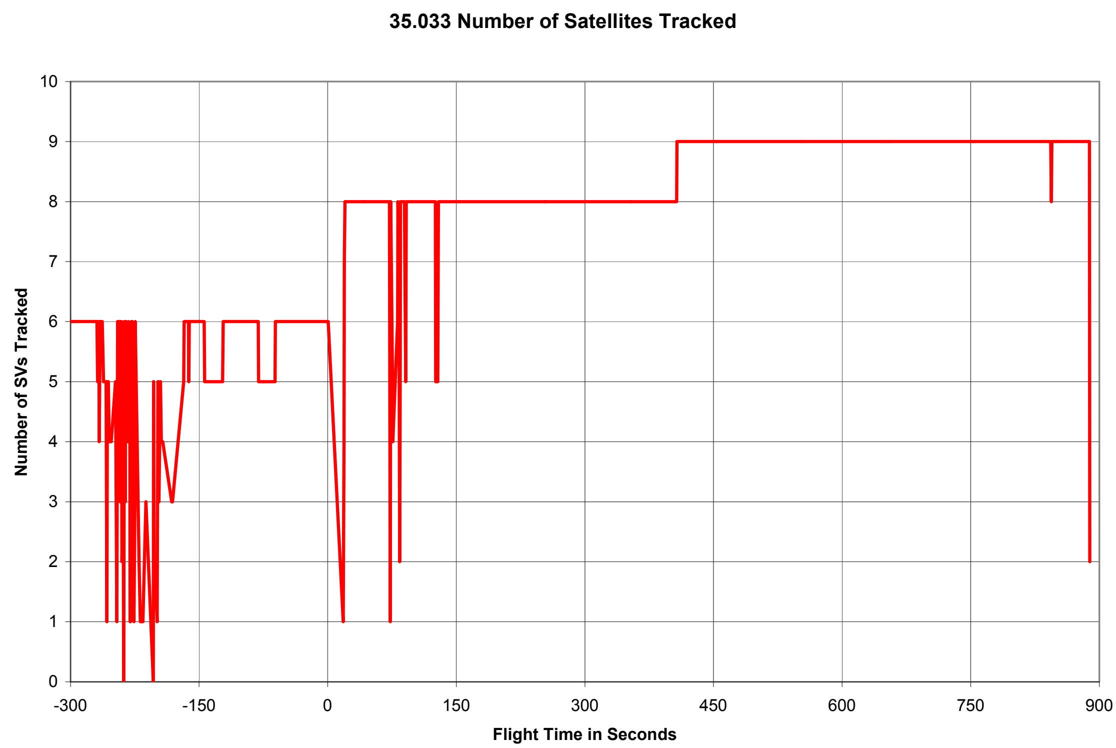
Pfaff/GSFC

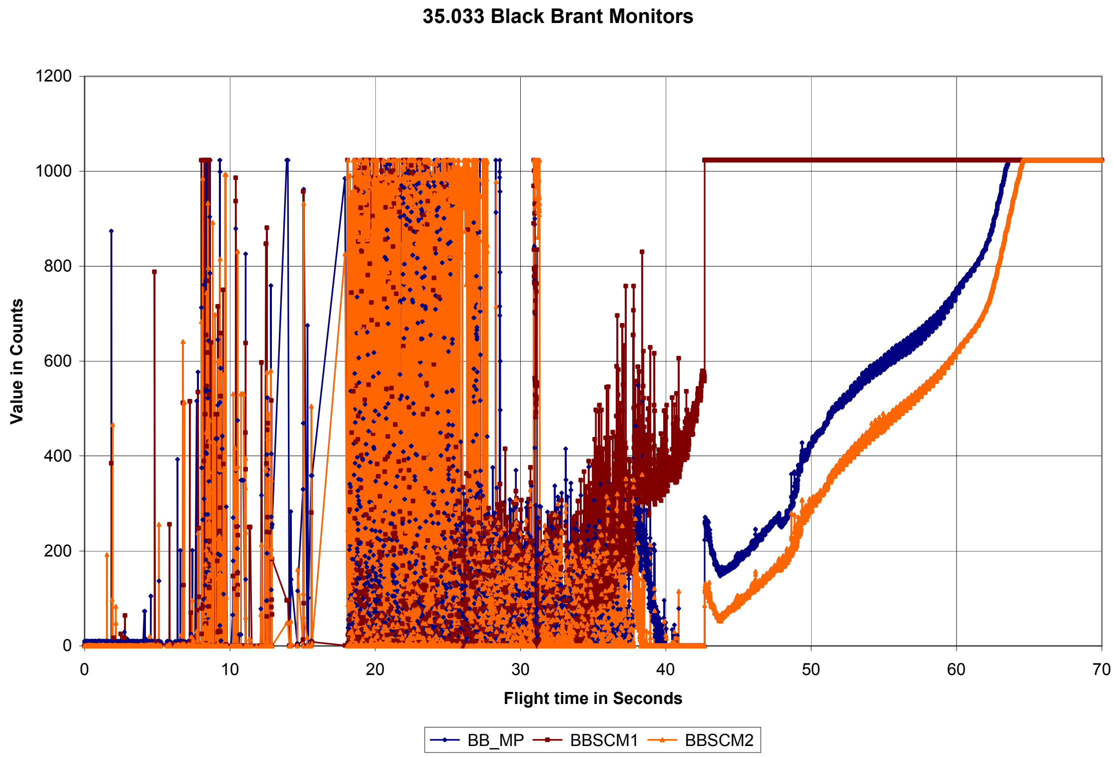

35.033 Altitude vs Velocity
Altitude in Km
Velocity in M/s
Flight Time in Seconds
Altitude (Km)
Total velocity (m/s)


35.033 Thrust Axis Acceleration
166 sps
Acceleration in G's
Flight Time in Seconds

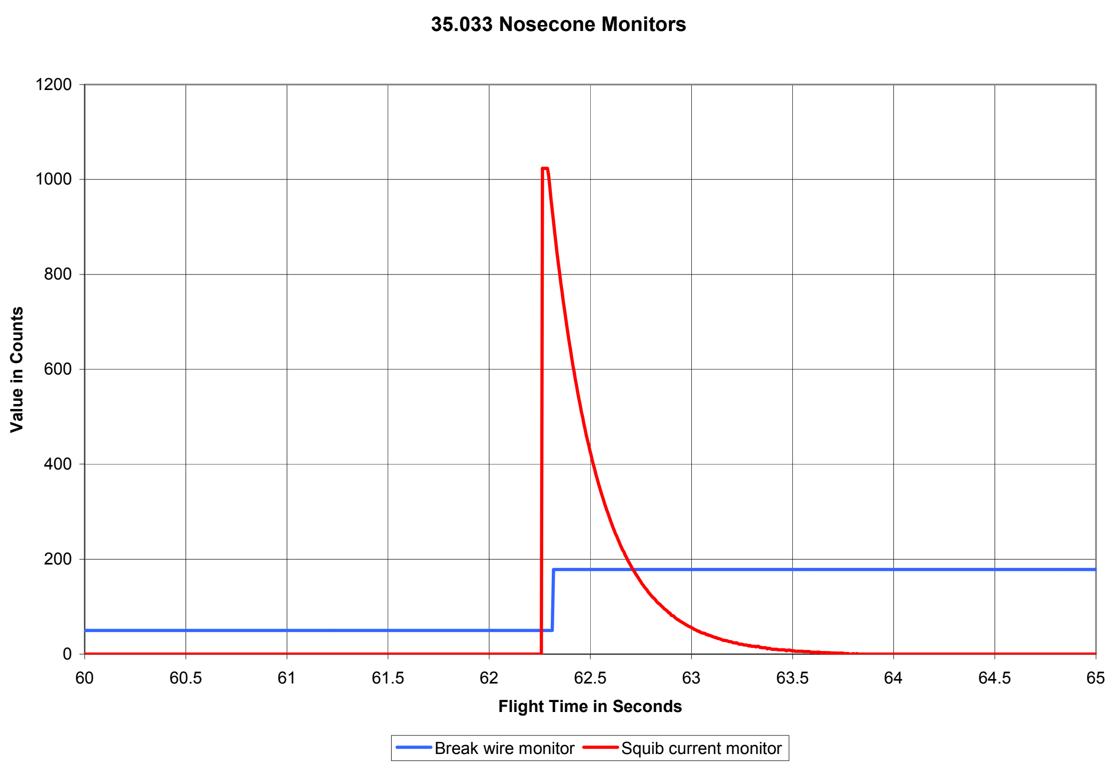

35033 Flight Data
Onboard GPS Position
Single Point Solution
Latitude
79
78.5
78
77.5
77
76.5
76
75.5
75
74.5
74
73.5
73
72.5
72
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
Longitude


35.033 Satellite Signal Strength
dB/Hz
0
5
10
15
20
25
30
35
40
45
50
-300
-150
0
150
300
450
600
750
900
Flight Time in Seconds
PRN1
PRN4
PRN5
PRN6
PRN7
PRN9
PRN11
PRN14
PRN20
PRN25
PRN30


35.033 Number of Satellites Tracked
Number of SVs Tracked
0
1
2
3
4
5
6
7
8
9
10
-300
-150
0
150
300
450
600
750
900
Flight Time in Seconds

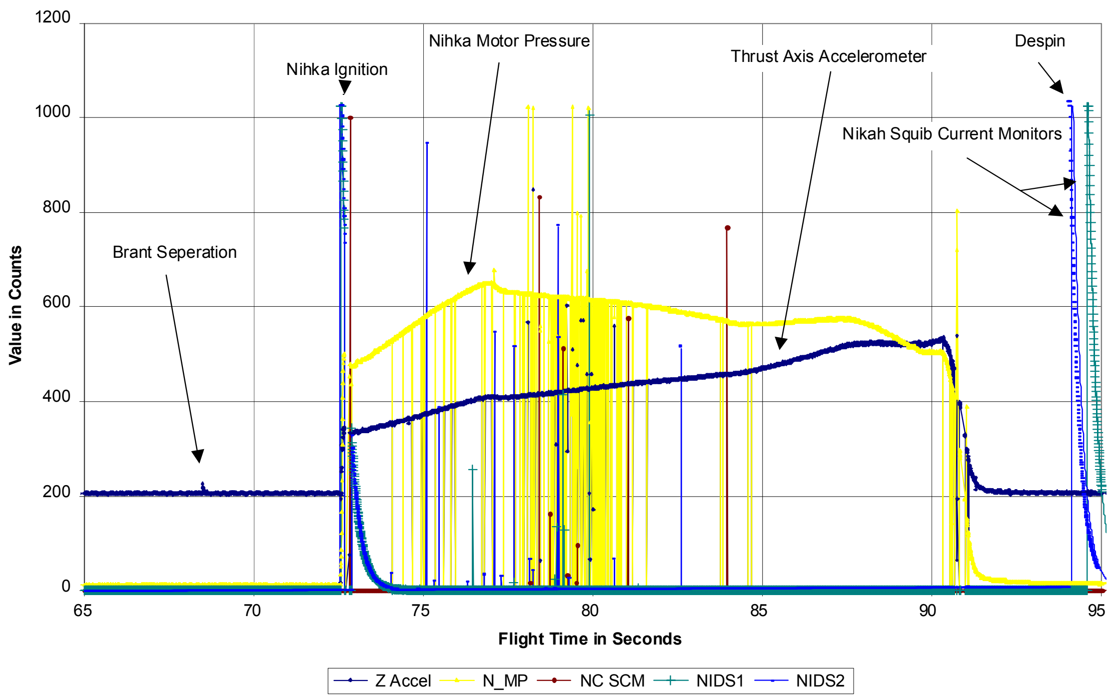


35.033 Black Brant Monitors
Value in Counts
0
200
400
600
800
1000
1200
0
10
20
30
40
50
60
70
Flight time in Seconds
BB_MP
BBSCM1
BBSCM2

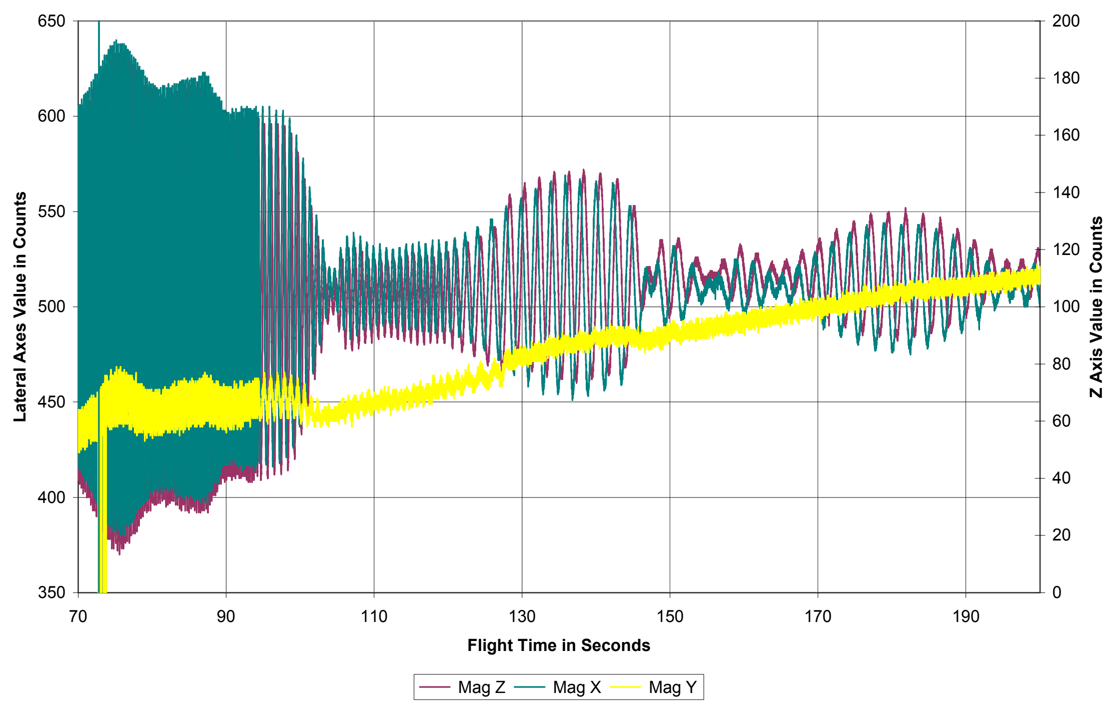


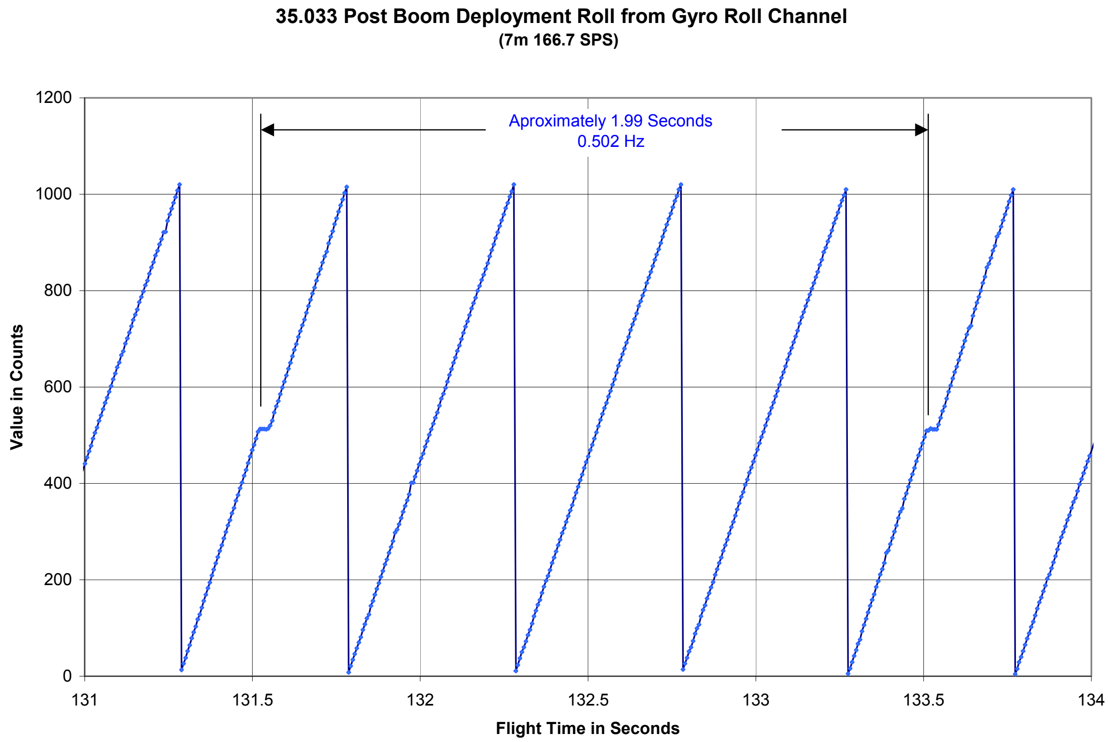
35.033 Nosecone Monitors
Value in Counts
0
200
400
600
800
1000
1200
60
60.5
61
61.5
62
62.5
63
63.5
64
64.5
65
Flight Time in Seconds
Break wire monitor
Squib current monitor

35.033 Nikah Ignition through Despin (A9)

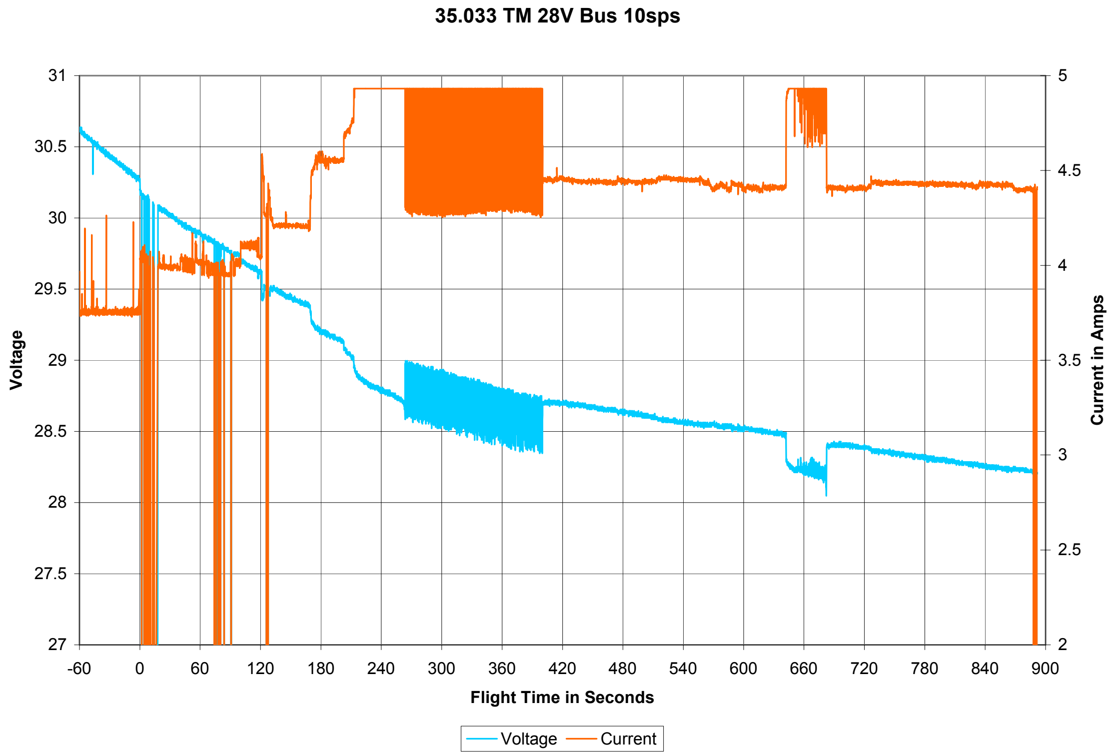


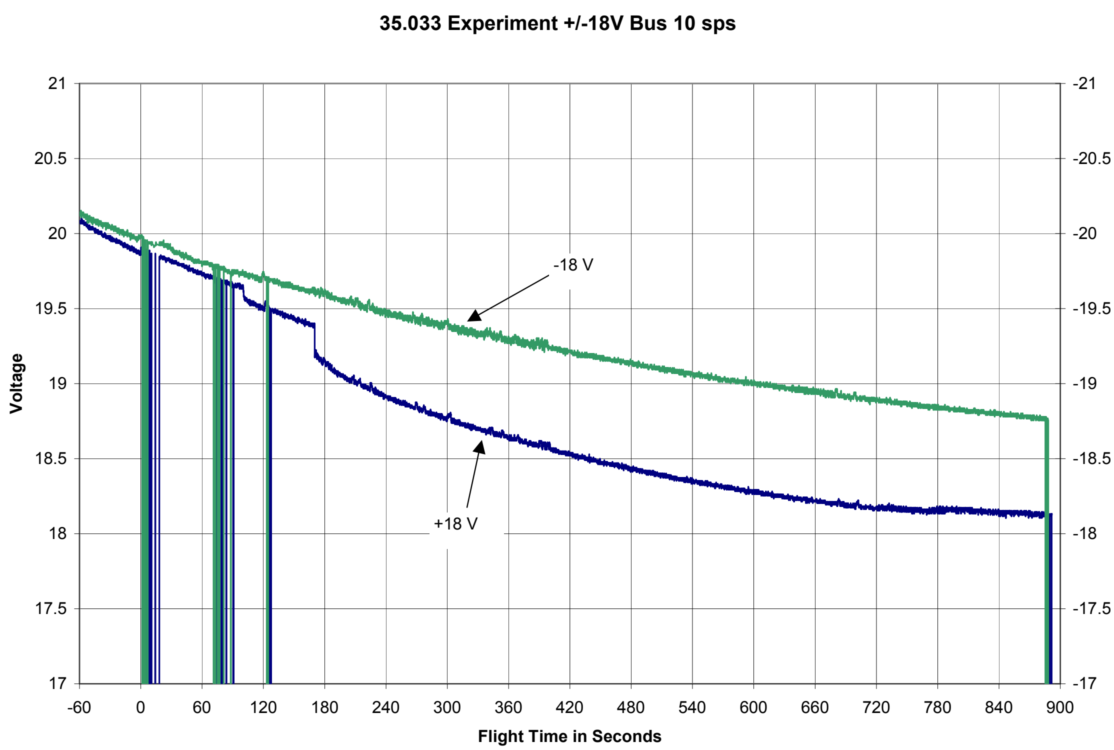
35.033 Magnetometer Channels (7m 166.7 sps)

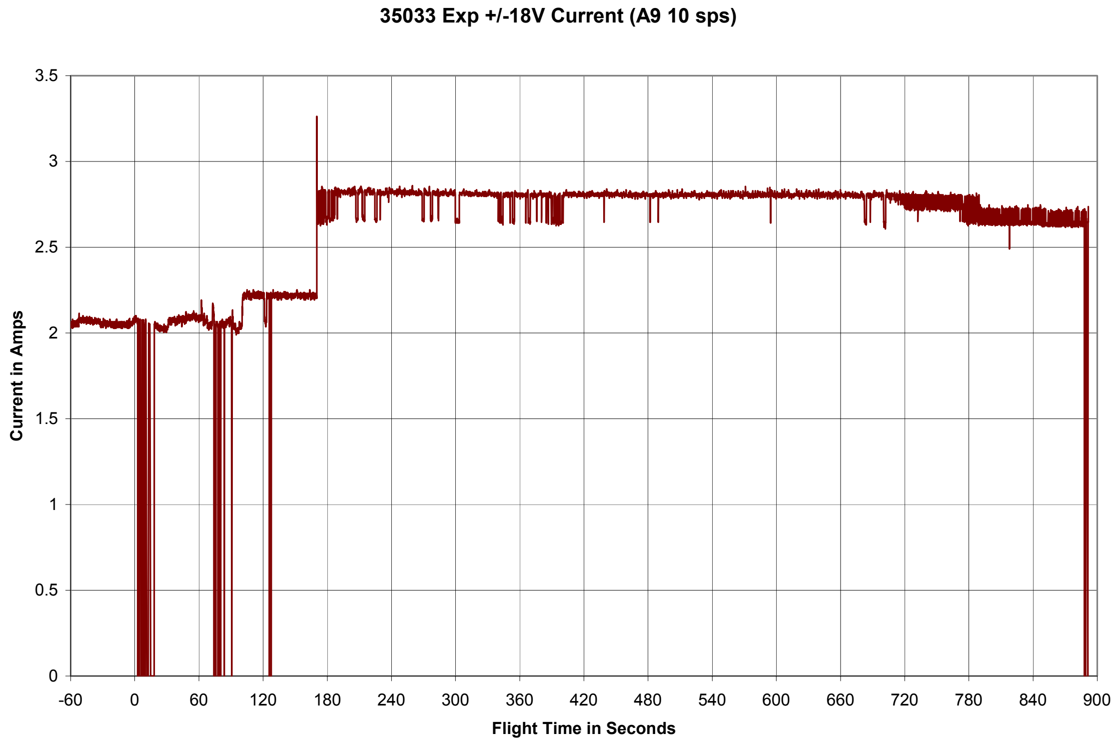


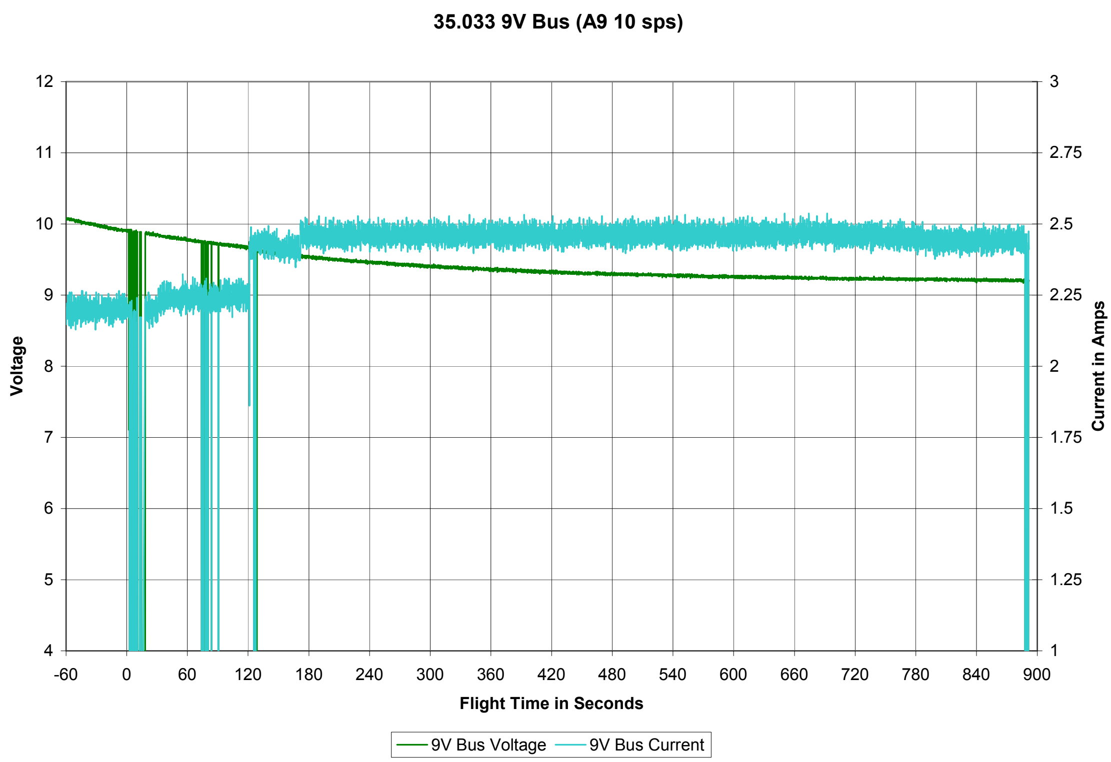


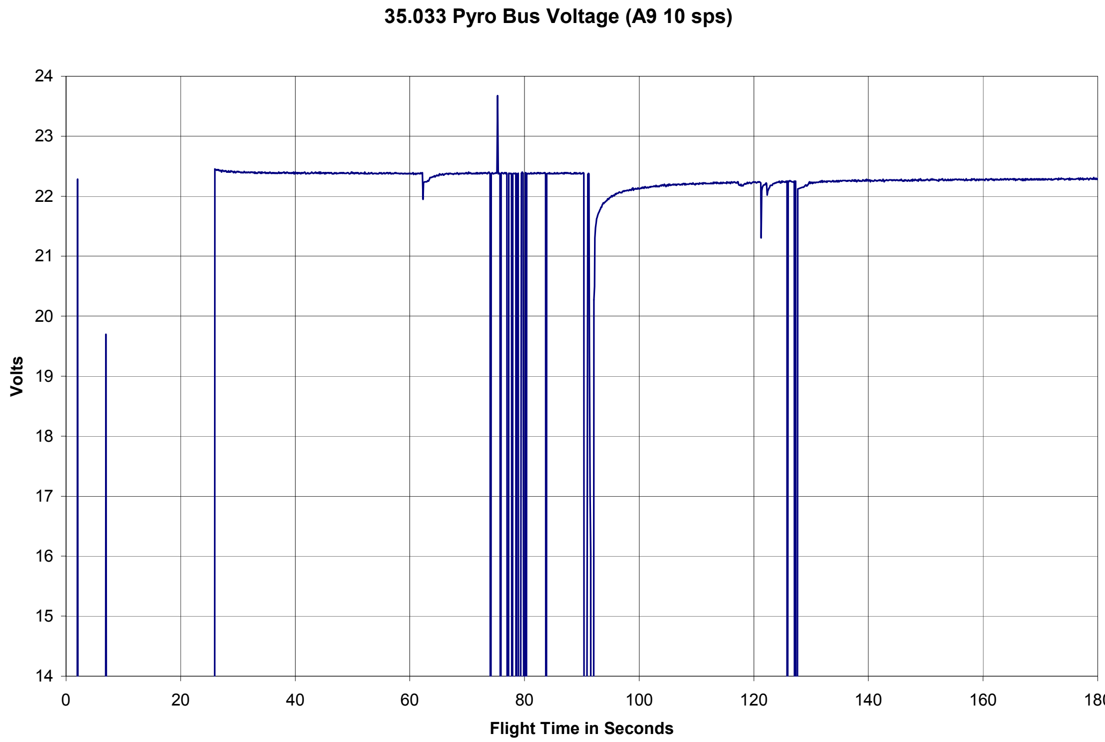
35.033 Post Boom Deployment Roll from Gyro Roll Channel
(7m 166.7 SPS)
Aproximately 1.99 Seconds
0.502 Hz
Value in Counts
Flight Time in Seconds
1200
1000
800
600
400
200
0
131
131.5
132
132.5
133
133.5
134

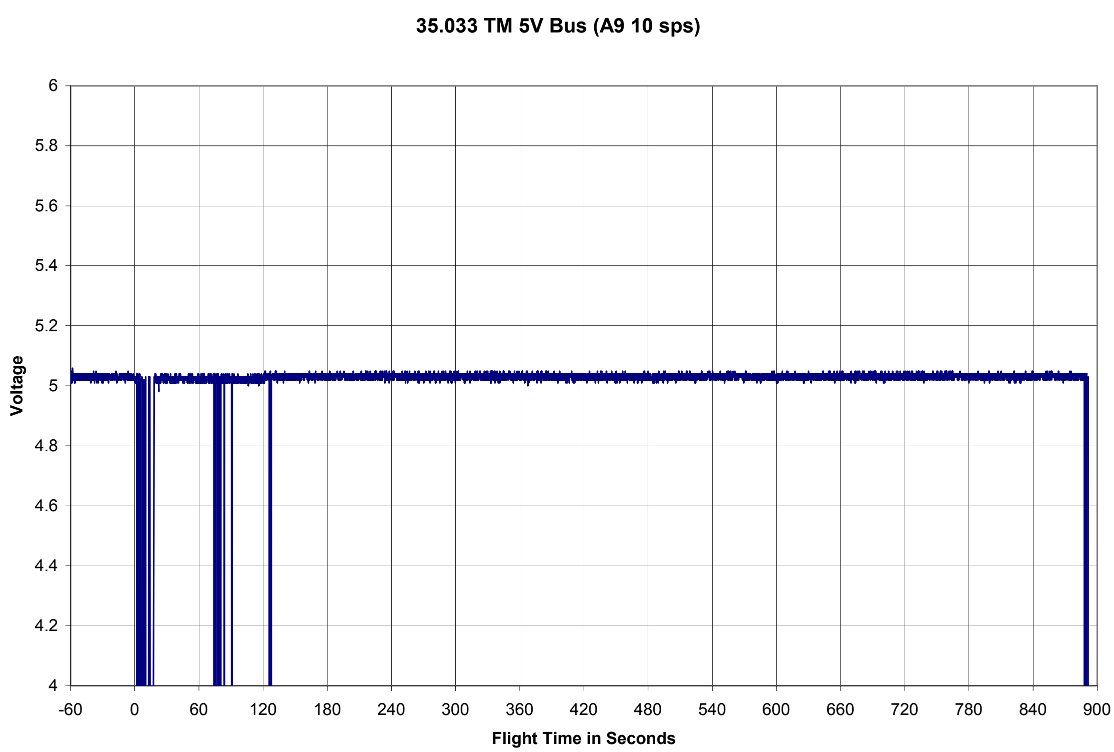

35.033 TM 28V Bus 10sps
Voltage
Current in Amps
Flight Time in Seconds
Voltage
Current
31
30.5
30
29.5
29
28.5
28
27.5
27
5
4.5
4
3.5
3
2.5
2
-60
0
60
120
180
240
300
360
420
480
540
600
660
720
780
840
900

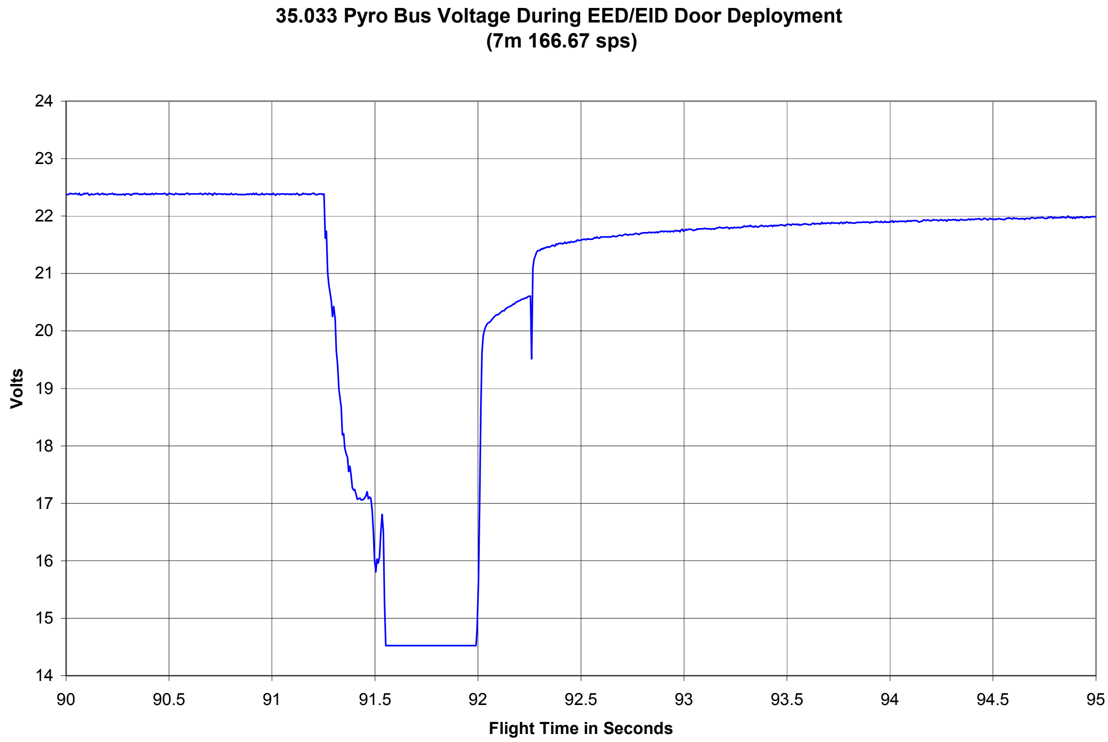

35.033 Experiment +/-18V Bus 10 sps
Voltage
Flight Time in Seconds
-18 V
+18 V
21
20.5
20
19.5
19
18.5
18
17.5
17
-21
-20.5
-20
-19.5
-19
-18.5
-18
-17.5
-17
-60
0
60
120
180
240
300
360
420
480
540
600
660
720
780
840
900

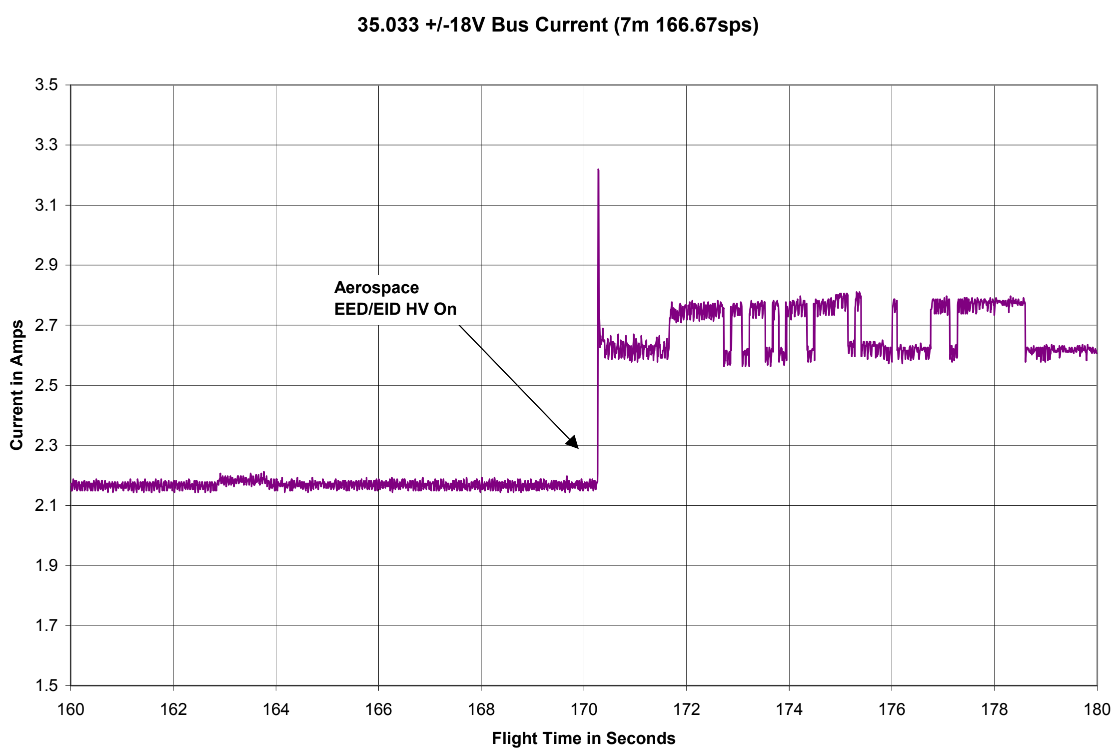

35033 Exp +/-18V Current (A9 10 sps)
Current in Amps
Flight Time in Seconds
3.5
3
2.5
2
1.5
1
0.5
0
-60
0
60
120
180
240
300
360
420
480
540
600
660
720
780
840
900

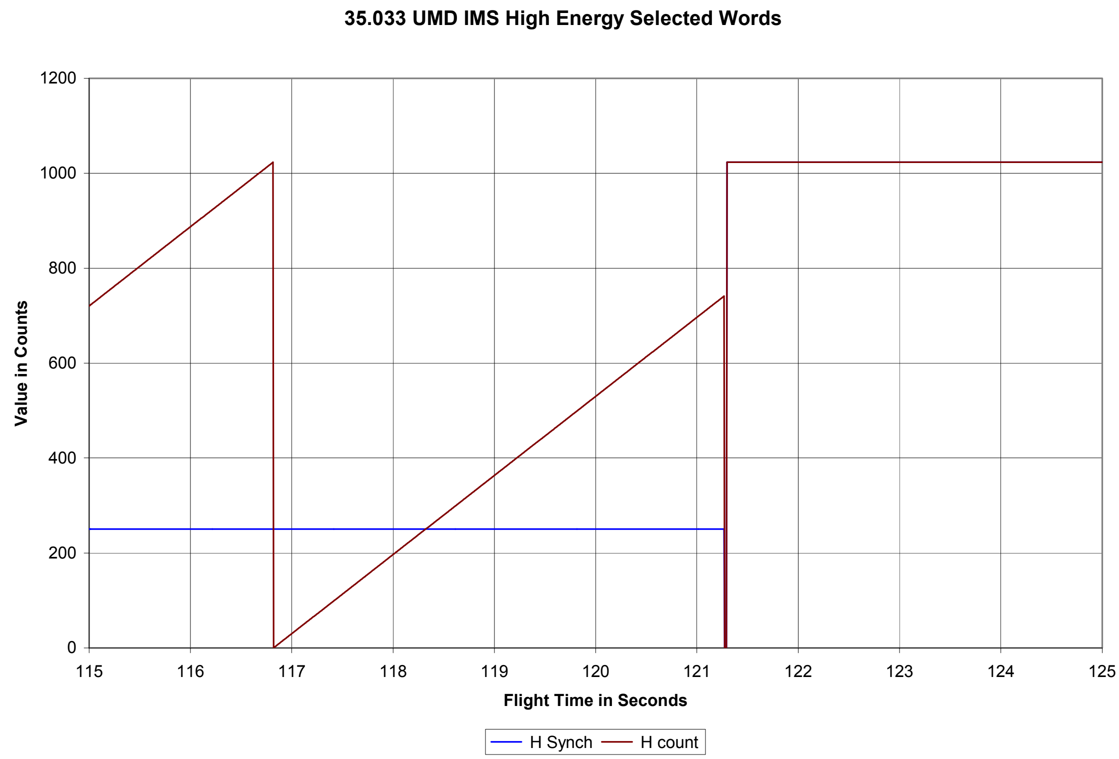

35.033 9V Bus (A9 10 sps)
Voltage
Current in Amps
Flight Time in Seconds
12
11
10
9
8
7
6
5
4
3
2.75
2.5
2.25
2
1.75
1.5
1.25
1
-60
0
60
120
180
240
300
360
420
480
540
600
660
720
780
840
900
9V Bus Voltage
9V Bus Current


35.033 Pyro Bus Voltage (A9 10 sps)
Volts
24
23
22
21
20
19
18
17
16
15
14
0
20
40
60
80
100
120
140
160
180
Flight Time in Seconds

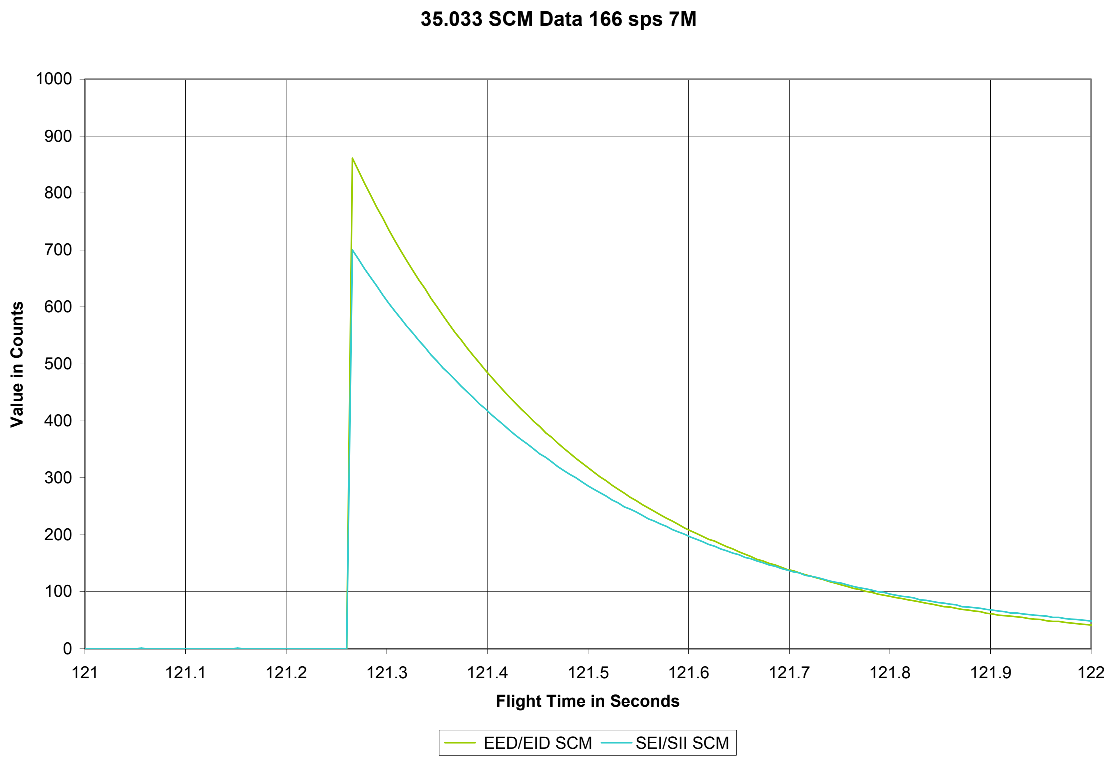

35.033 TM 5V Bus (A9 10 sps)
Voltage
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
-60
0
60
120
180
240
300
360
420
480
540
600
660
720
780
840
900
Flight Time in Seconds


35.033 Pyro Bus Voltage During EED/EID Door Deployment
(7m 166.67 sps)
Volts
24
23
22
21
20
19
18
17
16
15
14
90
90.5
91
91.5
92
92.5
93
93.5
94
94.5
95
Flight Time in Seconds

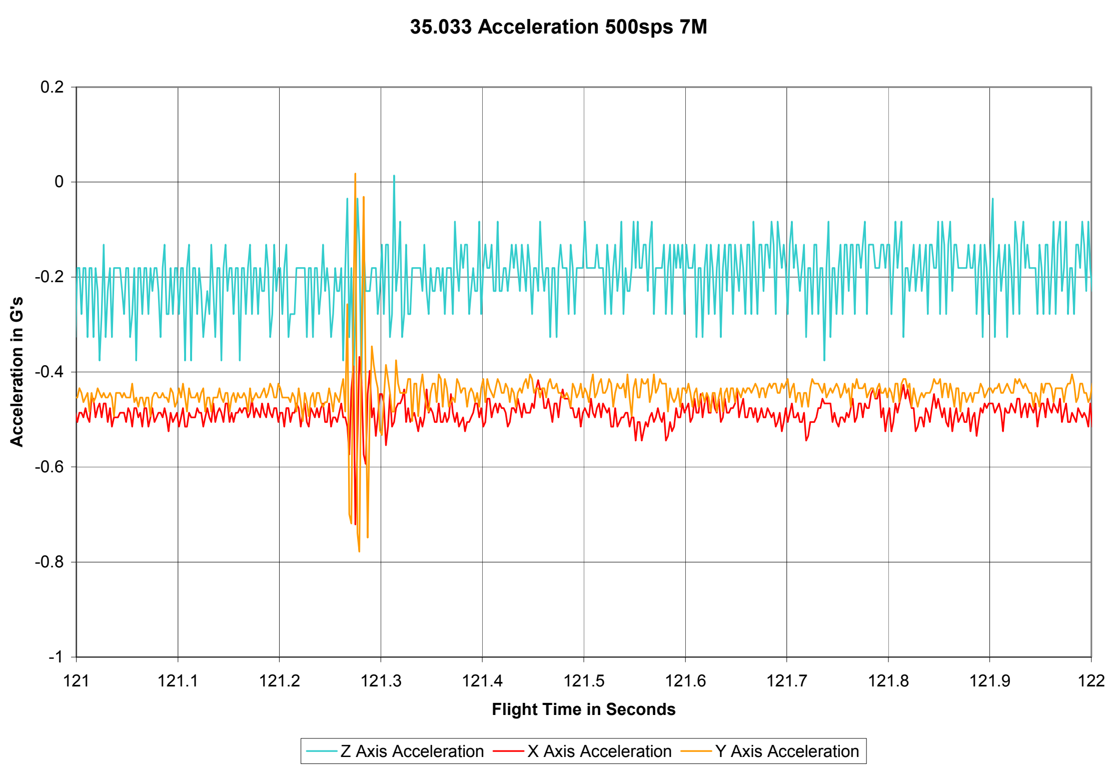

35.033 +/-18V Bus Current (7m 166.67sps)
Current in Amps
3.5
3.3
3.1
2.9
2.7
2.5
2.3
2.1
1.9
1.7
1.5
Aerospace
EED/EID HV On
160
162
164
166
168
170
172
174
176
178
180
Flight Time in Seconds


35.033 UMD IMS High Energy Selected Words
Value in Counts
1200
1000
800
600
400
200
0
115
116
117
118
119
120
121
122
123
124
125
Flight Time in Seconds
H Synch
H count

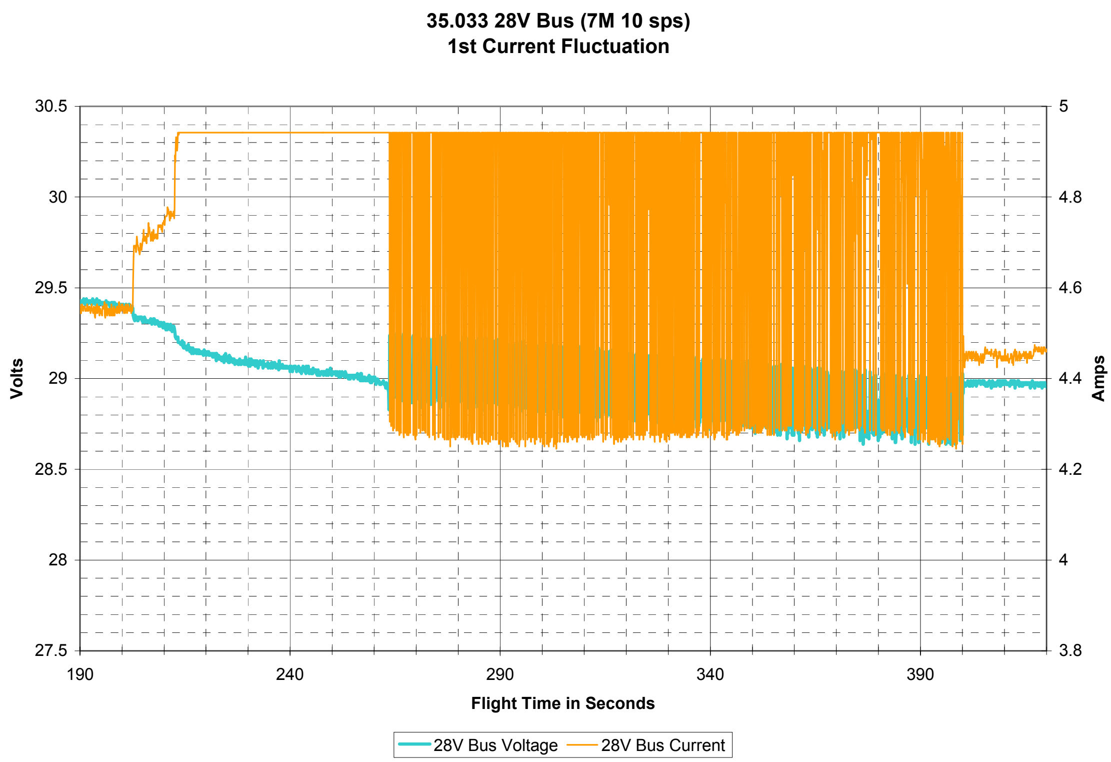

35.033 UMD Analog Channels 166.67 sps 7m
Value in Counts
600
500
400
300
200
100
0
121
121.1
121.2
121.3
121.4
121.5
121.6
121.7
121.8
121.9
122
Flight Time in Seconds
UM TMP1
UM HV1
UM HV2
UM TMP2

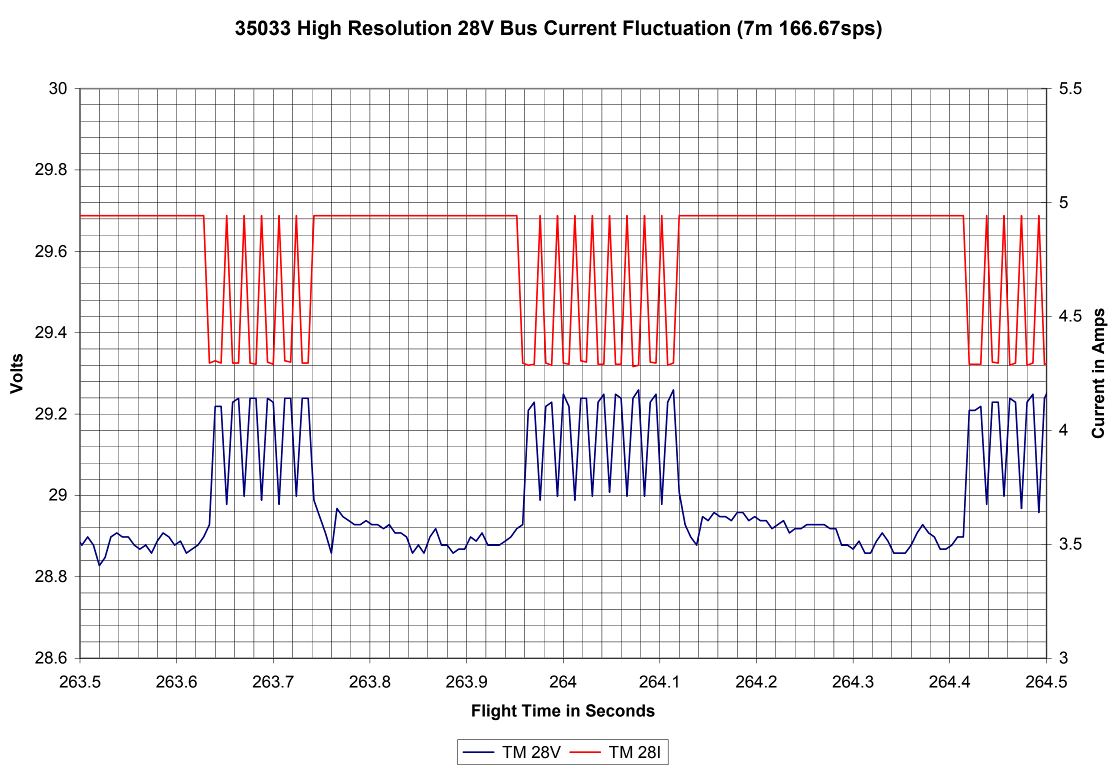


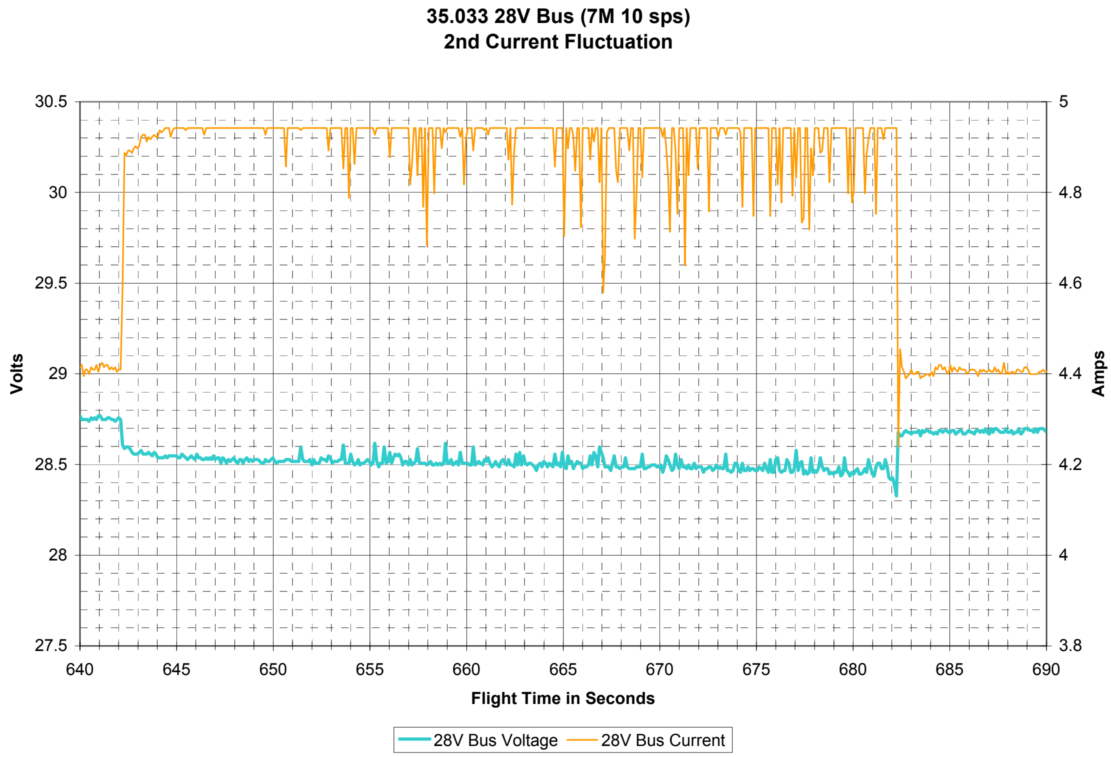
35.033 SCM Data 166 sps 7M
Value in Counts
1000
900
800
700
600
500
400
300
200
100
0
121
121.1
121.2
121.3
121.4
121.5
121.6
121.7
121.8
121.9
122
Flight Time in Seconds
EED/EID SCM
SEI/SII SCM



35.033 Acceleration 500sps 7M
Acceleration in G's
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
121
121.1
121.2
121.3
121.4
121.5
121.6
121.7
121.8
121.9
122
Flight Time in Seconds
Z Axis Acceleration
X Axis Acceleration
Y Axis Acceleration


35.033 28V Bus (7M 10 sps)
1st Current Fluctuation
Volts
Amps
Flight Time in Seconds
28V Bus Voltage
28V Bus Current
30.5
30
29.5
29
28.5
28
27.5
5
4.8
4.6
4.4
4.2
4
3.8
190
240
290
340
390


35033 High Resolution 28V Bus Current Fluctuation (7m 166.67sps)
Volts
Current in Amps
Flight Time in Seconds
TM 28V
TM 28I
30
29.8
29.6
29.4
29.2
29
28.8
28.6
5.5
5
4.5
4
3.5
3
263.5
263.6
263.7
263.8
263.9
264
264.1
264.2
264.3
264.4
264.5



35.033 28V Bus (7M 10 sps)
2nd Current Fluctuation
Volts
Amps
30.5
30
29.5
29
28.5
28
27.5
5
4.8
4.6
4.4
4.2
4
3.8
640
645
650
655
660
665
670
675
680
685
690
Flight Time in Seconds
28V Bus Voltage
28V Bus Current

CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	4/8/2003	

Post Flight Report

ACS

SPACE VECTOR
A Pemco Aviation Group Company

Attitude Control Systems

Subject: Telemetry Data Reduction – 35.033 MagACS

Reference: ACS Requirements - 35.033 / Pfaff Revision 10 - 10/4/02 (attached)

From: S. D. Lyon, Space Vector Corp.

Date: April 11, 2003

General observations and statements:

1. The launch of 35.033/Pfaff occurred 12/14/02 at 11:16:48Z from Svalbard, Norway.
   (zero time used by nsroc/GNC was 11:16:48.14 Z)
2. TM data was obtained via an email from Charlie Kupelian from T-5 to T+900 with 0.1 sec time resolution and 10-bit data resolution. Data was reduced from T+50 to T+800 sec.
3. A MIDAS platform was installed in the payload and was not a part of the ACS. Data from the platform was analyzed in preparation of this report. However, the MIDAS was assumed to be perfect – no attempt was made to include drift coefficients.
   The MIDAS was uncaged just prior to launch at **Azimuth = 185.3°, Elevation = 84.8°**. The magnetic field vector (**-B**) was given at Azimuth **= 175.4°, Elevation = 82.3°**. The maneuver to the field (as read by the MIDAS) should be nominally **Pitch = 2.44°, Yaw = -0.97°**.
4. There was a 0.26 sec time discrepancy between the mission time on the TM data file and the ACS programmed events (the ACS was late). Since the ACS clock was synchronized by "first motion", it is assumed to be correct in this report.

Analysis of the telemetry data:

1. The payload was yo-yo despun to 1.1 rps at **T+94** sec. This was complete at T+95 and achieved a Roll Rate of **1.11** rps. See figure 1.

2. At **T+96** the autobias routine was enabled. The purpose of this routine is to adjust the bias of the magnetometers and to remove the effects of roll axis misalignment on the Z-axis rate sensor. The "REVCTR" channel indicates that 0.2 sec was required to sync up in Roll (REV0) and then two complete Roll revolutions to accomplish the Autobias. See Figure 3.

3. The ACS was automatically enabled at the end of the autobias at T+98.0 sec. The initial conditions were:
   Theta = 12.57°, Pitch = +12.44° , Yaw = +8.44°, Az = 211.86°, El = 70.48°.
   (Theta is the absolute angle between P/L roll axis and -β and is calculated by the ACS controller from the vector sum of the Y & Z magnetometer signals.)

4. The ACS begin to maneuver the P/L toward -β by reducing the magnitude of Theta. The servo deadband was set to ±3.5° during this maneuver.
   At **T+105**, pointing was inside the deadband with:
   Theta = 2.36°, Pitch = 2.42° , Yaw = 1.93°, Az = 199.56°, El = 82.14°.
   This maneuver required 12.2 lb-sec of impulse against a predicted worse-case 22 lb-sec.
   The ACS was disabled at T+117 for boom deployment and Roll rate trim.

5. At T+117, the booms began to deploy and the ACS Roll control was enabled. The Roll control was initially set to establish a "floor" of 0.5 rps. The deploying booms hit this threshold at ~T+125 when the Roll thrusters began firing to maintain the rate at 0.5 rps. At T+136, the ACS was programmed to lower the rate to 0.385 ± 0.036 rps. **0.43 rps** was achieved. Referance Figure 1. The Roll control was estimated to require 28 lb-sec of impulse whereas the actual flight useage was measured at 70 lb-sec. An error was discovered (by Jeff Benton) in the method used to calculate the Roll control impulse. A corrected Gas Budget is included in this report. Fortunately there was ample gas to perform the mission.

6. A second autobias was enabled at T+139. The "REVCTR" channel indicates that 1.0 sec was required to sync up in Roll (REV0) and then one complete Roll revolution to accomplish the Autobias. As initially programmed, this second autobias was intended to only adjust the bias on the Z-rate sensor to account for changes in cross-coupled Roll rate. However,during pre-launch testing it was discovered that the magnetometers were influanced by the boom proximity. The program was changed to autobias both the rate sensor and magnetometers. Figure 2 shows the affect on theta when the magnetometers are incorrectly biased.

7. The ACS was automatically reenable by the autobias routine at T+143.5 and it began to reacquire -β with the deadband now set at ±1.5°. At **T+155**, pointing was inside the deadband with: **Theta = 0°, Pitch = 4.92° , Yaw = -0.94°, Az = 179.96°, El = 79.84°.**

8. At T+165 sec, a Hysteresis Wide-deadband of 10° was installed – after which there was no further nozzle activity until **T+450**. The mean Theta, Pitch and Yaw angles were:
   Theta = 3.0°, Pitch = +3.0° , Yaw = -3.0°, Az = 165.12°, El = 81.28°

9. At **T+450** the deadband was set to ±1.5° to update to -β. After the update, the mean Theta, Pitch and Yaw angles were:
   Theta = 2.4°, Pitch = 10.2° , Yaw = -1.35°, Az = 180.23°, El = 74.55°
   The deadband was set to wide at **T+465**, after which there was no further ACS activity.

Conclusions:

1. The ACS performed as specified in the Requirements document in that:
   It adjusted the Roll spin rate to the specified rate in the specified time.
   Maneuvered to the magnetic field in the specified time and with an acceptable precision.
   Turned off at the specified time.

2. On future missions: if there are to be two (or more) autobias calls, all should include autobiasing both the rate sensor **and** magnetometers.

3. The method of calculating Roll axis impulse requirements should include 2X Roll nozzles with the p/l radius as the moment arm.

S D Lyon, 4/11/03

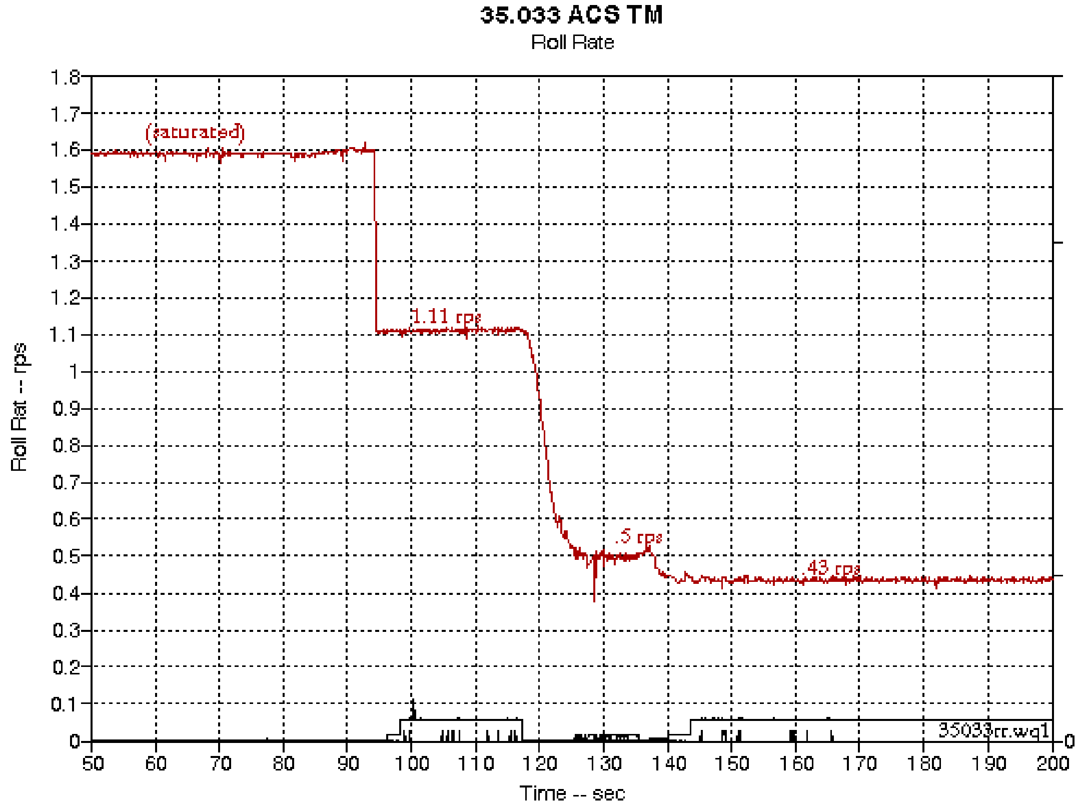


Figure 1

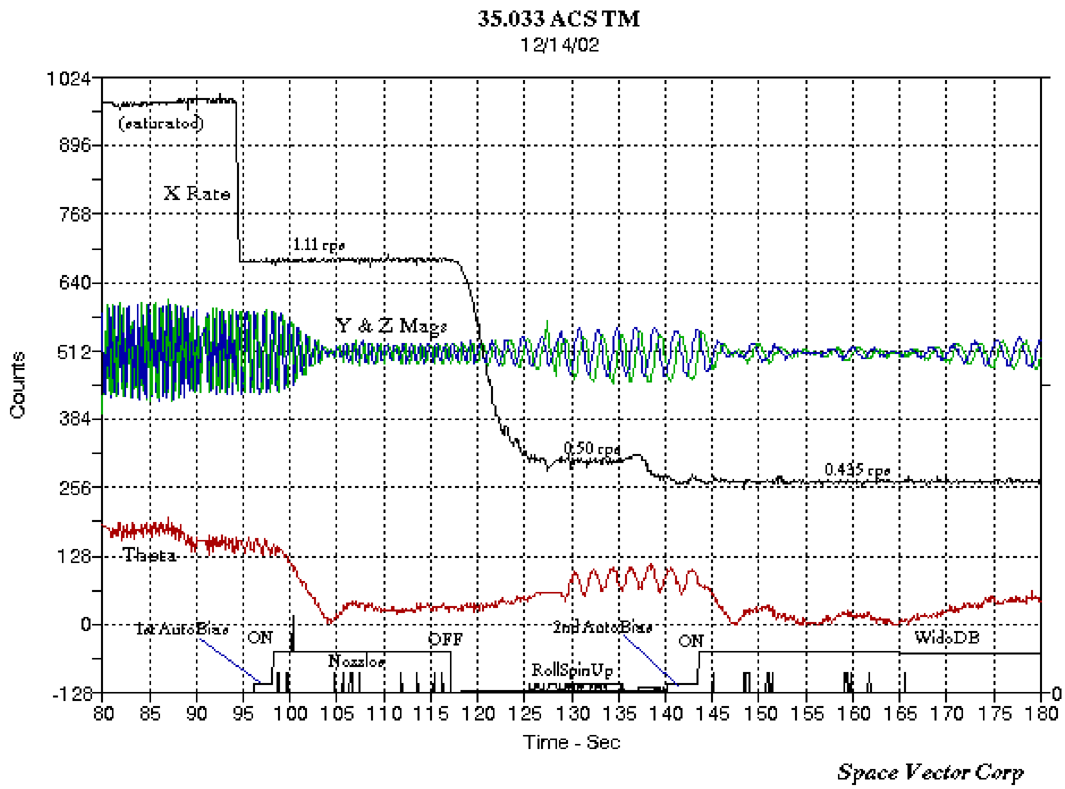


Figure 2

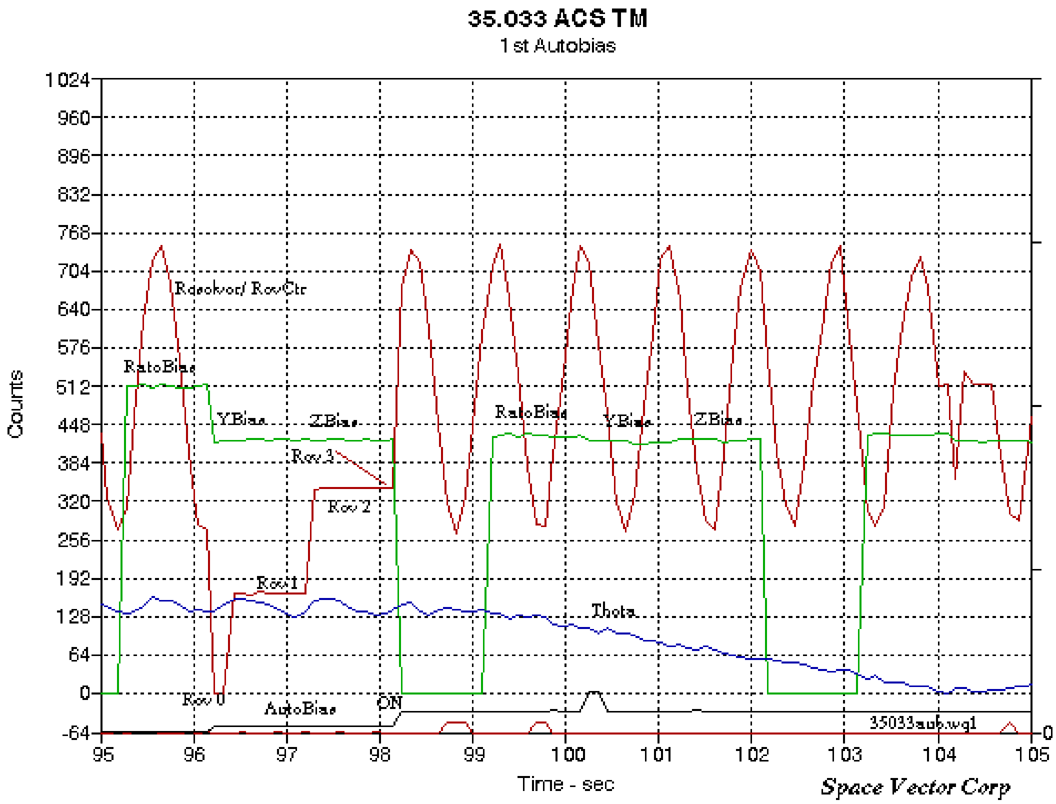


Figure 3

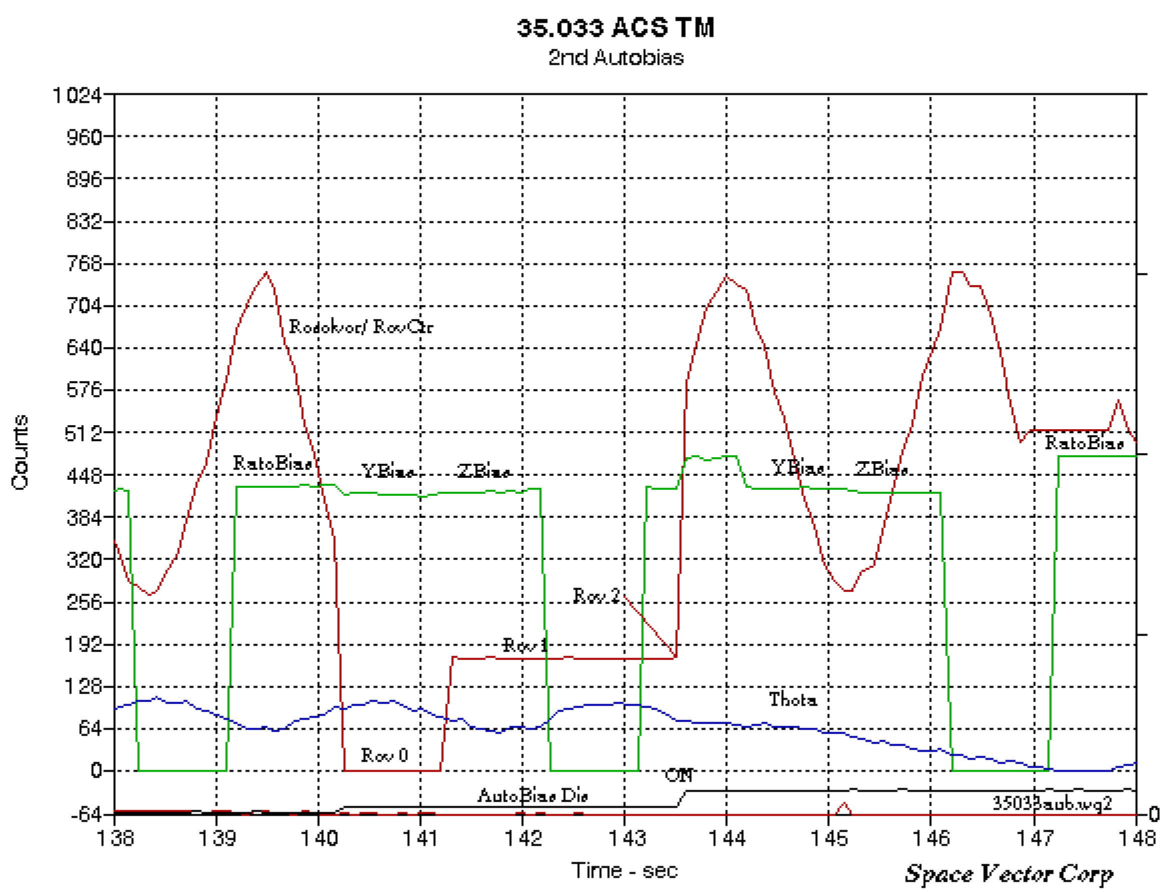


Figure 4

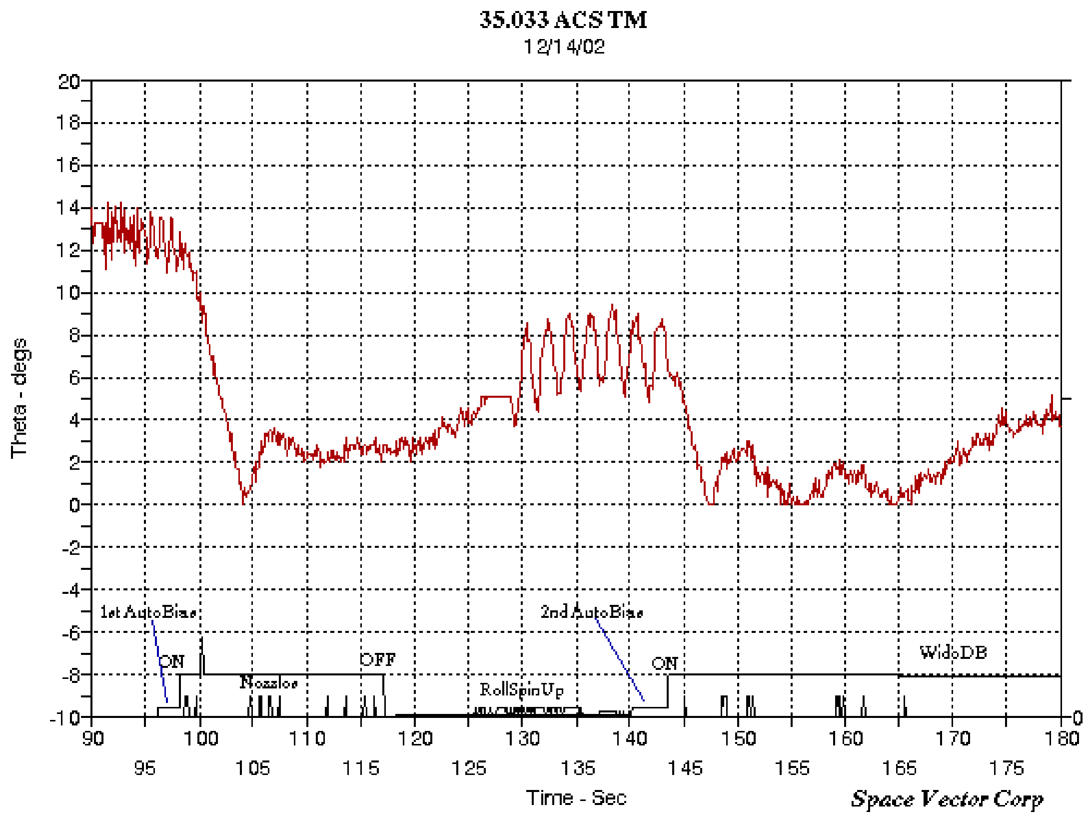


Figure 5

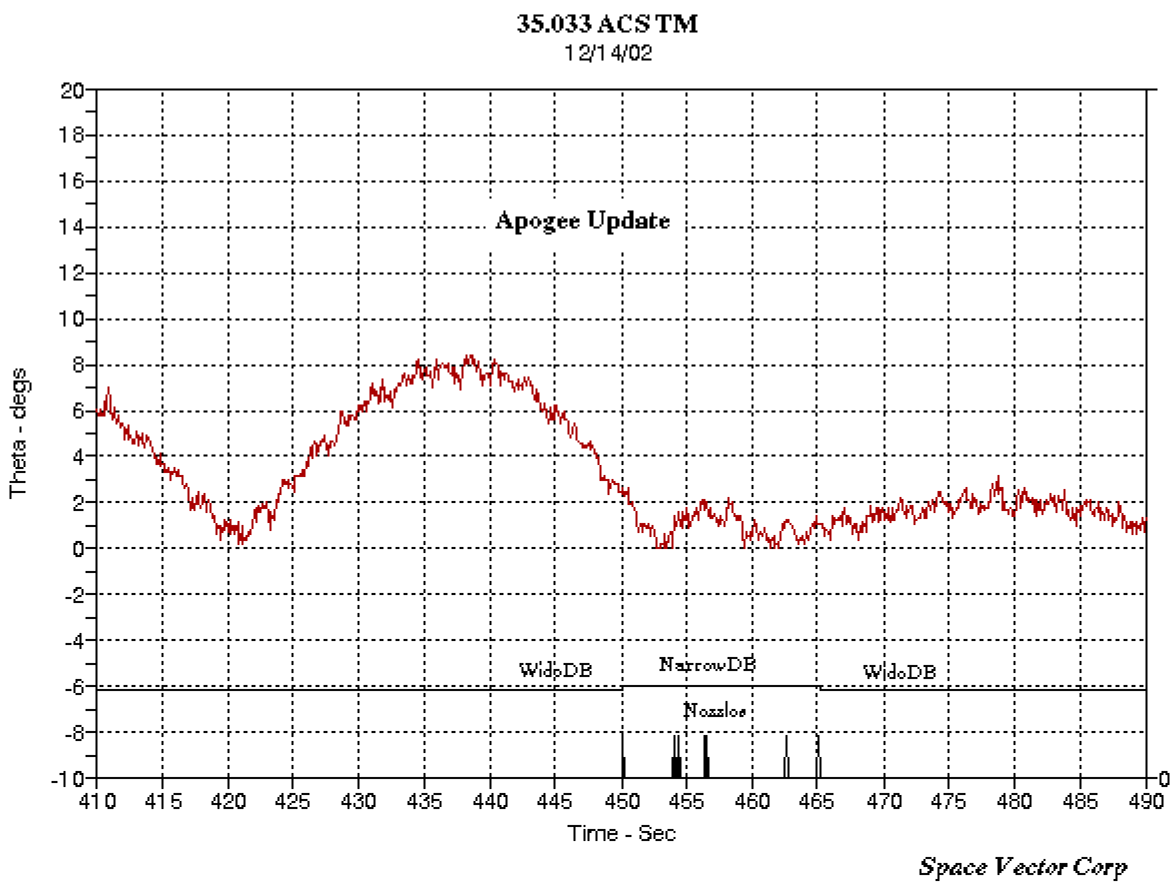


Figure 6

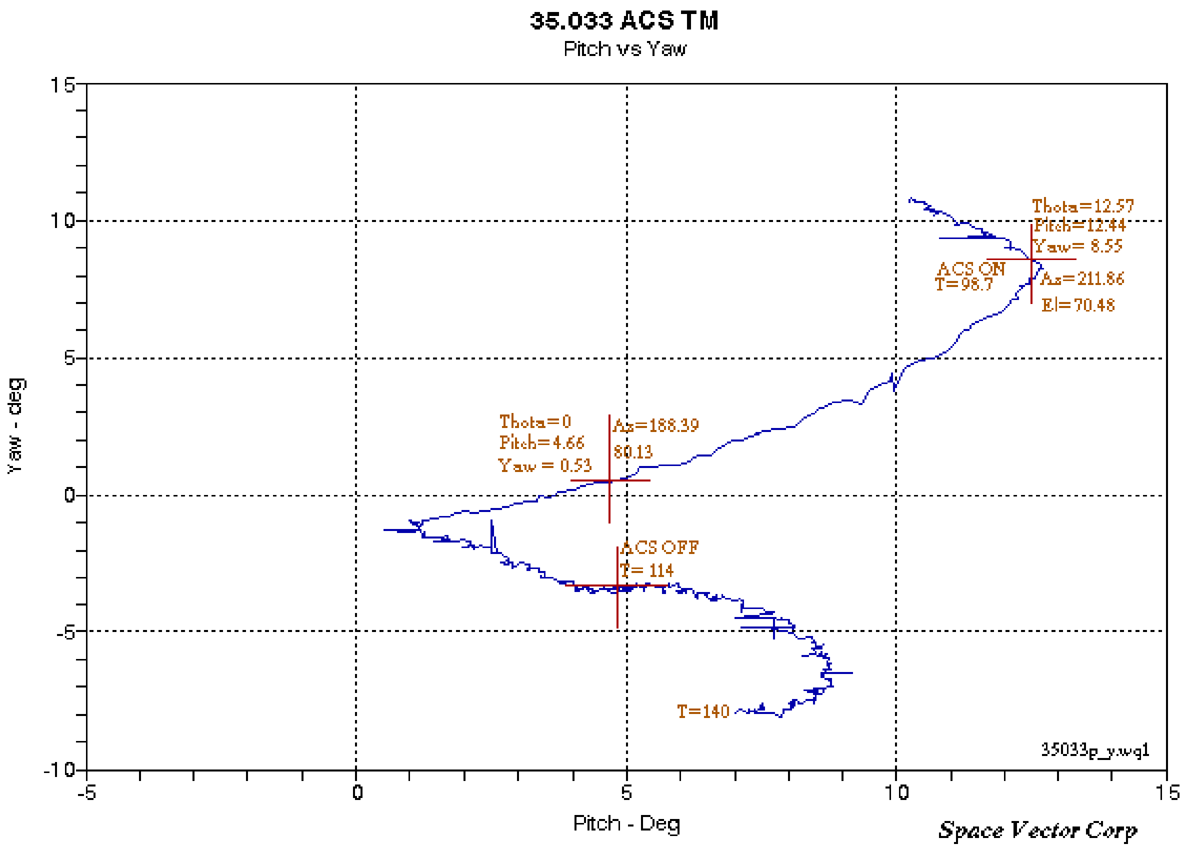


Figure 7

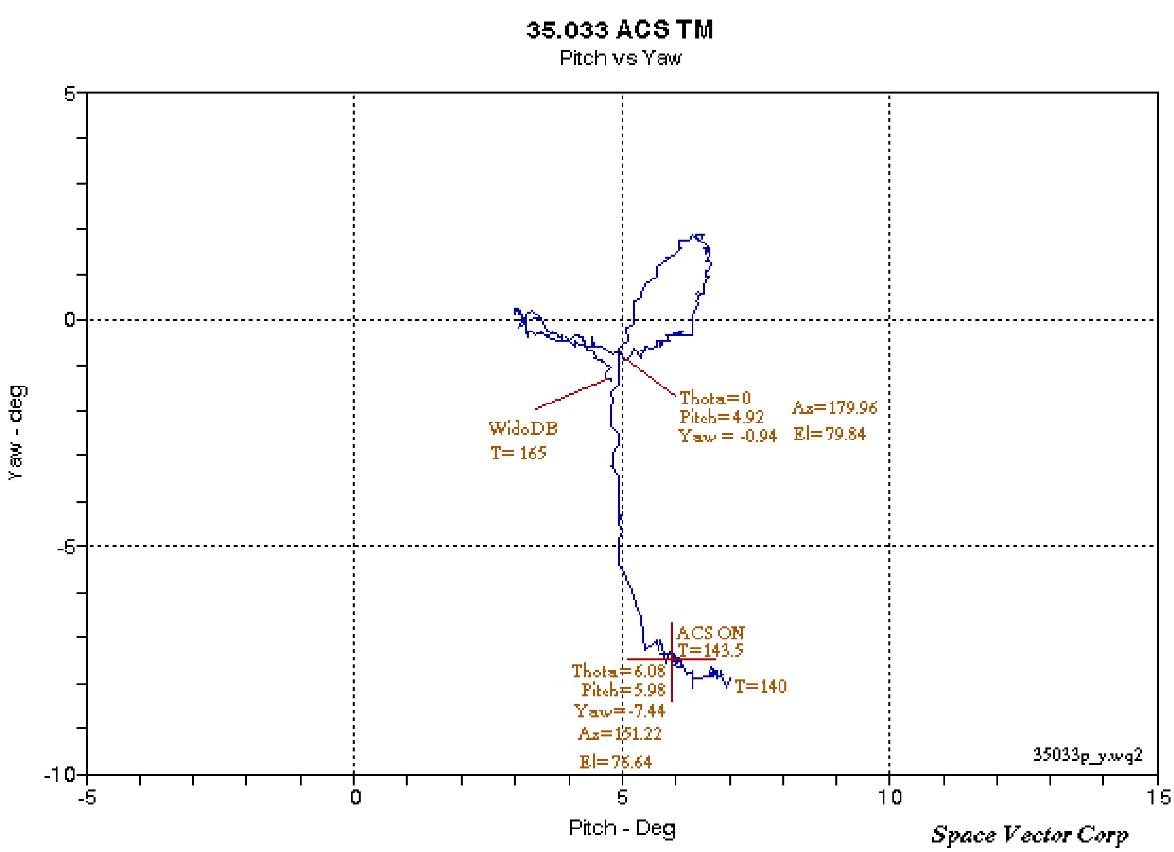


Figure 8

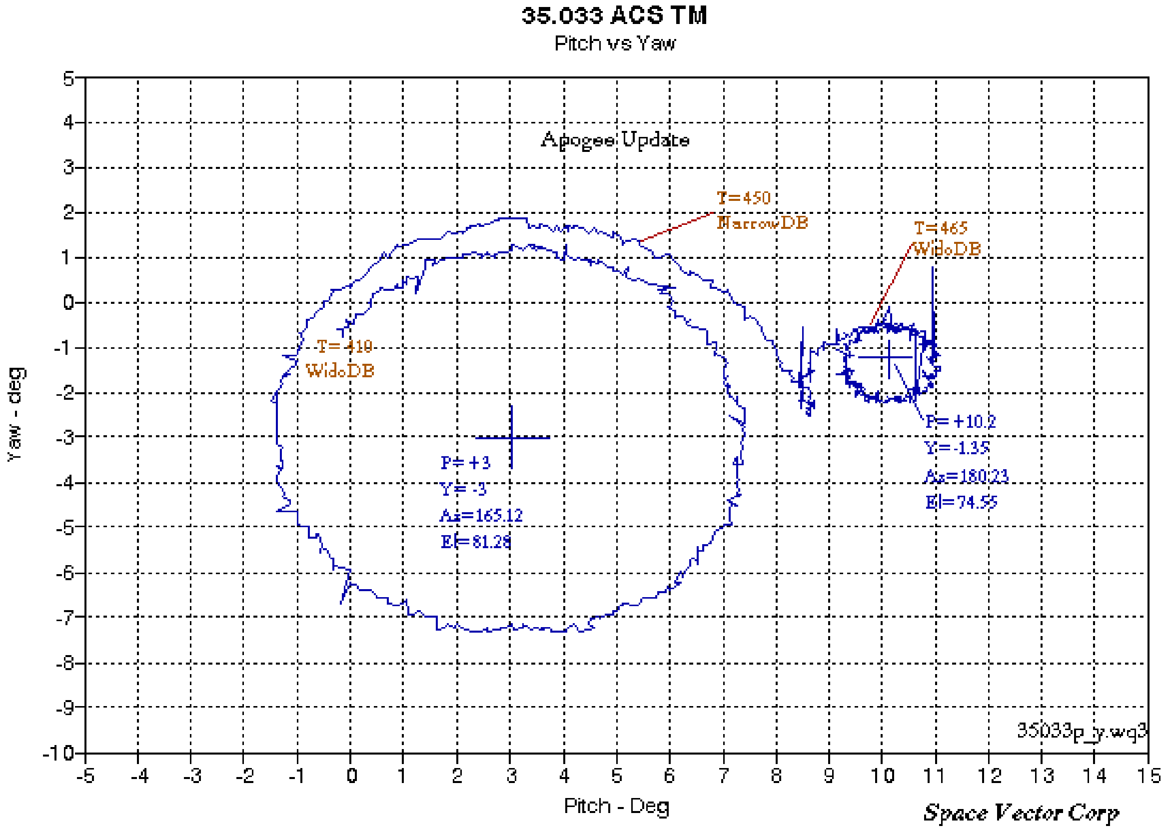


Figure 9

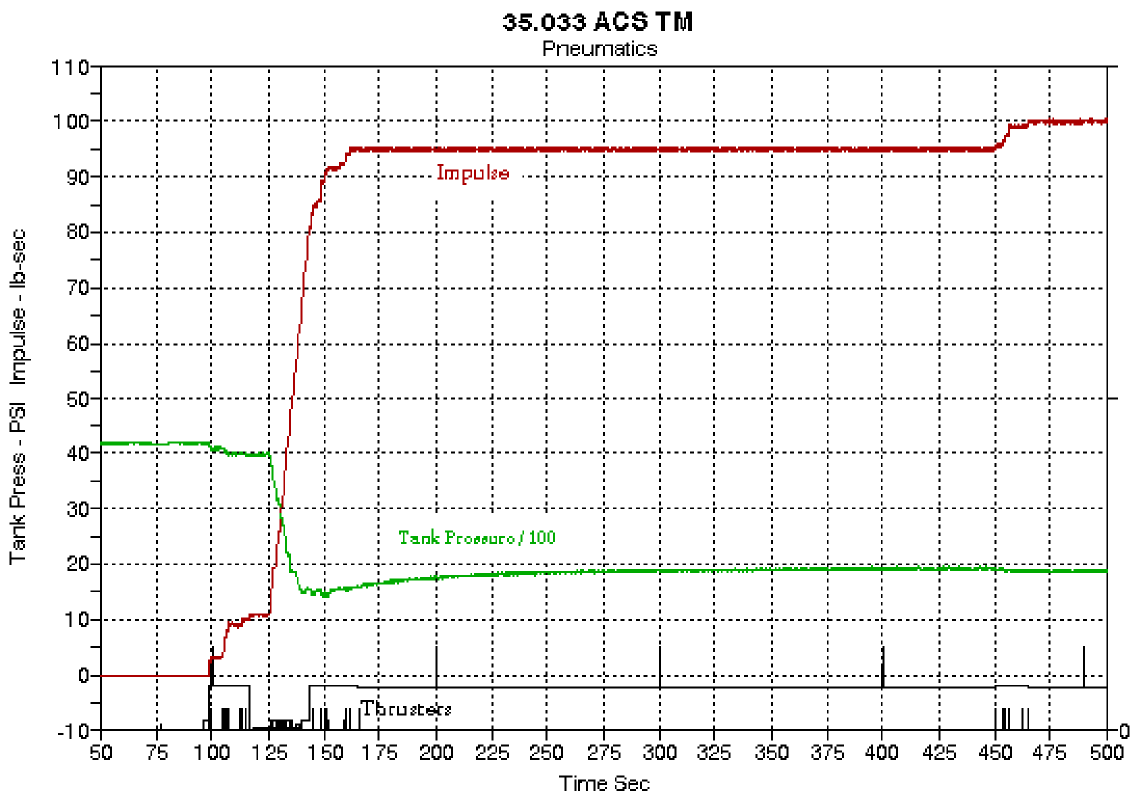


Figure 10

ACS GAS BUDGET

35.033 MagACS

(Updated from actual flight data)

Configuration 1:

Ixx	Iyy	Roll Rate	Moment arm	Pitch Rate
5.63 SF^2	329.4 SF^2	1.1 rps	4.97’	5.2°/s

Event 1:	Autobias Magnetometers & Rate sensor	Time Required	3 Sec	
Event 2:	Maneuver from FPA to -B (~53°)	Time Required	18.3 Sec	
		Impulse Required		20 lb-sec
Event 3:	Set Roll rate at 0.5 rps threshold during boom deployment	Time Required	18 Sec	
		Impulse Required (actual)		41 lb-sec
Event 4:	Decrease Roll rate from 0.5 rps to 0.35 rps	Time Required	3 Sec	
		Impulse Required (actual)		28 lb-sec
Event 5:	Perform 2nd Autobias	Time Required	3 Sec	
Event 6:	Reacquire B	Time Required	10 Sec	
		Impulse Required (est.)		10 lb-sec

Total impulse required **99 lb-sec**

Impulse Available:

Semi-Adiabatic Blowdown Simulation
Gas - Nitrogen, Tank Volume 370 in^3 (Gamma used = 1.35)
Start Pressure 4180 psia, Temp 560R, Density 0.0102 lb/in^3
End Pressure 400 psia, Temp 307R, Density 0.0023 lb/in^3
Gas Weight 2.9 lbm, Average Isp 63.8 lbf-sec/lbm
Impulse available = **186 lb-sec**

Margin:

At 4180 psia ((186/99)-1)*100 = **87.87 %**

ATTITUDE CONTROL SYSTEM REQUIREMENTS

Flight:	**35.033 / Pfaff**	ACS Model:	16471-3
Revision	9	Gyro SN:	NA
Launch Date:	January 2003	Gas:	Nitrogen
Location:	Norway, Svalbard		
Originator:	Charlie Kupelian Tracy Gibbs	Concurred By:	
Date:	4 October 2002	Date:	
Phone:	757-824-1838	Phone:	
Fax:	757-824-2411	Fax	

Payload Parameters	Config. 1 8/01/02	Config. 2 8/01/02	Config. 1 10/03/02	Config. 2 10/03/02
Pitch MOI Sl-Ft.^{2}	329.2	329.4	370.78	370.38
Pitch Moment Arm Ft	4.91	4.97	4.85	4.89
Roll MOI Sl-Ft.^{2}	5.63	20.1	5.47	21.24
Roll Rate / RPS	1.1	0.35	1.1	0.35

Alignments	Azimuth	Elevation	(Other)
Launcher Location	*lat: 78.931504*	*Long: 11.850368*	
Launcher Settings	*193 °*	*82 °*	
Target Coordinates	*175.4 °*	*82.3 °*	~460 mGauss
Mag. Alignment	X axis @ P/L 0°	+Y axis pointing fwd.	+Z axis @ P/L 270°

DOCUMENT REVISION HISTORY

Rev	Author	Date	Description
5	C. Kupelian	8/1/02	Finalized mass properties/time line
6	C. Kupelian	8/5/02	Change Roll control scheme / times
7	S. Lyon	10/2/02	Time line changed to match Rev L (1 sec added to each event)
8	R. Kiefer	10/3/02	Updated mass properties
9	R. Kiefer	10/4/02	Wide deadband increased to ±10°. Add apogee update at 450-465 sec.

DETAILED MISSION REQUIREMENTS

Item	Time/Sec.	Config	Event
	T + 94		De-spin to ~1.1 rps
1	T + 96	1	Begin Auto-bias (Mag & Rate Sensor), Roll Rate 1.1 rps (requires 3 revs max)
2	T + ~99	1	Auto-bias complete, ACS Enabled, Align to -**B** vector.
3	T + 101	1	ACS Enable Override
4	T + 117	1	Disable ACS
	T + 118-136	1-2	Payload deploys booms & experiments, despins to 0.278 rps
5	T + 118-136	2	ACS Roll control, maintain spin at ≥0. 5 rps
6	T + 137-140	2	ACS Roll control, despin to ≥0.35 rps
7	T + 140	2	Begin 2nd Auto-bias, Roll Rate 0.35 rps (requires 2 revs max)
8	T + ~146	2	Auto-bias complete, ACS Enabled, Re-align to -**B** vector.
9	T + ~155	2	Maneuver complete
10	T + 169	2	Open Servo Deadband to ±10° (hysteresis)
11	T + 450	2	Tighten servo deadband to ±1.5° for apogee update
12	T + 465	2	Open Servo Deadband to ±10° (hysteresis)

SPACE VECTOR
A Pemco Aviation Group Company ™
Attitude Control Systems

Doc. No. 1752-018

SYSTEM DATA BOOK

MAGNETIC
DIGITAL ATTITUDE CONTROL SYSTEM

35.033 / Pfaff

Revised 10/07/02

Revision 9

SPACE VECTOR CORPORATION

9223 DEERING AVE.

CHATSWORTH, CA. 91311
October 7, 2002

1752-201

REQUIREMENTS

ATTITUDE CONTROL SYSTEM REQUIREMENTS

Flight:	**35.033 / Pfaff**	ACS Model:	16471-3
Revision	9	Gyro SN:	NA
Launch Date:	January 2003	Gas:	Nitrogen
Location:	Norway, Svalbard		
Originator:	Charlie Kupelian Tracy Gibbs	Concurred By:	
Date:	4 October 2002	Date:	
Phone:	757-824-1838	Phone:	
Fax:	757-824-2411	Fax	

Payload Parameters	Config. 1 8/01/02	Config. 2 8/01/02	Config. 1 10/03/02	Config. 2 10/03/02
Pitch MOI Sl-Ft.^{2}	329.2	329.4	370.78	370.38
Pitch Moment Arm Ft	4.91	4.97	4.85	4.89
Roll MOI Sl-Ft.^{2}	5.63	20.1	5.47	21.24
Roll Rate / RPS	1.1	0.35	1.1	0.35

Alignments	Azimuth	Elevation	(Other)
Launcher Location	*lat: 78.931504*	*Long: 11.850368*	
Launcher Settings	*193 °*	*82 °*	
Target Coordinates	*175.4 °*	*82.3 °*	~490 mGauss
Mag. Alignment	X axis @ P/L 0°	+Y axis pointing	+Z axis @ P/L 270°

DOCUMENT REVISION HISTORY

Rev	Author	Date	Description
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DETAILED MISSION REQUIREMENTS

Item	Time/Sec.	Config	Event
	T + 94		De-spin to ~1.1 rps
1	T + 96	1	Begin Auto-bias (Mag & Rate Sensor), Roll Rate 1.1 rps (requires 3 revs max)
2	T + ~99	1	Auto-bias complete, ACS Enabled, Align to **-B** vector.
3	T + 101	1	ACS Enable Override
4	T + 117	1	Disable ACS
	T + 118-136	1-2	Payload deploys booms & experiments, despins to 0.278 rps
5	T + 118-136	2	ACS Roll control, maintain spin at ≥0. 5 rps
6	T + 137-140	2	ACS Roll control, despin to ≥0.35 rps
7	T + 140	2	Begin 2nd Auto-bias (Rate Sensor), Roll Rate 0.35 rps (requires 2 revs max)
8	T + ~146	2	Auto-bias complete, ACS Enabled, Re-align to -**B** vector.
9	T + ~155	2	Maneuver complete
10	T + 169	2	Open Servo Deadband to ±10° (hysteresis)
11	T + 450	2	Tighten servo deadband to ±1.5° for apogee update
12	T + 465	2	Open Servo Deadband to ±10° (hysteresis)

MAGNETIC DIGITAL ATTITUDE CONTROL SYSTEM
TECHNICAL DESCRIPTION

HARDWARE:

Space Vector Model 16471-1 Attitude Control System is provided for the 35.033 mission. This system consists of:

- A 17.26" dia. X 11" skin assembly.
- An ACS Electronics Electronics Assembly (model 36251-21).
- A Four-nozzle Roll spin-up/spin down and a remotely located Two-nozzle Reaction Control Subsystem.
- A X and Z axis rate sensor and power supply.
- A 370 in^3 reservoir; when pressurized with Nitrogen gas to 5000 psi the total available impulse is 206 lb-sec.

FLIGHT PROGRAM:

The ACS is programed to:

- Align the payload spin axis to the earth's magnetic field to ± 2° at Svalbard using the payload Magnetometers as sensors.
- Maintain the payload spin rate at 0.5 rps during the payload boom deployment.
- After deployment of payload booms, the ACS decrease the payload spin rate to 0.35 rps using a X-axis rate sensor.
- Provide Alignment of the payload spin axis to the -B Vector to ± 1.5°.
- Provide a final Deadband of ± 10°(hysteresis)

CONFIGURATION LOG

FLIGHT NUMBER : **35.033 / Pfaff**

ACS	P/N 16471-2	S/N 00-034
ELECTRONICS	P/N 36251-21	S/N 00-041
BATTERY	P/N 36371	S/N 00-027
RATE SENSOR	P/N 21391-2	S/N 02-026
RATE SENSOR P. S.	P/N 36731-2	S/N 00-018

SOFTWARE

MONITOR	36251D20
ACS	35033ACS
FLIGHT TIMELINE	35033r6FLT

(Note: Imbedded software is the property of Space Vector Corp.)

PNEUMATICS

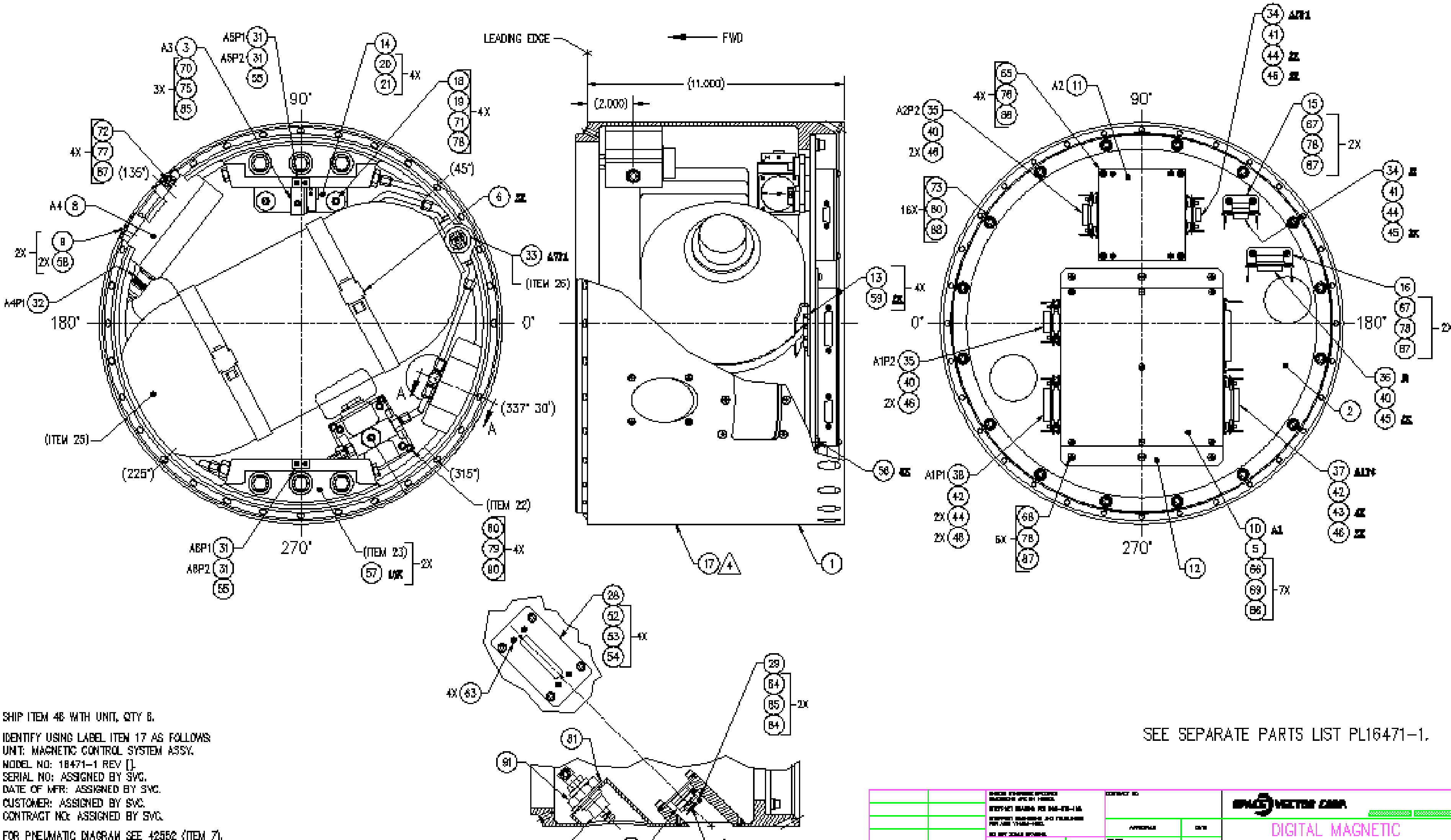
ROLL NOZZLES	41378 - 8 .125 dia
TRANSVERSE NOZZLES	41378 - 8 .125 dia
REGULATOR	P/N 41251-2

PRESSURE VESSEL:

Volume	370 in^3
Operating Pressure	5000 psig
Proof Pressure	7500 psig
Burst Pressure	10000 psig
Weight (empty)	9.7 lbs
Manufacturer	Structural Composites Industries, Pomona,CA
FSCM	58943
Mfg Part No.	1269815 (ALT183)

16471-1 | 1 | B

–	PRODUCTION RELEASE	97/09/04	DD	SD	GB
A	INC ECO 8807 (A)	98/10/21	DN	SD	DN
B	INC ECO 9011 (B)				



SEE SEPARATE PARTS LIST PL16471–1.

NOTES: UNLESS OTHERWISE SPECIFIED

1. SECURE ALL HARDWARE USING ITEM 95.
2. WIRE PER SCHEMATIC 16472–1.
3. FOR PNEUMATIC DIAGRAM SEE 42552 (ITEM 7).
4. IDENTIFY USING LABEL ITEM 17 AS FOLLOWS:
   UNIT: MAGNETIC CONTROL SYSTEM ASSY.
   MODEL NO: 16471–1 REV [].
   SERIAL NO: ASSIGNED BY SVC.
   DATE OF MFR: ASSIGNED BY SVC.
   CUSTOMER: ASSIGNED BY SVC.
   CONTRACT NO: ASSIGNED BY SVC.
5. SHIP ITEM 46 WITH UNIT, QTY 6.

NASA

APPLICATION

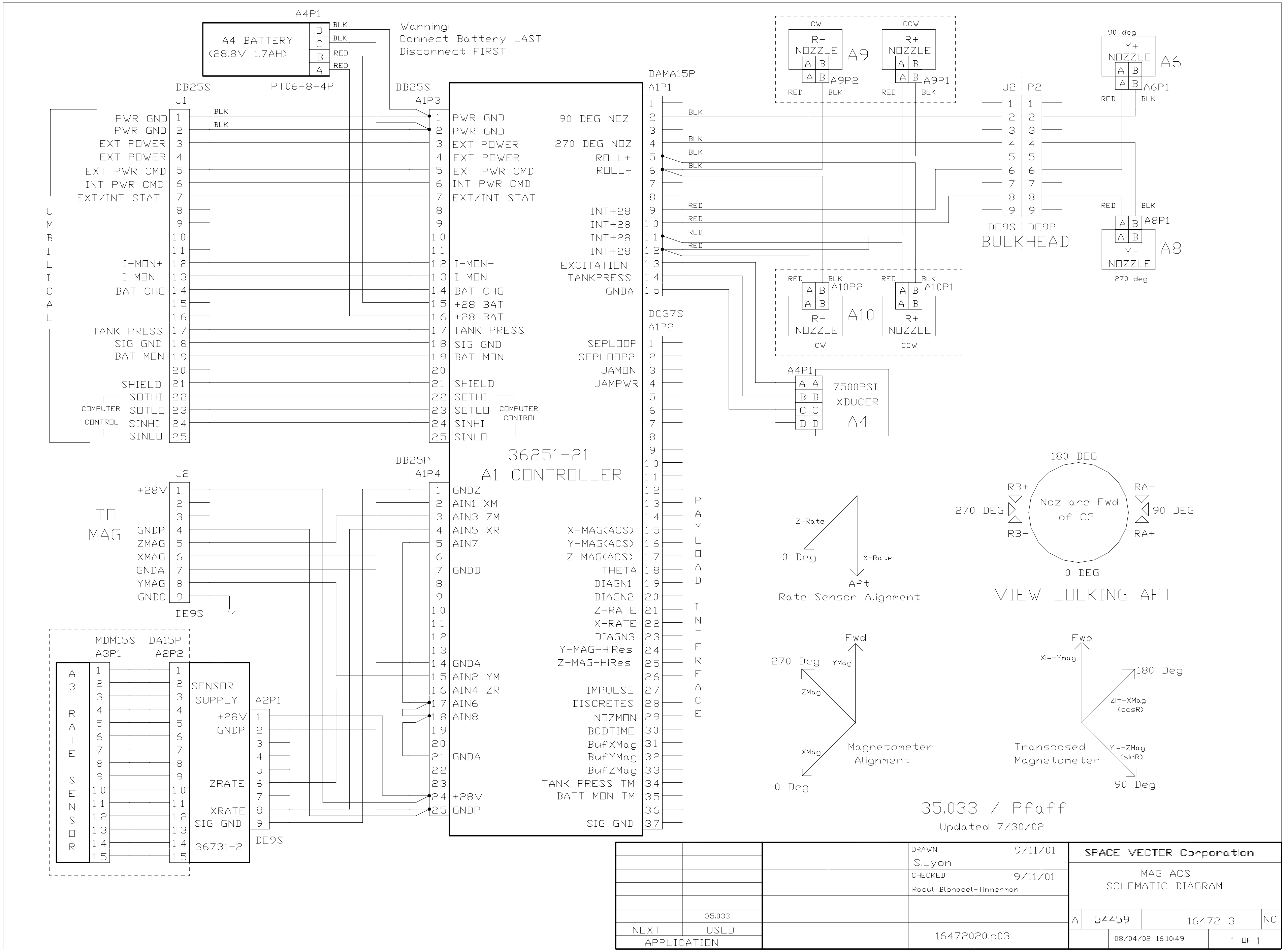
S. LYON	97/08/27
T. RING	97/06/01
D. DECKER	97/08/27
S. DIETRICH	97/08/27
W. THOMPSON	97/08/28

SPACE VECTOR CORP.

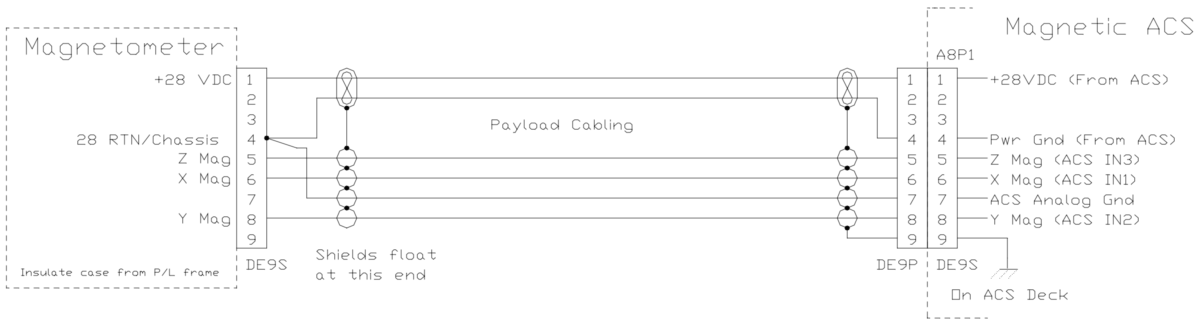
DIGITAL MAGNETIC ATTITUDE CONTROL SYSTEM ASSEMBLY

D | 54459 | 16471–1 | B

SCALE 1/2 | SHEET 1 OF 1


A4 BATTERY
(28.8V 1.7AH)
A4P1
PT06-8-4P
Warning:
Connect Battery LAST
Disconnect FIRST
DB25S
J1
DB25S
A1P3
UMBILICAL
PWR GND
PWR GND
EXT POWER
EXT POWER
EXT PWR CMD
INT PWR CMD
EXT/INT STAT
I-MON+
I-MON-
BAT CHG
+28 BAT
+28 BAT
TANK PRESS
SIG GND
BAT MON
SHIELD
SOTHI
SOTLO
SINHI
SINLO
COMPUTER CONTROL
36251-21
A1 CONTROLLER
DAMA15P
A1P1
90 DEG NOZ
270 DEG NOZ
ROLL+
ROLL-
INT+28
INT+28
INT+28
INT+28
EXCITATION
TANKPRESS
GNDA
DC37S
A1P2
SEPLOOP
SEPLOOP2
JAMON
JAMPWR
X-MAG(ACS)
Y-MAG(ACS)
Z-MAG(ACS)
THETA
DIAGN1
DIAGN2
Z-RATE
X-RATE
DIAGN3
Y-MAG-HiRes
Z-MAG-HiRes
IMPULSE
DISCRETES
NOZMON
BCDTIME
BufXMag
BufYMag
BufZMag
TANK PRESS TM
BATT MON TM
SIG GND
PAYLOAD INTERFACE
DB25P
A1P4
GNDZ
AIN1 XM
AIN3 ZM
AIN5 XR
AIN7
GNDD
GNDA
AIN2 YM
AIN4 ZR
AIN6
AIN8
GNDA
+28V
GNDP
J2
TO MAG
+28V
GNDP
ZMAG
XMAG
GNDA
YMAG
GNDC
DE9S
MDM15S
A3P1
DA15P
A2P2
A3 RATE SENSOR
SENSOR SUPPLY
+28V
GNDP
ZRATE
XRATE
SIG GND
36731-2
A2P1
DE9S
CW
CCW
R- NOZZLE
R+ NOZZLE
A9
A9P2
A9P1
J2
P2
DE9S
DE9P
BULKHEAD
90 deg
Y+ NOZZLE
A6
A6P1
A8P1
Y- NOZZLE
A8
270 deg
A10P2
A10P1
A10
A4P1
7500PSI
XDUCER
A4
180 DEG
RB+
RA-
270 DEG
90 DEG
Noz are Fwd of CG
RB-
RA+
0 DEG
VIEW LOOKING AFT
Z-Rate
0 Deg
X-Rate
Aft
Rate Sensor Alignment
Fwd
270 Deg
YMag
ZMag
XMag
0 Deg
Magnetometer Alignment
Fwd
Xi=+Ymag
180 Deg
Zi=-XMag (cosR)
Yi=-ZMag (sinR)
Transposed Magnetometer
90 Deg
35.033 / Pfaff
Updated 7/30/02
35.033
NEXT
USED
APPLICATION
DRAWN
S.Lyon
9/11/01
CHECKED
Raoul Blondeel-Timmerman
9/11/01
16472020.p03
SPACE VECTOR Corporation
MAG ACS
SCHEMATIC DIAGRAM
A
54459
16472-3
NC
08/04/02 16:10:49
1 OF 1

REV.	DESCRIPTION	DATE	APPROVED
-	PRODUCTION RELEASE		



		DRAWN 10/28/99 R.BLONDEEL-TIMMERMAN	SPACE VECTOR Corporation
		CHECKED soll	MAGNETIC ACS PAYLOAD INTERFACE
	NASA/WYGANT		A 54459 NC
NEXT	USED		08/08/02 16:16:35 1 OF 1
APPLICATION			

System Pneumatics Worksheet

Customer: NSROC
File 35033pne.xls

Flight: 35.033 Rev 8
Prepared by Lyon

Experimenter: Pfaff
Date 03-Oct-02

Parameter	Airbearing	Flight Config 1	Flight Config 2	
Transverse MI - SF^^	66.80	370.68	370.38	
P/Y Accel - Deg/Sec^^	4.00	4.00	4.04	
P/Y Moment Arm - ft	2.42	4.85	4.89	
P/Y Noz Torque - ft*lbs	4.66	25.87	26.11	
P/Y Noz Thrust - lbs	1.93	5.34	5.34	
Noz Part Number				
P/Y Noz Dia - inches	0.094	0.125		
P/Y Noz Area - in^^	0.0069	0.0123		
P/Y Noz Efficiency - Cf	1.20	1.62		
P/Y Chamber Pressure - Pc	231	269		
at Ambient	231	254		
Regulator -		440		
Impulse TM Cal lb-sec/V	16	44		
Polar MI - SF^^	3.50	5.47	21.24	
Roll Accel - Deg/Sec^^	23.69	92.00	23.69	
Roll Moment Arm - ft	1.41	1.41	1.41	
Roll Noz Torque - ft*lbs	1.45	8.78	8.78	
Roll Noz Thrust - lbs	1.03	6.23	6.23	
Noz Part Number				
Roll Noz Dia - inches	0.070	0.125		
Roll Noz Area - in^^	0.0038	0.0123		
Roll Noz Efficiency - Cf	1.20	1.62		
Roll Chamber Pressure - Pc	222	313		
at Ambient	222	298		
Impulse TM Cal lb-sec/V	17	102		
Regulator Press - psi				
It/Ip	19.1	67.8	17.4	
Gas Type		Nitrogen		
Reservoir Volume - cu. in.		370		
Reservoir Press - psi		5000		
Available Impulse - lb*sec		206		

TM CALIBRATION DATA

PAYLOAD INTERFACE CONNECTOR

DCMA-37P

Pin	Signal
1	- SEP LOOP RTN (Not used this mission)
2	- SEP LOOP (Not used this mission)
3	- G SWITCH +28V (Optional)
4	- G SWITCH (Optional)
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	- X-MAG (ACS frame)
16	- Y-MAG (ACS frame)
17	- Z-MAG (ACS frame)
18	- THETA (Absolute error to Mag Field)
19	- SVC DIAGN1 (resolver sin)
20	- SVC DIAGN2 (resolver cos)
21	- ZRATE
22	- XRATE
23	- SVC DIAGN3 (advanced resolver)
24	- Y-MAG –HiResolution
25	- Z-MAG –HiResolution
26	- SVC DIAGN4 (R/MBIAS)
27	- IMPULSE
28	- DISCRETES
29	- NOZ MONITOR
30	- BCD TIME
31	- BUFFERED RAW X Mag (payload frame
32	- BUFFERED RAW Y Mag (payload frame)
33	- BUFFERED RAW Z Mag (payload frame)
34	- TANK PRESSURE
35	- BATTERY MONITOR
36	
37	- SIGNAL GROUND

Note: Harness connector is a DC37P which mates with a DC37S on the ACS electronics. ACS expects a circuit closure between Pins 3 & 4 at liftoff. (OPTIONAL)

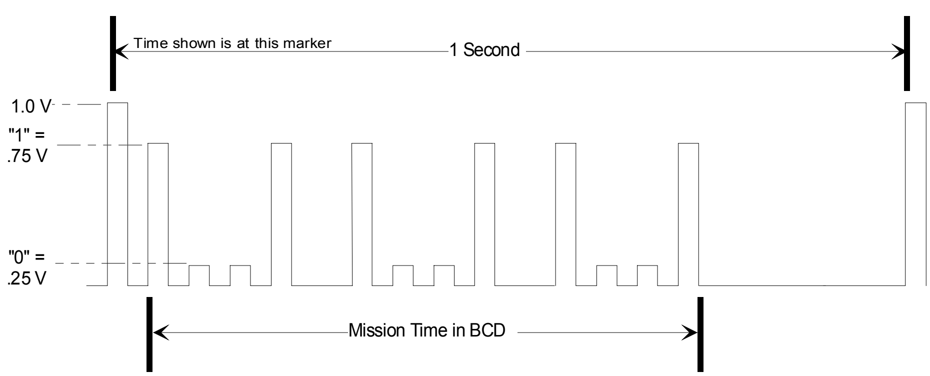
TELEMETRY CALIBRATION DATA

DATA	NOM. RANGE (± Full Scale)	CONVERSION (0 - 5 Volts)	CONVERSION (0 – 1023 Counts)
ACS X MAGNETOMETER	$\pm 90^{o}$	$\sin^{-1}((V_{TM} - 2.5V) * 0.554)$	$\sin^{-1}((C_{TM} - 512) * 2.7E-3)$
ACS Y MAGNETOMETER	$\pm 90^{o}$	$\sin^{-1}((V_{TM} - 2.5V) * 0.554)$	$\sin^{-1}((C_{TM} - 512) * 2.7E-3)$
ACS Z MAGNETOMETER	$\pm 90^{o}$	$\sin^{-1}((V_{TM} - 2.5V) * 0.554)$	$\sin^{-1}((C_{TM} - 512) * 2.7E-3)$
Y MAG HIRESOLUTION	$\pm 11.25^{o}$	$\sin^{-1}((V_{TM} - 2.5V) * 0.0692)$	$\sin^{-1}((C_{TM} - 512) * 3.38E-8)$
Z MAG HIRESOLUTION	$\pm 11.25^{o}$	$\sin^{-1}((V_{TM} - 2.5V) * 0.0692)$	$\sin^{-1}((C_{TM} - 512) * 3.38E-8)$
SINRESL	$\pm 90^{o}$	± 1.25V +2.5V (indicator)	± 204C +512C (indicator)
COSRESL	$\pm 90^{o}$	± 1.25V +2.5V (indicator)	± 204C +512C (indicator)
THETA (Servo Error)	$0 - 90^{o}$	$\sin^{-1}(V_{TM} * .3012)$	$\sin^{-1}(C * 1.4707E-3)$
Z RATE	$\pm 30^{o}$/sec	12^{o}/sec/ V_{TM} -30^{o}/sec	0.059^{o}/sec/ C -30^{o}/sec
X RATE	600^{o}/sec	120^{o}/sec/ V_{TM}	0.586^{o}/sec/ C
BATTERY VOLTAGE	20-35 Volts	$3 V_{Bat} / V_{TM} + 20 V_{bat}$	
TANK PRESSURE	0 - 7500 PSI	1500 PSI / V_{TM}	7.5 PSI /C
BufX MAGNETOMETER	$\pm 90^{o}$	Same as Input	
BufY MAGNETOMETER	$\pm 90^{o}$	Same as Input	
BufZ MAGNETOMETER	$\pm 90^{o}$	Same as Input	

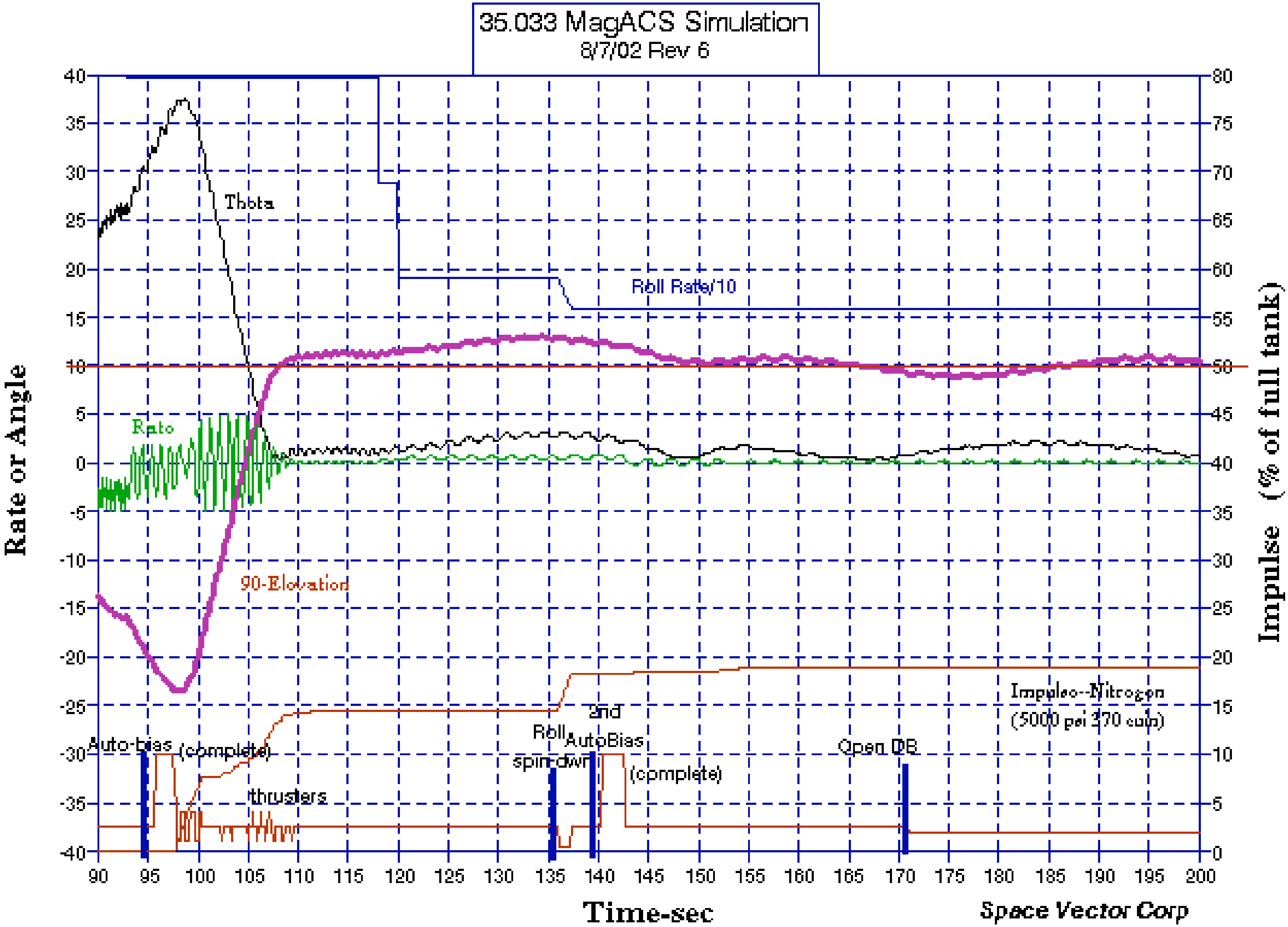
NOZZLE TM:	+Z [1]	2.500V
	-Z [1]	1.250V
	+X	.625V
DISCRETES:	ACS Enabled [2]	2.500V
	ACS Armed [2]	1.250V
	MagBias ON	.625V
	AutoAlign	.313V
	Narrow DB	.156V
	TM Cal Mode	.039V
	Time Hack	5V for .1 sec

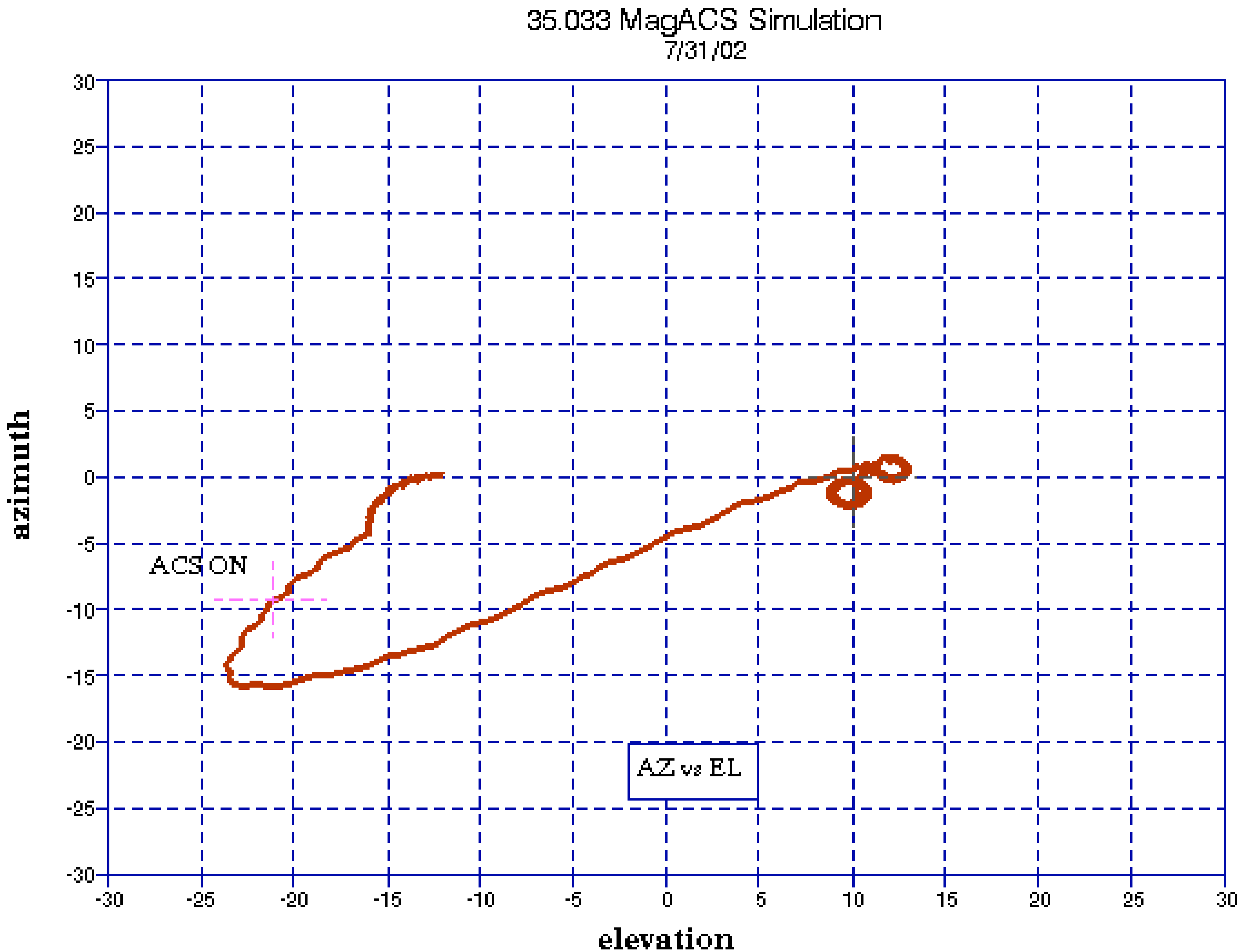
([1,2] One or the other - not on simultaneously)

BCD TIME:



ANALYSIS


35.033 MagACS Simulation
8/7/02 Rev 6
Rate or Angle
Impulse (% of full tank)
Theta
Roll Rate/10
Rate
90-Elevation
Impulse--Nitrogen
(5000 psi 370 cuin)
Auto-bias
(complete)
thrusters
Roll
spin dwn
2nd
AutoBias
(complete)
Open DB
Time-sec
Space Vector Corp


35.033 MagACS Simulation
7/31/02
azimuth
elevation
ACS ON
AZ vs EL
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30

ACS GAS BUDGET

35.033 MagACS

(Note: This data is for Rev 6 Requirements)

Configuration 1:

Ixx	Iyy	Roll Rate	Moment arm	Pitch Rate
5.63 SF^2	329.4 SF^2	1.1 rps	4.97'	5.2°/s

Event 1: Autobias Magnetometers & Rate sensor — Time Required 3 Sec

Event 2: Maneuver from FPA to -B (~53°) — Time Required 18.3 Sec
Impulse Required 30 lb-sec

Event 3: Set Roll rate at 0.5 rps threshold during boom deployment — Time Required 18 Sec
Impulse Required (est.) 10 lb-sec

Event 4: Decrease Roll rate from 0.5 rps to 0.35 rps — Time Required 3 Sec
Impulse Required 8 lb-sec

Event 5: Perform 2nd Autobias Rate Sensor only — Time Required 3 Sec

Event 6: Reacquire B — Time Required 10 Sec
Impulse Required (est.) 10 lb-sec

Total impulse required **58 lb-sec**

Impulse Available:

Gas - Nitrogen, Tank Volume 370 in^3 (Gamma used = 1.35)
Start Pressure **5000** psia, End Pressure 400 psia
Impulse available = **206 lb-sec**
Start Pressure **2500** psia, End Pressure 400 psia
Impulse available = **119 lb-sec**

Margin:

At 5000 psia ((206/58)-1)*100 = **255 %**

At 2500 psia ((119/58)-1)*100 = **105 %**

SOFTWARE
(Time Line & Gains)

Time Line Synopsis

Flight Time	Event
T-45	Telemetry Cal OFF
T+94	*De-spin to ~1.1 rps*
T+95	Autobias Magnetometers & Rate Sensor (enables ACS when complete)
T+~99	Maneuver to $-\beta$ (±2° deadband)
T+101	ACS Enable Override
T+117	Disable ACS
T+118-136	*Payload deploys booms, despins payload to 0.278 rps*
T+118-136	ACS Roll Control, maintain spin at ≥ 0.5 rps.
T+137-140	ACS Roll Control, despin to ≥ 0.35 rps.
T+140	Begin 2nd Auto-bias Rate Sensor (enables ACS when complete)
T+~146	Re-Align to $-\beta$ Vector
T+169	Open servo deadband to ±5° (hysteresis type)
T+100-1000	Time Hacks on Discrete TM -every 100 secs & at 555 sec.

```
 E000 00 05       TTABLE      dw T-45
 E002 E2 40 00 00             dw .TMCALOF,0        Initializes registers, turns Cal
off

 E006 00 23                   dw T-15
 E008 E2 52 00 00             dw .ARMTIME,0        Arm pullaway timer sync

 E00C 00 92                   dw T+96              Roll rate = 1.1rps
 E00E E2 37 00 00             dw .BIASON,0         Align rs/mag, turns on ACS when
complete

 E012 00 96                   dw T+100
 E014 E2 4C 00 00             dw .TIMEMRK,0

 E018 00 97                   dw T+101
 E01A E2 3A 00 00             dw .BIASOFF,0        Fail-safe in case autobias fails

 E01E 00 97                   dw T+101
 E020 E2 22 00 00             dw .TTICKOF,0        Turns Time ticks to console off

 E024 00 A7                   dw T+117
 E026 E2 2B 00 00             dw .ACSOFF,0         Acquired Beta

 E02A 00 A8                   dw T+118
 E02C E2 46 00 A4             dw .SPINMODE,164     Roll spinup mode (to 0.534 +/-
.036 rps)

 E030 00 BB                   dw T+137
 E032 E2 4F 00 81             dw .SPINDWN,129      Roll spindown mode (to 0.385 +/-
.036 rps)

 E036 00 BE                   dw T+140
 E038 E2 49 00 00             dw .SPINOFF,0        Shuts off spin mode

 E03C 00 BE                   dw T+140
 E03E E2 1F 00 00             dw .ALIGN_RS,0       Autoalign Rate Sensor

 E042 00 BF                   dw T+141
 E044 E2 2E                   dw .SETGAIN
 E046 E1 99                   dw .GTABL2

 E048 00 C5                   dw T+147
 E04A E2 3A 00 00             dw .BIASOFF,0        Fail-safe in case autobias fails

 E04E 00 D7                   dw T+165             +4 sec rate mode
 E050 E2 19                   dw .WDBAND1
 E052 00 76                   dw 118               = +-10 degs

 E054 00 FA                   dw T+200
 E056 E2 4C 00 00             dw .TIMEMRK,0

 E05A 01 18                   dw T+230             500Km up
 E05C E2 2E                   dw .SETGAIN
 E05E E1 A9                   dw .GTABL3

 E060 01 18                   dw T+230
 E062 E2 31                   dw .WDBAND
 E064 00 68                   dw 104               = +-10 degs
```

```
E066 01 5E                    dw T+300
E068 E2 4C 00 00              dw .TIMEMRK,0

E06C 01 C2                    dw T+400
E06E E2 4C 00 00              dw .TIMEMRK,0

E072 01 F4                    dw T+450             Apogee update
E074 E2 34                    dw .NDBAND
E076 00 1C                    dw 35                = +-1.5 degs

E078 02 03                    dw T+465
E07A E2 19                    dw .WDBAND1
E07C 00 68                    dw 104               = +-10 degs

E07E 02 1C                    dw T+490             Apogee
E080 E2 4C 00 00              dw .TIMEMRK,0

E084 02 8A                    dw T+600
E086 E2 4C 00 00              dw .TIMEMRK,0

E08A 02 EE                    dw T+700
E08C E2 4C 00 00              dw .TIMEMRK,0

E090 03 20                    dw T+750             500Km down
E092 E2 2E                    dw .SETGAIN
E094 E1 99                    dw .GTABL2

E096 03 20                    dw T+750
E098 E2 31                    dw .WDBAND
E09A 00 76                    dw 118               = +-10 degs

E09C 03 52                    dw T+800
E09E E2 4C 00 00              dw .TIMEMRK,0

E0A2 03 B6                    dw T+900
E0A4 E2 4C 00 00              dw .TIMEMRK,0

E0A8 04 1A                    dw T+1000
E0AA E2 4C 00 00              dw .TIMEMRK,0

E0AE               ENDTIME    equ *
E0AE 33 35 2E 30 33 33        db "35.033r9flt "
E0BA 20 31 30 2F 37 2F        date
```

```
# Actual wind profile generated by AWICS.
# Data input is set to be of type mpsdeg
#
# Date:  2002/12/14
# Data from 100 meter wind mast
"11:16:05"        18.0         4.0         332.0
"11:16:05"        33.0         4.0         332.0
"11:16:05"        48.0         3.5         326.0
"11:16:05"        63.0         3.5         326.0
"11:16:05"        78.0         5.0         225.0
"11:16:05"        93.0         5.8         227.0
"11:16:05"       108.0         6.4         231.0
# Data from file:
# t/export/home/awics/Awics/windprofiles/norsk_radar_ball1.pro
"00:00:14"        125.20      7.80         238.8
"00:00:19"        148.20      6.70         230.5
"00:00:25"        172.70      5.70         238.1
"00:00:30"        196.70      7.00         232.9
"00:00:35"        219.90      8.40         234.0
"00:00:40"        245.30      7.10         242.6
"00:00:45"        271.40      7.00         235.2
"00:00:50"        294.90      7.40         234.7
"00:00:55"        318.80      7.00         245.4
"00:01:00"        344.20      8.10         263.6
"00:01:05"        368.80      8.70         231.8
"00:01:10"        391.20      6.20         221.3
"00:01:15"        411.20      8.60         241.9
"00:01:20"        432.20      7.40         234.7
"00:01:26"        455.90      6.30         233.1
"00:01:31"        481.10      7.50         237.8
"00:01:36"        506.40      7.70         242.2
"00:01:41"        532.20      6.70         235.7
"00:01:46"        558.50      7.40         232.9
"00:01:51"        586.50      8.10         233.7
"00:01:56"        616.60      5.50         229.3
"00:02:06"        659.00      5.30         227.2
"00:02:16"        718.60      4.90         233.8
"00:02:28"        786.10      4.00         226.8
"00:02:38"        849.50      2.80         270.0
"00:02:48"        908.20      2.00         244.1
"00:02:58"        966.00      2.60         230.2
"00:03:08"        1019.00     3.00         162.7
"00:03:18"        1073.50     1.10         217.5
"00:03:30"        1128.00     2.30         152.7
"00:03:40"        1181.30     2.10         165.1
"00:03:50"        1231.30     2.30         164.9
"00:04:00"        1276.30     2.50         144.8
"00:04:10"        1322.10     2.50         149.2
"00:04:20"        1370.30     3.90         160.4
"00:04:31"        1420.60     3.80         162.0
"00:04:41"        1476.60     5.30         146.1
```

"00:04:51"	1534.30	5.50	156.1
"00:05:01"	1587.90	5.50	161.3
"00:05:11"	1636.80	5.80	161.4
"00:05:21"	1684.60	3.90	156.9
"00:05:34"	1741.30	4.70	146.8
"00:05:46"	1799.50	4.40	148.6
"00:05:56"	1851.00	5.90	170.8
"00:06:06"	1897.80	6.30	170.8
"00:06:16"	1941.60	7.40	168.8
"00:06:28"	1987.40	5.40	171.4
"00:06:38"	2034.20	6.10	198.9
"00:06:48"	2083.80	7.40	201.4
"00:06:58"	2134.30	6.10	213.2
"00:07:08"	2180.60	5.20	205.4
"00:07:18"	2226.50	6.80	209.9
"00:07:30"	2274.60	5.40	210.0
"00:07:40"	2326.50	7.60	203.5
"00:07:50"	2374.10	6.10	214.9
"00:08:00"	2418.20	6.40	207.6
"00:08:10"	2465.30	7.80	201.7
"00:08:20"	2511.50	9.10	204.6
"00:08:32"	2560.00	8.30	196.7
"00:08:42"	2614.90	8.30	190.1
"00:08:52"	2666.70	9.10	204.0
"00:09:02"	2716.00	7.00	208.5
"00:09:12"	2768.60	5.60	211.0
"00:09:22"	2822.10	5.70	210.8
"00:09:34"	2882.70	6.30	216.6
"00:09:44"	2944.00	4.70	202.6
"00:09:54"	2998.20	4.80	163.8
"00:10:26"	3118.20	5.50	187.9
"00:10:56"	3308.70	7.00	197.2
"00:11:28"	3506.90	5.80	182.6
"00:11:58"	3708.70	6.50	150.1
"00:12:30"	3905.80	7.00	161.8
"00:13:00"	4102.00	8.40	153.7
"00:13:34"	4304.20	10.20	149.3
"00:14:04"	4497.50	11.10	147.2
"00:14:38"	4689.90	12.10	147.5
"00:15:08"	4887.10	12.80	145.5
"00:15:42"	5084.30	10.10	147.7
"00:16:12"	5270.40	7.50	143.9
"00:16:43"	5442.00	6.80	142.1
"00:17:13"	5618.60	5.70	136.7
"00:17:44"	5792.90	4.60	144.0
"00:18:15"	5971.80	3.90	168.6
"00:18:46"	6158.70	3.60	181.2
"00:19:16"	6343.30	3.00	189.9
"00:19:49"	6529.60	3.30	152.9
"00:20:51"	6803.50	5.60	181.9
"00:21:52"	7152.90	5.70	191.0

"00:22:53"	7519.60	6.90	226.0
"00:23:54"	7876.90	4.60	226.2
"00:24:56"	8219.90	7.50	213.7
"00:26:00"	8613.80	9.90	228.6
"00:27:02"	9037.60	11.60	249.9
"00:28:02"	9387.20	11.30	253.3
"00:29:05"	9663.90	10.10	237.2
"00:30:07"	9975.40	12.40	252.7
"00:31:10"	10321.60	14.10	270.4
"00:32:11"	10648.80	14.60	269.5
"00:33:11"	10968.30	11.90	262.1
"00:34:12"	11287.40	13.70	269.5
"00:35:14"	11588.90	19.30	266.1
"00:36:15"	11910.10	14.70	280.3
"00:37:15"	12227.10	13.90	279.8
"00:38:15"	12519.10	13.90	271.4
"00:39:16"	12815.20	16.50	264.1
"00:40:17"	13109.90	14.50	263.1
"00:41:17"	13396.90	12.10	256.0
"00:42:17"	13676.80	12.00	265.0
"00:43:17"	13970.90	15.60	268.7
"00:44:18"	14293.50	18.70	276.2
"00:45:18"	14618.60	17.10	277.1
"00:46:18"	14930.40	15.20	274.7
"00:47:18"	15232.30	9.80	265.8
"00:48:18"	15517.00	14.20	259.3
"00:49:18"	15813.60	16.10	259.9
"00:50:18"	16127.10	13.90	262.8
"00:51:18"	16426.50	16.80	274.0
"00:52:18"	16707.50	18.20	271.5
"00:53:18"	16987.70	17.70	269.7
"00:54:18"	17283.60	14.90	282.4

Data from file:
t/export/home/awics/Awics/windprofiles/norsk_radar_ball0.pro

"01:00:28"	17492.70	12.40	261.2
"01:01:28"	17761.40	14.30	273.1
"01:02:28"	18032.50	16.20	277.0

Data from ECMWF Vindprofiles:
t/export/home/awics/Awics/windprofiles/ecmwfwind.pro

"00:00:00"	19000.00	15.49	280.54
"00:00:00"	20000.00	14.50	277.34
"00:00:00"	21000.00	13.56	273.69
"00:00:00"	22000.00	12.68	269.51
"00:00:00"	23000.00	11.88	264.73
"00:00:00"	24000.00	11.17	259.31
"00:00:00"	25000.00	10.58	253.22
"00:00:00"	26000.00	10.12	246.50
"00:00:00"	27000.00	9.81	239.24

Post Flight Report

Vehicle Systems

8.0 Vehicle Systems

PFAFF 35.033
MISSION CLOSEOUT REPORT

Alfred Halter
Vehicle System Engineer

Summary

The Pfaff 35.033 mission was Launched form NY Alseund Norway on December 14, 2002 at 1116:47 UT. The BBV second stage ignition occurred at 12.4 second and the BBV motor separation occurred at 68.4 seconds. The Nihka ignition occurred at 72.5 seconds, and payload Despin occurred at 94.1 seconds. Despining After Nihka motor burnout, the payload was de-spun from 4Hz he after BBV motor to the desired 1.1hz. The BBX vehicle reached an altitude of 766.09Km with a dispersion of within 1.18 sigma of the payload predicted impact. All Vehicle Systems rocket motors and sub-systems performed nominally.

Expended Hardware

Vehicle Components	Part Number	Serial Number
Terrier Booster (MK 70)	Mk 12 Mod 1	0558
Terrier Fins	DGEN13391	1136,1138,1139.1140
Black Brant V Motor	600-00046-5	MV606
Black Brant V Igniter	600-04862-3	MV722
BBV 4 Fin Tail Assembly	600-03010-39	TA5-592
BBV Exit Cone	600-00048-3	EA4701-01
Nihka Motor	600-03801-3	NIH-52
Nihka Igniter	600-03842-3	NIH-725
Nihka Exit Cone	600-03834-7	_ W/Motor
Sub Systems	**Part Number**	**Serial Number**
BBV Igniter Housing	600-02012-35	97-460
Nihka Igniter Housing	600-00045-131	90-243
BBX/XII Separation System	600-03015-1	98-018
FEOS (SS Tip)	680-04007-1	
LEOS	680-04100-1	
Longitudinal Gun Kit	700-12901-1	1-018
Longitudinal Gun Rebuild Kit	2Each (680-04003-11,680-04003-13,700-12902-1,GE34-166-1	Used for test
Vehicle Pyrotechnics	**Part Number**	**Serial Number**
BBV Ignition	Holex 9293-1 2ea	823, 824
BBV Separation	Holex 3702 2ea	075, 076
Nihka Ignition	Holex 9293-1 2ea	826, 827
Despin	Holex 5801 2ea	005, 006
Terrier Initiator	SDI 103377-119 2ea	0637, 0635
LEOS	Holex 6201 2ea	1536, 1538

Expended Payload Pyrotechnics

Nosecone Deployment	3702	2ea
6 Meter Boom Extend	Weitzmanns	2ea
8 Meter Boom Fold Down	2801	2ea.
8 Meter Boom Extend	Weitzmanns	2ea.
Search Coil Boom Deployment	2801	1ea
EED/EID Boom Deployment	2801	1ea
EED/EID Door Deployment	2801	2ea
Knudsen Boom Deployment	2801	1ea
Weitzmann Tail Can Booms Deployment	Weitzmanns	2ea
Tail Can Booms Door Deployment	2801	2ea

Procedure Log 7

35.033 GE / Pfaff

Comprehensive Procedure Review Checklist

#	Procedure Title	Procedure #	Location	Reviewed (Initial/Date)
Electrical System Procedures				
1	EE TM Checkout Procedure	EEPUB-35033-01	TM (Groundstation)	[signature]
2	EE TM Integration Procedure	EEPUB-35033-02	TM (Groundstation)	
3	EE Environmental/Vibration Procedure	EEPUB-35033-03	TM (Groundstation)	
4	EE Environmental/Corona Test Procedure	EEPUB-35033-04	TM (Groundstation)	
5	EE Magnetic Calibration Procedure	EEPUB-35033-05	TM (Groundstation)	
6	Electrical Systems Power Systems Data Package	EEPUB-3503351	EE (blockhouse)	
Mechanical Systems Procedures				
7	Assembly procedure for Bristol radax type joint all diameter payloads.	12-10-1	ME (WFF & SVBD)	[signature]
8	Assembly procedure for Bristol type v-bands on all diameter payloads.	12-10-2	ME (WFF & SVBD)	
9	Assembly procedure for Bristol longitudinal v-band deployment gun.	12-10-7	ME (WFF & SVBD)	
10	Assembly procedure for blow-off door using Holex 2801 cutter.	12-10-11	ME (WFF & SVBD)	
11	Assembly procedure for Bristol FEOS.	12-10-8	ME (WFF & SVBD)	

12	NSROC Environmental Testing Policy Manual	Reference	ME (WFF)	
13	Work instruction for MOI table	50-2-1	ME (WFF)	
14	Work instruction for Bend Test machine (Static load facility)	50-7-1	ME (WFF)	
15	Gisholt balance machine setup	50-9-1	ME (WFF)	
16	Working Dynamic Balance procedure (2 plane)	50-10-1	ME (WFF)	
17	Work instruction for Vibration testing	50-12-1	ME (WFF)	
18	Work instruction for Spin Deployment Testing.	50-14-1	ME (WFF)	
Flight Performance / Wind Weighting Procedures				
19	FP Design Process	PA 0200	FP (WFF)	
Vehicle Systems Procedures				
20	Terrier MK12, Mod1, Rocket Motor Removal, Inspection and Installation in the Shipping Container.	31-8-1B	VS (blockhouse)	
21	Black Brant Removal, Inspection and Installation in the Shipping Container	31-17-1A	VS (blockhouse)	
22	Black Brant V Fin Survey and Alignment	31-17-5	VS (blockhouse)	
23	Inspection of Nihka Rocket Motor	31-17-3	VS (blockhouse)	
24	Terrier Rocket Motor Assembly for MK 12 or MK 70	30-3-5A	VS (blockhouse)	
25	Black Brant V Motor Assembly, Black Brant IX and Black Brant X Vehicles for Rail Launch	30-3-6	VS (blockhouse)	

26	Nihka Motor Assembly, Black Brant X Vehicle for Rail Launch	30-3-4	VS (blockhouse)	
27	Launcher Installation and Prelaunch Black Brant X Rail Launch Vehicle	30-3-1	VS (blockhouse)	
28	Launcher Rigging for Umbilical Retraction	30-30-1	VS (blockhouse)	
29	Installation & Removal of the Launcher Safety Support Systems	10-7-5	VS (blockhouse)	
30	BB5 Capacitor-Discharge Igniter Housing System Handbook, Ignition-Despin-Separation and Thrust-Termination-System Functions	ER 90896/A	VS (blockhouse)	
31	Black Brant V/Black Brant X Capacitor Discharge Igniter Housing System Handbook including Electrical Checkout and Mechanical Assembly Procedures for the Ignition, Despin, Separation and Thrust Termination System Functions.	ER 83865/B	VS (blockhouse)	
32	Black Brant Lateral Ejecting Ogive Systems Handbook (LEO)	ER 98615/A	VS (blockhouse)	
Attitude Control System Procedures				
33	GNC MACS Integration Procedure	ACS-MACS-SIT-023	ACS (WFF & SVBD)	
34	GNC Space Vector Analog 20610-2 Midas Platform Acceptance Test Procedure	GYO-TM-ATP-027	ACS (WFF & SVBD)	
35	GNC Pneumatics Aerospace Ground Equipment - Boost Pump	SPS-ALL-OPS-019	ACS (WFF & SVBD)	
Launch Countdown Procedure				
36	Integrated Launch Countdown Procedure	35.033	MM (SVBD & PFRR)	

NASA Procedures and Guidelines				
37	Ground Safety Data Package	GSFC/WFF Model NO: NRS-2488	MM (SVBD & PFRR)	[signature]
38	Procedures for field pressurization of ACS Pneumatics	TP-841.3	MM (SVBD & PFRR)	↓
39	Procedures for pressurization of high pressure vessels	TP-841.3	MM (SVBD & PFRR)	↓
40	Pneumatics Aerospace Ground Equipment, Boost Pump	25-1-1	MM (SVBD & PFRR)	↓
NASA Contingency Procedure's				
41	Sounding Rocket Operations in Event of Electrical Storm	803-WI-8072.1.2	MM (SVBD)	[signature]
42	SSOP for Booster Ignition Failure	803-WI-8072.1.3	MM (SVBD)	↓
43	SSOP for Launch Postponement/Cancellation	803-WI-8072.1.4	MM (SVBD)	↓
44	SSOP for Vacuum Pump Operations w/o Remote Switching	803-WI-8072.1.6	MM (SVBD)	↓
45	SSOP for operations in cold weather environments	803-WI-8072.1.7A	MM (SVBD)	↓
Code 800 Work-Hour Policy				
46	Code 800 work-hour policy	800-PG-8715.0.1	MM (SVBD & PFRR)	[signature]

Anomalies Reported 8

NSROC Nonconformance Report Log

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
318	7/25/2002	35.033 - Pfaff		Jim Hoffman	☐		☑	7/25/2002

Nonconformance Description/Cause

The print calls for hole C-13 thru C-16 to be tapped #4-40 and they have been tapped #8-32.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
319	7/29/2002	35.033 - Pfaff		Jim Hoffman	☐		☑	7/29/2002

Nonconformance Description/Cause

The print calls for the flange bolt circle to be on a 5.000 B.C. and the actual is 4.986.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
342	8/2/2002	35.033 - Pfaff		C. Kupelian	☐		☑	10/23/2002

Nonconformance Description/Cause

During Electrical checks for 35.033 Pfaff, The MFT support module was found to be defective.
The serial number is MFTS-103.
This number was also on the box: 33320

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
344	8/2/2002	35.033 - Pfaff		G. Rosanova	☐		☑	10/23/2002

Nonconformance Description/Cause

Mechanical interference was noticed between aft end of Aft Exp. Section (D38561) and forward end of Telemetry section (D38530). Experiment interface connectors in aft end of exp. skin would have interfered with top of PCM stack in TM. Not enough space was alotted for large connector shells and large bundles of twisted-shielded wires during design of these sections. It was determined that 3.5 inches of additional length was needed between interfering components to avoid the problem.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
348	8/26/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

The CETP search coil preamp mounting layout requires through holes for attachment instead of the existing threaded holes tapped in the mounting plate.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
349	8/26/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

The TM gyro housing assembly was oriented incorrectly. Also, the cutout in the housing base used for routing the cable harness needs to be modified to furnished more clearance.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
350	8/26/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☐	10/23/2002

Nonconformance Description/Cause

The print specified #8-32 tapped holes in the mast flange, subsequent review revealed the flange was tapped with #6-32 threaded holes.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
351	8/28/2002	35.033 - Pfaff		J.Deaton for G. Ro	☐		☑	10/23/2002

Nonconformance Description/Cause

The CETP boom were discovered to be longer than had been originally planned. The boom lengths were 9.5 inches longer than modeled which created concerns over clearance in the OGIVE during the spinning phase of the mission.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
353	8/28/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

Interference exists between the connector on the CETP current loop electronic box on the fwd side of deck 2 and the Knudsen boom assembly.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
354	8/28/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

One of the boom screw heads (1 for each Calgary boom) rubs against deck #1 (Dwg # D37306) in the stowed position.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
355	8/29/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

Because of connector locations, the experimenters requested the orientation of the CETP triax boom mounts (two total) to be positioned on opposite sides from what was originally modeled.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
356	8/29/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

The magnetometer in its original position interfers with the top of the CETP Current loop.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
357	8/29/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

The mounting plates layout for the (2) 8m Weitzman assys and (2) Weitzman boom probe assys layouts are incorrect by being located on the wrong side. The hinge of the 8m booms were flipped to fold opposite than what is required.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
358	8/29/2002	35.033 - Pfaff		J.Deaton for G. Ro	☐		☑	10/23/2002

Nonconformance Description/Cause

The mounting holes for one of the Tailcan booms was noted to be off by approx. 1 degree.

359	8/30/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

The x-axis CETP loop antenna sensors were secured somewhat differently and not as well as the z and y-axis loops.

360	8/31/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

During assembly of the GSFC analog (bottom deck #4) electronic box simulator located on deck #5, the electrical connectors were aligned 90 degrees out from where the prefabricated wire bundle/connectors assembly was located.

362	9/2/2002	35.033 - Pfaff		J.Deaton for G. Ro	☐		☑	10/23/2002

Nonconformance Description/Cause

The original location of the drilled hole and slot in the magnetometer boom for the CETP triax cannot be used due to the final position of the CETP Triax on its boom.

364	9/4/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

The mounting hole pattern in deck #3 for both 8m Weitzman assys is too far inboard and prevents the booms from rotating 90 degress at the hinge. The booms actually hit deck #3.

369	9/13/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

The GSFC magnetometer mounting block hole pattern did not match the hole pattern in the magnetometer boom.

373	9/16/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

During the second fit check of the nosecone, one of the deck plates caught on one of the pan-head liner attachment screws located in the aft section of the nosecone.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
374	9/19/2002	35.033 - Pfaff		J. Deaton for G. R	☐		☑	10/23/2002

Nonconformance Description/Cause

The Aerospace boom experiment currently installed on the aft deck #6, with booms deployed, will be located directly under and in line with the 8 m Weitzman booms above on deck #3. According to the experimenter this will cause an unwanted shadowing affect between the boom sensors.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
377	9/25/2002	35.033 - Pfaff		J.Deaton for G. Ro	☐		☑	10/23/2002

Nonconformance Description/Cause

After performing the vibration testing on the payload, it was discovered that several of the attached screws, securing several of the experiments to deck #6, were found loose.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
378	9/23/2002	35.033 - Pfaff		J.Deaton for G. Ro	☐		☑	10/23/2002

Nonconformance Description/Cause

During the payload bend test, results from the first push/pull cycle indicated the structure over deflected by .25 inches in the plane with aft experiment doors.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
384	9/30/2002	35.033 - Pfaff		T. Sterling	☐		☑	10/23/2002

Nonconformance Description/Cause

The GPS system would not acquire SVs outside and would only acquire inside if extremely close to a re-radiation source. The GPS system would lose track on SVs when the PCM system was powered in certain configurations. The PCM stack was found to be a source of high levels of EMI. The GPS receiver was found to have a sensitivity problem and was determined to be the source of the acquisition problems.

NCR#	Date	Mission	Project	Preparer	CA Req	CATS #	MRB Action Re	Final Closeout Date
410	10/23/2002	35.033 - Pfaff		G. Rosanova	☐		☑	10/23/2002

Nonconformance Description/Cause

During the design phase of this mission, the Weitznam booms in the Nihka Tail Can were oriented correctly. They were required to be 5 deg offset (CW looking aft) from the Weitzman booms in the forward experiment. However, during post DR design iterations, the orientation of the upper booms was changed, but the tail can booms did not follow.

Total NCR's = 25

NSROC Nonconformance Report

NCR#: 00318 **Date:** 7/25/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Experiment Deck **Serial #:** N/A **Document:** D37312

Effectivity Date: 7/17/2002 **Revision:** - **Preparer:** Jim Hoffman

Affected Area: Manufacturing

Nonconformance Description/Cause:

The print calls for hole C-13 thru C-16 to be tapped #4-40 and they have been tapped #8-32.

Disposition: ☐ Rework ☐ Repair ☑ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☐ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Fabrication Error

CA/PA To Be Performed:

These holes are for #4-40 standoffs to mount a connector bracket on the aft side of deck. Will fabricate standoffs with #8-32 studs to thread into deck. Affect on assembly will be positive as it will add stiffness to the connector mount.

Disposition/CA Authorization G. Rosanova/

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Ken DiGiulian	Ted Gass	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 7/25/2002	Date 7/25/2002	Date

Disposition Verification

Performed By: Killmon, Andy **Date Completed:**

Inspected By: Hoffman, Jim **Date Inspected:**

Verified By: N/A **Date Verified:**

Final Closeout Date: 7/25/2002

NSROC Nonconformance Report

NCR#: 00319 **Date:** 7/29/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Magnetometer Boom Base **Serial #:** N/A **Document:** D37316

Effectivity Date: 7/8/2002 **Revision:** - **Preparer:** Jim Hoffman

Affected Area: Manufacturing

Nonconformance Description/Cause:

The print calls for the flange bolt circle to be on a 5.000 B.C. and the actual is 4.986.

Disposition: ☐ Rework ☐ Repair ☑ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☐ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Fabricated Mechanical Part **Defect Code:** Fabrication Error

CA/PA To Be Performed:

Test/ Investigate via fit check to mating part. Use-As-Is fit check ok. PA is none

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Ken DiGiulian	Ted Gass	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 7/29/2002	Date 7/29/2002	Date

Disposition Verification

Performed By: Cain, Jeff **Date Completed:** 7/25/2002

Inspected By: Hoffman, Jim **Date Inspected:** 7/25/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 7/29/2002

NSROC Nonconformance Report

NCR#: 00342 **Date:** 8/2/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: MFT Support Module **Serial #:** MFTS-103 **Document:**

Effectivity Date: **Revision:** **Preparer:** C. Kupelian

Affected Area: Manufacturing

Nonconformance Description/Cause:

During Electrical checks for 35.033 Pfaff, The MFT support module was found to be defective.
The serial number is MFTS-103.
This number was also on the box: 33320

Disposition: ☑ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☑ Test/Investigate ☐ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Electrical Parts **Defect Code:** Defective

CA/PA To Be Performed:

Replace defective MFT support module with a new one from stock. Furthur investigation by the engineering has revealed that the Max 233 was defected. The chip was replaced with the new chip along with the new inverter. The system was tested again with acceptable results.

Disposition/CA Authorization Kupelian & Anh Nguyen

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Charlie Lankford	N/A
Date 10/10/2002	Date 10/10/2002	Date

Disposition Verification

Performed By: Boulter, Dave **Date Completed:** 10/10/2002

Inspected By: Nguyen, Anh **Date Inspected:** 10/10/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00344 **Date:** 8/2/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Aft Experiment Skin **Serial #:** **Document:** C37314

Effectivity Date: **Revision:** **Preparer:** G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

Mechanical interference was noticed between aft end of Aft Exp. Section (D38561) and forward end of Telemetry section (D38530). Experiment interface connectors in aft end of exp. skin would have interfered with top of PCM stack in TM. Not enough space was alotted for large connector shells and large bundles of twisted-shielded wires during design of these sections. It was determined that 3.5 inches of additional length was needed between interfering components to avoid the problem.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Design Change

CA/PA To Be Performed:

CA: One of the experiments was reported to be 2.72 shorter as built that the original design (GSFC Analog Electronics Box). The remainder of the 3.5 in. was available by reducing clearance between Decks 4 and 5 (D37310, D37311). Therefore, Deck 6 (D37312), which is in the aft experiment structure was moved forward by 3.5 in. The aft experiment longerons (C37314) were shortened to 21.55 in. long, effectively moving Deck 5 forward .75 inches. The deployable doors for the Aerospace Corporation will be lengthened by 4.25 in. Consequently, no extension adapters will be added to the payload, nor will the paload gain weight.

PA: Avoiding interference problems are the responsibility of the design engineer to check and double-check his work and make sure all parts of an assembly are properly accounted for.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Jim Deaton	Brian Hall	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 10/10/2002	Date 10/22/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:**

Inspected By: Rosanova, Giovanni **Date Inspected:**

Verified By: N/A **Date Verified:**

NSROC Nonconformance Report

Final Closeout Date: 10/23/2002

NCR#: 00348 **Date:** 8/26/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Mounting deck # 3 **Serial #:** **Document:** D37306

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The CETP search coil preamp mounting layout requires through holes for attachment instead of the existing threaded holes tapped in the mounting plate.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☑ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Design Change

CA/PA To Be Performed:

The design was changed and the tapped holes were drilled to provide through hole attachment. Update Dwg #D37306

Disposition/CA Authorization Giovanni Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 8/26/2002	Date 8/26/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 8/26/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 8/26/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00349 **Date:** 8/26/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: TM gyro assy **Serial #:** **Document:** D38575

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The TM gyro housing assembly was oriented incorrectly. Also, the cutout in the housing base used for routing the cable harness needs to be modified to furnished more clearance.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Design Change

CA/PA To Be Performed:

Investigation revealed that the lid of the TM gyro was mounted on the wrong end of the gyro assembly housing. The lid was removed and reinstalled to provide proper orientation. The cutout was added to the base. (PA) In order to avoid the need for a cutout in the base, the standard notch cut in the deck plate will be elongated further out radially.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 9/10/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Morrison, Dana **Date Completed:** 9/10/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 9/10/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00350 **Date:** 8/26/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Mast flange **Serial #:** **Document:** D37306

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The print specified #8-32 tapped holes in the mast flange, subsequent review revealed the flange was tapped with #6-32 threaded holes.

Disposition: ☑ Rework ☐ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☐ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Fabricated Mechanical Part **Defect Code:** Fabrication Error

CA/PA To Be Performed:

Tap the holes for #8-32 screws.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☐ **MRB Required**

Signatures:

Jim Deaton	Giovanni Rosanova	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 8/26/2002	Date 8/26/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 8/26/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 8/26/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00351 **Date:** 8/28/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: CETP antenna boom **Serial #:** **Document:** D37645

Effectivity Date: **Revision:** **Preparer:** J.Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The CETP boom were discovered to be longer than had been originally planned. The boom lengths were 9.5 inches longer than modeled which created concerns over clearance in the OGIVE during the spinning phase of the mission.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Electrical Parts **Defect Code:** Experiment Problem

CA/PA To Be Performed:

Investigation revealed that the boom lengths had always been modeled at 9.5 inches shorter than actual which would provide the margin of clearance originally designed. The booms lengths were shortened by 9.5 inches. The change was approved by the experimenter.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Jim Deaton	Brian Hall	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 8/28/2002	Date 10/23/2002	Date 8/28/2002

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 8/28/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 8/28/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00353 **Date:** 8/28/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Knudsen booms **Serial #:** **Document:** D37308

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

Interference exists between the connector on the CETP current loop electronic box on the fwd side of deck 2 and the Knudsen boom assembly.

Disposition: ☐ Rework ☐ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Electrical Parts **Defect Code:** Experiment Problem

CA/PA To Be Performed:

The current loop electronics box was moved toward 0 degrees to eliminate the interference. Update Dwg #D37308.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 8/28/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 8/28/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 8/28/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00354 **Date:** 8/28/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Knudsen booms **Serial #:** **Document:** (Ref.) Exp. Dwg.

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

One of the boom screw heads (1 for each Calgary boom) rubs against deck #1 (Dwg # D37306) in the stowed position.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☑ Test/Investigate ☐ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Fit Interference

CA/PA To Be Performed:

Remove the lock washer under the screw. Reinstall screws using Loctite.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 8/28/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 8/28/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 8/28/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00355 **Date:** 8/29/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: CETP booms **Serial #:** **Document:** D37289, sht 2

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

Because of connector locations, the experimenters requested the orientation of the CETP triax boom mounts (two total) to be positioned on opposite sides from what was originally modeled.

Disposition: ☐ Rework ☐ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Experiment Problem

CA/PA To Be Performed:

Reposition the mounts of the CETP triax booms opposite than what was originally planned. The new location does not cause a problems with payload symmetry. Update Dwg # D37289.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Jim Deaton	B. Hall	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 8/29/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 8/29/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 8/29/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00356 **Date:** 8/29/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Magnetometer **Serial #:** **Document:** D37304

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The magnetometer in its original position interfers with the top of the CETP Current loop.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Fit Interference

CA/PA To Be Performed:

Relocate the magnetometer forward .30 inches to provide adequate clearance for the CETP booms. Update Dwg # D37304.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Jim Deaton	Brian Hall	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 8/29/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 8/29/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 8/29/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00357 **Date:** 8/29/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: GSFC Weitzman booms **Serial #:** **Document:** D37309,D37310

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The mounting plates layout for the (2) 8m Weitzman assys and (2) Weitzman boom probe assys layouts are incorrect by being located on the wrong side. The hinge of the 8m booms were flipped to fold opposite than what is required.

Disposition: ☑ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Experiment Problem

CA/PA To Be Performed:

The boom assemblies were sent back to Kaleva and the manufacturer was asked to follow 95100-Geodesic-ICD when repositioning the mounting plates. The plates were mounted on the opposite side of the boom assemblies and were fit checked with satisfactory results.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Jim Deaton	Brian Hall	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 9/4/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Kaleva **Date Completed:** 9/4/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 9/4/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00358 **Date:** 8/29/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Nihka Tailcan Assy **Serial #:** **Document:** D38583

Effectivity Date: **Revision:** **Preparer:** J.Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The mounting holes for one of the Tailcan booms was noted to be off by approx. 1 degree.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Fabrication Error

CA/PA To Be Performed:

Drill a new set of holes radially CW looking forward 1 degree from the existing aft set of holes. After the repair a fit check was performed with satisfactory results. Update Dwg # D38583.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 8/31/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Shop **Date Completed:** 8/31/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 8/31/2002

Verified By: **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00359 **Date:** 8/30/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: CETP delrin side plates **Serial #:** **Document:** in work

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Other

Nonconformance Description/Cause:

The x-axis CETP loop antenna sensors were secured somewhat differently and not as well as the z and y-axis loops.

Disposition: ☐ Rework ☐ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Electrical Parts **Defect Code:** Experiment Problem

CA/PA To Be Performed:

The ME group recommended that additional support side plates, made from delrin, be fabricated and added to the x-axis loop antenna. The delrin supports were made and installed with the concurrence of the experimenter. Create a new drawing.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Jim Deaton	Brian Hall	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 8/31/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Morrison, Dana **Date Completed:** 8/31/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 8/31/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00360 **Date:** 8/31/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: GSFC electronic boxes **Serial #:** **Document:** D37311

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

During assembly of the GSFC analog (bottom deck #4) electronic box simulator located on deck #5, the electrical connectors were aligned 90 degrees out from where the prefabricated wire bundle/connectors assembly was located.

Disposition: ☐ Rework ☐ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Design Change

CA/PA To Be Performed:

The analog box was re-positioned where the connectors on the wire bundle and the electronic boxes are aligned.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 8/30/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 8/30/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 8/30/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00362 **Date:** 9/2/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Magnetometer boom **Serial #:** **Document:** D37304

Effectivity Date: **Revision:** **Preparer:** J.Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The original location of the drilled hole and slot in the magnetometer boom for the CETP triax cannot be used due to the final position of the CETP Triax on its boom.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Fabricated Mechanical Part **Defect Code:** Design Change

CA/PA To Be Performed:

Modify the fiberglass magnetometer boom by cutting a slot in the boom that is 1.0 in wide and .9 in. long using the centerline and aft edge of the original hole as the datum point. Also cut a slot that is .38 in. wide and 1.5 inches long using the aft edge of the first slot and the original hole as the datum point. The final assembly was fit checked with satisfactory results. Update Dwg # D37304.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 9/3/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Morrison, Dana **Date Completed:** 9/3/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 9/3/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00364 **Date:** 9/4/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: 8m Weitzman Assy **Serial #:** **Document:** D37309

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The mounting hole pattern in deck #3 for both 8m Weitzman assys is too far inboard and prevents the booms from rotating 90 degress at the hinge. The booms actually hit deck #3.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Fit Interference

CA/PA To Be Performed:

The cause of this problem was Kaleva changed the mounting hole pattern after the decks were made. The 8m Weitzman assys were removed, deck #3 was removed, a deck layout was performed with the Weitzman assys providing optimum clearance for the hinge joint, a set of new holes were drilled approximately .75 outboard of the existing holes, all systems were reinstalled, and the assys were fit checked with acceptable results. Update Dwg D37309.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 9/5/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 9/5/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 9/5/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00369 **Date:** 9/13/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: GSFC Magnetometer **Serial #:** **Document:** D37306

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The GSFC magnetometer mounting block hole pattern did not match the hole pattern in the magnetometer boom.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Electrical Subassemblies **Defect Code:** Design Change

CA/PA To Be Performed:

Drill a new hole pattern in the magnetometer boom. This will change the magnetometer orientation from 0 degrees to 180 degrees orientation. This change was authorized by Dr. Pfaff.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 9/16/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 9/16/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 9/16/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00373 **Date:** 9/16/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Nosecone aft liner **Serial #:** **Document:** D40468

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

During the second fit check of the nosecone, one of the deck plates caught on one of the pan-head liner attachment screws located in the aft section of the nosecone.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Fabricated Mechanical Part **Defect Code:** Design Change

CA/PA To Be Performed:

Remove the liner from the nosecone, remove the aft (only) liner attachment pads, countersink the existing tapped holes in the pads, remove any burrs and check threads with a finishing tap, reinstall pads and liner using new countersink head screws. Perform fit check of payload and verify adequate clearance exists when removing the payload from the nosecone. Also, a nosecone deployment test was performed with acceptable results.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 9/19/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 9/19/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 9/19/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00374 **Date:** 9/19/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: EED/EID Aerospace boom **Serial #:** **Document:** D38561

Effectivity Date: **Revision:** **Preparer:** J. Deaton for G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

The Aerospace boom experiment currently installed on the aft deck #6, with booms deployed, will be located directly under and in line with the 8 m Weitzman booms above on deck #3. According to the experimenter this will cause an unwanted shadowing affect between the boom sensors.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Fabricated Mechanical Part **Defect Code:** Mislocated

CA/PA To Be Performed:

The Aerospace aft experiment located between deck plates #5 and #6 and attached to deck #6 will be repositioned by rotating the aft section in the payload skin 33.75 degrees, CCW (Fwd looking aft). The existing holes in the skin for the ACS nozzles can no longer be used and new holes will have to be machined in the skin 33.75 degrees, CW (Fwd looking aft) to accommodate the ACS section. The existing holes will be covered. Perform a thorough inspection of all wiring harnesses bends and verify acceptable clearances are maintained. Installed a new hole pattern on the forward skin to mount forward experiment structure. This change also required the nosecone to be rotated the same as the skin. A new "O" orientation point was stamped on the skin and the nosecone to accommodate repositioning the two sections.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Jim Deaton	Brian Hall	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 9/20/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Machine Shop **Date Completed:** 9/20/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 9/20/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00377 **Date:** 9/25/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: SeveralExp. **Serial #:** **Document:**

Effectivity Date: **Revision:** **Preparer:** J.Deaton for G. Rosanova

Affected Area: Testing

Nonconformance Description/Cause:

After performing the vibration testing on the payload, it was discovered that several of the attached screws, securing several of the experiments to deck #6, were found loose.

Disposition: ☐ Rework ☐ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☑ Test/Investigate ☐ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Experiment Problem

CA/PA To Be Performed:

This issue was discussed with each experimenter and they will take appropriate measures to ensure that their fasteners be properly secured, possibly with loctite, to handle flight loads.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 9/25/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Experimenter **Date Completed:** 9/25/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 9/25/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00378 **Date:** 9/23/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Payload **Serial #:** **Document:**

Effectivity Date: **Revision:** **Preparer:** J.Deaton for G. Rosanova

Affected Area: Testing

Nonconformance Description/Cause:

During the payload bend test, results from the first push/pull cycle indicated the structure over deflected by .25 inches in the plane with aft experiment doors.

Disposition: ☐ Rework ☐ Repair ☑ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☑ Test/Investigate ☐ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Experiment Problem

CA/PA To Be Performed:

The bend test was conducted on 9/23/02. Flight V-bands were used during the test. The following is a summary of the results.

- Desired Test Moment = 150,000 lb.-in. at payload base
- Load Station = 51.15 in. TNT (base of ogive)
- Predicted tip deflection = 0.74 in.
- Measured tip deflection = 1.10 in.

This over-deflection was first noticed during the first push/pull “exercise” cycle of the test. Testing personnel were then instructed to measure the compliance of the two V-band joints on the payload (Nosecone base and Nihka Igniter aft joint). These measurements are summarized below.

- Nosecone joint (V-band) = 1.18E-8 rad/lb.-in.
- Igniter joint (V-band) = 6.74E-9 rad/lb-in.
- Nominal used by FP (V-band) = 6.0E-9 rad/lb.-in.

Because of these results, the nosecone aft joint was thought to be the culprit for the over-deflection. First, end gaps on the V-band were measured and found to be within the nominal range. Then, both halves of the joint were inspected and it appeared that the V-band was not making proper contact on the Aft Experiment Skin side. A “GO-NO GO” gage was also used to check the joint profiles and the Aft Experiment side fit loosely in the “GO” half of the gage. Therefore, in order to verify that this joint was the culprit, the bend test was repeated by pushing at the nosecone base, thus removing any contribution from the flexing body by this joint. In addition, the two ACS radax joints were instrumented for compliance measurements. The results are summarized below.

- Desired Test Moment = 150,000 lb.-in. at payload base
- Load Station = 85.9 in. TNT (base of nosecone skirt)
- Predicted tip deflection = 0.53 in.
- Measured tip deflection = 0.90 in.
- ACS fwd joint compliance (Radax) = 6.05E-10 rad/lb.-in.
- ACS aft joint compliance (Radax) = 6.50E-10 rad/lb.-in.
- Nominal used by FP (Radax) = 4.0E-9 rad/lb.-in.

NSROC Nonconformance Report

☐
Notice that the ACS joints were measured to be an order of magnitude stiffer than nominal. Therefore, these were ruled out as possible culprits. At this point, because there was still an over-deflection, the model used to predict tip deflection was scrutinized. It was discovered that the stiffness distribution (EI) used by Flight Performance had an error in the middle of the Telemetry section, which described a portion of this section to be stiffer than actual. This error was corrected and new predicted tip deflection for the load case pushing at the base of the ogive was calculated.

☐Corrected tip deflection prediction = 0.99 in.

This is still less than the measured deflection of 1.10 in. No more mistakes could be found in the model and no obvious mechanical problems could be identified other than the Nosecone V-band. Therefore, Flight Performance has manipulated the flight model to match the measured tip deflection. This includes inserting the measured Nosecone joint compliance. Then, using this modified model, the flight dynamics were recalculated and found to have sufficient margin for a favorable flight. No action was taken to mechanically modify the joint halves at the base of the nosecone since there would be greater risk of exacerbating the problem than fixing it.

In conclusion, the payload structure has been deemed acceptable for flight.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Jim Deaton	Brian Hall	N/A
Date 10/21/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: N/A **Date Completed:**

Inspected By: N/A **Date Inspected:**

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00384 **Date:** 9/30/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: GPS **Serial #:** **Document:**

Effectivity Date: **Revision:** **Preparer:** T. Sterling

Affected Area: System Test

Nonconformance Description/Cause:

The GPS system would not acquire SVs outside and would only acquire inside if extremely close to a re-radiation source. The GPS system would lose track on SVs when the PCM system was powered in certain configurations. The PCM stack was found to be a source of high levels of EMI. The GPS receiver was found to have a sensitivity problem and was determined to be the source of the acquisition problems.

Disposition: ☑ Rework ☐ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☑ Test/Investigate ☐ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Electrical Parts **Defect Code:** Integration and Testing

CA/PA To Be Performed:

CA- The GPS receiver and pre-amp were replaced. Numerous test including an all up test at the old antenna range was preformed with the new GPS components and all systems on and deployable components deployed (except Weitzman boom extension). In this configuration EMI with respect to the GPS system was not noted.

Disposition/CA Authorization T. Sterling

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Jim Deaton	Charlie Lankford	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 10/21/2002	Date 10/21/2002	Date

Disposition Verification

Performed By: Haugh, Herb **Date Completed:** 9/20/2002

Inspected By: Sterling, Thad **Date Inspected:** 9/30/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

NSROC Nonconformance Report

NCR#: 00410 **Date:** 10/23/2002 **Mission:** 35.033 - Pfaff **Project:**

Temporary NCR#:

System Name: Nihka Tail Can **Serial #:** **Document:** D38583

Effectivity Date: **Revision:** **Preparer:** G. Rosanova

Affected Area: Assembly

Nonconformance Description/Cause:

During the design phase of this mission, the Weitznam booms in the Nihka Tail Can were oriented correctly. They were required to be 5 deg offset (CW looking aft) from the Weitzman booms in the forward experiment. However, during post DR design iterations, the orientation of the upper booms was changed, but the tail can booms did not follow.

Disposition: ☐ Rework ☑ Repair ☐ UAI ☐ Reclassify ☐ Scrap ☐ RTV

☐ Test/Investigate ☑ Drawing Change - ECN #: ☐ Refer To MRB

Item Code: Mechanical Parts **Defect Code:** Design Change

CA/PA To Be Performed:

The Nihka Tail Can and Cross-bar push-off section (between the Black Brant Igniter and the Nihka) will be rotated 22.5 deg (two radax holes) CW looking aft, new mounting holes for the Tail Can booms will be drilled 5.0 deg CCW looking aft for a net rotation of the booms 17.5 deg CW looking aft. The Tail Can boom door openings will also be widened to accommodate the shift, and new doors/doublers will be made. The tail can will be subjected to 3-axis random vibration (no booms installed) and the doors will be deployed to verify proper function.

Disposition/CA Authorization G. Rosanova

☐ **CATS Required** **CATS #:** ☐ **Mission Review Panel** ☑ **MRB Required**

Signatures:

Jim Deaton	Brian Hall	N/A
SQA Rep./SQA MRB Rep.	Engineering/MM MRB Rep.	Customer (Where Applicable)
Date 10/23/2002	Date 10/23/2002	Date

Disposition Verification

Performed By: Tucker, Brian **Date Completed:** 10/23/2002

Inspected By: Rosanova, Giovanni **Date Inspected:** 10/23/2002

Verified By: N/A **Date Verified:**

Final Closeout Date: 10/23/2002

Lessons Learned 9

Lessons Learned

Issue #1:

After the final settings were made to the ACS at Space Vector and the final timeline established, the experimenter decided to change the timeline during integration which cost the mission an extra 3 days and almost caused a delay in shipment to Norway.

Lessons Learned:

Issues such as this seem to be a recurring problem within the program. They have been for as long as I can remember. The only "realistic" expectation is to establish a clear understanding (as clear as possible) of the mission timeline as early as possible. Given certain changes between predicted and measured mass properties at the last minute during integration it is extremely difficult to prevent this. Measuring the "real" mass properties at the last minute is in part to blame for this issue. Try to establish integration schedule well in advance (at least several months) of the planned shipping date to help alleviate the bottleneck toward the end.

Issue #2:

During the GPS testing at the NASA/WFF outdoor antenna field, personnel from the NASA Air Traffic Control Tower came over and wanted to know what we were doing. They indicated that we were supposed to notify them before we started our testing. They were concerned whether our test could impact their runway operations.

Lessons Learned:

For future GPS testing at the antenna range, NSROC Mission Manager will notify the NASA Air Traffic Control Tower at 1-757-824-1109 prior to the start of any such testing.

Issue #3:

During the GPS outdoor testing, problems were encountered with not having telephones or access to equipment required for communicating between the F-10 Ground Station, N-162 Mobile TM, and the NSROC TM personnel positioned with the payload at the antenna field. NSROC had to use their personal cellular phones to provide the communication link and complete the test. This problem continues to surface each time the GPS test is performed

Lessons Learned:

NSROC needs to make arrangements to have NASA/WFF install telephones or equivalent communication equipment in the same building that NSROC uses to power the GPS system located adjacent to the antenna field. NSROC should make arrangements to support of the test if NASA does not.

Issue #4:

During testing in the field an ACS valve failed. Even after being advised by the mission manager not to use Federal Express, a spare valve was shipped anyway on Federal Express. Due to the anticipated delay the valve that failed was rebuilt rather than replaced with a like spare.

Lessons Learned:

The preferred carrier recommended for subsequent Norway missions is SAS airlines via Jet Pac or Pilot Pac not Federal Express.

Issue #5:

There were some problems with not having a waiver in place when the schedule required exceeding the work hour limitations as established by NASA policy.

Lessons Learned:

Before going to the range again, arrangements need to be made to quickly obtain a waiver when work hours limitations need to be exceeded. This effort will fall under the NSROC mission manager responsibilities.

Issue #6:

Due to the launcher rail width being much wider on the launchers in Norway, several problems were encountered with rigging the ACS, pneumatics, and other system umbilicals to the launch vehicle.

Lessons Learned:

Recommendations were made for future missions that engineering prepare layout drawings detailing locations and rigging methods for umbilical installation when using the wider launcher rails, well in advance of anticipated field operations.

Issue #7:

Problems were encountered with the file transfers.

Lessons Learned:

1 Gigabyte memory sticks will be purchased which can be plugged into the USB ports on the computers of engineers and technicians in the field. This will facilitate quick and reliable transfer of data between equipment.

Issue #8:

Tracy's emergency kits with hand-held portable radios, rechargeable flashlights, medical supplies, etc. proved to be very useful at the range. The team made several positive comments to Tracy expressing their appreciation for his efforts in preparing the kits and making them available at the range.

Lessons Learned:

For future missions, we need to evaluate if more kits are needed and also establish a replenishment procedure to keep the kits stocked with items that have not exceeded their shelf life.

Issue #9:

The blanket purchase request that the NSROC mission manager was provided for purchasing supplies and needed equipment at the range proved to be extremely useful, efficient, and time saving.

Lessons Learned:

The NSROC mission manager should be given a "blanket" purchase request (with Kings Bay Company) of this type for subsequent missions from the SvalRak launch facility.

Issue #10:

Shipping NSROC equipment under the ITAR license that was used for this mission was too restrictive. Shipping all of the mission's assets under one license restricts separating any part of the return shipment

Lessons Learned:

Investigate using other ITAR licensing regulations and other options for shipping the mission's assets.

Issue #11:

Software problems were encountered with the GPS wind weighting system that was borrowed from NASA/WFF. The Norwegians and NASA personnel at Wallops finally solved the problems. If not corrected, this could have lead to missing a launch opportunity or the launch window.

Lessons Learned:

Before using the NASA/WFF GPS system on the next mission, the launch team should work with NASA to ensure proper familiarization and checkout of the equipment thus preventing this from occurring again.

Issue #12:

All post flight activities went as planned except for initially trying to load all of the return shipment in a Conax cargo carrier. The Conax carrier was too expensive. The shipment was separated into smaller shipping containers.

Lessons Learned:

Do not use Conax carriers for shipping from Norway

Issue #13:

An issue was raised that some of the new team members had their first encounter with ESD around the payload. In Sweden, as well as some of the ranges located in colder, dryer, and/or low humidity environments, ESD is not only a concern for the payload electronics but also ordnance devices.

Lessons Learned:

Many NSROC team members have taken the NSROC ordnance awareness training with covers ESD training for ordnance handlers. Recommendations were made to also offer the electrical certification ESD training as an awareness class to NSROC employees that will be working around the electronic systems of the payloads.

Issue #14:

There seems to have been some questions as to who is the NSROC team member responsible for ordering the shipping crates needed for the mission. Tracy Gibb indicated he assumes this responsibility for his missions.

Lessons Learned:

The NSROC Mission Manager will assume this responsibility.

Issue #15:

There was some difficulty obtaining the experimenter's requirements questionnaire at the beginning of the mission.

Lessons Learned:

Continue to request completed science requirements data packages from all PI's. This will be initiated at the MIC by providing the PI with a hardcopy of the document. Subsequent follow-ups with the PI via email and phone contact will be made to try and obtain the completed packages. Continue to update the questionnaire in the SR handbook.

Issue #16:

Possible payload coning during the boom deployment sequence with only a lower roll control programmed ACS system.

Lessons Learned:

(a) Inputs, outputs, and uses of the STRAN and FLEX6D analysis programs, including structural modeling of each set of booms for the STRAN program.

(b) Post flight data reduction indicates that the payload's coning angle peaked at 8^o at T+146 seconds. The coning reduces after this peak and appears to level out.

Issue #17:

The ACS performed as specified in the Requirements document in that:

1) It adjusted the Roll spin rate to the specified rate in the specified time.
2) Maneuvered to the magnetic field in the specified time
3) Maneuvered with acceptable precision.
4) Turned off at the specified time.

Lessons Learned:

(a) On future missions: if there are to be two (or more) autobias calls, all should include autobiasing both the rate sensor **and** magnetometers.

(B) The method of calculating Roll axis impulse requirements should include 2X Roll nozzles with the p/l radius as the moment arm.

Issue #18:

Many lessons were learned on this mission from a mechanical design and packaging standpoint. These points are summarized below.

Lessons Learned:

- Leave ample clearance between back shells of interface connectors and components in adjacent sections, especially if the payload is wired with twisted and shielded harnesses.
- Allow for easy assembly and disassembly of experiment structures, taking into account the substantial wire harness that will accompany it. Consider interface connectors between sections that need to be taken apart several times during the mission life cycle.
- Many experiment screws came loose during vibration testing. It will be a challenge, but future payload teams need to encourage experimenters to torque their fasteners one last time before environmental testing.
- The orientation of tail can booms relative to the 6m booms on the forward end of the payload was supposed to be offset by 5^{o} in order to compensate for bending during deployment. This requirement was communicated late in the mission life cycle and thus caused significant re-work to correct. Since and NCR was written to capture this issue, it will serve as a good

reference to future engineers who will have tail can booms on their payloads so that the offset can be designed in before hardware is built.

- Update ME43447 "Mechanical Field Assembly Procedure for Experiment Structures" to reflect lessons learned during final assembly in the field.
- Investigate possibility of designing future ACS modules with umbilical connectors farther away from 0^{o}. This will help to avoid tight fits under the launcher in Svalbard, which is wider than or conventional launchers.
- Recommend interface connector on Langmuir probe assembly rather than having it hard-wired. This will facilitate disassembly in the field for coating of the sphere.
- Obtain interface control drawings from Weitzman boom manufacturers earlier in design cycle. Kaleva design changes their mounting hole pattern, but I did not get their ICD until after their decks had been built.
- Design a better cooling approach for the Calgary booms. The cooling lines, which entered through the Telemetry section and were fed up to the boom tips, were removed and the entire payload was purged rather than just the SEI/SII sensors.
- Change the Nihka tail can modifications to include a door/cover for mounting the electrical interface connector. Having it hard mounted to the skin made it difficult to install in the field.

Self Assessment 10

Self Assessment

Part 1: SPAF

NSROC's self-assessment for this mission is an "Excellent" overall for the SPAF. This is based on the following three factors:

1) SOW Compliance

    a. Performance relative to design.

        i. This mission was a new mission. Extensive design effort was required. The design was provided in an "as timely manner as possible" and in accordance with the published schedule. To the best of our knowledge all systems performed as designed. Therefore, NSROC self-assessment for this portion of the SPAF is considered "excellent".

    b. Performance relative to fabrication.

        i. This mission was a new mission. Extensive fabrication effort was required. All fabrication was completed on time and in accordance with the published schedule. Therefore, NSROC self-assessment for this portion of the SPAF is considered "excellent".

    c. Performance relative to testing.

        i. Testing was completed in an efficient and thorough manner, in accordance with the published schedule. Therefore, NSROC self-assessment for this portion of the SPAF is considered "excellent".

    d. Performance relative to field operations.

        i. Field operations were conducted in accordance with the published schedule. The only exception being the delivery of the MCR. Extensive ACS analysis was required and could not have been provided any sooner. NSROC self-assessment for this portion of the SPAF is considered "excellent".

2) Safety

    a. All safety standards, requirements and regulations, as listed in the SOW, were strictly adhered to at all times throughout the lifecycle of this mission. Therefore, NSROC self-assessment for this portion of the SPAF is considered "excellent".

3) Flexibility

    a. NSROC was able to efficiently and effectively respond to all "real-time" needs of the science group. Therefore, NSROC self-assessment for this portion of the SPAF is considered "excellent".

Part 2: <u>MOAF</u>

NSROC is currently unable to provide a self-assessment regarding the C "factor" (Cpam & Cpbm). The lack of a Science post-flight report, gauging mission success in relationship to each success criterion was not submitted. Therefore, we are unable to provide an accurate assessment.

NSROC is currently unable to provide a self-assessment regarding the $MOAF_b$. The lack of a Science post-flight report, gauging mission success in relationship to each success criterion was not submitted. Therefore, we are unable to provide an accurate assessment.

Overall I feel the NSROC process is working extremely well and I can foresee continual improvement, efficiency and growth. I look forward to serving in the mission manager capacity and I will gladly accept any and all future missions so assigned. Thank you.

Tracy Gibb
Mission Manager
Pfaff/35.033