One Black Brant IIA test of recovery package: vehicle no. AAA-II-101

Rance, E.W.; National Research Council of Canada. Radio and Electrical Engineering Division

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OPERATIONS REQUIREMENT NO. 173 FOR BLACK BRANT ROCKET AAA-II-101 RECOVERY TEST JRPC NO. 6616

PREPARED BY

RADIO AND ELECTRICAL ENGINEERING DIVISION

OTTAWA

JUNE 1966

ABSTRACT

This OR is for the launching of one Black Brant IIA rocket during daylight hours when there is radar aurora on the trajectory. The vehicle will carry the new Black Brant II and V separation and recovery unit, plus upper atmosphere experiments. Recovery of the nose cone is required.

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JRPC APPROVAL NO. 6616

OPERATIONS REQUIREMENT NO. 173

One Black Brant IIA Test of Recovery Package

Vehicle No. AAA-II-101

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TEST SECURITY CLASSIFICATION

The security classification of information in this OR is **UNCLASSIFIED.**

1.0 GENERAL INFORMATION

1.1 Operations Command

The following personnel will be at the Churchill Research Range, Fort Churchill, in connection with this program:

Project Coordinator	-	A. Staniforth, NRC
Project Scientist	-	A. Staniforth, NRC
Mission Controller	-	Capt. E.W. Rance, NRC
Payload & Ground Instrumentation	-	Approximately five NRC personnel, to be named
	-	One engineer from BAL, to be named.

It is expected that Mr. W.L. Haney of NRC will be present as an observer during this test.

Times and dates of arrival of all personnel will be passed to CRR approximately two weeks prior to the arrival of the team at the Range.

1.2 Range Time Utilization

1.2.1 Test Duration and Frequency

This test will require a countdown of approximately three hours plus the range time required for a successful recovery mission. A single test during daylight hours will satisfy this requirement.

1.2.2 General Countdown

TIME	FUNCTION/SERVICE
Preparation Phase:	
F-5 day (approx.)	Nose cone, nose cone instrumentation, check-out equipment and nose cone control unit arrive at Fort Churchill. This equipment will be consigned to CRR. CRR is requested to supervise the unloading and arrange to have the equipment transported and stored in the preparation area allotted to this project (6.1.2).
	Range User personnel arrive at Fort Churchill.
F-4 day (approx.)	Range User personnel begin setting up check-out equipment and preparation of nose cone instrumentation.
F-1 day	Nose cone preparation complete.
	Move nose cone, payload control console, power supplies, etc., to blockhouse if not moved before.
	Battery charging complete.
	Install all batteries to payload.

1.2.2 General Countdown (cont'd.)

TIME	FUNCTION/SERVICE	RESP.
F-1 day (cont'd.)	Complete instrumentation check-out with nose cone shroud off.	
	Range install radar beacon and check operation.	
	Magnetometer check.	
	Check complete length of umbilical cable from console in blockhouse to vehicle 50-pin connector with test box.	Range
Launch Phase:		
T-360	Final visual inspection of payload and battery check.	User
	Assemble nose cone shroud to payload.	User
	Remove strippable paint and clean nose cone.	User
T-250	All Range User personnel on station.	MC
T-240	Move nose cone to Hazardous Assembly.	User
T-220	Obtain weight and C. of G. of Nose Cone.	User/LS
	Assemble nose cone to motor.	User/LS
	Obtain weight and C. of G. of complete vehicle.	User/LS
T-180	Vehicle brought to Launch Bay.	LS/TC

1.2.2 General Countdown (cont'd.)

TIME	FUNCTION/SERVICE	RESP.
T-170	Install vehicle on Launcher.	LS/TC
	Range begin count with Range User.	All
	Check that payload control console is disconnected from umbilical cable.	MC/TC
	Connect umbilical to vehicle.	User/MC/TC
	Connect radar beacon batteries.	User/MC/TC
	Install access hatch in forward body temporarily.	User/MC/TC
	Clean nose cone.	User/MC/TC
T-140	Clear Launch Bay for Horizontal Instrumentation Checks.	LS/TC
	Connect Control Console to Umbilical.	MC/TC
T-135	Begin Horizontal Instrumentation Checks.	All
T-95	Horizontal Checks completed.	
	Stations report results of checks.	
T-90	Disconnect BH control console from umbilical.	MC/TC
T-60	Arm vehicle.	TC/LS
T-30	Elevate launcher.	TC/LS
T-20	BH control console connected to umbilical.	MC/TC
T-15	Begin Vertical Instrumentation Checks.	All

1.2.2 General Countdown (cont'd.)

TIME	FUNCTION/SERVICE	RESP.
T-8	Vertical checks complete.	MC/TC
T-5	Voice count at 1-minute intervals to T-2 minutes.	TC
T-3.5	Radar interrogate beacon continuously for remainder of test, unless hold occurs.	RDR
T-2	TLM paper recorders on at slow speed.	TLM
	TLM magnetic tape recorders on high speed.	TLM
	TLM acknowledge recorders on.	TLM
	Payload latch power on and commence 2.5V (midband) calibration.	User
T-110 sec.	5-volt calibration (lower edge).	User
T-100 sec.	0-volt calibration (upper edge).	User
	Hold for aurora, resumption of count on 30-seconds notice. After 1/2 hr. re-cycle to 3.5 min.; PS may request re-cycle at less than 1/2 hr. to allow 1/2 hr. hold at T-90 sec. at more opportune time.	All
	Note: Telemetry real time and magnetic recorders and payload T/M links, except No. 4, to come on 30 seconds prior to resumption of count.	
T-90 sec.	Voice count at 10-second intervals to T-10 seconds.	TC

1.2.2 General Countdown (cont'd.)

TIME	FUNCTION/SERVICE	RESP.
T-90 sec. (cont'd.)	Radar beacon to internal power.	RD
	Link No. 1, 3 cycles of 11-step (0 to 5 volts) calibration.	User
	Multiplex relays to transfer position.	User
T-75 sec.	T/M Link No. 1 to signal inputs and in-flight calibrator on.	User
T-40 sec.	T/M real time recorders to flight speed.	TLM
	Payload multiplex relays to flight position.	User
	Remove latching power.	User
T-10 sec.	Voice count at 1-second intervals to T + 10 seconds.	TC
T-0 sec.	Black Brant motor ignites.	
T+10 sec.	Voice count at 10 sec. intervals to splash.	TC
T+15.5 sec.	Rocket motor burns out.	
T+197 sec.	Apogee - approximately 500,000 ft.	
T+320 sec. (approx.)	Nose cone separates from motor.	
T+470 sec. (approx.)	Drag parachute deploys followed by main parachute.	
T+600 sec. (approx.)	Impact of nose cone.	

1.3 Test Objectives

1.3.1 Primary

To launch rocket AAA-II-101 during daylight hours when weather conditions in the impact area are suitable for a recovery operation and to recover the separated nose cone. The rocket is to be launched when there is radar aurora on the trajectory.

1.3.2 Secondary

To ascertain and record rocket trajectory and performance

1.4 Test Description

1.4.1 General

Black Brant IIA rocket AAA-II-101 will be fitted with a new separation and recovery mechanism and, also, will carry several experiments in its nose cone for scientific investigation of the upper atmosphere. It is desired that this vehicle be launched from the universal launcher to obtain an effective elevation of 85^{o} and an azimuth to ensure an impact in the recovery area. The presence of radar aurora on the trajectory is required. This test is to be carried out early in the day so that there is sufficient daylight for the recovery of the nose cone.

1.4.2 Experiments

The primary experiment on this vehicle is a new separation and recovery package for the Black Brant II and V vehicles that is being subjected to a flight test. This package separates the nose cone from the motor during the flight; in this case on the downward leg of the trajectory when the vehicle is at an altitude of approximately 200,000 ft. Separation is obtained by causing a mechanism to release a manacle ring. This action is initiated by a signal from a timer in the payload. The separated, and

1.4.2 Experiments (cont'd.)

unstable, nose cone will tumble and, therefore, decelerate as it falls into the sensible atmosphere. At approximately 20,000 ft. the payload recovery actuating system causes the secondary separation device to operate. This forcefully expels the parachute cover plate which deploys the drogue/pilot parachute into the airstream. This action also actuates the pyrotechnic reefing line cutters on the main deployment bag and drag action of the drogue/pilot parachute deploys the main parachute canopy into the airstream. The main parachute should result in the nose cone impacting at a velocity of not greater than 27 fps. This mechanism uses proven components and techniques in all critical areas. The manacle rings' designs are based on a similar unit used on the "Skylark" rocket. The parachute recovery system is a scaled version of the proven Space General Corporation "Aerobee" package.

Vehicle AAA-II-101 will also carry upper atmosphere experiments as follows:

a. A Neutron Detector which is designed to measure the intensity of neutrons at high altitude in the energy range 0.2 to 10 Mev. It employs a "phoswich" technique to discriminate between neutrons, γ-rays, and charged particles (U of C).

b. Plasma Probe measurements of the fine structure of electron density and electron energy spectrum inside and outside auroral formations (NRC).

c. Micrometeoroid Detector - an acoustic-type impact counter concerned with impact rates and energy distribution inside and outside major meteor showers and association with auroral activity (NRC).

d. A total of six cameras will be fitted into this payload. Two 35-mm cameras will be mounted to scan to the rear of the vehicle and will record lift-off; two 35-mm cameras will be mounted in the recovery section of the nose cone and will record separation and parachute deployment; two 8-mm cameras will be mounted looking out of the nose cone at right angles to record the position of the horizon and provide data to assist in vehicle attitude determination.

1.4.3 Performance and Timings

In addition to experiments, this vehicle will also carry a horizon sensor and a solar aspect indicator together with magnetometers, accelerometers and an angle-of-attack indicator to assist in the evaluation of vehicle performance and attitude. The operation of critical functions of the separation and recovery mechanisms will be monitored and telemetered for recording.

Events of primary importance during the flight are:

a. motor burnout at approximately 15.5 secs.;

b. peak altitude at approximately 197 secs.;

c. nose cone separation at approximately 320 secs.;

d. deployment of the drag parachute followed by the main parachute;

e. nose cone impact.

1.4.4 Personnel

Range User personnel will attend to all details of the payload and nose cone assembly, check-out and monitoring and will:

a. man the NRC nose cone instrumentation console in blockhouse, and

b. require access to the nose cone in the launch bay during the horizontal instrumentation checks.

1.5 Test Vehicle Description

The Black Brant IIA is a single-stage, solid-propellant, unguided sounding rocket developed by the

1.5 Test Vehicle Description (cont'd.)

Canadian Armament Research and Development Establishment. The rocket for this test will use a 15KS25000 motor filled at Bristol Aerospace Limited, Winnipeg, and airlifted to Churchill. The stabilizer unit will be the standard Black Brant II, four-fin unit. This unit was shipped to Churchill from Montreal by rail and assembled, aligned and trimmed at Churchill. The Range User arranged for the stabilizer to be aligned to produce a vehicle roll rate of approximately 0.75 rps maximum stabilizing to approximately 0.65 rps.

Operation and handling instructions for the 15KS25000 motor are detailed under CARDE TN 1528/63, copies of which are held by the Range. The critical points concerning this vehicle are:

Length	-	360 inches (approx.)
Diameter	-	17.2 inches
Launch Weight	-	2750 lbs. (approx.)
Weight at Burnout	-	950 lbs. (approx.)
Propellant	-	Aluminized single grain polyurethane-ammonium perchlorate
Total Impulse (sea level)	-	380,000 lbs.
Motor Burning Time	-	15.5 seconds
Guidance	-	None. Four fixed-fin stabilization.
Cut-down System	-	None.

Final weighing of the vehicle prior to launch may require minor corrections to performance predictions based on actual vehicle all-up weight. All performance calculations quoted are based on a vehicle all-up weight of 2,680 lbs.

1.5.1 Complete Vehicle Drawing

1.5.1.1 Vehicle Drawing

See Figure 1.

1.5.1.2 Nose Cone Drawing

See Figure 2.

1.5.2 Telemetry Systems

Link No. 1: The primary nose cone telemetry is a PAM/FM/FM system operating at 219.5 MHz, 1 watt nominal. FM modulation will consist of 16 IRIG SCO's and an IRIG commutator, 30 channels by 10 rps. The antenna system consists of two quadraloop radiators, mounted 180° apart on the surface of the nose cone at Station 90. The polarization is linear.

Link No. 2: A second telemetry transmitter in the nose cone will be a PAM/FM/FM transmitter operating at 240.2 MHz, 1 watt. Modulation will consist of 13 IRIG SCO's and an IRIG commutator, 30 channels x 10 rps. The antenna system consists of two quadraloop radiators mounted 180° apart on the surface of the nose cone at Station 115. The polarization is linear.

1.5.3 Beacons

CRR is requested to provide two beacons for this test. A DPN-41 radar beacon is required to facilitate radar tracking of the vehicle and a SARAH unit to aid in locating the separated nose cone after impact. Range User will provide space and mounts for the beacons; a box for holding five Yardney Type HR-3 batteries, wiring from the DPN-41 to the batteries and to the umbilical connector (seven conductors), and a pair of quadraloop beacon antennas with coaxial cable to the DPN-41 beacon. Range User will also provide a directional coupler for monitoring incident power to the antenna system. The

FIGURE I

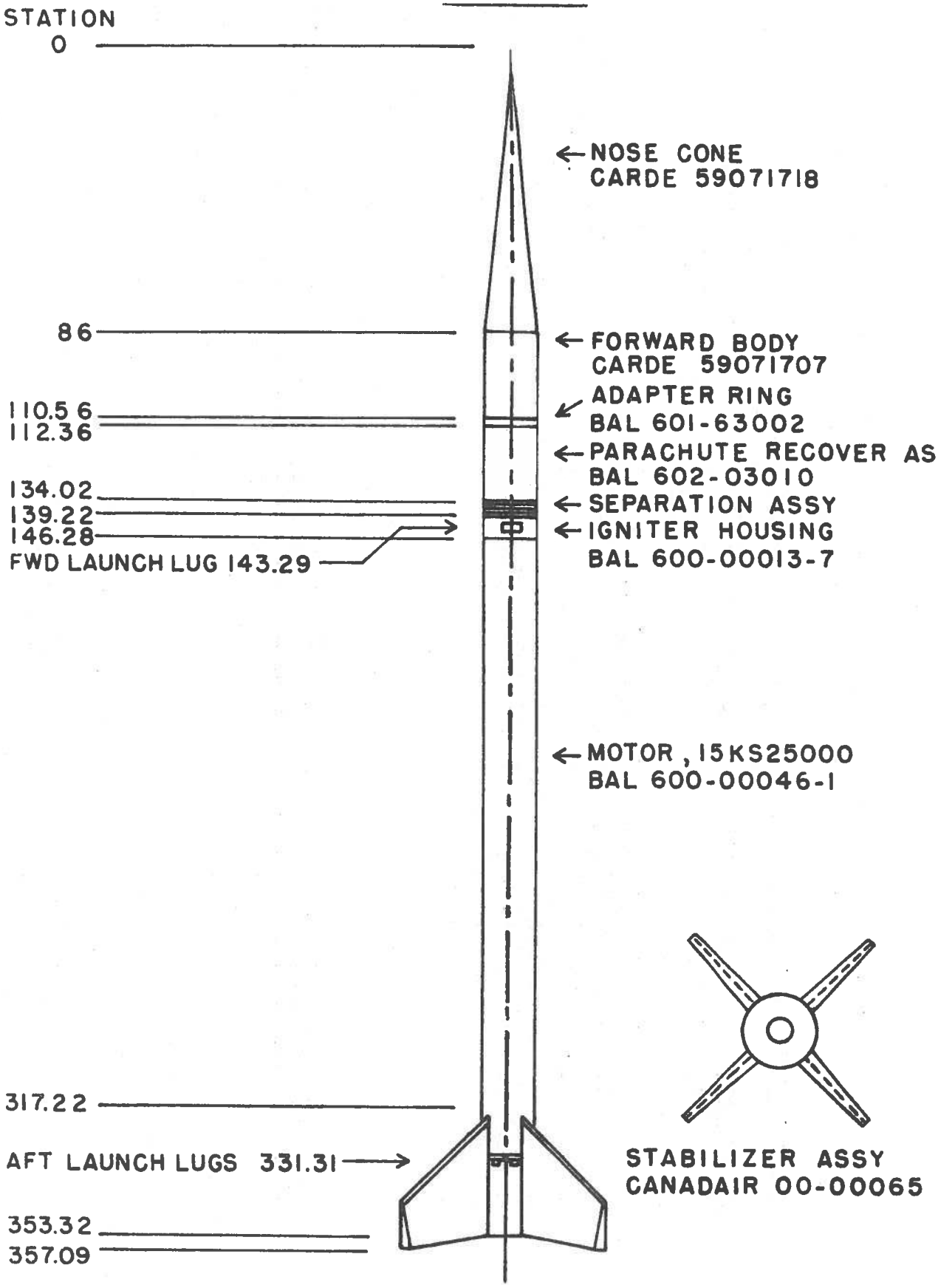
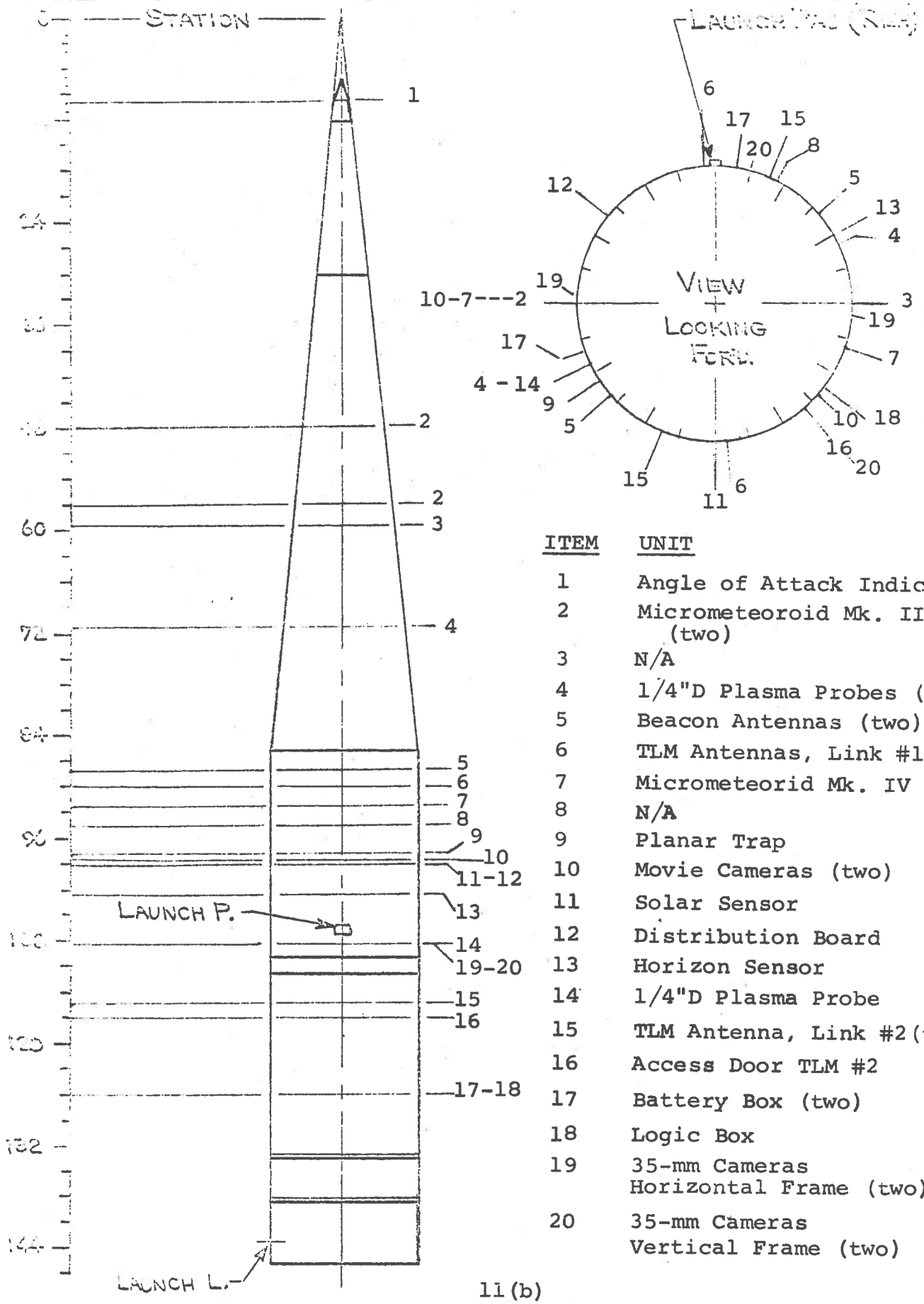

STATION
0
86
110.56
112.36
134.02
139.22
146.28
FWD LAUNCH LUG 143.29
317.22
AFT LAUNCH LUGS 331.31
353.32
357.09
NOSE CONE
CARDE 59071718
FORWARD BODY
CARDE 59071707
ADAPTER RING
BAL 601-63002
PARACHUTE RECOVER ASSY
BAL 602-03010
SEPARATION ASSY
IGNITER HOUSING
BAL 600-00013-7
MOTOR, 15KS25000
BAL 600-00046-1
STABILIZER ASSY
CANADAIR 00-00065

FIGURE 2

NOSE CONE LAYOUT



ITEM	UNIT
1	Angle of Attack Indicator
2	Micrometeoroid Mk. III (two)
3	N/A
4	1/4"D Plasma Probes (two)
5	Beacon Antennas (two)
6	TLM Antennas, Link #1 (two)
7	Micrometeorid Mk. IV (two)
8	N/A
9	Planar Trap
10	Movie Cameras (two)
11	Solar Sensor
12	Distribution Board
13	Horizon Sensor
14	1/4"D Plasma Probe
15	TLM Antenna, Link #2 (two)
16	Access Door TLM #2
17	Battery Box (two)
18	Logic Box
19	35-mm Cameras Horizontal Frame (two)
20	35-mm Cameras Vertical Frame (two)

1.5.3 Beacons (cont'd.)

coupling will be 20 db down. User will monitor beacon functions on Link No. 1. The monitor circuit is shown under Appendix I.

The antennas for the DPN-41 beacon will be tuned for a beacon transmitter frequency of 2900 MHz and a beacon receiver frequency of 2800 MHz.

It is understood that operation, control and check-out of the beacons is to be the responsibility of CRR.

1.6 Range User's Instrumentation

The Range User will supply all equipment for check-out and assembly of the nose cone payload. This instrumentation will consist of:

1.6.1 User's Room - Blockhouse

A control console unit (the same unit as used in previous tests) will be used to monitor the launch. Channels IRIG Nos. 1-6 and Nos. 9-18 inclusive of TLM Link #1 and IRIG Nos. 1-6 and Nos. 9, 11, and Nos. 15-18 inclusive of TLM Link #2 will be monitored from this console. Discriminator outputs from main telemetry are, therefore, to be displayed on the meters in the blockhouse. An NRC selector will be connected to the meter display panel to allow selected channels to be displayed on an oscilloscope in the control console. Receivers for the 219.5 MHz and 240.2 MHz links will be included with the console, together with a tunable discriminator and a 17-inch display oscilloscope. A telemetry antenna, as provided by CRR in March 1966, is required on the roof of the blockhouse for this equipment.

1.6.2 Nose Cone Assembly Area - Operations Building

High impedance instruments will be installed in this room to monitor discriminator outputs from

1.6.2 Nose Cone Assembly Area - Operations Building (cont'd.)

channels IRIG 9-17 inclusive of TLM Link No. 1. Outputs from main telemetry are to be provided at the RF/Real Time patch panel. User will provide signals of 85 kHz and 100 kHz for recording on the CRR telemetry magnetic tape recorder. The arrangement of these instruments is detailed under Appendix V.

Range User will provide equipment for separating and detecting the six event channels, IRIG 1-6 of Link #1. This equipment will be operated in the telemetry room by CRR.

This test will require two decommutators. The User will provide the additional decommutator required and CRR will be requested to set up this instrument in main telemetry. User will provide an operator. This equipment is required to provide real time, quick look data, from both Link No. 1 and Link No. 2 commutators.

Doppler Range Experiment:

The payload of the rocket will include two stable 100 kHz oscillators. The output of one will be telemetered in Link #1 and of the other on Link #2. The Link #1 transmitter is frequency stabilized by a crystal-controlled oscillator from which a stable 85.75 kHz signal is derived. This signal will be telemetered on Link #1. Thus, three independent frequency stable signals will be telemetered to the ground receiving sites from the rocket.

It is the intention that these received signals be compared with frequency stable reference oscillators at the receiving sites to obtain the Doppler shift due to rocket motion and thereby obtain data from which the rocket trajectory may be computed.

In addition to the telemetry receiving sites at Twin Lakes and the Launch Site, CRR is requested to set-up and operate a telemetry receiving station at the radar site. Telemetry reception and recording at the radar site is primarily for the Doppler experiment so that a direct comparison can be made with range data from the tracking radars.

1.6.2 Nose Cone Assembly Area - Operations Building (cont'd.)

The telemetry receiving systems at the Launch Site is indicated on the block diagram, Appendix V. This includes the processing and recording required for the Doppler data. All equipment shown in the User Preparation Area and also the Yagi antenna for linear polarization reception will be supplied by the Range User. The complete data recording assignments for the magnetic tape recorders is given in para. 2.3.2.1 and Appendix IV.

1.6.3 Radar Site

CRR is requested to install and operate a telemetry receiving station at the Radar Site, as indicated on the system diagram, Appendix VI. The 100 kHz and 85 kHz reference oscillators and summing network (mix) will be supplied by the Range User. The output levels from this unit will be 1.0 to 2.0 volts rms, and less than 200 ohms impedance.

It is requested that this site be manned by two telemetry section personnel, one being necessary for antenna tracking.

It is essential that this station be able to receive Links #1 and #2 from the rocket when the rocket is on the Universal Launcher in the vertical position. If this is deemed unlikely, then a means of transmitting the reference oscillator signals to the User Preparation Area in the Operations Building should be provided.

1.6.4 Twin Lakes

Magnetic tape recorder track allocations are detailed in the block diagram, Appendix VII. The ground reference oscillator unit supplied by the Range User as a reference for the Doppler experiment will be a unit similar to that used at the Radar Site and the Launch Site.

1.7 Range User's Responsibilities

1.7.1 Countdown

A general countdown is detailed under 1.2.2. A detailed Range User's countdown will be mailed so as to arrive at CRR no later than T-5 days.

1.7.2 Telemetry

Changes in telemetry details, frequencies or SCO's, are not expected. Should such changes be required CRR will be advised of all details prior to T-5 days. Completed forms PAA23-240 detailing real time playback requirement for pen and oscillograph recordings will be mailed so as to arrive at CRR no less than five (5) working days prior to the scheduled test.

1.7.3 Vehicle Trajectory Information

Performance predictions and wind weighting information for this vehicle are detailed under the CARDE Data Booklet for Black Brant vehicles AA-II-37, 58, 59 and 60. Copies of this booklet were supplied to CRR in 1965.

1.7.4 RF Usage and Clearance

The main telemetry frequencies used for this payload are 219.5 and 240.2 MHz as assigned to NRC.

1.7.5 Ordnance Items

Characteristics of propellant, igniter and squib are available in the CARDE Technical Note on the Black Brant 15KS24000 rocket, T.N. 1528/63. The igniter squib is an M.56 Mod. VI.

Bellows actuators (squib) are used in the payload. Two types of these devices, both made by the Hercules Powder Company of Wilmington, Delaware, are used. The characteristics are:

1.7.5 Ordnance Items (cont'd.)

	Type BA31D2	Type BA31K2
Bridge Resistance:	5-9 ohms	4-5 ohms
Maximum Non-fire:	50 ma., one 30 sec. pulse	50 ma, one 30 sec. pulse
Minimum Fire:	0.3 amp.	0.3 amp.
Recommended Fire:	1.0 amp.	1.0 amp.
Ignition Time:	0.25 milli-seconds (at 1.0 amp.)	0.6 milli-seconds (at 1.0 amp.)

The three one-quarter inch plasma probe extension mechanisms use one type BA31D2 each; the two micrometeoroid door ejection mechanisms use two type BA31K2 each. The location of these items is shown under Appendix II and the firing circuit under Appendix III. The two 8-mm camera doors require two type BA31K2's each.

1.7.6 Payload Handling

The Range User will assemble the nose cone to the motor in Hazardous Assembly. Assistance by CRR personnel is requested for this operation.

1.7.7 Material and Services

Range User personnel authorized to request material and services support from CRR are Mr. A. Staniforth, the Project Coordinator, and Capt. E.W. Rance, the Mission Controller.

1.8 N.R.

1.9 Summary of Frequency Utilization

Link No.	Frequency	Class	Equipment	Location
1	219.5 MHz	U	Telemetry	Nose Cone
2	240.2 MHz	U	Telemetry	Nose Cone

1.10 Scheduling Responsibilities

The normal impact area will suffice for this vehicle. Detailed scheduling will be requested following the arrival of the test team at the Range.

2.0 DATA

2.1 Metric Data

Tracking radar only is required for this test. DOVAP is not required.

Launch to Impact:

Item	Data	Interval	Data Points/sec.	Reduced Data Accuracy Class I	Class II	Class III
1.	Position (X,Y,Z)	Throughout Flight	1 per sec. T-0 to T+100 sec.; 1 pt per 5 sec. T+105 sec. to T+290 sec.; 1 pt per sec. T+291 to impact.	Plotting Board Data to best possible accuracy.		

Magnetic tape recording of metric data with IRIG "B" timing is required; data reduction by the Range is not required. A copy of the record from the radar function recorder is required to obtain the AGC data.

Impact: Impact coordinates are desired by sound ranging equipment.

2.2 Engineering Photography - NR

2.3 Telemetry

2.3.1 Equipment and Data

The primary telemetry station will satisfy telemetry ground station requirements, for this test, with Twin Lakes station operating as a "back-up" station.

2.3.2 Recordings

2.3.2.1 Magnetic Tape Records

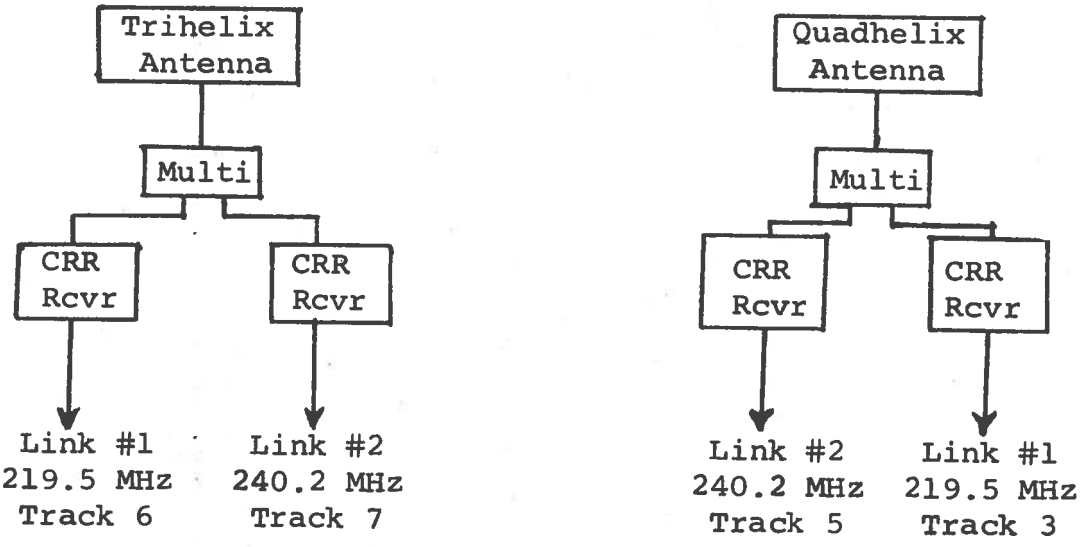
Magnetic tape recordings of telemetry are requested for approximately two minutes during the vertical instrumentation checks (TLM to be notified of times by MC) and from T-2 minutes to loss of signals plus post flight for AGC calibration. Track assignments requested are:

Track	Record
1	IRIG Timing, Format "B" and Format "C" and Link #1 mixed 100 kHz and 85 kHz signals.
2	Receiver signal strength, lift-off data, Link #2 mixed 100 kHz signal, and Doppler signals.
3	Nose cone telemetry, Link #1 (219.5 MHz).
4	Voice countdown, 17 kHz tape servo reference and 100 kHz - 85 kHz reference signals.
5	Nose cone telemetry, Link #2 (240.2 MHz).
6	Nose cone telemetry Link #1 (219.5 MHz) and 85 kHz - 100 kHz reference signals.
7	Nose cone telemetry Link #2 (240.2 MHz) and 100 kHz reference signals.

The receiver-antenna combinations are shown in Fig. 3. The 85 kHz and 100 kHz reference signals will be provided by Range User from the User area in Operations Building as shown in Appendix V.

2.3.2.1 Magnetic Tape Records (cont'd.)

FIG. 3



The signals to be recorded on Track 2 consist of:

S.C.O.

IRIG No.	Freq.	Signal
5	1.3 kHz	Link #1, 85 kHz Doppler
6	1.7 kHz	Link #1, 100 kHz Doppler
7	2.3 kHz	Link #2, 100 kHz Doppler
8	3.0 kHz	AGC of user receiver for Link #2 (240.2 MHz)
13	14.5 kHz	AGC of receiver for Link #2 (240.2 MHz)
14	22.0 kHz	AGC of receiver for Link #1 (219.5 MHz)
15	30.0 kHz	AGC of receiver for Link #1 (219.5 MHz)
16	40.0 kHz	Igniter flash indicator
17	52.5 kHz	Umbilical pull-away indicator
18	70.0 kHz	Frequency comparator (Doppler)
--	100.0 kHz	Link #2, mixed signal (Doppler)

2.3.2.1 Magnetic Tape Records (cont'd.)

The following details apply to the data to be recorded:

Item No.	Link #1 Freq.	IRIG Channel No.	Freq.	Dev. ±%	Measuring Rate	Class	Accuracy ±%	Remarks
1	219.5 MHz FM/FM	1	400 Hz	0	Cont.	I	-	Rigid 1/4" Probe Extension
2	219.5 MHz FM/FM	2	560 Hz	0	Cont.	I	-	MM Mk. IV Door A
3	219.5 MHz FM/FM	3	730 Hz	0	Cont.	I	-	MM Mk. IV Door B
4	219.5 MHz FM/FM	4	960 Hz	0	Cont.	I	-	MM Mk. IV Shutter A
5	219.5 MHz FM/FM	5	1.3 kHz	0	Cont.	I	-	MM Mk. IV Shutter B
6	219.5 MHz FM/FM	6	1.7 kHz	0	Cont.	I	-	70K ft. Alt. Sw.
7	219.5 MHz FM/FM	9	3.9 kHz	7.5	Cont.	I	2%	Neutron Detector A
8	219.5 MHz FM/FM	10	5.4 kHz	7.5	Cont.	I	2%	Neutron Detector B
9	219.5 MHz FM/FM	11	7.35 kHz	7.5	Cont.	I	2%	Plasma Probe Sweep
10	219.5 MHz FM/FM	12	10.5 kHz	7.5	Cont.	I	2%	Horizon Sensor
11	219.5 MHz FM/FM	13	14.5 kHz	7.5	Cont.	I	2%	Plasma Probe Cyl. AC
12	219.5 MHz FM/FM	14	22.0 kHz	7.5	Cont.	I	2%	Plasma Probe Trap DC
13	219.5 MHz FM/FM	15	30.0 kHz	7.5	Cont.	I	2%	Plasma Probe Trap AC
14	219.5 MHz FM/FM	16	40.0 kHz	7.5	Cont.	I	2%	Plasma Probe Swept Probe

2.3.2.1 Magnetic Tape Records (cont'd.)

Item No.	Link #1 Freq.	IRIG Channel No.	Freq.	Dev. ±%	Measuring Rate	Class	Accuracy ±%	Remarks
15	219.5 MHz FM/FM	17	52.5 kHz	7.5	Cont.	I	2%	Plasma Probe Con. AC
16	219.5 MHz PAM/FM	18	70.0 kHz	7.5	Pulse 300/sec.	I	2%	Commutator 10 x 30 per sec.

Item No.	Link #2 Freq.	IRIG Channel No.	Freq.	Dev. ±%	Measuring Rate	Class	Accuracy ±%	Remarks
1	240.2 MHz FM/FM	1	400 Hz	0	Cont.	I	-	Motor Separation #1, Timer/150K ft. Sw.
2	240.2 MHz FM/FM	2	560 Hz	0	Cont.	I	-	Motor Separation #2, Timer/ 150K ft. Sw.
3	240.2 MHz FM/FM	3	730 Hz	0	Cont.	I	-	Parachute Bulkhead
4	240.2 MHz FM/FM	4	960 Hz	0	Cont.	I	-	Motor Separation Sw.
5	240.2 MHz FM/FM	5	1.3 kHz	0	Cont.	I	-	150K ft. Alt. Sw. #1
6	240.2 MHz FM/FM	6	1.7 kHz	0	Cont.	I	-	150K ft. Alt. Sw. #2
7	240.2 MHz FM/FM	8	3.9 kHz	7.5	Cont.	I	2%	Linear Accel. Lateral + Camera Shutter
8	240.2 MHz FM/FM	9	5.4 kHz	7.5	Cont.	I	2%	Linear Accel. Lateral + Camera Shutter
9	240.2 MHz FM/FM	10	7.35 kHz	7.5	Cont.	I	2%	Linear Accel. Z-axis
10	240.2 MHz FM/FM	11	30.0 kHz	7.5	Cont.	I	2%	Aspect Sensor

2.3.2.1 Magnetic Tape Records (cont'd.)

Item No.	Link #2 Freq.	IRIG Channel No.	IRIG Channel Freq.	Dev. ±%	Measuring Rate	Class	Accuracy ±%	Remarks
11	240.2 MHz FM/FM	12	40.0 kHz	7.5	Cont.	I	2%	Vibration Accel. and Timer Output
12	240.2 MHz FM/FM	13	52.5 kHz	7.5	Cont.	I	2%	Vibration Accel. and Timer Output
13	240.2 MHz PAM/FM/FM	14	70.0 kHz	7.5	300/sec.	I	2%	Commutator 10 x 30 per sec.

Calibration, both Link #1 and Link #2:
The event channels, IRIG Nos. 1-6 should be set to read zero on the output meter with zero SCO signal, and mid-scale with SCO signal turned on.

The calibration on the subcarrier oscillators, including the 3.9 kHz unit and higher, is 0 to 5 volts for a ±6.75% deviation. (Zero level corresponding to +6.75% deviation and +5 volts is connected to Channel 2 of the commutator on the 70 kHz subcarrier oscillator. This reference is also applied at 10-second intervals to the 7.35, 10.5, 14.5, 22.0, 30.0, 40.0 and 52.5 kHz subcarrier oscillator channels of Link #1 only, by a calibrator unit in the nose cone.

CRR is requested to provide receiver AGC calibration for the rocket telemetry links at Launch Site and at Twin Lakes. The following calibration ranges are requested at the pre-amplifier input:

For:

Link No. 1, 219.5 MHz)
Link No. 2, 240.2 MHz) 0, 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000 μvolts

The telemetry report should include details such as receiving antenna type, gain and polarization, pre-amplifier and/or multicoupler gain, and diversity combiner characteristics (if used).

2.4 Other Data

2.4.1 Documentary Optics

Documentary 16 mm color photography is requested from the arrival time of project personnel. This is to include coverage of payload assembly and checkout, as well as the launch phase.

The movie coverage should include the following sequences:

1. Setting up racks in preparation area.
2. Working on nose cone instrumentation with shroud off.
3. Placing shroud on instrumentation.
4. Moving nose cone to Hazardous Assembly.
5. Assembly to motor.
6. Placing complete vehicle on launcher.
7. Launch.

4 x 5 still photography is requested on call throughout the program for coverage of payload assembly, checkout and vehicle assembly. Still photographs, which should include some 35 mm color transparencies, should include the following:

1. Equipment in preparation area.
2. Nose cone instrumentation, shroud off.
3. Nose cone instrumentation, shroud on.
4. Control console in Blockhouse.
5. Assembled rocket and motor on dolly.
6. Rocket on launcher, horizontal.
7. Rocket on launcher, vertical.
8. Close-up of umbilical cable from launcher boom to vehicle.
9. Recovery site and payload after impact.

3.0 METEOROLOGICAL SERVICES

3.1 Forecasts

The following information is requested for planning and operational purposes. This information should be presented to the Range User Mission Controller who will be responsible for informing all Range User personnel in the Fort Churchill area.

3.1.1 Long Range

3-5 day outlook of general weather conditions, particularly temperature, wind, and cloud cover.

3.1.2 Planning

30-72 hour forecasts (wind, cloud cover, temperature).

3.1.3 Operational

30-hour or less forecasts (wind, cloud cover, temperature).

3.2 Observations

Rawinsonde data on wind, temperature, humidity pressure and density are requested as close to the firing time and launch site as possible and to an altitude of 90 to 100K ft. Standard surface measurement of wind velocity, temperature, and pressure are also requested commencing at T-2 hours at 30-minute intervals.

3.3. Impact Prediction

The Range User has supplied the Range with the vehicle data required for impact prediction.

3.4 Minima

This rocket is to be launched into skies sufficiently clear of clouds to ensure radar acquisition and a recovery operation using the Range helicopters. Surface winds in the recovery area should be light.

3.5 Consultant Services

It is requested that the CRR meteorologist be available for consultation from T-4 hours to launch.

4.0 SUPPORT INSTRUMENTATION

4.1 Communications - General

4.1.1 Communications Recordings

Standard acceptable.

4.1.2 Communications Plan

The standard Range communications are acceptable for this test.

4.2 Radio

4.2.1 Frequency Control and Analysis

The assistance of FCA to monitor payload RF may be requested during the preparation phase.

4.3 Wire

4.3.1 Intercom

Standard acceptable.

4.3.2 Telephone

It is requested that a telephone in the Technical Support Section building be available for Range User use during this test.

All long distance charges will be borne by the Range User.

4.3.3 Umbilical Cable

The standard umbilical Blockhouse to Universal Launcher is satisfactory for this test.

4.3.4 Public Address - NR.

4.4 Timing

Timing on the magnetic tape records is requested to be:

a. IRIG Format "B", 100 pps with a 1 kHz carrier;
b. IRIG Format "C", 2 pps with a 100 Hz carrier;
c. Time signals from WWV.

Item (c) can be recorded during post-flight calibration together with items (a) and (b).

First motion is to be indicated by an increase in the amplitude of the timing pulses. It is assumed that timing equipment is on prior to the start of Horizontal Checks.

Timing Format "C" is requested on all paper records at 4 inches per second or slower. Timing Format "B" is requested on all paper records at 4 inches per second or higher.

4.5 Sequencer - NR.

4.6 Visual Countdown and Status Indicators

4.6.1 Visual Countdown Indicators

No.	Function to Be Displayed	Type Indicator	Interval Start	Interval Stop	Remarks
1	Range Countdown	Clock, (digital is preferred)	T-180 mins.	T+10 mins.	To be easily viewed from payload control console. Same facility desired in nose cone preparation area in Operations Bldg.

4.6.2 Visual Status Indicators

The standard visual status indicators are acceptable for this test.

4.7 Data Handling

Range User will obtain all data produced by CRR from the official appointed by CRR for data assembly and release. Certain items of "quick-look" data are to be obtained from the originating section direct as arranged at the pre-flight briefing.

4.8 Command Control

No command control or destruct system will be used.

4.9 Other Support Instrumentation

It is requested that sound ranging equipment be used to determine impact coordinates.

The support of Prince Albert Radar Laboratory is required to keep the Project Scientist advised of the status of radar aurora over Churchill. PARL support will be arranged for by the Range User.

CRR is requested to operate the 30 MHz Riometer at the Blockhouse throughout the period that the NRC team are at the Range. The Riometer antenna is to be directed along the expected vehicle trajectory. Records for the full period are required by the Project Scientist.

5.0 MATERIAL AND SERVICES

5.1 Services

5.1.1 Power

115V, 60 Hz power is required in the User area of the Blockhouse and in the Nose Cone Assembly area of the Operations Building for User use. These services should consist of a minimum of one 30-amp. outlet and three 15-amp. outlets. Each service is to be independently fused.

5.1.2 Food Services

Approximately twelve NRC personnel will require food services and accommodation for approximately three weeks. CRR is requested to arrange for these services. Food services will be required for User personnel at launch. Names of personnel will be notified approximately two weeks prior to arrival.

5.1.3 Fire Protection

No additional fire protection services are anticipated in excess of normal.

5.1.4 Medical Service

None required in excess of normal.

5.1.5 Guards and Security - NR.

5.1.6 Pad Services and Engineering

The Universal Launcher is required to be fitted with the CARDE-supplied Black Brant, 4-fin rocket rail system for this test. Installation and alignment of these rails should be completed by CRR prior to T-1 day.

The assistance of contractor launch personnel will be required for motor assembly; also, for stabilizer assembly and alignment in the rocket assembly area.

5.1.7 Water - NR.

5.1.8 Survey - NR.

5.1.9 Other Services - NR.

5.2 Vehicles and Ground Handling Equipment

5.2.1 Vehicles

The rocket and all necessary hardware will be supplied to CRR by NRC, by NRC contractors, or has been supplied by CARDE and is held at the Range.

5.2.2 Ground and Heavy Equipment

CRR is to supply suitable dollies and lifting equipment for movement of the motor and complete rocket in the Assembly Area and at the Launcher.

5.2.3 Search Lights and Floodlights - NR.

5.2.4 Other Equipment

CRR is requested to supply equipment for, and obtain all-up weight and centre of gravity of the nose cone, the motor, and the complete vehicle.

5.3 Propellants, Gases, Chemicals - NR.

5.4 Chemical and Physical Analysis - NR.

5.5 Bioscience - NR.

5.6 Test Instrument Maintenance and Calibration - NR.

5.7 Climatic Clothing Requirements

Range User personnel may require climatic clothing (parkas, storm pants, flight boots and mitts) while at the Range.

6.0 TRANSPORTATION LOGISTICS

CRR is requested to inform W.L. Haney by Telex of the arrival of the shipments at Fort Churchill.

6.1 Surface

6.1.1 Personnel

On occasions, Range User personnel may wish to use the bus service provided by the Range Contractor for transport of Range personnel to and from the Launch Site.

CRR is requested to arrange for the loan of one station wagon and a power wagon for the full-time use of the User personnel attached to this program.

6.1.2 Cargo

The motor for this vehicle together with other Black Brant motors were airlifted to Churchill from Winnipeg. The stabilizer units were a separate shipment from the motors and were shipped from Montreal via rail express.

The NRC cargo will be in two shipments, one by rail and one by air. The rail shipment will consist of thirty pieces weighing approximately 4400 lbs.; the air shipment twenty-one pieces weighing approximately 3000 lbs.

All shipments will be addressed to CRR. CRR is requested to have the equipment taken to the Launch Site when it is received in Churchill.

6.2 Air - NR.

7.0 RECOVERY

It is required that the nose cone with the payload be recovered. A special separation and recovery package is a part of this vehicle and should result in a relatively soft landing for the separated nose cone. There is no requirement to recover the expended motor. However, if the empty motor is located, it is desired that the igniter housing and separation ring be removed and returned to the User. Recovered fins will also be of interest.

7.1 Normal

7.1.1 Procedures

The standard procedure for a recovery operation is requested. The maximum recovery time will be predicted by the condition of the impact area. Blowing snow or sand that will cover the nose cone, or impact in water or soft mud that will make locating the nose cone more difficult the longer the time between impact and recovery, will be the factors governing desirable recovery time. The nose cone and payload will weigh approximately 300 pounds and will be free of explosives once the separation and recovery packages have operated successfully.

7.1.2 Aircraft

The standard helicopter service as provided by the Range Contractor should satisfy the recovery operation. However, the use of a fixed wing, beacon equipped aircraft might facilitate locating the nose cone.

7.1.3 Special Vehicles

There is no requirement anticipated for special, over-snow vehicles for this test.

7.2 Salvage and Disposal

The separated nose cone will be free of items requiring a render-safe procedure and may be moved and transported by helicopter as soon as located. A small residue of

7.2 Salvage and Disposal (cont'd.)

unburned propellant may remain in the motor case and, therefore, the expended motor should be treated and handled with care. The recovered components are to be returned to Launch for Range User examination. Packaging and shipping action on recovered components may be requested by the Mission Controller.

8.0 AIRCRAFT AND SEACRAFT

8.1 Non-range Aircraft

The decision regarding the use of a fixed-wing aircraft for the locating of the nose cone/payload is left to the discretion of the Range.

8.2 Seacraft - NR.

9.0 DATA PROCESSING AND DISPOSITION

9.1 General Information

After the one-year period of retention, all raw data is to be released to NRC (Radio and Electrical Engineering Division, Attention: Mr. W.L. Haney).

After two years retention period, all file copies of the Flight Test Report are to be released to NRC (Radio and Electrical Engineering Division, Attention: Mr. W.L. Haney).

If all NRC personnel have departed from the Range before data is available, data should be forwarded to NRC (Radio and Electrical Engineering Division, Attention: Mr. W.L. Haney).

9.2 Disposition of Data

ITEM NO.	DESCRIPTION	ORIG.	CYS.	TIME REQUIRED	FINAL RECIPIENT	AGENCY TO PICK-UP DATA	TYPE OF PRESENTATION	REMARKS
	9.2.1 Metric Data							
	9.2.1.1 Launch to Impact							
1	Position		4	T+6H	NRC	NRC	R-PLOT	Note (a)
			1	T+5CD	NRC	NRC	R-MAGT	Note (b)
			1	T+5CD	NRC	NRC	R-GRAF	
	9.2.1.2 Impact							
2	Impact Coordinates		2	T+10	NRC	NRC	F-FRPT	

Note (a) - Real time plotting board data of range, azimuth, and elevation is requested for each radar on valid track.

(b) - Copy of Sanborn Model 150, 6-channel, function recorder for FPG-11 Radar.

9.2 Disposition of Data (cont'd.)

ITEM NO.	DESCRIPTION	ORIG.	CYS.	TIME REQUIRED	FINAL RECIPIENT	AGENCY TO PICK-UP DATA	TYPE OF PRESENTATION	REMARKS
	9.2.2 Photography							
4	Still photos		2	T+15	NRC	NRC	R-PHOTO	4.2.7
	Documentary Film		1	T+21	NRC	NRC	R-PHOTO	4.2.5
	9.2.3 Telemetry							
	9.2.3.1 Recording							
5	Magnetic tape recording of telemetry data	1		T+5CD	NRC	NRC	R-MAGT	5.2.1.1(4)
			1	T+5CD	NRC	NRC	R-MAGT	5.2.1.4(4)
		1		T+5CD	NRC	NRC	R-MAGT	5.3.1.1(2)
	9.2.3.2 Special Requirements							
6	Real Time paper records	1		T+1H to T+1	NRC	NRC	R-GRAF)	To be detailed prior to T-5 days
	Playback paper	1		T+2	NRC	NRC	R-GRAF)	
	9.3 Meteorological Data							
7	Report on all requested observations including completed winds aloft form closest to T-0.		4	T+15	NRC	NRC	F-FRPT)	6.2.3.1(2) 6.2.3.2(2)
8	Final report on all requested observations		3	T+30CD	NRC	NRC	F-FRPT	

ITEM NO.	DESCRIPTION	ORIG.	CYS.	TIME REQUIRED	FINAL RECIPIENT	AGENCY TO PICK-UP DATA	TYPE OF PRESENTATION	REMARKS
	9.4 Support Instrumentation							
9	30 MHz Riometer	1		T+2	NRC	NRC	R-GRAF	
	9.5 Material and Services Report - NR.							
	9.6 Transportation Reports							
10	Receiving and Shipping Report	1		T+30	NRC	NRC	F-FRPT	All equipment in and out of Fort Churchill
	9.7 Recovery Reports							
11	Details as to time, place, conditions of nose cone/payload, motor, etc.							
	9.8 Aircraft Reports - NR.							

10.0 FACILITIES

10.1 Facilities - General

10.1.1 Hazardous Storage

It is required that the motor, igniter and other pyrotechnic items be stored under conditions of controlled temperature. The preferred storage temperature for these items is 70°F. Motor storage temperature limits are -20°F to +150°F. However, all cases of this motor being subjected to temperature less than 32°F must be recorded, both as to time duration and minimum temperature of each exposure. The Mission Controller shall be advised of all cases of exposure.

10.1.2 Storage

Storage of empty shipping crates is required for the period the equipment is at the Range. An area of approximately 200 sq. ft., 8 ft. high, will be required for this 'dead' storage. The Mission Controller will advise the Range Operations Manager when crates are emptied, ready for storage, and when they are required for re-packing at the completion of the test.

10.1.3 Preparation

An area of approximately 300 sq. ft. is required in the nose cone assembly area of the operations building for nose cone assembly, initial check-out, battery charging and for User instrumentation used in monitoring and recording data during flight. Space, lines, and a suitable cabinet (as supplied in March 1966) are required in this area for the Telex equipment. The same location in the northeast corner of the room is requested for this test for the Telex and User Equipment. The RF/Real Time patch panel is required.

10.1.4 Blockhouse

An area of about 100 sq. ft. is required in the User room of the blockhouse for the payload check-out

10.1.4 Blockhouse (cont'd.)

console and associated equipment. This area must be close to the umbilcal terminal box and the Range discriminator display console.

10.1.5 Observation Station - NR.

10.1.6 Office Space

It is requested that office space in the Technical Support Section building be made available to this team.

10.2 Launch Facilities

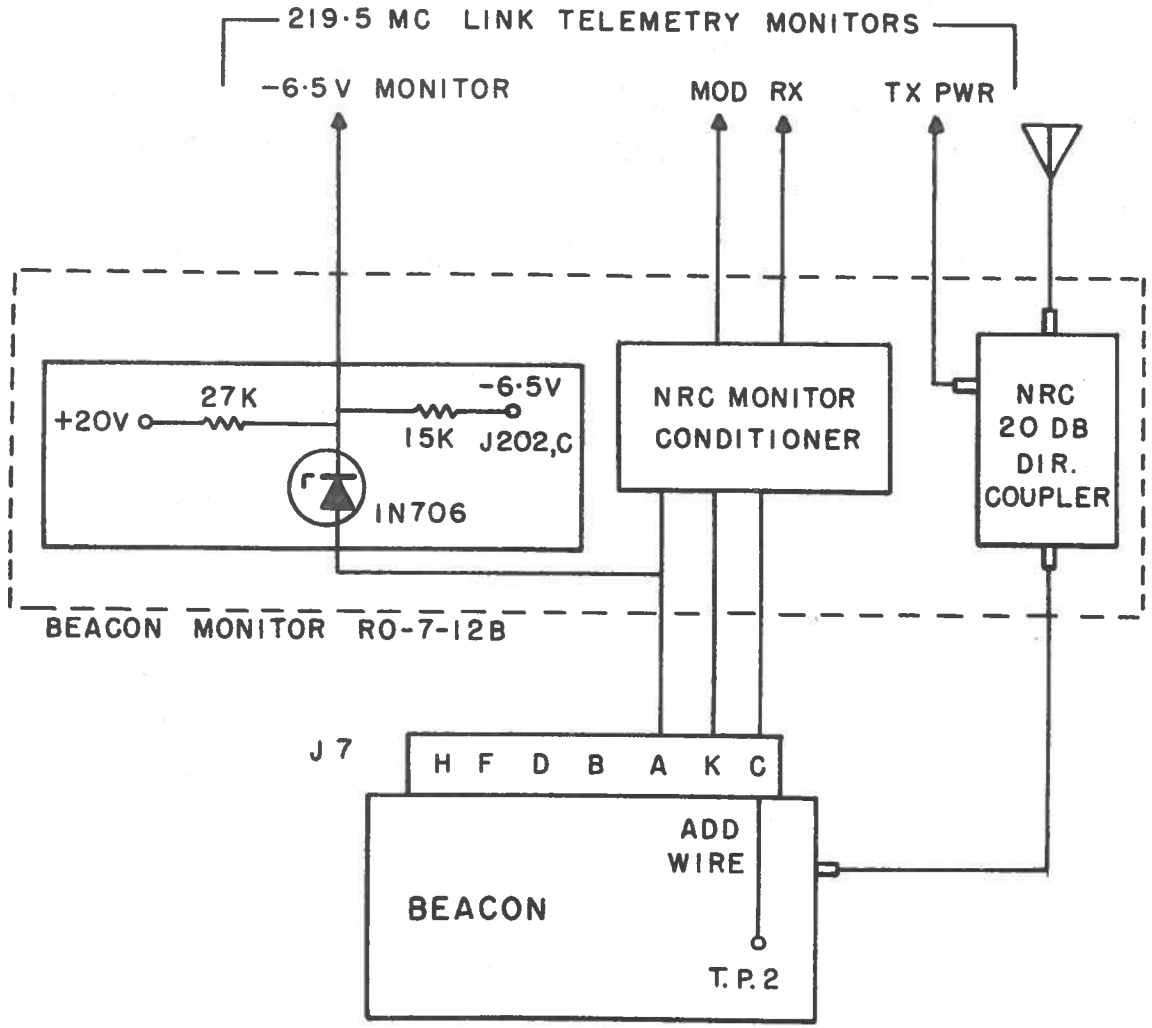
The Universal Launcher complex is to be used for this operation. Range User personnel will require access to the rocket assembly area for vehicle build-up and final assembly of the nose cone, also to the Launch Bay for payload tests during the countdown.

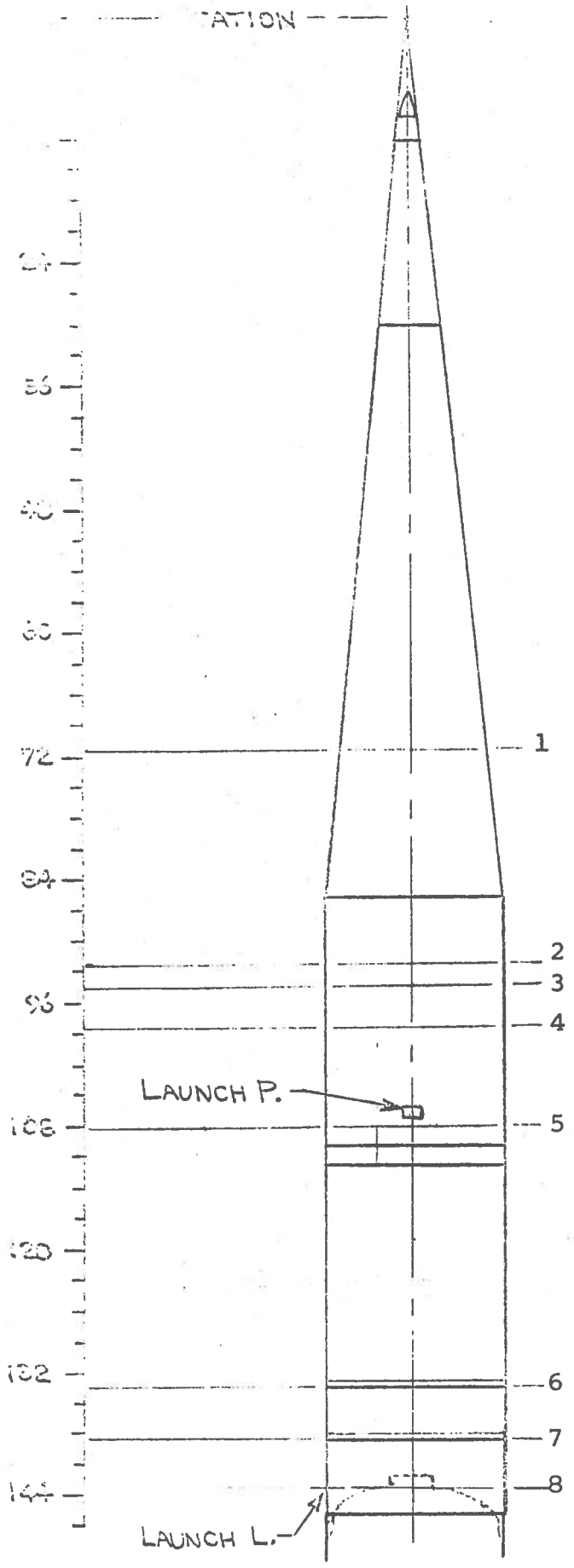
11.0 RANGE SAFETY

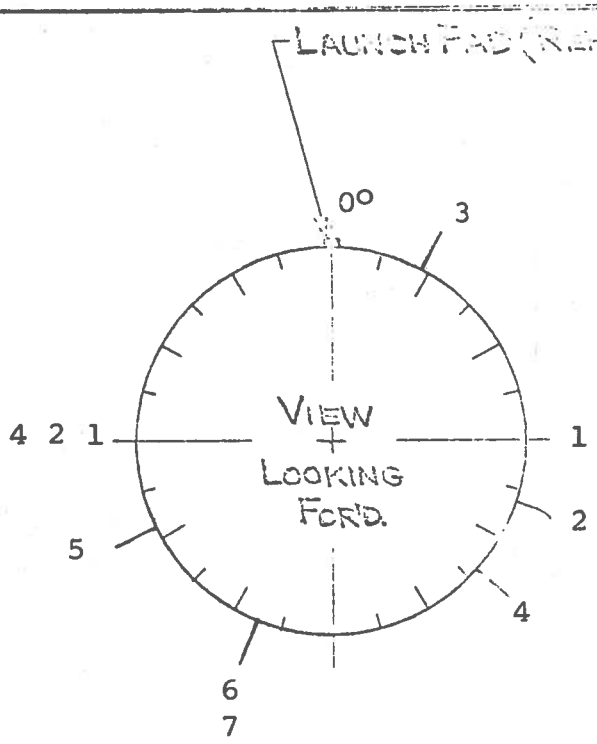
CRR is responsible for all range safety.

APPENDIX I

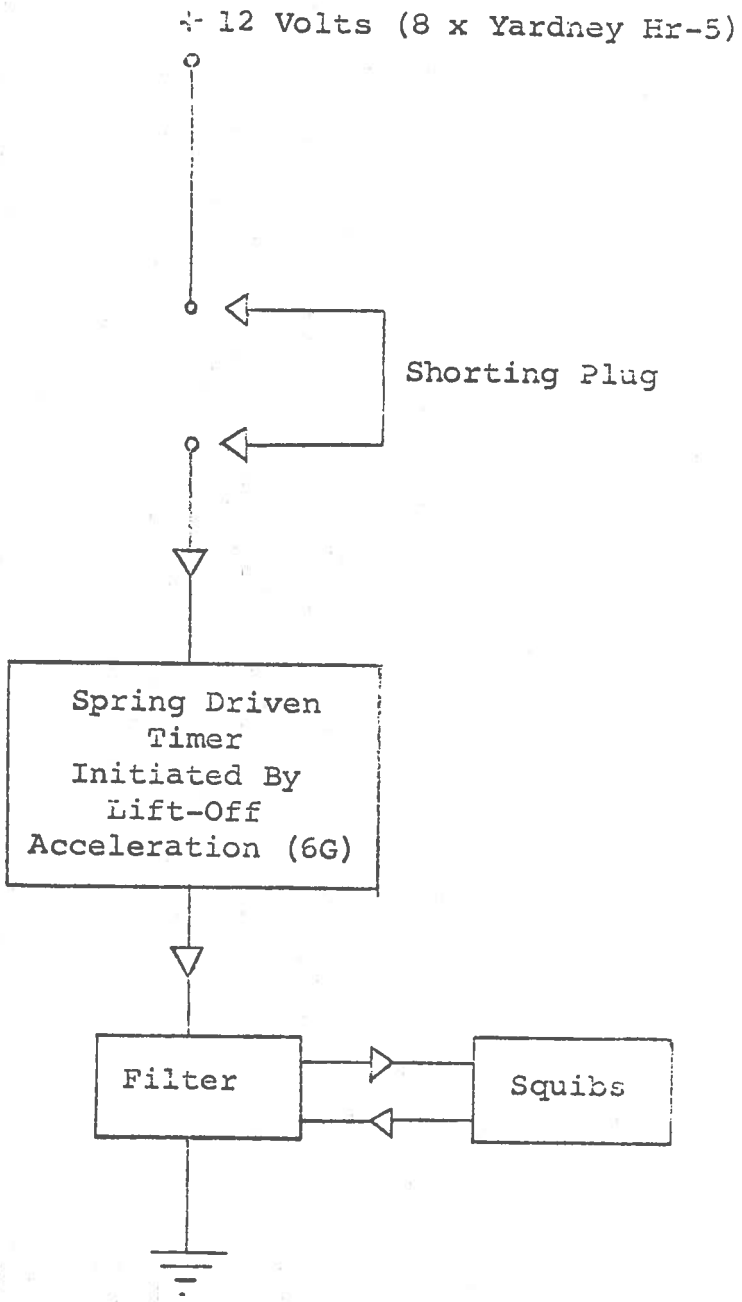
DPN-41 RADAR BEACON MONITOR FUNCTIONS







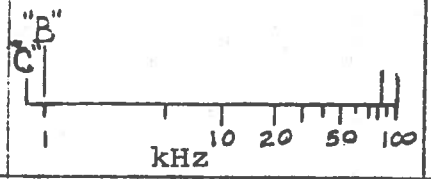
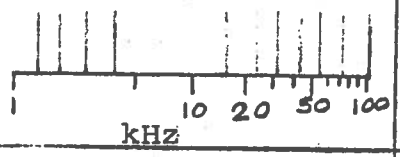
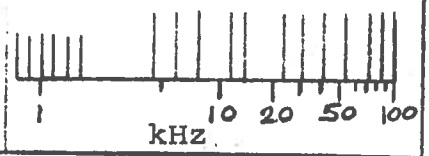
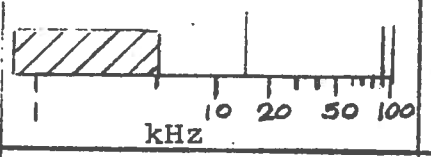
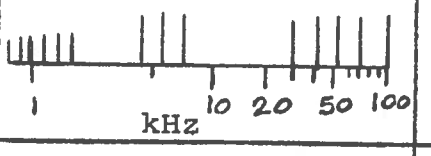
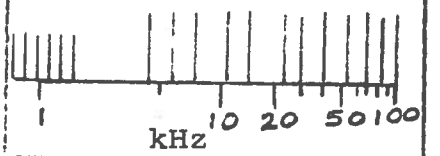
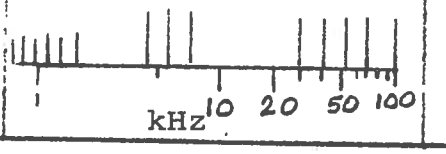
Item	Unit
1	1/4" dia. Plasma Probes (two)- one BA31D2 each
2	Micrometeoroid Mk. IV (two) Doors - two BA31K2 each
3	N/A
4	Movie Camera Doors (two) Two BA31K2 each
5	1/4" dia. Plasma Probe One BA31D2
6	Parachute Deployment Ring Four BA31K2
7	Motor Separation Ring Four BA31K2
8	Igniter, Jet Thrust Expl. B.

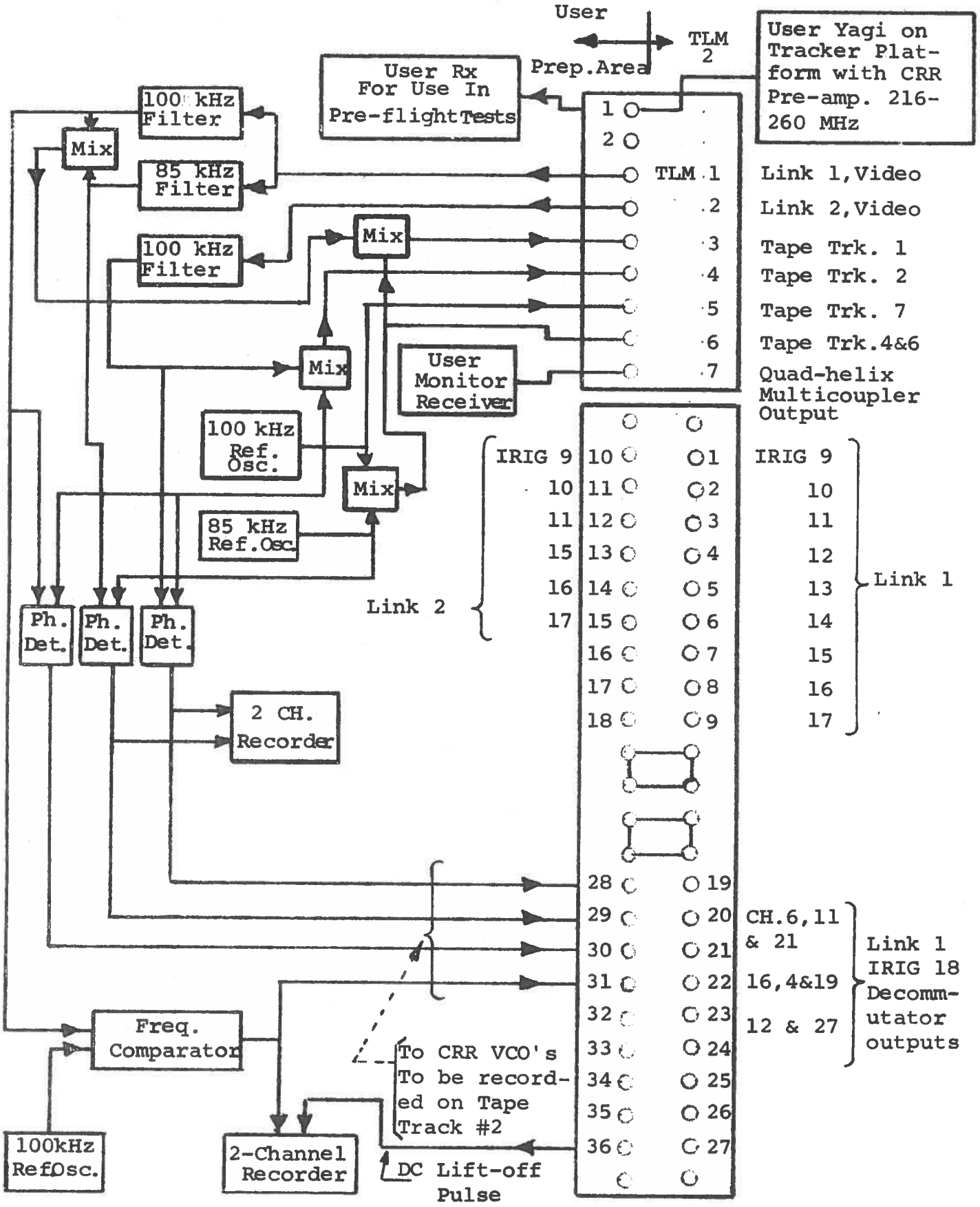


SQUIB FIRING CIRCUIT

APPENDIX IV

Launch T/M Tape Recorder Bandwidth Allocations
Vehicle AAA-II-101

Track	Bandwidth	Equipment Supplied By	Data	Source
1		CRR and User	Timing "B" & "C" Link #1 mixed 100 kHz & 85 kHz signals.	Link #1 TLM and User Doppler
2		CRR and User	IRIG #5,6,7,8, 13,14,15,16,17, and 18. Link #2 mixed 100 kHz signals	TLM Rx AGC Lift-off Data Link #2 TLM and User Doppler
3		CRR	IRIG #1 to #6 and #9 to #18 and 85 kHz and 100 kHz	Nose Cone TLM Link #1 219.5 MHz
4		CRR and User	Voice Count Tape Servo Ref. 85 kHz - 100 kHz Reference	CRR Frequency Stable Oscillator
5		CRR	IRIG #1 to #6, #9 to #11 and #15 to #18 and 100 kHz	Nose Cone TLM Link #2 240.2 MHz
6		CRR and User	IRIG #1 to #6 and #9 to #18 100 kHz Ref. 85 kHz Ref.	Nose Cone TLM Link #1 219.5 MHz
7		CRR and User	IRIG #1 to #6, #9 to #11, and #15 to #18 and 100 kHz Reference	Nose Cone TLM Link #2 240.2 MHz

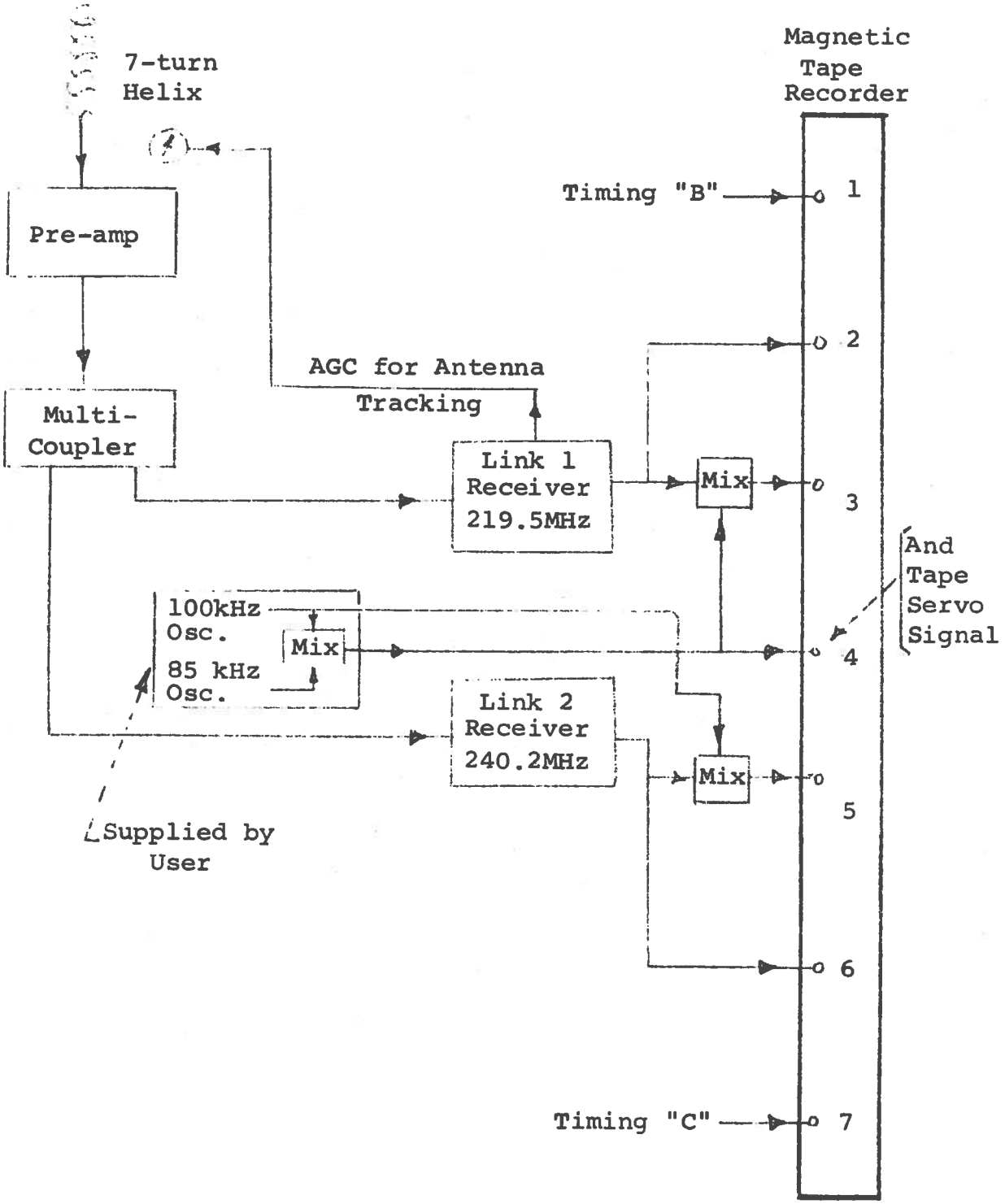


APPENDIX V

RANGE USER INSTRUMENTATION - NOSE CONE PREPARATION AREA

APPENDIX VI

TELEMETRY INSTRUMENTATION RADAR SITE



APPENDIX VII

TELEMETRY INSTRUMENTATION TWIN LAKES