Provisional operational requirement for Black Brant rocket AD-II-23
National Research Council of Canada. Radio and Electrical Engineering Division

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ASSOCIATE COMMITTEE ON SPACE RESEARCH

PROVISIONAL OPERATIONS REQUIREMENT FOR BLACK BRANT ROCKET AD-II-23

PREPARED BY

RADIO AND ELECTRICAL ENGINEERING DIVISION

OR NO._____

OTTAWA

NOVEMBER 1962

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1.0 GENERAL INFORMATION

1.1 Operations Command

The following personnel will be at the Rocket Facility, Fort Churchill, in connection with this program.

A total of ten range-user personnel (NRC) will work on this program at Fort Churchill.

One or two representatives from the University of Saskatchewan may be present to assist in experiment preparation.

No visitors are expected at this test.

1.2 Range Time Utilization

1.2.1 Test Duration and Frequency

This OR is for requested support in firing one Black Brant IIA rocket. It is anticipated that Range User equipment and personnel will be at the Rocket Facility for about one month, commencing about February 21st, 1963. Support for living accommodation, transport, equipment and rocket storage, assembly and blockhouse space, power, and communications is requested for this period. It is expected that a representative from CARDE will be present and can advise or assist the range contractor in rocket assembly, fin alignment, and arming. Operation of the Range Telemetry Station and radar may be requested a day or two before the scheduled firing in conjunction with nose cone instrumentation preparation and a complete "dress" rehearsal of the launching.

Day-to-day rescheduling of the launching may be necessary due to weather and other requirements of the vehicle and experiments. Data on vehicle performance and launch restrictions should be available from CARDE. It is understood that a report concerning the Black Brant IIA vehicle will be available from CARDE in January 1963.

Desired experiment conditions are:

(a) during a near pass of the Alouette Satellite, if still operating,

(b) aurora,

(c) darkness and no cloud cover.

and are listed in the order of decreasing importance. Absence of both (a) and (b) may justify postponement of a scheduled launching.

1.2.2 General Countdown

TIME	FUNCTION/SERVICE
Preparation Phase:	
F-7 day	Rocket motor, fins, igniter, arrive at Fort Churchill via air transport. These parts may be shipped several weeks prior to this time as the shipment may be included with the vehicles used in the CARDE launchings in Feb. 1963. Range requested to unload and transport to launch site storage (6.1.2).
	Nose cone, nose cone instrumentation, check-out equipment and nose cone control unit arrive at Fort Churchill. Range requested to unload and transport to storage (in preparation area) (6.1.2).
	Range User personnel arrive at Fort Churchill. Accommodation and personnel transportation support requested. (Request for accommodation will be made to DRNL.) (5.1.2)

1.2.2 General Countdown (cont'd.)

TIME	FUNCTION/SERVICE
Preparation Phase: (cont'd.)	
F-6 day	Range User personnel begin setting up check-out equipment and preparation of nose cone instrumentation. Request: 1. Preparation area space (10.1). 2. Blockhouse space (10.1). 3. Transportation (6.1.1). 4. Power (5.1.1). 5. Support for connection of umbilical cable (4.3.3). 6. Communications (4.1). 7. Parallactic camera operation (1.6.1). 8. Meteorological services (3.0). 9. Space for setting up beacon antenna (4.9).
F-1 day	Nose cone preparation complete. Request support from telemetry station and radar, pad services and engineering for launch "dress rehearsal". (5.1.6)
Launch Phase:	
	If it is very cold, it is desirable to keep the time between elevation of the launcher and ignition to a minimum. It is understood that minimum motor temperature for launching is -10°F on the engine skin. Heaters will be used in the nose cone payload space but the payload temperature must be kept above 32°F.
T-6:00:00	Battery charging complete. Install all batteries to payload. Begin instrumentation checkout in preparation room with nose cone off.
T-5:00:00	Final visual inspection of payload. Assemble nose cone to payload. Radar beacon check. Magnetometer calibration check. Nose cone sealing.
T-3:30:00	Assemble motor to nose cone.
T-3:00:00	Install rocket on launcher and connect umbilical cable.

1.2.2 General Countdown (cont'd.)

TIME	FUNCTION/SERVICE
Launch Phase (cont'd.)	
T-2:25:00	Clear area for horizontal instrumentation checks.
T-2:20:00	Begin horizontal instrumentation checks. Radar beacon checked on external and internal power.
T-2:00:00	Horizontal instrumentation checks complete. Turn off all radars and transmitters. Begin arming rocket. Install explosive bolts for ejection of electron density probes.
T-1:30:00	Arming completed.
T-0:30:00	Clear area and elevate launcher.
T-0:15:00	Final launcher settings completed. Begin vertical instrumentation checks.
T-0:05:00	Vertical instrumentation checks complete. Clear area for firing. Station checks: Telemetry, Radar, Instrumentation control, Camera sites. DRNL Riometer, Auroral radar, Magnetometer, etc.
T-0:03:00	Remotely arm bellows actuators, and explosive bolts. Telemetry and experiments switched to internal power. Radar beacon switched to internal power. Radars check beacon. NRC beacon receiver check.
T-0:02:00	Telemetry commutator turned on.
T-0:01:00	Instrumentation calibration begins. Magnetic recording begins.

1.2.2 General Countdown (cont'd.)

TIME	FUNCTION/SERVICE
T-0:00:20	Instrumentation calibration complete. Acknowledge all green on instrumentation control panel.
T-0:00:00	Black Brant IIA rocket ignites.
T+0:00:15	Rocket motor burns out.
T+0:00:35	Electron density packages ejected.
T+0:00:40	Light extended and turned ON.
T+0:00:200	Apogee (approximately 85 miles alt.)
T+0:00:400	Impact

Apart from initial preparations and checkout the camera sites at O'Day and Belcher need not be manned, except on those days scheduled for a launching or a complete "dress rehearsal".

1.3 Test Objectives

1.3.1 Primary

Scientific measurements in the upper atmosphere:

(a) Measurement of electron density detail structure within an auroral formation by a radio frequency impedance probe method using three separate ejected packages (University of Saskatchewan).

(b) Photometer measurements within an aurora (necessary in conjunction with (a)). (University of Saskatchewan).

(c) Flux-gate magnetometer measurements on components of the earth's magnetic field. (University of Alberta).

(d) A single Langmuir probe. (NRC)

1.3.2 Secondary

(a) Flight test of a radar beacon and light system to determine trajectory. The vehicle will be instrumented with one light and each of the electron density packages will have one light.

(b) To obtain data on environmental conditions in the vehicle nose cone: linear acceleration, temperature, and vibration.

1.4 Test Description

The Black Brant IIA vehicle AD-II-23 will be instrumented with a number of experiments for scientific investigation of the upper atmosphere and instrumentation to obtain data on the environment of the nose cone during a flight. The preferred launch azimuth is approximately due East with impact into Hudson's Bay. Recovery is not required, but sound ranging is requested to obtain data on dispersion. The desired launch conditions are: (a) during darkness with launch into an auroral formation, (b) no cloud cover. These conditions are essential and if not present at the time of a scheduled launching, could be cause for a postponement. Clear visibility is essential at the camera stations at O'Day and Belcher as well as the launch site.

Events of primary importance during flight are the vehicle position and time when the electron density packages are ejected and the time of extension of the vehicle-borne light. Other events of interest are motor burnout, apogee, and impact.

Range User personnel will man only the nose cone instrumentation control console during the rocket flight and a beacon receiver (at the same location). Range User personnel will also operate a real time display of the commutated (70 kc) channel of the 219.5 mc link. RFOAR is requested to provide an output from a 219.5 mc receiver for Range User's discriminator and 17-inch oscilloscope. It is assumed that the parallactic camera stations at O'Day and Belcher will be operated by DRNL personnel.

1.5 Test Vehicle Description

The Black Brant IIA is a single stage, solid propellant, unguided sounding rocket. BB IIA AD-II-23 will be fitted with

1.5 Test Vehicle Description (cont'd.)

BB I fins and will have a 7.65 inch cylindrical forward body extension between the standard cylindrical forward body and the motor. The forward launch lug is mounted on the extension so that the spacing between forward and rear launch lugs is not changed from the standard configuration. In all other respects the vehicle is a standard BB IIA rocket.

Length	332.5 inches (approx.)
Diameter	17.2 inches
Launch weight	2700 lbs. approx.
Weight at burnout	900 lbs. approx.
Propellant	Aluminized single grain polyurethane-ammonium perchlorate
Total impulse	380,000 lbs.
Motor burning time	15.5 seconds
Guidance	None - 3 fixed fin stabilization
Cut-down system	None

General performance of the vehicle will be obtained from CARDE. The weight and centre of gravity of the nose cone and payload are furnished by NRC to CARDE, who then calculate vehicle performance. A manual on the Black Brant IIA vehicle is expected to be furnished by CARDE in January 1963. Special instructions concerning the BB I fins fitted on AA-II-26 will be furnished to RFOAR by CARDE.

1.5.1 Vehicle Drawing

See Appendix I.

1.5.2 Nose Cone Drawing

See Appendix 2.

1.5.3 Telemetry System

The nose cone telemetry is a PAM/FM/FM system operating at 219.5 mc, 5 watts with a possible alternative frequency being 218.0 mc. The antenna consists of three blade radiators mounted symmetrically about the surface of the nose cone at station 115.2. The polarization is linear.

Each of the three electron density probes contains a 2 watt FM transmitter. The experiment information is in the form of a 15 kc amplitude modulated signal which is used to modulate the transmitters. Three separate FM receivers will be required on the following frequencies: 227.0 mc, 228.0 mc, 229.0 mc. An alternate frequency in case of interference will be 220.0 mc. A unit containing three detectors and three voltage-controlled oscillators (in standard IRIF bands) will be supplied by NRC so that the received probe data can be recorded on the same magnetic tape as the nose cone telemetry signal (219.5 mc link) although on a separate track. The probe or impedance measuring frequency range is different in each of the three units: (a) 10 to 20 mc/s, (b) 16 to 29 mc/s, 25 to 40 mc/s. A few milliwatts of power may be radiated within the probe impedance frequency ranges. The probe transmitter antenna on all three units is formed by two 1/4 wavelengths of steel tape which spring out from the package on ejection to form a linear polarization dipole.

Range User identification of the three electron density probes will be:

Red	227.0 mc
Yellow	228.0 mc
Blue	229.0 mc
Alternate	220.0 mc

1.5.4 Beacons

It is planned to use an NRC modified Canadian Aviation Electronics, #16106/01/2/810, S-band beacon for radar tracking. This unit is tunable from 2700 mc to 2900 mc. The antenna system consists of a pair of quadraloop antennas mounted 180° apart at station 115.2 on the nose cone. Polarization is linear. Technical information on the beacon will be forwarded to the Range about February 1st, 1963.

1.5.5 Command Control/Destruct System

The Black Brant IIA rocket contains no destruct or flight termination system.

1.5.6 Ordinance Items

Characteristics of propellant engine igniter and squib will be available from CARDE.

Two bellows actuators (squib) are used in the extension mechanism for the nose cone light. These devices are Type BA 31D2 made by Hercules Powder Co., Wilmington, Del.:

Bridge resistance:	5-9 ohms
Max. non-fire:	50 ma., one 30 sec. pulse
Min. fire:	0.3 amp.
Recommended fire:	1.0 amp.
Ignition time:	0.25 milliseconds at 1.0 amp.

Six explosive bolts are used for ejection of the electron density packages, two bolts per package. These devices are made by the Raymond Engineering Company.

Bridge resistance:	6-12 ohms
Max. non-fire:	50 milliamps
Min. fire:	100 milliamps
Ignition time:	2 millisec. at 200 ma.
Min. strength:	1500 lb. tension
Operating temp.	150°C for 4 mins. max.

The explosive bolts will not be installed for any tests in the nose cone preparation area. They may be installed at the same time as rocket motor arming. The firing circuit to each pair of bolts is protected by reactive r-f filters. Two acceleration sensitive time delay relays are used in parallel to energize the bolt circuit. These are actuated by a 6G acceleration lasting for 2 3/4 seconds.

The location of these items is shown on the drawing given in Appendix III.

1.6 Range User's Instrumentation

The range user will supply all equipment for check-out and assembly of the nose cone payload. Range User personnel will operate the control unit for the payload and a beacon receiver during the firing.

1.6.1 DRNL Instrumentation Support

DRNL will be requested to operate the following equipment prior to and during the launch phase:

(a) 4" by 5" Rapid Scan Spectrometer, 4000-7000 A°.
(b) HB Photometer
(c) 35 mm. All Sky Camera
(d) Flux Gate Magnetometer
(e) Height Finding Stations (for aurora and rocket borne light)
(f) Auroral Radar
(g) Prince Albert Radar (to be arranged by NRC with PARL)
(h) Ionosonde
(i) 30 mc Zenithal Riometer (to be arranged by NRC with DRTE)

1.7 Summary of Frequency Utilization

Freq.	Class	Equipment	Location
2800 mc	I	Radar Beacon	Conical Section Nose Cone
219.5 mc (218.0 mc alternate)	I	Telemetry	Conical Section Nose Cone
227.0 mc*	I	Electron density probe (Red)	Ejected from Nose Cone Forward Body at T+35 sec.
228.0 mc*	I	Electron density probe (Yellow)	
229.0 mc*	I	Electron density probe (Blue)	

*220.0 mc - alternate frequency of the probe frequencies.

2.0 DATA

2.1 Metric

Coordinate System: cartesian, with origin at base centre of launcher, Z-axis passing through origin and earth centre of gravity. X-axis passing through the origin perpendicular to Z-axis and oriented true North, Y-axis passing through origin and perpendicular to X and Z axes. Positive directions Z, X, Y are up, north and east respectively.

2.1.1 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	1.0 from T-0 to T+40 sec. 2 from T+40 to splash	1000 ft.	500 ft.	--
2.	Velocity (V_X,V_Y,V_Z,V_S)	Throughout Flight	1.0 from T-0 to T+40 sec. 2 from T+40 to splash	1000 ft.	500 ft.	
3	Trajectory Angles θ and ϕ	Throughout Flight	1.0 from T-0 to T+40 sec. 2 from T+40 to splash	1000 ft.	500 ft.	

where θ = arcsine $\frac{V(Z)}{V(S)}$

ϕ = arctangent $\frac{V(Y)}{V(X)}$

where V_S = tengential velocity.

Radar data is requested from list-off, T - 0.

2.1.2 Impact

Impact coordinates are desired by sound ranging (GR-8) even though recovery is not a requirement.

2.2 Engineering Photography

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.

4 x 5 still photography is requested on call throughout the program for coverage of payload assembly, checkout, and vehicle assembly. One negative of each photograph taken is to be sent to NRC, Radio and Electrical Engineering Division, Attention: Mr. W.L. Haney.

Engineering analysis of the launch phase is not required.

2.3 Telemetry

It would be desirable to duplicate all telemetry reception and recording functions whenever possible. Appendix contains a list of equipment Range User will take to Fort Churchill. Some items, such as receivers, may be made available for operation and under complete control by the RFOAR telemetry station for this program.

2.3 Telemetry (cont'd.)

ITEM NO.	LINK FREQ.	NO.	FREQ.	DEV ±%	MEASURING RATE	RECORDING INTERVAL	CLASS	ACCURACY ±%	REMARKS
1	219.5 PAM/FM/FM	1	400 cps	7.5	Cont.	T-0:01 to splash	I	2%	
2	219.5 PAM/FM/FM	..	660 cps		Cont.	T-0:01 to splash	I	2%	
3	219.5 PAM/FM/FM	4	960 cps	7.5	Cont.	T-0:01 to splash	I	2%	
4	219.5 PAM/FM/FM	5	1.3 kc	7.5	Cont	T-0:01 to splash	I	2%	
5	219.5 PAM/FM/FM	9	3.9 kc	7.5	Cont.	T-0:01 to splash	I	2%	
6	219.5 PAM/FM/FM	10	5.4 kc	7.5	Cont.	T-0:01 to splash	I	2%	
7	219.5 PAM/FM/FM	11	7.35 kc	7.5	Cont.	T-0:01 to splash	I	2%	
8	219.5 PAM/FM/FM	12	10.5 kc	7.5	Cont.	T-0:01 to splash	I	2%	
9	219.5 PAM/FM/FM	13	14.5 kc	7.5	Cont.	T-0:01 to splash	I	2%	
10	219.5 PAM/FM/FM	14	22.0 kc	7.5	Cont.	T-0:01 to splash	I	2%	
11	219.5 PAM/FM/FM	15	30.0 kc	7.5	Cont.	T-0:01 to splash	I	2%	
12	219.5 PAM/FM/FM	16	40.0 kc	7.5	Cont.	T-0:01 to splash	I	2%	

2.3 Telemetry (cont'd.)

ITEM NO.	LINK FREQ.	NO.	FREQ.	DEV ±%	MEASURING RATE	RECORDING INTERVAL	CLASS	ACCURACY ± %	REMARKS
13	219.5 PAM/FM/FM	17	52.5 kc	7.5	Cont.	T-0:01 to splash	I	2%	
14	219.5 PAM/FM/FM	18	70.0 kc	7.5	Cont.	T-0:01 to splash	I	2%	Commutator Channel
15	227.0 mc AM/FM				Cont.	T-0:01 to splash	I	2%	
16	228.0 mc AM/FM				Cont.	T-0:01 to splash	I	2%	
17	229.0 mc AM/FM				Cont.	T-0:01 to splash	I	2%	

NOTE:

Details of the data channels ontthe 219.5 mc link are given in Appendix IV.

2.3.1 Recordings

The following recordings on magnetic tape are requested:

Track	Record
1	IRIG Timing Format B
2	Voice Countdown
3	Nose Cone Telemetry (219.5 mc)
4	Receiver Signal Strength
5	Electron Density Probes (227.0, 228.0, 229.0 mc)
7	IRIG Timing Format C

The reference recorded with the composite video nose cone telemetry (219.5 mc) signal should be a 17 kc square wave modulated 50% by a precision 60 cps supply. This is to be mixed with the composite signal at a level not greater than the 14.5 kc subcarrier level. A 100 kc sinusoidal reference is also to be recorded on the same track as the 219.5 mc link at a level one-half that of the peak composite signal. Two timing signals are requested:

a) standard time format B with a 1 kc carrier

b) standard time format C with either a 100 cps or a 1 kc carrier, 1 kc carrier preferred.

Time format C or B is to be interrupted from T - 0:00:15 to T - 0:00:00.

The signal strength of the 219.5 mc, 227.0 mc, 228.0 mc, 229.0 mc links and of the beacon receiver (operated by Range User) is to be recorded from T-0:01:00 to impact. These may be recorded as FM data by use of voltage controlled subcarrier oscillators which can be supplied by NRC if necessary:

Signal Strength

Link	Subcarrier Frequency	IRIG No.
219.5 mc	7.35 mc	11
Beacon Receiver	14.5 kc	13
227.0 mc	22.0 kc	14
228.0 mc	30.0 kc	15
229.0 mc	40.0 kc	16

2.3.1 Recordings (cont'd.)

Range User (NRC) will supply to RFOAR a unit containing three detector amplifiers and subcarrier oscillators for signal processing between the receivers for the 227.0 mc, 228.0 mc and 229.0 mc links and the input to the magnetic tape recorder.

Electron Density Probes (Track 5)

Subcarrier Frequency	IRIG No.	Link
40.0 kc	16	227.0 mc (Red)
52.5 kc	17	228.0 mc (Yellow)
70.0 kc	18	229.0 mc (Blue)

2.3.2 Special Requirements

. Real time paper records of the following channels is requested.

ITEM NO.	S.C.O. FREQ.	DATA FREQ. (cps)	PAPER RATE (in/sec.)	RECORD INTERVAL (sec.)	DATA
219.5 Mc FM/FM Link					
1	3.9 kc	20	0.4	T+0 to T+50	X-axis Accelerometer
2	5.4 kc	20	0.4	T+0 to T+50	Y-axis Accelerometer
3	22.0 kc	330	0.4	T+0 to Impact	Magnetometer) U. of Alta. use
4	30.0 kc	450	0.4	T+0 to Impact	Magnetometer) a 600 cps galvanometer (note 1)
5	70 kc Com. Ch. 4	10	0.4	T+0 to Impact	RF) Radar Beacon
6	70 kc Com. Ch. 5	10	0.4	T+0 to Impact	Modulator)
7	70 kc Com. Ch. 7	10	0.4	T+0 to Impact	Magnetometer (Schonstedt)
8	70 kc Com. Ch. 9	10	0.4	T+0 to Impact	Magnetometer (U. of Alberta)
9	70 kc Com. Ch. 12	10	0.4	T+0 to Impact	Light Monitor
10	70 kc Com. Ch. 13	10	0.4	T+0 to T+25	Motor Pressure
11	70 kc Com. Ch. 14	10	0.4	T+0 to T+50	Z-axis Accelerometer
12	70 kc Com. Ch. 16	10	0.4	T+0 to T+50	Vibration Accelerometer
Ground Telemetry					
13	7.35 kc	50	0.4	T+0 to Impact	Signal Strength: 219.5 mc
14	14.5 kc	50	0.4	T+0 to Impact	Signal Strength: Beacon Receiver
15	22.0 kc	50	0.4	T+0 to Impact	Signal Strength: 227.0 mc
16	30.0 kc	50	0.4	T+0 to Impact	Signal Strength: 228.0 mc
17	40.0 kc	50	0.4	T+0 to Impact	Signal Strength: 229.0 mc

NOTE 1:

Data bandwidth is not consistant with paper speed, but we are only interested in equipment operation for this record.

2.3.2 Special Requirements (cont'd.)

Range User will provide a real time telemetry display for own use to monitor the commutated channel (70.0 kc of the 219.5 mc link). This equipment will include a receiver and subcarrier discriminator and oscilloscope. If no telemetry antenna or multicoupler output is available for the Range User's receiver for use in flight, the Range is requested to provide a suitable signal from the 219.5 mc link for input to Range User's tunable discriminator or display oscilloscope.

Range User will provide and operate a beacon receiver to include a low-noise travelling-wave amplifier and spectrum analyzer. Range support is requested in recording the signal strength, with the use of a subcarrier oscillator, on the same tape track as the signal strength of the 219.5 mc, 227.0 mc, 228.0 mc and 229.0 mc links. RFOAR is requested to provide an audio monitor from the output of the receiver (RFOAR) on the 219.5 mc link. This will be used by a Ranger User representative to observe the "event" channels during the launch phase.

Calibration:

(a) 219.5 mc link - The 660 cps event channel is not calibrated; the information being essentially of an off/on nature. The output will be within the limits of the IRIG No. 3 frequency band.

The event channels on IRIG bands 1, 4 and 5 should be calibrated in terms of a zero to 5 volt signal for ±7 1/2% deviation (zero level corresponding to +7 1/2% deviation and +5 volts to -7 1/2% deviation).

The calibration on the subcarrier oscillators, including the 3.9 kc unit and higher, is 0 to 5 volts for a ±6.75% deviation (zero level corresponds to +6.75% deviation and +5 volts to -6.75% deviation). A zener diode reference of +5 volts is connected to channel 2 of the commutator on the 70 kc subcarrier. This reference is also applied at 10 second intervals to all other subcarrier oscillators during flight except those lower in frequency than the 3.9 kc unit.

(b) 227.0, 228.0, 229.0 mc links - Calibration of the electron density probes will be done before assembly in the nose cone since calibration cannot be done after the packages are installed. Calibration will be done by Range User with support by RFOAR telemetry. Details of the procedure are not available at present but will be forwarded to the Range as soon as possible.

2.3.2 Special Requirements (cont'd.)

(c) Signal strength - RFOAR is requested to supply calibration of the 219.5 mc, 227.0 mc, 228.0 mc and 229.0 mc links in terms of 0 to 1 millivolt applied to the receiver or preamplifier inputs.

The Range User will provide a calibrated signal generator for calibration of the beacon receiver.

2.4 Other Data

Other data collected includes photographs from the camera stations and other records of ground based equipment furnished by DRNL.

None of these records require processing or reduction by RFOAR.

Range User personnel assigned to instrumentation sites:

NAME	SECURITY CLEARANCE	PURPOSE	PLACE
1 person (name to be supplied later)	--	Audio monitor the composite video signal from the 219.5 mc link for observation of the low frequency "event" channels. This function may be duplicated at Ranger User's receiver.	RFOAR Telemetry

3.0 METEOROLOGICAL SERVICES

3.1 Forecasts

Data concerning launching restrictions due to weather conditions may be obtained from CARDE. The following information is requested for planning and operational purposes (concerning the nose cone payload).

3.1.1 Long Range

3-5 day forecast 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). It is requested that the RFOAR meteorologist be available for consultation from T - 12 hours to launch.

3.2 Observations

Rawinsonde data on wind, temperature, humidity, pressure and density is requested as close to the firing time and launch site as possible. Standard surface measurement of wind velocity, temperature and pressure are also requested commencing at T-6 hours at one-hour intervals.

Additional observations may be requested by CARDE or by CARDE in consultation with Range Safety personnel. It is likely that wind data will be requested to at least 2000 feet at hourly intervals from T - 6 to launching.

3.3 Minima

The launch site and the camera stations at O'Day and Belcher must be clear of cloud cover and ground haze for a clear

3.3 Minima (cont'd.)

view of aurora and the vehicle borne and electron density packages lights. It is realized that presence of aurora may rule out detection of these lights during a portion, or even all of the flight. It is essential that visibility be at least 7 miles and that aurora be visible from the launch site and camera stations at launch time.

4.0 SUPPORT INSTRUMENTATION

4.1 Communications - General

Telephone communications are requested between the sites at which the range user will be working: preparation area, blockhouse, launcher and DRNL. It is understood that DRNL provide communication by SSB to the camera sites at Belcher and O'Day so that communication from the launch area to these sites will be via DRNL. A separate wire or radio link to carry the voice countdown to the camera stations from the launch site would be desirable.

None of the transmission need be recorded.

4.2 Radio

Not required, provided satisfactory communications via DRNL can be provided to the camera sites.

Frequency control and analysis is not required.

4.3 Wire

4.3.1 MOPS

It is requested that a loudspeaker on the missile operations intercom should be located near the checkout and control console provided by the Range User. A clock or digital display of the countdown time is also requested near the control console and in the nose cone preparation area occupied by Range User. Wire communication with DRNL is required for relaying the countdown to the camera sites, unless a direct line to these sites is available (preferred) or it is adviseable to provide a direct radio link between the launch area and the camera stations.

A wire line to DRNL is requested for transmission of Range timing for time correlation of ground measurements made by DRNL with vehicle data.

4.3.2 Telephone

Point-to-point communications between the following sites is requested.

4.3.2 Telephone (cont'd.)

Blockhouse to DRNL
Blockhouse to Nose Cone preparation area
Blockhouse to Launcher
Launcher to Nose Cone pereparation area

Communication between the blockhouse and Fort Churchill is also requested. Charges for long distance service will be borne by the Range User.

4.3.3 Umbilical Cable

The nose cone umbilical cable has a maximum of 50 wires (5 amps. max. per wire). The Range is requested to supply a cable from the blockhouse to the launcher with at least thirteen No. 8 wires, or larger, and the remainder, No. 16. Two of the thirteen heavy wires are requested for a 115 volt, 500 watt heater in the vehicle nose cone. Terminations at the blockhouse and launcher should be to Jones' type barrier strips in shielded boxes. The Range User will supply a 15-foot cable for connection between the control console and the range termination in the blockhouse and a 50-foot cable for connection between the range termination at the launcher and the vehicle umbilical connector.

If Range or Range User power supplies can be installed in a bunker close to the launcher, additional wire monitor and control lines will be required, from the blockhouse. Up to seven* such supplies are used, four lines each for monitor and control are required. It is considered that power supplies in a bunker near the launcher would be used only for operating the nose cone payload on external power. Payload battery charging would be done from Range User sources in the blockhouse and in close proximity to the nose cone instrumentation control console.

4.3.4 Photometer Light

It is requested that a small incandescent lamp be installed on the launcher for testing the photometer instrument in the vehicle nose cone. The photometer has a viewing angle of ±7 1/2 degrees and will be mounted in the conical section of the nose cone about station 76 in line with the forward body launch lug. A lamp equivalent to those in ordinary 2-cell flashlights is probably sufficient. Further details will be furnished as soon as possible.

*+26.2V, 5 amp.; -6.5V, 750 ma.; +12V, 5 amp.; +12V, 5 amp.; +12V, 5 amp.; +12V, 250 ma.; -12V, 250 ma. All grounded.

4.4 Timing

Timing on the magnetic tape records is requested to be:

a) IRIG Format B, 100 pss with a 1 kc carrier, and

b) IRIG Format C, 2 pps with a 1 kc carrier.

Timing Format C is to be interrupted from T - 0:00:15 to T - 0:00:00 (ignition). It is assumed that timing commences with calibration at T - 0:01. If timing commences with ignition, no interruption is required.

If Format B only is available, it should be interrupted in the above manner unless timing commences at ignition.

Timing Format C is requested on all paper records. If it is not available, some suitable timing correlated with the timing on the magnetic tape is requested on the paper records.

4.5 Sequence

NO.	FUNCTION	INTERVAL START	INTERVAL STOP	REMARKS
1	Ignition Pulse	T - 0	-	-

4.6 Visual Countdown and Status Indicators

NO.	FUNCTION TO BE DISPLAYED	TYPE INDICATOR	INTERVAL START	INTERVAL STOP	REMARKS
1	Range Countdown	Clock, digital preferred	T-6 hrs.	T+5 mins.	To be easily viewed from payload control console. Same facility desired in nose cone preparation area.

4.7 Data Handling

A block diagram of the system for this program appears in Appendix V.

4.8 Command Control

No command control or destruct system will be used.

4.9 Other Support Instrumentation

The Range User intends to operate a beacon receiver during the flight. A suitable location for User-supplied, small horn antennas is requested. It is preferred that the receiver be set-up close to the payload console and that the r-f cable running to the antennas be as short as possible.

5.0 MATERIAL AND SERVICES

5.1 Services

5.1.1 Power

115V, 60 cps power is requested in assembly area and blockhouse. This should consist of one 30 amp. service outlet and three 15 amp. outlets.

5.1.2 Food Services

Ten NRC personnel, and one or two University of Sask. representatives, will require food services for approximately one month. DRNL will be requested to arrange for this service and accommodation.

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

A complete "dress rehearsal" of the launching is requested on the day previous to the scheduled firing. This will include installing the rocket on the launcher, performing all payload checks, and testing of all communications. All personnel and services involved in an actual launching should be involved in this system test.

5.1.7 Water - NR

5.1.8 Survey - NR

5.1.9 Air

A supply of clean, dry air to pressurize the conical section of the nose cone to about 5 p.s.i.g. is requested to be available in the preparation area. The fitting on the nose cone will be similar to that used on automobile tires. The Range User will supply a suitable pressure gauge.

5.2 Vehicles and Ground Handling Equipment

5.2.1 Vehicles

The rocket and all necessary hardware will be supplied to RFOAR by NRC or CARDE.

5.2.2 Ground and Heavy Equipment

RFOAR should 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

RFOAR is requested to supply equipment for, and obtain all up weight and centre of gravity of the complete vehicle. CARDE will supply special equipment necessary for fin alignment.

5.3 Propellants, Gases, Chemicals - NR

5.4 Chemical and Physical Analysis - NR

5.5 Bioscience - NR

5.6 Test Instrument Maintenance and Calibration

RFOAR is requested to supply the calibration for the signal strength records of the 219.5 mc, 227.0 mc, 228.0 mc and 229.0 mc links. Range User will supply calibration source for the beacon receiver signal strength record. A 5-volt reference, accurate to 1/10 of 1 per cent for checking Range User's voltmeter would be desirable.

5.7 Climatic Clothing Requirements

DRNL will be requested to supply the climatic clothing requirements of Range User personnel.

6.0 TRANSPORTATION LOGISTICS

6.1 Surface

6.1.1 Personnel

The Range is requested to provide transportation of personnel between their wing quarters and their working area at the launch site daily. It may be necessary for personnel to work unusual hours and for this reason transport to and from living quarters is requested on an "on call" basis.

DRNL will be requested for the loan of a station wagon or panel truck for the full-time use of the personnel attached to this program.

6.1.2 Cargo

RFOAR is requested to provide for the unloading and transport to the range of the vehicle and check-out equipment. The motor and fin assembly will arrive at Fort Churchill by air transport. Other equipment will probably arrive by air but may be shipped by rail.

It is assumed that any special equipment, such as may be required for vehicle assembly, fin alignment, etc., will be supplied by CARDE.

a) Motor in crate: 3000 lbs., 24 in. x 30 in. x 17 ft.

b) Fin assembly in crate: 300 lbs.

c) Check-out equipment: Estimate is for about 12 crates, each 30 x 30 x 40 ins. and each weighing between 150 lbs. and 450 lbs. Total weight 300 to 3500 lbs.

d) Nose cone and playload in crate: Approximately 350 lbs., 24 in. x 24 in. x 10 ft.

e) Estimate of 200 lbs. of electronic equipment from University of Saskatchewan to arrive at Fort Churchill at the same time as items c) and d).

6.2 Air - NR

7.0 RECOVERY

No recovery is required.

8.0 AIRCRAFT AND SEACRAFT

No aircraft or seacraft will be used in this program.

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 & Electrical Engineering Division, Attention: Mr. W.L. Haney).

After the 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	1	1	T+6H	CARDE	CARDE	R-PLOT	note (a)
				T+6H	NRC	NRC		
2	Position,		4	T+30 CD	NRC	NRC	F-TRPT and F-PLOT	note (b)
	Velocity,		1	T+30 CD	CARDE	NRC		
	Trajectory Angles,		1	T+30 CD	U.of Alta.	NRC		
	$(X, Y, Z, V_X, V_Y, V_Z, V_S, \theta, \phi)$		1	T+30 CD	U.of Sask.	NRC		
	9.2.1.2 Impact							
3	Impact		1	T+10	CARDE	NRC	F-FRPT	
	Coordinates		1	T+10	NRC	NRC		

Note (a) - Real time plotting board data of range, azimuth, and elevation is requested.

Note (b) - This report should include tabulated data and plots of position, velocity, and trajectory angles with time. The method of smoothing data should be explained.

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 and documentary film		1	T+15	NRC	NRC	R-PHOTO	note (c)
	9.2.3 Telemetry							
	9.2.3.1 Recording							
5	Magnetic Tape Recordings of Telemetry Data	1	1	T+5 CD	NRC	NRC	R-MAGT	
	9.2.3.2 Special Requirements							
6	Real Time Paper Records		1	T+3 H	NRC	NRC	R-GRAF	
	9.3 Meteorological Data							
7	Report on all Requested Observations	1		T+15	CARDE	NRC	F-FRPT	
			3	T+15	NRC	NRC		
			1	T+15	U.of Alta.	NRC		
			1	T+15	U.of Sask.	NRC		
	9.4 Support Instrumentation - NR							
	9.5 Material and Services Report - NR							

Note (c) - One negative of each still photo and one copy of the processed documentary are requested.

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
	9.6 Transportation Reports							
8	Receiving and Shipping Report	1		T+30	NRC	NRC	F-FRPT	All equipment in and out of Fort Churchill
		1		T+30	CARDE	NRC		

9.7 Recovery Reports - NR

9.8 Aircraft Reports - NR

10.0 FACILITIES

10.1 Facilities - General

(1) Storage for equipment crates of about 200 sq. ft. area by 8 ft. high. It is requested that no range user equipment be stored where the equipment temperature may become lower than -40°F.

(2) Preparation area of about 300 square feet for nose cone assembly and checkout. At least 15 ft. of overhead clearance is required. A rope hoist or equivalent capable of lifting 500 lbs. is required and should be installed 15 ft. above the floor.

(3) Hazardous storage for the motor, igniter and squib is requested.

(4) About 100 square feet of space is requested in the blockhouse for the payload checkout console and beacon receiver.

These facilities are requested for the period February 21st to March 21st, 1963.

11.0 RANGE SAFETY

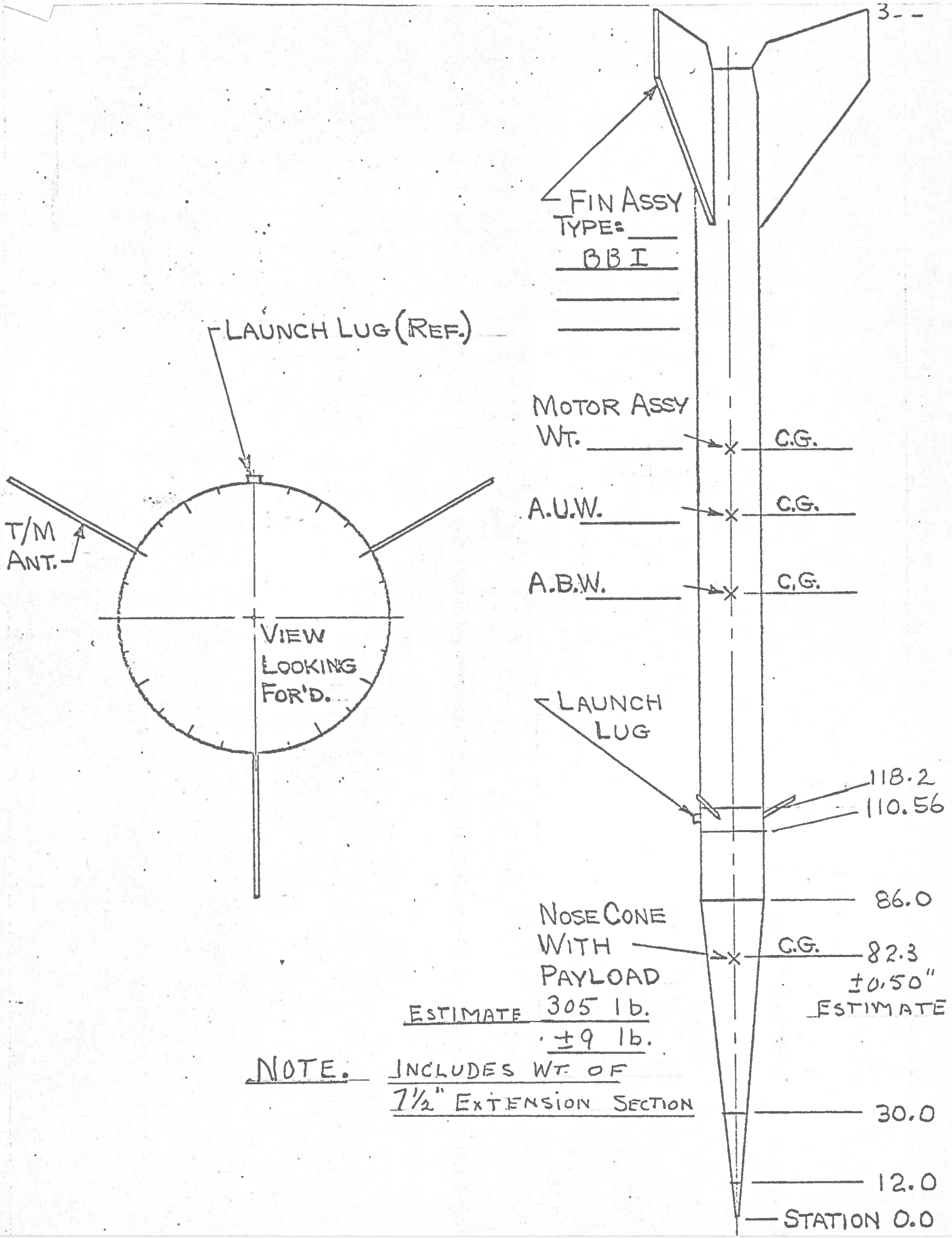
RFOAR is responsible for all range safety.

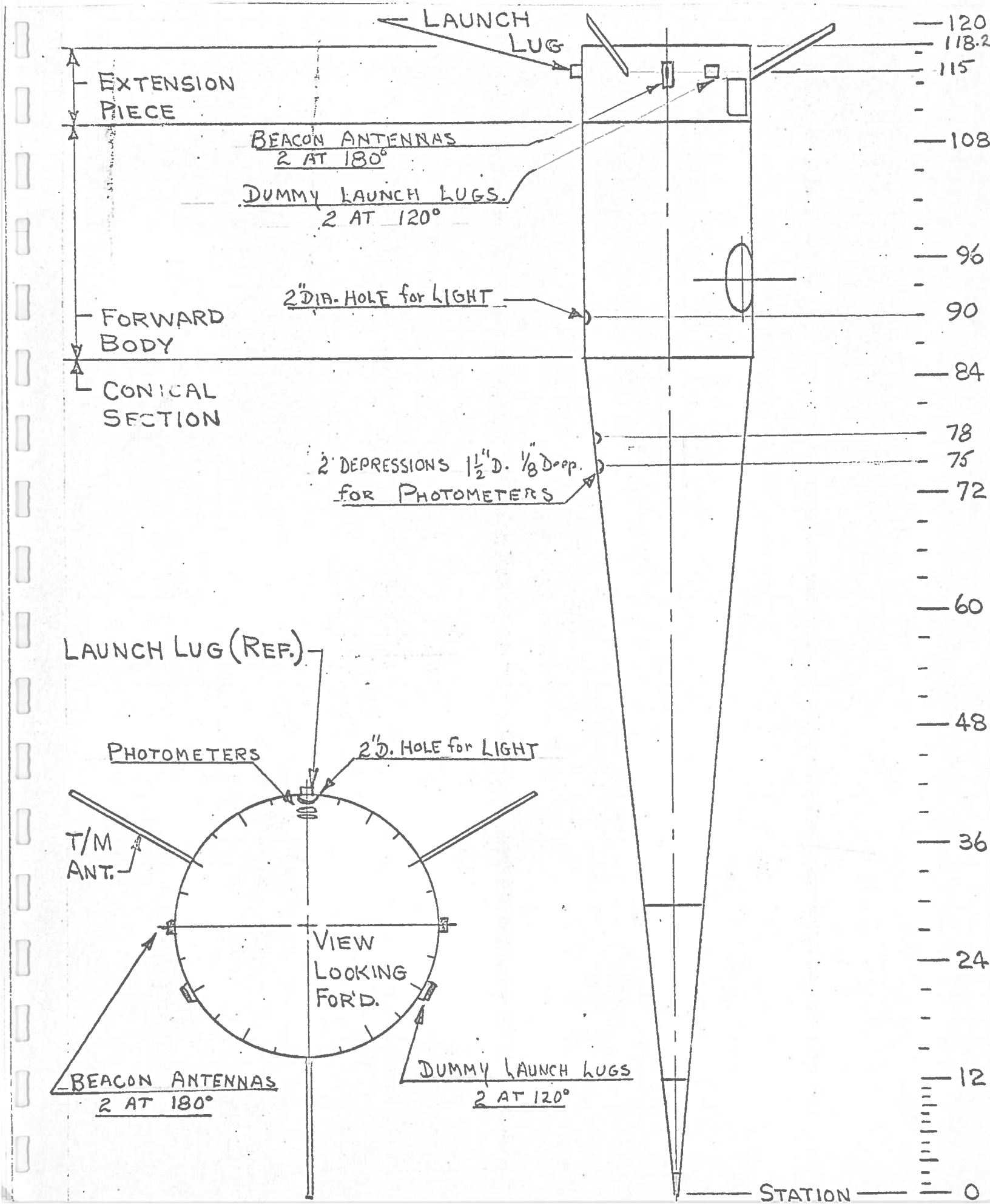
CLASSIFICATION

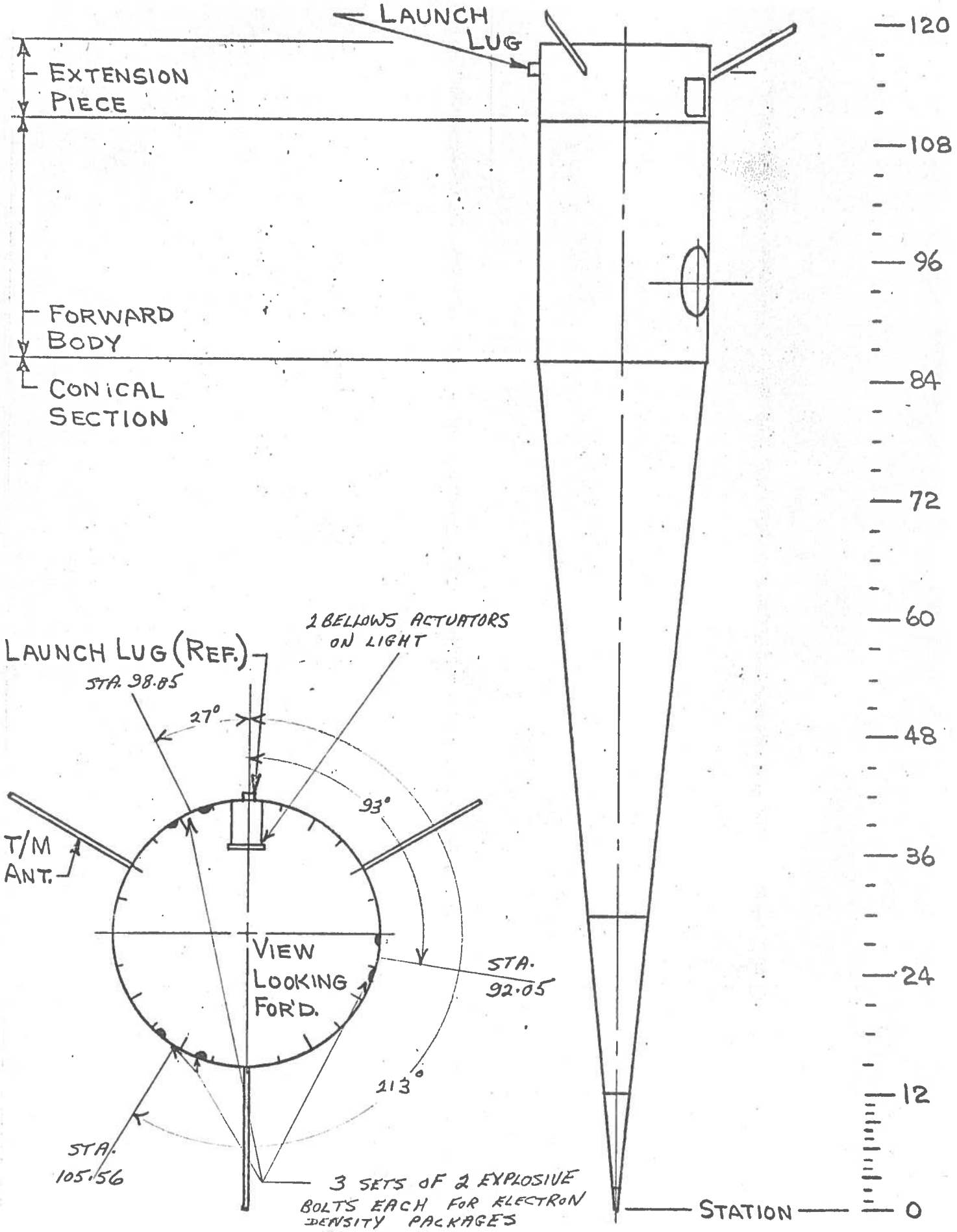
This document is Unclassified.

RF

Vehicle Configuration




LAUNCH LUG
EXTENSION PIECE
BEACON ANTENNAS 2 AT 180°
DUMMY LAUNCH LUGS. 2 AT 120°
2" DIA. HOLE for LIGHT
FORWARD BODY
CONICAL SECTION
2 DEPRESSIONS 1½" D. ⅛ Deep. FOR PHOTOMETERS
120
118.2
115
108
96
90
84
78
75
72
60
48
36
24
12
STATION
0
LAUNCH LUG (REF.)
PHOTOMETERS
2" D. HOLE for LIGHT
T/M ANT.
VIEW LOOKING FOR'D.
BEACON ANTENNAS 2 AT 180°
DUMMY LAUNCH LUGS 2 AT 120°

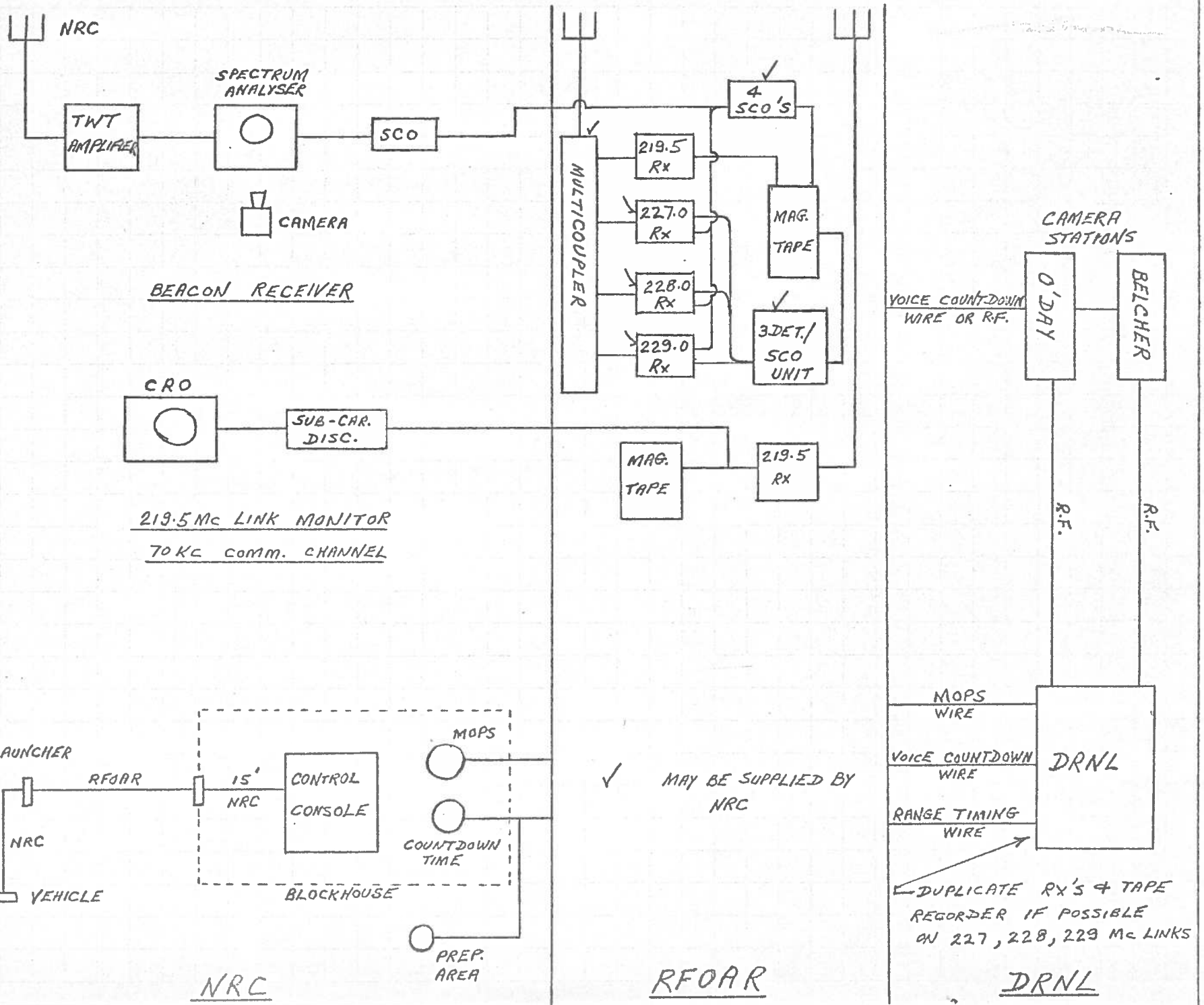

LAUNCH LUG
EXTENSION PIECE
FORWARD BODY
CONICAL SECTION
120
108
96
84
72
60
48
36
24
12
0
STATION
LAUNCH LUG (REF.)
STA. 98.85
27°
2 BELLOWS ACTUATORS ON LIGHT
93°
T/M ANT.
VIEW LOOKING FOR'D.
STA. 92.05
213°
STA. 105.56
3 SETS OF 2 EXPLOSIVE BOLTS EACH FOR ELECTRON DENSITY PACKAGES

15 November 1962 APPENDIX IV OR

Telemetry on 219.5 Mc Link

U.of S. RED PROBE EXIT NOSE CONE PRESSURE SWITCH	T/M +26v	400 c/s IRIG #1	
LIGHT MONITOR EXT.	LIGHT	660 c/s	
U.of S. YELLOW PROBE EXIT	T/M +26v	960 c/s IRIG #4	
U. of S. BLUE PROBE EXIT	T/M +26v	1300 c/s IRIG #5	
LINEAR ACCELEROMETER ±5G X-AXIS	T/M CAL. +5v.	3.9 Kc. BW 59	
LINEAR ACCELEROMETER ±5G Y-AXIS	T/M CAL. +5v	5.4 Kc. BW 81	
PHOTOMETER U.of S.		7.35 Kc. BW 110	
PHOTOMETER U.of S.		10.5 Kc. BW 160	
LANGMUIR PROBE PLANAR	±12v	14.5 Kc. BW 220	
BUCKMASTER MAGNETOMETER ROLL	MAGNET. ±12v	22 Kc. BW 330	
BUCKMASTER MAGNETOMETER ROLL	MAGNET. ±12v	30 Kc. BW 450	
VIBRATION ACCELEROMETER	T/M +26v +250v	40 Kc. BW 600	
VIBRATION ACCELEROMETER	T/M +26v +250v	52.5 Kc. BW 790	
T/M COMMUTATOR 30 x 10/s	T/M +26v	70 Kc. BW 1050	

CALIBRATE 0		CAL. GND	1
" 5		T/M CAL	2
BEACON -6.5v		BEACON	3
" R.F.		"	4
" MOD		"	5
" Rx		"	6
SCHONSTEDT MAGNETOMETER SIG		MAGNET. +6v	7
" BIAS		"	8
BUCKMASTER MAGNETOMETER SIG		MAGNET. ±12v	9
" SIG		"	10
" SIG		"	11
LIGHT OP. MON		LIGHT	12
MOTOR PRESSURE SIG		T/M CAL. +5v	13
LINEAR -3 TO +20G ACCELEROMETER Z AXIS SIG		T/M CAL. +5v	14
PHOTOMETER			15
VIBRATION ACCELEROMETER RMS SIG		T/M +26v +250v	16
" RMS SIG		T/M +26v +250v	17
TEMPERATURE T/M PACKAGE		T/M +26v	18
TEMPERATURE TOP OF H-FRAME		T/M +26v	19
U. of S. PROBES: RED Tx MON		U.of S. PKGS.	20
" RED 12v MON.		"	21
" YELL. Tx MON.		"	22
" YELL. 12v MON		"	23
" BLUE Tx MON		"	24
" BLUE 12v MON		"	25
U.of S. PROBES SUBCOMMUTATE	6 MONITORS 250v MON. & MASTER	SQUIB +12v	26
"		"	27
MASTER		T/M +26v	28
MASTER		"	29
MASTER		"	30



APPENDIX V SYSTEM BLOCK DIAGRAM OR

NOV 15/62