Provisional operations requirement for Black Brant Rocket AE II-24
National Research Council of Canada. Radio and Electrical Engineering Division

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NATIONAL RESEARCH COUNCIL OF CANADA

ASSOCIATE COMMITTEE ON SPACE RESEARCH

PROVISIONAL OPERATIONS REQUIREMENT FOR BLACK BRANT ROCKET AE II - 24

PREPARED BY

RADIO AND ELECTRICAL ENGINEERING DIVISION

O. R. NO. 119

OTTAWA

MARCH 1964

OPERATIONS REQUIREMENT NO. ____________

BLACK BRANT IIA, AE-II-24

Atmospheric Pressure and Density Launch

June 4, 1963

Project No.: AE-II-24

SUBMITTED BY: S G Jones

S.G. Jones, Trial Coordinator,
Radio & Electrical Eng. Div.,
National Research Council

APPROVED: W L Haney

W.L. Haney, Head,
Space Electronics Section,
Radio & Electrical Eng. Div.,
National Research Council

ACCEPTED: ____________________

RFOAR Operations

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PAGE	SECTION NO.	INST./REMARKS
2	1.2.1	Para. 1, line 10 - One rps should read two rps.
		Para. 1, line 11 - CARDE should read CBA.
		Para. 2, line 6 - CARDE should read CBA.
5(b)	1.2.2	T - 0:30:00 - 85° should read 80° effective.
7	1.4	Para. 4, line 3 - 85° should read 80°.
i(b)	1.5.6	After "Delete para. 6, delete first sentence and add: The firing line for the vacuum closure valve in the nose cone will be brought out the umbilical connector.

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PAGE	SECTION NO.	INST./REMARKS
Cover	Title	Change rocket number to AE-VA-24/04.
i		Change Trial Coordinator to A. Staniforth.
1		Change Trial Coordinator to A. Staniforth.
2	1.2.1	Para. 1, line 4: October 7, 1963 should read April 1, 1964.
		Para. 3, line 7: 1.5 Kw should read 5 Kw.
3,4,5, 5a, 5b, 5c, 6	1.2.2	Replace with new pages.
7	1.4	Delete item (c).
8	1.4	Para. 2: Delete to end of para. beginning at "....and in dumping liquid air or ...."
	1.5	Para. 1: Should read "The Black Brant VA is a single stage, solid propellant, unguided sounding rocket. Black Brant VA, AE-VA-24/04, will have Black Brant V fins ......". Read BB V fins wherever BB II fins are mentioned and read AE-VA-24/04 wherever AE-II-24 is mentioned. Instructions regarding these fins will be furnished by CBA.
9	1.5.4.1	See O.R. for AA-II-43, AD-II-44 or AD-II-36 regarding beacon, except in-flight monitoring will not be done.
	1.5.4.2	DOVAP not required.
10	1.5.6	Para. 2: "Five bellows actuators ....." The four bellows actuators used for the nose cone ejection are Hercules Powder Co. Type BA31K2. The actuator for the vacuum line closure valve at Sta. 85 is Type BA31K7.

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PAGE	SECTION NO.	INST./REMARKS
10	1.5.6 (Cont'd.)	Characteristics of BA31K2 & BA31K7 are: Bridge resistance: 4-5 ohm Max. non-fire: 50 ma. Min. fire: 0.3 amp. Recommended fire: 1.0 amp. Ignition time: 0.6 sec. at 1.0 amp. One type BA31K7 bellows actuator is used on the launcher boom for disconnecting the cooling air ducts from the blowers. Delete Para. 5. Delete Para. 6. Add: The firing line for the vacuum closure valve in the nose cone will be brought out at the igniter access hatch. This line, and the line to the actuator on the cooling duct release mechanism, will be taken to the NRC junction box on the launcher boom. Four of the 140 User umbilical lines will be used.
11	1.6	Para. 3: Diffusion pump heater requires 350 watts power, not 250 watts. Delete from "The diffusion pump will be strapped...." to end of para. Para. 4: 5.0 Kw portable generator, not 1.5 Kw. Delete last sentence and add: This unit will be used while moving the nose cone from the preparation area to the launch bay. The nose cone is to be mated to the motor in the launch bay. Delete Para. 5, and add following:

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PAGE	SECTION NO.	INST./REMARKS
11	1.6 (Cont'd.)	"It is planned that the motor and blowers for providing cooling air to the diffusion pump and thermoelectric coolers be mounted on the launcher. The cooling air ducts to the diffusion pump and manual valve above the diffusion pump will be connected to a cable to the launch bay roof so that they will swing clear of the launcher when released. The diffusion pump is also to be supported by a cable so that it will swing clear of the launcher when vacuum pumping is terminated. See Appendix VII for drawing of vacuum system in launch bay."
12	1.6	Delete para. describing use of Zeolite pump. The Zeolite pump will not be used.
	1.7	Add: 225.7 mc link, for transmission of ADR and Radar AGC data to launch T/M station.
14	2.2	Under movies, item 6 should read "Moving nose cone to Launch Bay ......" Under still photo coverage, item 7, delete "... and liquid air pump line."
18	2.3.1	Revise the magnetic tape track allocations as follows:

Track	Record
1	IRIG Timing Format "B" and Format "C"
2	Received Signal Strength Data
3	Nose Cone Telemetry (219.5 mc)
4	Voice Countdown, tape servo reference, and radar data (225.7 mc)
5	Nose Cone Telemetry (219.5 mc)
6	IRIG Timing Format "B"
7	IRIG Timing Format "C"

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PAGE	SECTION NO.	INST./REMARKS
18	2.3.1 (Cont'd.)	The tape servo reference to be recorded on Track 4 should be a 17 kc square-wave, modulated 50% by a precision 60 cps supply. A 100 kc sinusoidal reference is to be recorded on Track 5, with the nose cone telemetry signal. Signal strength data will be recorded in the the same way as outlined in O.R. 130 for Rocket AA-II-43.
19	2.3.2	Change paper rate for items 11 and 12 to 10 inches per second and include this recording with item 14. Similar requirements for paper records apply as for vehicles AA-II-43, AD-II-44 and AD-II-36. A decommutator will be operated by the Range User in real time. Details on playback records will be decided after arrival of User personnel at the CRR.
20	2.3.2	Under calibration (a) 219.5 mc link: Delete references to 400, 560, 730 and 960 cps event channels and add: "IRIG channels 1 to 4 inclusive are event channels, the data being essentially of an on/off nature. The deviations on these channels when on will be within the ±7.5% limits."
24	4.3.3	Delete and substitute as in O.R. 130 for rocket AA-II-43.
27	5.1.1	5.0 Kw generator, not 1.5 Kw.
	5.1.6	Delete para. 2.

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PAGE	SECTION NO.	INST./REMARKS
28	5.1.6	Para. 1: Cleaning will be done in the Launch Bay. Under requested support: (b) diffusion pump will not be mounted on the launcher but will be hung by cable from the roof. (c) the vacuum line between the mechanical pump and the diffusion pump will be 1 1/4 inch I.D. PVC plastic pipe. (d) delete.
28	5.1.9	Delete.
29	5.3	Delete and add: 5 gallon drums of cleaning solvent (chlorothene - nu and acetone) will be supplied by Range User.
30	6.0	DRNL is requested to inform Mr. W.L. Haney by Telex of the arrival of check-out equipment at CRR.
32	6.1.2	Add: "DRNL is requested to provide for loading and transport of User Equipment to the railway depot at the conclusion of the rocket firings.
35	9.2	Under item 6 add: Playback paper records, 1 original, required T + 2 days, for NRC, to be picked up by NRC.

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PAGE	SECTION NO.	INST./REMARKS
37	10.1	Change last sentence to read: "These facilities are requested for the period April 1 to April 30th, 1964."
	Appendices	Replace Appendices I, II and III with revised sheets attached. Add Appendix VII, Vacuum System, Sheets 1, 2 and 3.

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OR

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The security classification of information in this OR is UNCLASSIFIED.

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OR

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.

Three representatives from the University of Toronto will be present to assist in experiment preparation. One of these representatives will act as project scientist.

One or two visitors are expected at this test (one from NRC, Ottawa, and one from the University of Toronto).

A list of names with duties and dates of arrival will be forwarded to RFOAR at a later date.

Trial Coordinator	S.G. Jones
Project Scientist	R.N. Grenda
Vehicle Controller	Capt. E.W. Rance

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 October 7th, 1963. Support for living accommodation, transport, equipment and rocket storage, assembly and blockhouse space, power, and communications is requested for this period. Rocket assembly, fin alignment, arming, placing the rocket on the launcher, etc., will be the responsibility of the range contractor. The fins of this vehicle are to be set to produce a one rps roll rate. CARDE is responsible for informing CRR concerning the proper alignment of the fins. 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 experiment. Data on vehicle performance and launch restrictions will be made available from CARDE for this particular rocket. This data is based, in part, on information supplied to CARDE by NRC on estimated nose cone weight and centre of gravity and nose cone holes and projections. It is understood that a report concerning the Black Brant IIA vehicle originating from CARDE is available to RFOAR.

Desired experiment conditions are:

(a) during daylight, with no cloud cover at launch site,

(b) following a night with auroral activity.

The conical section of the nose cone (sta. 0 to sta. 86) will be sealed and evacuated shortly after arrival of Range User personnel at CRR. It will be necessary to vacuum pump this section continuously for several days prior to launch. Range User will supply a motor driven mechanical pump, an oil diffusion pump, and hose, for this purpose. RFOAR is requested to supply a portable 1.5 kw, 110 volt, 60 cps generator so the pump can be operated while the nose cone is being moved to assembly with the motor and then to the launcher. It is desirable that pumping be continuous during vehicle assembly and continue until 30 seconds before launching. The motor supplied with the pump will be explosion proof. See also para. 1.6.

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. 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. This equipment will be consigned to DRNL. DRNL 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. Accommodation and personnel transportation support requested. (Request for accommodation will be made to DRNL.) (5.1.2)
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. Complete assembly of conical section of nose cone and install bellows actuators for the eject-extend mechanism. Install vacuum line closure valve with bellows actuator. Install safety harness on nose cone.
8. Conical Section of nose cone connected to vacuum pump and pumped continuously from this time to launch (1.6).
9. Meteorological services (3.0).
10. Support for setting up diffusion pump in Launch Bay and motor and blowers on Launcher. (5.1.6)
11. Office space at DRNL and telephone.
12. Support for installing a fixed mechanical pump (non-portable) in the Launch Bay vestibule and 1 1/4 inch dia. vacuum line from this pump to a position on the floor of the Launch Bay below Sta. 86 on the rocket. (5.1.6)

1.2.2 General Countdown (Cont'd.)

TIME	FUNCTION/SERVICE
Preparation Phase:	
F-1 day	Install bellows actuators for release of cooling air ducting from blowers mounted on Launcher.
	Nose cone instrumentation preparation complete.
	Battery charging complete.
	Install all batteries to payload.
	Complete instrumentation check-out.
	Radar beacon check.
	Request support of telemetry station, radar, DRNL, and 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. The vacuum pumping system will very likely not allow use of the clam shell heat shield during this launch. It is understood that minimum motor temperature for launching is $0^{o}F$ on the engine skin.
	Final visual inspection of payload and battery check.
	Check complete length of umbilical cable, from blockhouse to vehicle 50-pin connector with test box.
	Assemble nose cone to payload in Preparation Area.
	Check telemetry compartment sealing.

1.2.2 General Countdown (Cont'd.)

TIME	FUNCTION/SERVICE
Launch Phase (cont'd.)	
T-4:30:00	All Range User personnel on station.
T-4:25:00	Range being count with Range User.
T-4:20:00	Transfer vacuum pump and diffusion pump heater to portable generator power. Move nose cone with pumps and portable generator to launcher direct from Preparation Building.
T-4:00:00	Mount nose cone on motor. Check shorting plug on bellows actuators for nose tip ejection. Remove safety harness from nose cone tip. Carefully clean nose cone from Sta. 0 to Sta. 100. Install safety harness on nose cone tip. Clean remainder of vehicle.
T-3:30:00	Range conduct firing circuit checks of motor. User check vacuum line closure valve, and cooling air duct release circuits.
T-3:00:00	Install vehicle on launcher. Check that payload control console is disconnected from umbilical. Connect umbilical to vehicle. Transfer mechanical pumping from portable equipment to equipment in launch bay vestibule utilizing solenoid operated valves and relays so that pumping is not interrupted. Attach support cables to diffusion pump and cooling ducts. Turn on blowers mounted on Launcher. Transfer diffusion pump heaters and thermoelectric cooler from portable power to Launch Bay power.

1.2.2 General Countdown (Cont'd.)

TIME	FUNCTION/SERVICE
Launch Phase (cont'd.)	
T-3:00:00 (cont'd.)	Connect motor temperature sensor. Install telemetry antennas. Clean vehicle aft of Sta. 100.
T-2:10:00	Clear launch bay for horizontal instrumentation checks.
T-2:05:00	Begin horizontal instrumentation checks. External power on. Discharge batteries to plateau. Internal power on. Telemetry note signal condition of SCO's. Check all umbilical monitor functions. Check cold cathode gauges with monitor hot cathode gauge and by varying nose cone pressure. Check solar aspect sensor with mask and light. Radar beacon checked with external and internal power. Radar interrogate beacon while SCO calibration is done at 0, 2.5 and 5.0 volts. Telemetry check 225.7 mc ground link from Radar Site. Payload switched to external. All umbilical power off.
T-1:20:00	Horizontal checks completed.
T-1:00:00	Range arm vehicle and connect firing lines to vacuum line closure value and cooling duct disconnects. It is understood that all power must be off during Arming. The following procedure will be followed for the vacuum system for this period: 1. Close manual valve on mechanical pump in the launch bay vestibule, turn off mechanical pump. 2. Turn off diffusion pump heaters. 3. Turn off power to the thermoelectric coolers. 4. Turn off cooling air motor (blowers on Launcher). If power is to be off for more than ten minutes, close manual valve above the diffusion pump.

1.2.2 General Countdown (Cont'd.)

TIME	FUNCTION/SERVICE
Launch Phase	
T-1:00:00 (cont'd.)	Turning power on: 1. Turn on power to mechanical pump. Open valve on mechanical pump. 2. Turn on blower motor and power to thermoelectric coolers. 3. Turn power on to diffusion pump heaters when backing line pressure (1 1/4" dia. line to mechanical pump) is low enough. 4. Open manual valve above the diffusion pump if it has been closed. Remove harness from nose cone tip.
T-0:35:00	Automatic hold to allow for any necessary pumping time. T/C check with User Vehicle Controller.
T-0:30:00	Elevate launcher to nominal 85°.
T-0:20:00	Begin vertical instrumentation checks. External power on (for warm-up only). Internal power on. Check: Main Telemetry, Twin Lakes Telemetry. Telemetry note signal condition of SCO's. Check all battery monitors. Check pressure gauge monitors. Radar interrogate beacon. Payload telemetry switched to 2.5 volt calibrate for adjustment of telemetry paper recorders. T/M record signals for 30 seconds at 0.4 inches per second. Also record at full speed on magnetic tape. Payload switched to External. All power off.
T-0:14:00	Vertical checks complete. All instrumentation stations report status: 1. Telemetry 2. Radar 3. Vehicle Payload 4. DRNL 5. Project Scientist

1.2.2 General Countdown (Cont'd.)

TIME	FUNCTION/SERVICE
T-0:06:00	Automatic hold, check with User vehicle controller. One minute notice of resumption of count.
T-0:05:00	Clear Launch Bay for Firing.
T-0:04:00	External power on to payload filaments, if not already on.
T-0:03:00	Remotely arm payload bellows actuators. Telemetry and experiment instrumentation turned on internal power with signal inputs. Beacon turned on internal power. Check nose cone vacuum. Radar interrogate beacon.
T-0:02:30	Commence 2.5V calibration. T/M zero discriminators.
T-0:02:00	Start all instrumentation recorders, T/M acknowledge. Paper recorders on at slow speed.
T-0:01:35	Telemetry switched to 0-volt calibration.
T-0:01:25	Telemetry switched to 5-volt calibration.
T-0:01:15	Begin 3 cycles of 11 step (0 to 5 volts) calibration on telemetry.
T-0:01:00	Telemetry switched to signal input and internal calibration. Acknowledge all green on payload control console. Telemetry acknowledge signal condition of SCO's.
T-0:00:40	Paper recorder on to fast speed.
T-0:00:30	User fire bellows actuator to close valve inside nose cone on vacuum line from diffusion pump. Project Scientist acknowledge valve closed. User fire bellows actuator to release cooling air ducts from blowers on Launch boom. User close valve B in backing line from mechanical pump to diffusion pump. User open valve A in line from diffusion pump to nose cone.

1.2.2 General Countdown (Cont'd.)

TIME	FUNCTION/SERVICE
Launch Phase	
T-0:00:20	T/C acknowledge that pumping system has swung clear of Launcher.
T-0:00:15	Project Scientist acknowledge "GO" - "NO GO" condition.
T-0:00:00	Black Brant IIA rocket ignites.
T+0:00:15	Rocket motor burns out.
T+0:00:60	Nose cone tip (sta. 0 to sta. 36) ejected and low pressure gauges extended.
T+0:00:200	Apogee (approximately 115 miles alt.)
T+0:00:400	Impact.

1.3 Test Objectives

1.3.1 Primary

Scientific measurements in the upper atmosphere:

Measurement of atmospheric pressure with a composite orifice type probe especially at altitudes above 100 km, where essentially free molecular flow conditions apply. Gauges to measure static pressure and stagnation pressure at lower altitudes are also included.

1.4 Test Description

The main experiment carried in the nose cone of Black Brant AE-VA-24/04 is that concerned with the measurement of atmospheric pressure. Three sets of pressure gauges are included in the instrumentation: high pressure (strain gauge

1.4 Test Description (cont'd.)

type, medium pressure (thermopile type), and cold cathode low pressure gauges.

Several precautions have been taken to minimize the effect of vehicle outgassing which could seriously affect the validity of the data from the low pressure gauges:

(a) the low pressure gauges have been mounted near the tip of the conical section of the nose cone

(b) the conical section is evacuated and continuously pumped for some time previous to launch

(c) the outside of the nose cone is carefully cleaned and then covered with a plastic bag filled with argon (it is intended that the vehicle be launched with this bag in place).

The tip of the nose cone covers the low pressure gauges until approximately T + 60 seconds when this tip (sta. 0 to sta. 36) is ejected by timer controlled Bellows actuators which operate a release mechanism on a spring. The nose tip release mechanism also acts to move the low pressure gauge assembly forward so that the orifices are located near station 0.

The medium and high pressure gauges are exposed to the atmosphere during the whole flight. One set is located at sta. 81 to measure static pressure and another set at sta. 0 to measure ram pressure.

The experiment launch conditions are: during daylight and following a night with auroral activity. Launch elevation of 85º nominal is desired. There is no preferred launch azimuth. Presumably impact will be into Hudson's Bay Recovery is not required.

Events of primary importance during the flight are the nose tip ejection time (T + 60 sec.), the switching time of the telemetry multiplex relays (T + 60 sec.) as well as motor burnout, apogee, and impact. It is requested that sound ranging equipment be used for impact data.

The nose cone will be instrumented with a solar aspect sensor and magnetometers for attitude measurement. A prime requirement in the data reduction of the low pressure

1.4 Test Description (cont'd.)

gauge measurements is knowledge of the vehicle attitude and velocity vector (both desired to $\pm 1^{\circ}$ accuracy). It is also desired that the vehicle velocity be measured to within ±1% and vehicle position to within ±250 feet.

Range User personnel will operate the nose cone instrumentation control unit during the launching and monitor real time oscilloscope displays and metering of the discriminator outputs from the 219.5 mc link. RFOAR is requested to provide wired circuits from the telemetry room to the User area in the blockhouse for transmission of the discriminator outputs for IRIG. Channels 9-18 inclusive at the ±10V level for ±7.5% deviation into a 10K ohm at the blockhouse. Discriminator outputs must also be available for monitoring, using high impedance instruments, in the User area adjacent to the telemetry room in the Operations Building. Range User personnel will also operate the mechanical pump driving a diffusion pump during the pre-launch phase. RFOAR is requested to assist in operation of the mechanical pump and diffusion pump after the nose cone has left the preparation area and in dumping liquid air or liquid nitrogen to the Zeolite pump located in the nose cone.

1.5 Test Vehicle Description

The Black Brant IIA is a single-stage, solid-propellant, unguided, sounding rocket. Black Brant IIA, AE-II-24, will have modified Black Brant II 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	340.15 inches (approx.)
Diameter	17.2 inches
Launch weight	2800 lbs. approx.
Weight at burnout	900 lbs. approx.
Propellant	Aluminized single grain polyurethane-ammonium perchlorate
Total impulse (sea level)	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

1.5 Test Vehicle Description (cont'd.)

are furnished by NRC to CARDE, who then calculate vehicle performance. It is understood that RFOAR has a manual on the Black Brant IIA, furnished by CARDE. Special instructions concerning the BB II fins fitted on AE-II-24 will be furnished to RFOAR by CARDE.

1.5.1 Vehicle Drawing

See Appendix I.

1.5.2 Nose Cone Drawing

See Appendix II.

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 right-hand circular.

1.5.4 Transponders and Beacons

1.5.4.1 Radar Beacon

RFOAR is requested to provide a DPN-41 radar beacon. NRC will investigate the possibility of modifying this beacon so that it will self-trigger in a free-running mode when not being interrogated by a radar. It will also be modified so that battery voltage, receiver output, modulator output, and r.f. output can be monitored on the commutated channel of telemetry link 1. NRC will supply antennas (as used on vehicles AA-II-26 and AD-II-23) tuned for a beacon transmitter frequency of 2880 mc and beacon receiver frequency of 2810 mc. NRC will supply a box for the batteries and relay control for external/internal operation and charging.

It is understood that installation and check-out of this beacon will be the responsibility of NRC. NRC will forward to RFOAR a complete report on all modifications made on the beacon, together with a modification kit.

1.5.4.2 DOVAP

It may be desired to use DOVAP on this vehicle. This has not yet been decided and depends on the

1.5.4.2 DOVAP (cont'd.)

accuracy obtainable from Radar data. It would be desirable to avoid using DOVAP because of the possible out-gassing from the shroud antennas.

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.

Six bellows actuators (squib) are located in the nose cone:

Four are used in the nose tip ejection mechanism at station 30 and are fired at T + 60 seconds by the action of an electronic time delay circuit, timing from umbilical pull-away.

One actuator is located at sta. 88 and is operated at T - 30 seconds to operate the vacuum line closure valve.

One actuator is located at sta. 90 for release of the vacuum line from the diffusion pump at T - 25 seconds.

RFOAR is requested to be responsible for firing the actuators which operate the vacuum line closure valve and the vacuum line disconnect. Range User will provide two separate firing lines accessible via the igniter access hatch for this purpose.

The Bellows actuators are Type BA 31K2, made by Hercules Powder Company, Wilmington, Delaware:

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.

The location of these items is shown on the drawing given in Appendix III. The Bellows actuator arm/disarm and timer circuit is shown in Appendix IV.

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 will monitor the outputs of the 219.5 mc link in the blockhouse. A 17-inch oscilloscope display will be used for the 70 kc channel (commutated). For the other channels (IRIG Nos. 9-17 inclusive) a panel of meters (centre zero ±1 ma full scale) and an oscilloscope with differential input amplifier and a switch to select the desired channel will be employed. RFOAR is requested to provide wired circuits from the telemetry room (Operations Building) to the User area in the blockhouse for these ten channels. Discriminator outputs at ±10 volt level for ±7.5% deviation into a 10K ohm load at the blockhouse are required. The discriminator outputs must also be available for monitoring, using high impedance instruments, in the User area adjacent to the telemetry room in the Operations Building.

It is desired that the conical section of the nose cone (sta. 0 to sta. 86) be pumped as continuously as possible from F-6 to T-35 seconds.

Range User will supply a mechanical vacuum pump with an explosion-proof motor (1/2 horsepower) to operate on the output of a diffusion pump via a long hose. Heaters for the oil in the diffusion pump require about 250 watts of 115 volt, 60 cps power. In addition, a small fan or blower with an explosion-proof motor will be used for cooling the diffusion pump. The diffusion pump will be strapped to the outside of the nose cone at sta. 110 approximately until the rocket is placed on the launcher. At that time it is planned that the diffusion pump will be mounted on a bracket attached to the launcher boom.

RFOAR is requested to supply a portable 1.5 kw, 115 volt, 60 cps generator as a power source for the mechanical pump motor and the diffusion pump oil heaters and fan. This unit is to be used while moving the nose cone from the preparation area to the blockhouse, from the blockhouse to hazardous assembly, and from hazardous assembly with the complete vehicle to the launch bay.

It is planned that the diffusion pump be mounted on a bracket on the launcher boom, after the vehicle has been placed on the launcher rails. It must be mounted in such a way that it remains horizontal when the launcher is elevated or it may leak oil. The length of vacuum line from the diffusion pump to the nose cone (sta. 90) must be as short as possible, preferably less than 3 feet. It is proposed that a second mechanical pump and its motor be placed in the vestibule off the entrance to the launch bay with a suitable vacuum line connecting it to the diffusion pump on the launcher boom. It is understood that electrical power is available in the vestibule, so the portable generator would not be used further. Electrical power from the

1.6 Range User's Instrumentation (cont'd.)

vestibule to the diffusion pump heaters and fan is also required. Use of a second mechanical pump is largely a matter of convenience in that it can be set up ahead of time and serves to reduce the length of time required in transferring the diffusion pump from portable power and vacuum to fixed power and vacuum after the vehicle is placed on the launcher.

Pumping may be stopped and power to the diffusion pump heaters turned off while the vehicle is being armed, if this is a Range Safety requirement. Pumping will also cease while the diffusion pump is being mounted on the launcher boom and the mechanical pump is being connected in the launch bay vestibule. It is requested that periods during which the pumping is off be kept as short as possible. The sequence of manual valve operations is indicated in the countdown. If the diffusion pump is off for several minutes, the full warm-up time for the oil must be allowed before applying vacuum to the pump.

The diffusion pump may be considered expendable at lift-off. It may spread some oil if it falls off the launcher boom.

A Zeolite absorber pump will be located inside the conical section of the nose cone. Heater power (5 amps. 110 volts DC) via the User umbilical cable, will be supplied to the Zeolite to drive off absorbed gas until T-5 minutes. At T-5 minutes liquid air or nitrogen will be passed through the Zeolite cooling coils via a short hose from a tank on the launcher boom. Starting the flow of liquid air will be a manual operation by pulling a lanyard attached to the valve on the liquid air tank. The hose to the rocket (connection at sta. 90) will disconnect by rocket motion.

RFOAR support is requested in the above operations.

1.6.1 DRNL Instrumentation Support

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

(a) Provide a magnetic recording of the voice countdown.

(b) Report on the extent of auroral activity on the night previous to the scheduled launching.

1.7 Summary of Frequency Utilization

Freq.	Class	Equipment	Location
2800 mc	U	Radar Beacon	Cylindrical Section Nose Cone
219.5 mc (218.0 mc alternate)	U	Telemetry	Cylindrical Section Nose Cone

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 (Plotting Board)	Class II (ADR Tape)	Class III
1.	Position (X,Y,Z)	Throughout Flight	10 from T-0 to T+80 sec.	1000 ft.	250 ft.	--
			2 from T-0 to T+80 sec.			
2.	Velocity (V_X, V_Y, V_Z, V_S)	Throughout Flight	10 from T-0 to T+80 sec.	5%	$\pm$1%	--
			2 from T+80 to splash			
3.	Trajectory Angles θ and ϕ	Throughout Flight	10 from T-0 to T+80 sec.	$\pm 5^\circ$	$\pm 1^\circ$	--
			2 from T+80 to splash			

where $\theta = \text{arcsine} \dfrac{V(Z)}{V(S)}$

$\phi = \text{arctangent} \dfrac{V(Y)}{V(X)}$

where V_S = tangential velocity

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

2.1.2 Impact

Impact coordinates are desired by sound ranging equipment 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.

The movie coverage should include the following sequences:

1. Setting up racks in preparation area
2. Working on nose cone instrumentation
3. Conical section of nose cone with diffusion and mechanical pump in preparation area
4. Connecting conical section to cylindrical section of nose cone
5. Installing T/M antennas
6. Moving nose cone to Hazardous Assembly for assembly to motor
7. Assembly to motor
8. Placing vehicle on launcher and showing diffusion pump
9. Launch.

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.

Still photographs, which may include some 35 mm color transparencies, should include the following:

1. Equipment in preparation area
2. Nose cone instrumentation
3. Control console and other Range User equipment in blockhouse
4. Assembled nose cone and motor on dolly with diffusion and mechanical pumps.
5. Rocket on launcher, horizontal
6. Rocket on launcher, vertical
7. Close-up of nose cone showing umbilical cable, vacuum line and liquid air dump line

2.2 Engineering Photography (cont'd.)

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 V 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.

Operation of the telemetry facilities at Twin Lakes to duplicate functions at the launch site as much as possible is requested.

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	2	560 cps	7.5		T-0:02 to splash	I		)
2	219.5 PAM/FM/FM	1	400 cps	7.5	Cont.	T-0:02 to splash	I	2%	) Event
3	219.5 PAM/FM/FM	3	730 cps	7.5	Cont.	T-0:02 to splash	I		) Channels
4	219.5 PAM/FM/FM	4	960 cps	7.5	Cont.	T-0:02 to splash	I		)
5	219.5 PAM/FM/FM	9	3.9 kc	7.5	Cont.	T-0:02 to splash	I	2%	
6	219.5 PAM/FM/FM	10	5.4 kc	7.5	Cont.	T-0:02 to splash	I	2%	
7	219.5 PAM/FM/FM	11	7.35 kc	7.5	Cont.	T-0:02 to splash	I	2%	
8	219.5 PAM/FM/FM	12	10.5 kc	7.5	Cont.	T-0:02 to splash	I	2%	
9	219.5 PAM/FM/FM	13	14.5 kc	7.5	Cont.	T-0:02 to splash	I	2%	
10	219.5 PAM/FM/FM	14	22.0 kc	7.5	Cont.	T-0:02 to splash	I	2%	
11	219.5 PAM/FM/FM	15	30.0 kc	7.5	Cont.	T-0:02 to splash	I	2%	
12	219.5 PAM/FM/FM	16	40.0 kc	7.5	Cont.	T-0:02 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-0:02 to splash	I	2%	
14	219.5 PAM/FM/FM	18	70.0 kc	7.5	Cont.	T-0:02 to splash	I	2%	Commutator Channel, 30X 10 per second.

Note:

Details of the data channels on the 219.5 mc link are given in Appendix VI.

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	Reference Timing
6	Spare
7	IRIG Timing Format C

The tape servo reference to be recorded on track 5 should be a 17 kc square wave, modulated 50% by a precision 60 cps supply. A 100 kc sinusoidal reference is also to be recorded on this track.

Two timing signals are requested:

a) standard time format B with a 1 kc carrier,

b) standard time format C with a 100 cps carrier.

First motion is to be indicated by an increase in amplitude of the timing signals (level increased by three times).

The signal strength of the 219.5 mc link is to be recorded on track 4 of the magnetic tape recorder from T-0:02:00 to impact using voltage controlled subcarrier oscillators provided by NRC. Range User may also include on this track signal strength data obtained by the Range User Support Instrumentation (described in detail in Section 1.6 and Appendix VII of the OR's for rockets AA-II-41 and AD-II-42) as follows:

Receiver Signal Strength on Tape Track 4

Link	Antenna	Subcarrier Freq.	IRIG.No.
219.5	Range Telemetry	3.9 kc	9
219.5	User Circular Polarization	5.4 kc	10
219.5	User Vertical Polarization	7.35 kc	11
219.5	User Horizontal Polarization	10.5 kc	12

2.3.2 Special Requirements

Real time paper records of the following channels are 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	400 cps	5	0.4	T-2 to Splash	Nose cone ejection.
2	560 cps	5	0.4	T-2 to Splash	Pressure switch.
3	960 cps	5	0.4	T-2 to Splash	Solar aspect event.
4	730 cps	5	0.4	T-2 to Splash	Multiplex relay closure.
5	3.9 kc	60	4.0	T-2 to Splash	Pressure gauges.
6	5.4 kc	60	4.0	T-2 to Splash	Pressure gauges.
7	7.35 kc	60	4.0	T-2 to Splash	Pressure gauges.
8	10.5 kc	60	4.0	T-2 to Splash	Pressure gauges.
9	14.5 kc	60	4.0	T-2 to Splash	Pressure gauges.
10	22.0 kc	30	0.4	T-2 to Splash	Lateral accelerometer.
11	30.0 kc	10	0.4	T-2 to Splash.	Magnetometer
12	40.0 kc	10	0.4	T-2 to Splash	Magnetometer
13	52.5 kc	30	0.4	T-2 to Splash	Z-axis acceleromter.
14	70.0 kc	Commutator 30 x 10/S	10	T-2 to Splash	All commutated data.
Ground Telemetry					
14	Direct Record	10	0.4	T-2 to Splash	Signal strength, 219.5 mc link.

Note: Items 1,2,3,4 & 14 may be recorded, each equal displacement, on one paper tape.
Items 5,6,7,8 and 9 may be recorded, each equal displacement, on one paper tape.
Items 10,11,12 and 13 may be recorded, each equal displacement, on one paper tape.
Item 13 should be recorded on one paper tape, at two inches displacement.

Each paper record should include Time Format C, except that for item 13, which should include both timing Format B and C.

2.3.2 Special Requirements (cont'd.)

Range User will provide a real time telemetry for own use to monitor the commutated channel (70.0 kc) of the 219.5 mc link. This display will be on a 17-inch oscilloscope in the User's area in the blockhouse. RFOAR is requested to supply wired circuits to transmit discriminator outputs from the telemetry room (Operations Building) to the User area of the blockhouse. Range User may also operate a telemetry receiver, tunable discriminator, and auxiliary display oscilloscope in the blockhouse. RFOAR is requested to have a telemetry antenna on the roof of the blockhouse available for use with Range User's receiver. The antenna with lead in, made available in April 1963, would be suitable.

RFOAR is also requested to provide discriminator outputs from the telemetry station in the Operations Building to the adjacent User preparation area. Outputs from the 3.9 kc and 5.4 kc channels of the 219.5 mc link are requested for monitoring with User instrumentation by User scientists.

Range User will provide an audio monitor from the output of the receiver (RFOAR) on the 219.5 mc link. This will be used by a Range User representative to observe the "event" channels during the launch phase.

Calibration:

(a) <u>219.5 mc link</u> - The 560 cps, 730 cps and 960 cps event channels are not calibrated; the information being essentially of an off/on nature. The output of the 730 cps channel will be within the limits of the IRIG No. 3 frequency band, the output of the 960 cps channel will be within the limits of IRIG No. 4 frequency band, and the output of the 560 cps channel will be within the limits of IRIG No. 2 frequency band.

The event channel on IRIG band 1 (400 cps) 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 oscillator. 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.

2.3.2 Special Requirements (cont'd.)

(b) Signal Strength - RFOAR is requested to supply calibration of the 219.5 mc link in terms of 0 to 1 millivolt applied to the receiver or preamplifier input. The telemetry report should include details such as the receiving antenna type, gain and polarization, preamplifier and/or multicoupler gain, and diversity combiner characteristics (if used).

2.4 Other Data

No other data is collected other than records furnished by DRNL.

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 Range User's receiver in the blockhouse.	RFOAR Telemetry, Operations Building.

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). This information should be presented to the Range User Trial Coordinator who will be responsible for informing all Range User personnel at CRR.

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.

It is likely that wind data will be requested to at least 2000 feet at hourly intervals from T - 6 to launching for use of range wind predictor and Range Safety Officer.

3.3 Minima

The only launch condition for the experiment is that it take place in daylight (solar aspect sensor must be able to see the sun) following a night of auroral activity.

4.0 SUPPORT INSTRUMENTATION

4.1 Communications - General

Intercom communications (User Net) are requested between the preparation area, blockhouse, hazardous assembly, launch bay, and launch bay vestibule.

A User hard line is requested between the blockhouse and the User preparation area adjacent to the telemetry station in the Operations Building. This will be used primarily for conferences between the Project Scientist and the User Vehicle Controller.

None of the transmissions need be recorded except the Voice countdown by DRNL.

4.2 Radio

Not required.

The Frequency Control and Analysis Facility should be available to monitor radio frequency transmissions during the test.

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 User area in the Operations Building. Wire communication with DRNL is required for the Voice countdown.

4.3.2 Telephone

Telephones for Range User personnel are requested at the following locations:

(a) DRNL

(b) User preparation area in Operations Building

(c) User area in Blockhouse

4.3.2 Telephone (cont'd.)

Charges for long distance service will be borne by the Range User.

4.3.3 Umbilical Cable

The presently installed cable from the blockhouse terminates in two junction boxes on the launcher pedestal. One box contains the terminations of seventy No. 6 conductors and the other contains the terminations of seventy No. 16 conductors. There is no connection between these boxes. Cabling containing 140 No. 16 conductors connects the pedestal junction boxes to boxes mounted on the launcher boom. It is requested that the heavy wiring (No. 6 conductors) from the blockhouse be continued onto the launcher boom (i.e., replace seventy of the 140 No. 16 wires from launcher pedestal to boom with seventy No. 10 wires) or that provision be made for connections between the two junction boxes on the launcher pedestal.

Range User will supply a fifteen foot cable for connection between the User payload control console and the umbilical terminal boxes in the blockhouse. A short cable for connection between the junction boxes on the launcher boom and the umbilical connector on the rocket will also be supplied by the Range User.

4.4 Timing

Timing on the magnetic tape records is requested to be:

(a) IRIG Format B, 100 pps with a 1 kc carrier

(b) IRIG Format C, 2 pps with a 100 cps carrier

First motion is to be indicated by an increase in the amplitude of the timing pulses. It is assumed that timing commences with calibration at T - 0:02.

Timing Format B is requested on all paper records at 10 inches per second or higher.

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

4.5 Sequence

NO.	FUNCTION	INTERVAL START	STOP	REMARKS
1	Vacuum valve closure	T-30 sec.	-	-
2	Vacuum line disconnect	T-25 sec.	-	-
3	Motor ignition	T-0 sec.	-	-

The voice time count is requested at each minute from T - 00:05:00 to T - 00:01:00, at 10 second intervals from T - 00:01:00 to T - 00:00:10, at 1 second intervals from T - 00:00:10 to T + 00:00:10, and at 10 second intervals from T + 00:00:10 to splash.

4.6 Visual Countdown and Status Indicators

NO.	FUNCTION TO BE DISPLAYED	TYPE INDICATOR	INTERVAL START	STOP	REMARKS
1	Range Countdown	Clock, digital preferred	T-6 hrs.	T+10 mins.	To be easily viewed from payload control console. Same facility desired in nose cone preparation area in Operations Building.

4.7 Data Handling

Range User will obtain all data produced by the CRR from Detachment #2, USAF/OAR, Fort Churchill.

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. Recovery is not required.

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 four 15 amp. outlets. Each service is to be independently fused. A portable 1.5 kw generator, 110 volt, 60 cps, for running the mechanical pump while moving the nose cone to motor assembly and the assembled vehicle to the launcher is required. Power is also required in the launcher building for running the motor on the mechanical pump.

5.1.2 Food Services

Ten NRC personnel and three University of Toronto 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.

In order to reduce outgassing from the outer surface of the nose cone, a light plastic bag will be fitted

5.1.6 Pad Services and Engineering (cont'd.)

from sta. 0 to about sta. 100. This bag will be held by light cord or elastic and will be filled with argon. It will not extend more than a few inches above the profile of the nose cone. It is intended that this bag will remain in place at lift-off and will tear free in the lower atmosphere.

The nose cone will be carefully cleaned in the hazardous assembly prior to fitting the plastic bag. It would be very desirable if the motor could also be cleaned after assembly to the nose cone and also on the launcher.

It is requested that all personnel working on the vehicle have clean gloves and exercise care that no grease or dirt be allowed to contact the vehicle after it has been cleaned.

RFOAR support is requested in

(a) setting up User's portable pumping equipment,

(b) mounting diffusion pump on the launcher boom (sketch of suggested method to be forwarded to CRR at an early date),

(c) installing vacuum line from mechanical pump in launch bay vestibule to diffusion pump on the launcher boom (details on type and size of vacuum line necessary to be forwarded to CRR as soon as possible),

(d) mounting liquid air container on launcher boom and facility for dumping to Zeolite pump in vehicle nose cone.

5.1.7 Water - NR

5.1.8 Survey - NR

5.1.9 Air

Liquid air for cooling the Zeolite pump will be supplied by the Range User in the form of 25 litre capacity dewars. One such unit only is required but one or two spares will be shipped to CRR in case of delays in launching. A drawing of this unit and a suggested mounting will be forwarded to CRR as soon as possible.

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 nose cone before assembly to the motor and also of the complete vehicle. This may be done during the launch "dress rehearsal".

5.3 Propellants, Gases, Chemicals

Liquid air or nitrogen will be required for the Zeolite pump in the conical section of the nose cone. This will be supplied by the Range User.

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 record of the 219.5 mc link. 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

On occasion, 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.

DRNL will be requested for the loan of two station wagons or panel trucks for the full-time use of the personnel attached to this program. All drivers will have DND operators permit.

6.1.2 Cargo

DRNL is requested to provide for the unloading and transport to the Range of the nose cone and check-out equipment. RFOAR is requested to provide for the unloading and transport to the Range of the motor and fin assembly. The motor and fin assembly will arrive at Fort Churchill by air transport.

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 60 wooden boxes, each weighing between 20 and 200 lbs. Total weight about 6000 lbs.

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

e) Estimate of 500 lbs. of electronic equipment and pumps from University of Toronto to arrive at Fort Churchill at the same time as item (d).

6.1.2 Cargo (cont'd.)

Item (c) will probably be shipped by rail. Items (d) and (e) will arrive at Fort Churchill by air about the F-7 on the same plane as the main group of Range User personnel.

Item (c) includes equipment used in other launch programs sponsored by NRC during the same time period.

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.

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OR

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	T+6H	CARDE	NRC	R-PLOT	note (a)
		1	1	T+6H	NRC	NRC		
2	Position, Velocity, Trajectory Angles, $(X, Y, Z, V_X, V_Y, V_Z, V_S, \theta, \emptyset)$		5	T+30 CD	NRC	NRC	F-TRPT and F-PLOT	note (b)
			1	T+30 CD	CARDE	NRC		
			1	T+30 CD	U. of Toronto	NRC		
	9.2.1.2 Impact							
3	Impact Coordinates		1	T+10	CARDE	NRC	F-FRPT	
			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.

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CR

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	1	T+15	NRC	NRC	R-PHOTO	note (c)
			1	T+15	U. of T.	NRC		
	9.2.3 Telemetry							
	9.2.3.1 Recording							
5	Magnetic Tape Recordings of Telemetry Data	1		T+5 CD	NRC	NRC	R-MAGT	5.2.1.1(3)
			1	T+5 CD	NRC	NRC	R-MAGT	5.2.1.2(3)
			1	T+5 CD	NRC	NRC	R-MAGT	5.3.1.3(3)
	9.2.3.2 Special Requirements							
6	Real Time Paper Records		1	T+12 H	NRC	NRC	R-GRAF	
	9.2.4 Other Data: DNIL							
7	Magnetic Recording of Voice Countdown and report on Auroral Activity		1	T+15 CD	NRC	NRC	R-MAGT and F-FRPT	
	9.3 Meteorological Data							
8	Report on all requested observations	1	1	T+15	CARDE	NRC	F-FRPT	
			2	T+15	NRC	NRC		
			1	T+15	U. of T.	NRC		

9.4 Support Instrumentation - NR

9.5 Material and Services Report - NR

Note (c) - One negative of all photos (still and movie documentary) and one copy of the processed documentary are requested, for return by NRC. One print of all still and movic documentary film is requested for the University of Toronto.

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
	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 0°F.

(2) Preparation area of about 300 square feet for nose cone assembly and checkout.

(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 associated equipment (power supplies, battery chargers, discriminators, oscilloscopes, etc.).

(5) Office space and telephone at DRHL.

These facilities are requested for the period October 7th to November 7th, 1963.

11.0 RANGE SAFETY

RFOAR is responsible for all range safety.

CLASSIFICATION

This document is Unclassified.

RF

APPENDICES

I. Vehicle Drawing

II. Nosecone Drawing

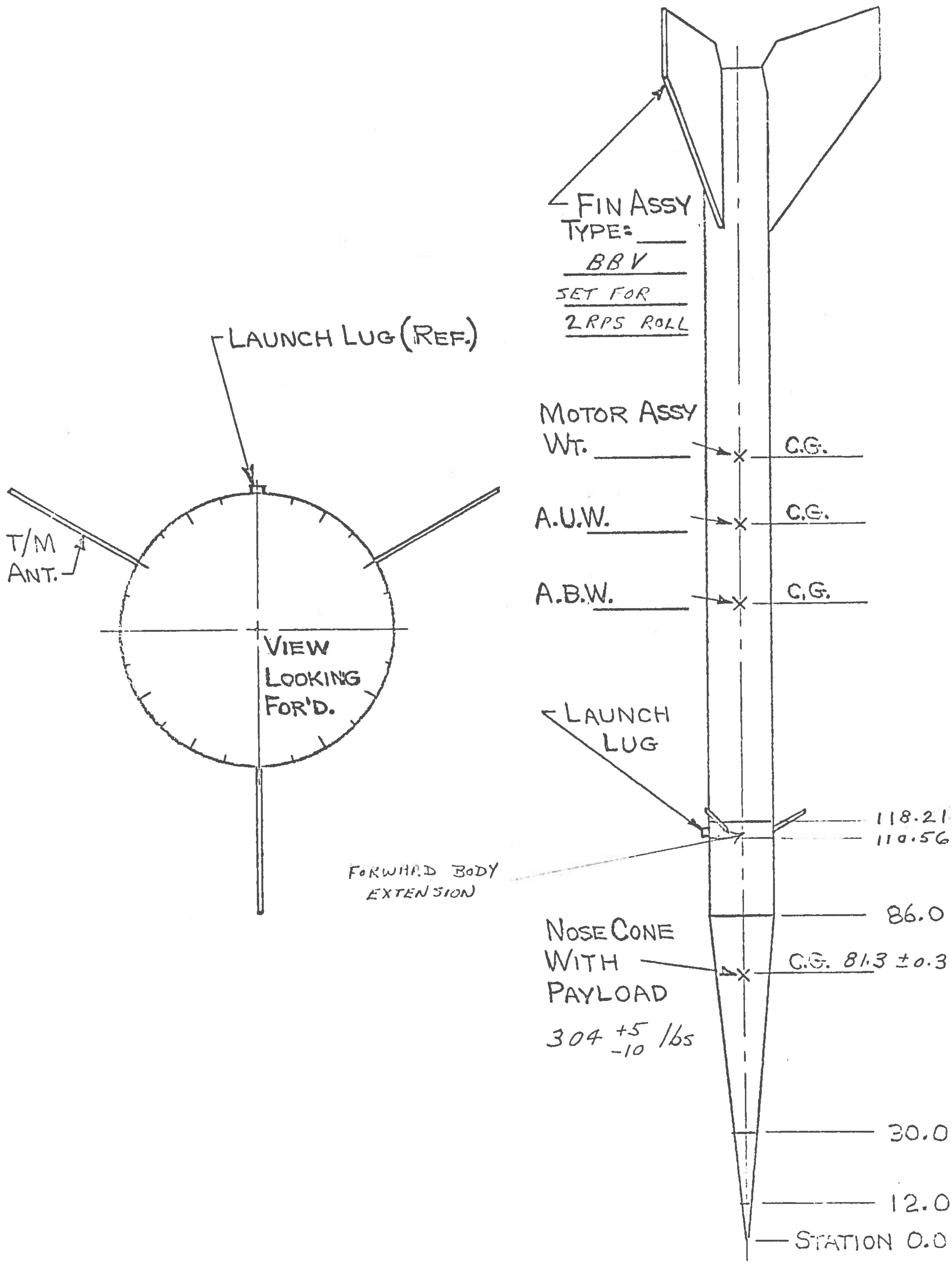
III. Ordnance Items Locations

IV. Squib Firing Circuit

V. Range User Equipment

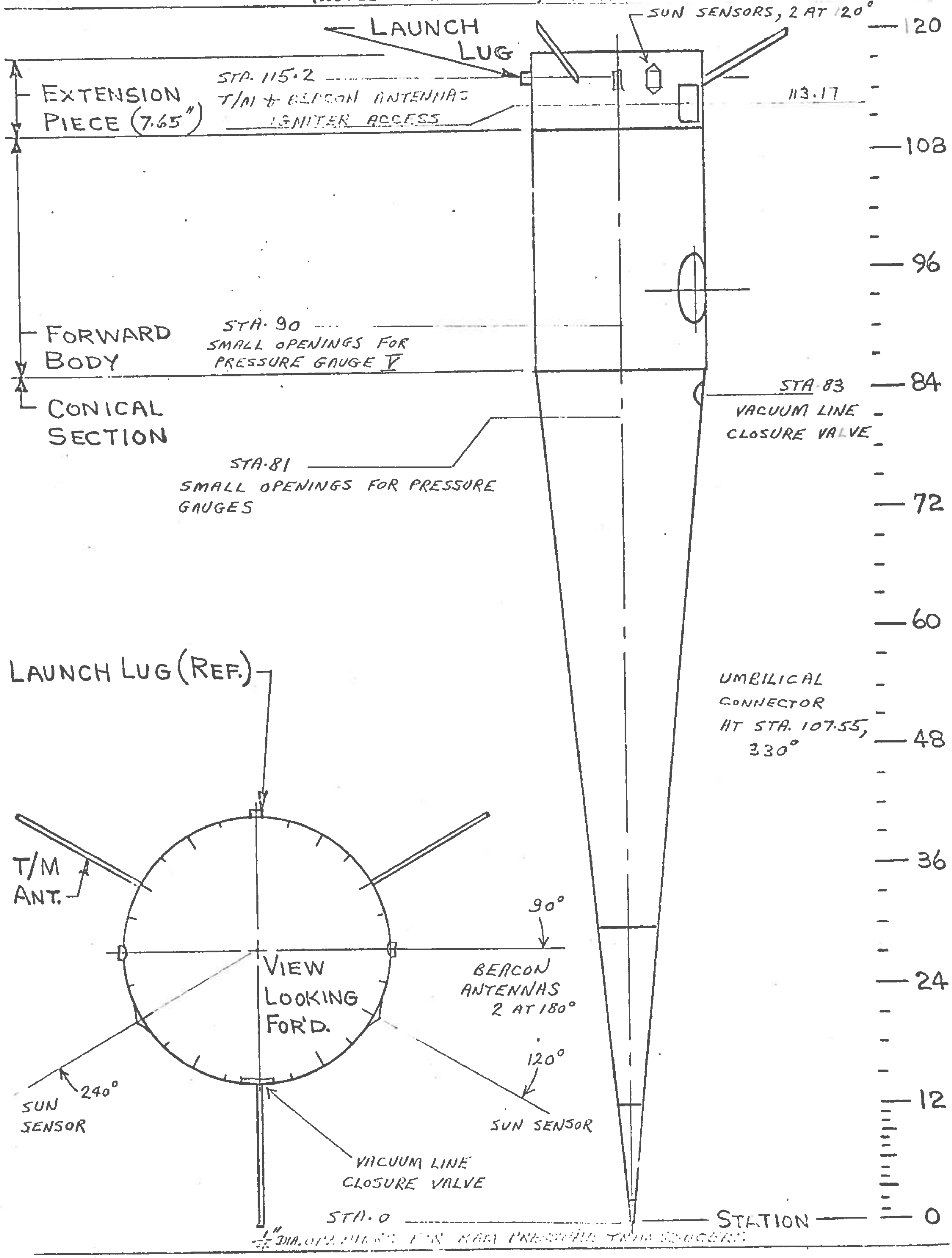
VI. Monitor and Control System

APPENDIX I
(Revised March 10th, 1964)

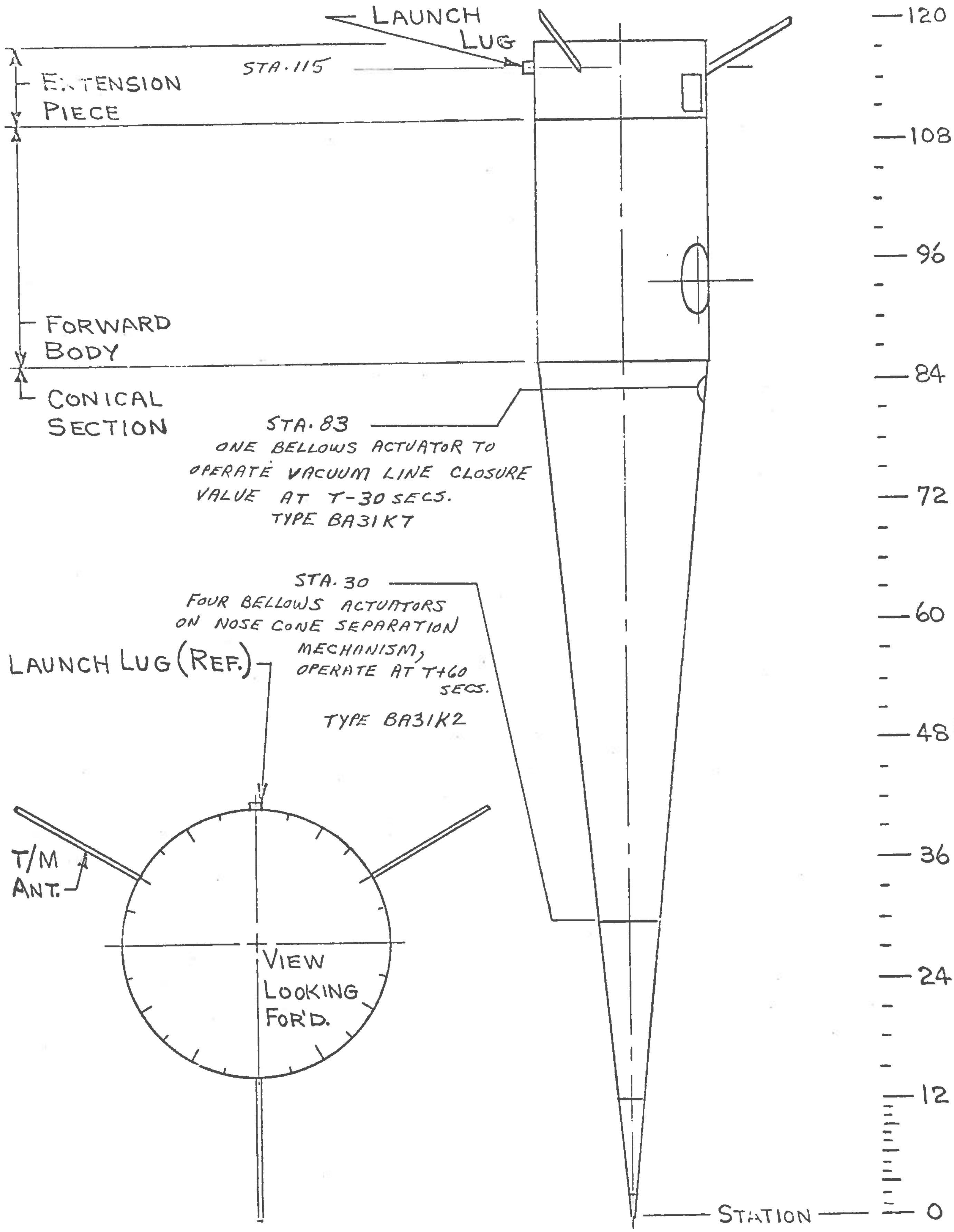


APPENDIX II

(Revised March 10th, 1964)



APPENDIX III
(Revised March 10, 1964)



APPENDIX IV

The squib firing circuit diagram was not available for inclusion in this O.R. It will be provided as soon as possible.

APPENDIX V

PRELIMINARY LIST OF RANGE USER EQUIPMENT FOR FALL FIRINGS AT FORT CHURCHILL

Panoramic Telemetering Indicator, Model TMI-Ib

Telemetering Test Oscillator, HP Model 200TR

FM-AM Signal Generator, Boonton Model 202G

Telemetry Receivers, Nems Clarke Model 1433 (two)

Telemetry Receivers, Nems Clarke Model 1432

Telemetry Receivers, Nems Clarke Model 1501A

Telemetry Receivers, Defence Electronics Model TMR-2A

Oscilloscope, 5", HP Model 122AR

Oscilloscope, 5", Tektronic Model 536

Oscilloscope, 3", Tektronic Model 310

Oscilloscope, 3", Tektronic Model 316

Oscilloscope, 17", I.T.T. Model 1735-0

Counter, Computer Meas. Model 225-C

V.T.V.M., HP Model 400 HR

Voltmeter, Digital, HP Model 405 CR

Telemetry Calibrator, Dynatronics Model 612

Tunable Discriminator, EMR Model 97H

Variable Filter, EMR Model 95F

Power Supplies 0-36V, Harrison Labs Model 808A

Power Supplies 0-36V, Harrison Labs Model 809A

Power Supplies 0-36V, Harrison Labs Model 814A

(cont'd.)

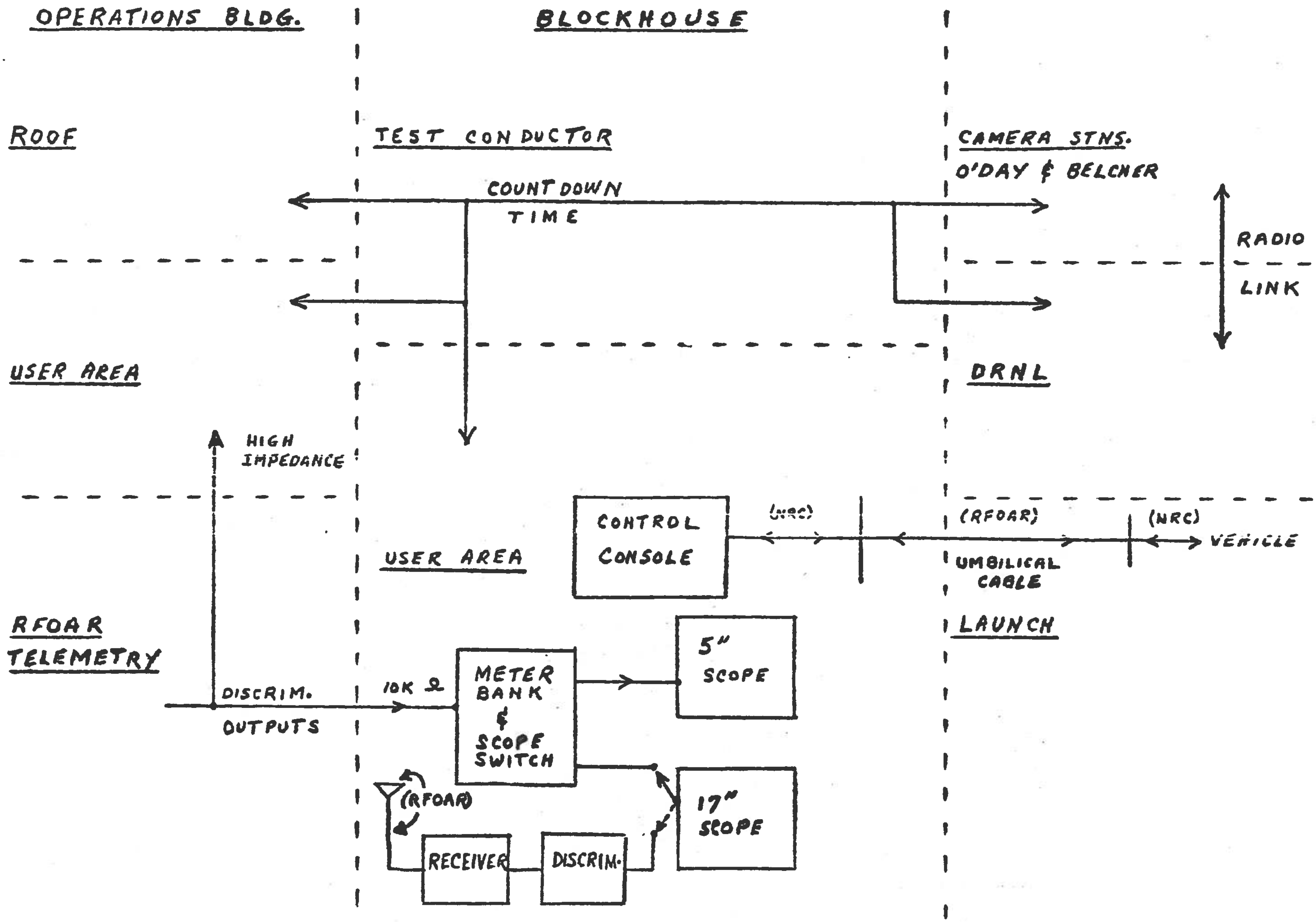
Spectrum Display, Nems-Clarke Model 200-3

Multicoupler, Nems-Clarke Model MC-406-45-237

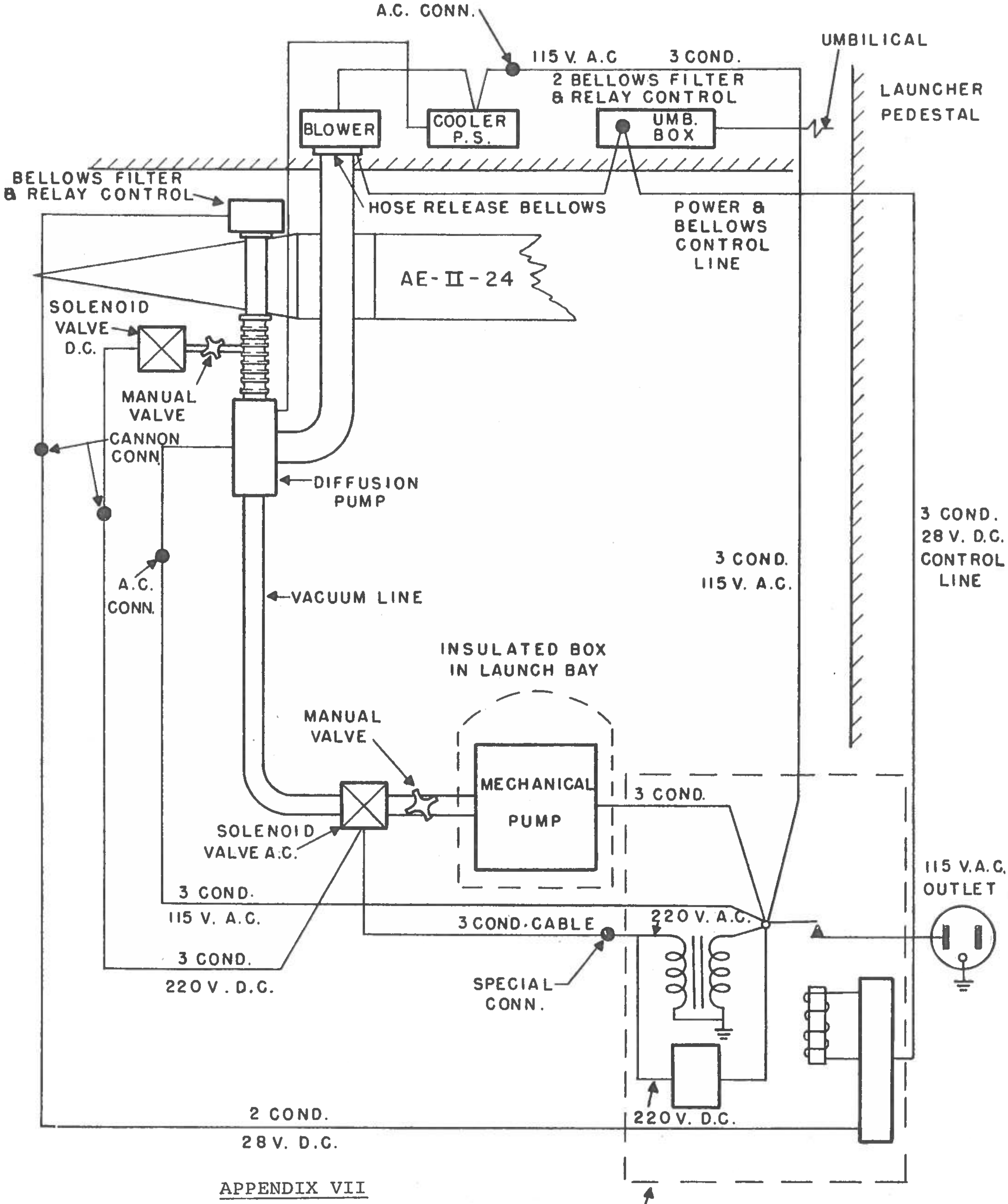
Pre-amplifier (RF), Nems-Clarke Model PR-203-45-237

Audio Amplifier, Heathkit Model EA-3

Subcarrier Oscillators, antennas S-band receiver, camera, etc.	Range User Support Instrumentation
Control & Monitor Console, Meter Bank, etc.	Range User Control and Monitor Instrumentation



APPENDIX VI MONITOR AND CONTROL SYSTEM



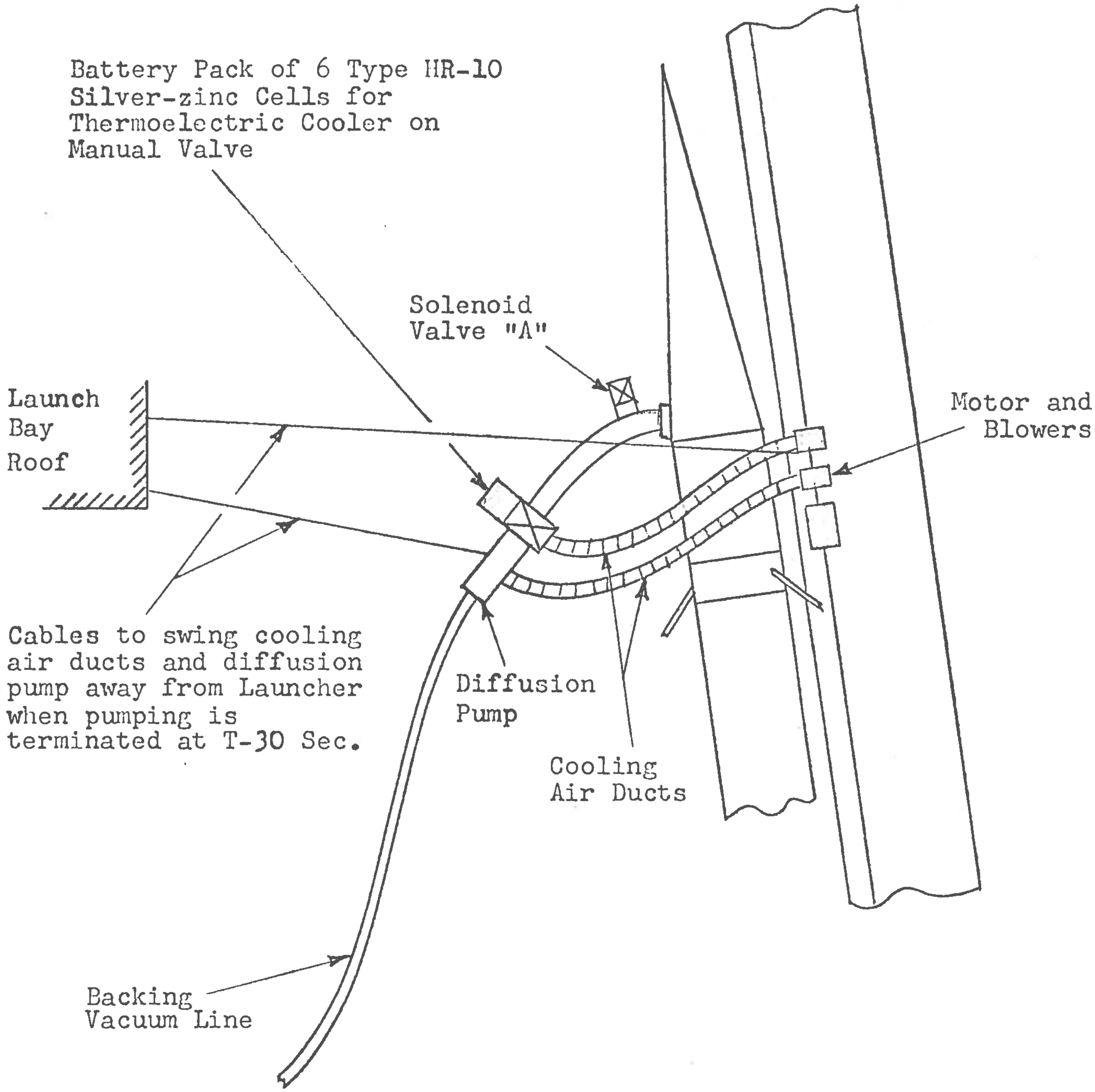
APPENDIX VII

VACUUM PUMPING SYSTEM

AE - II - 24

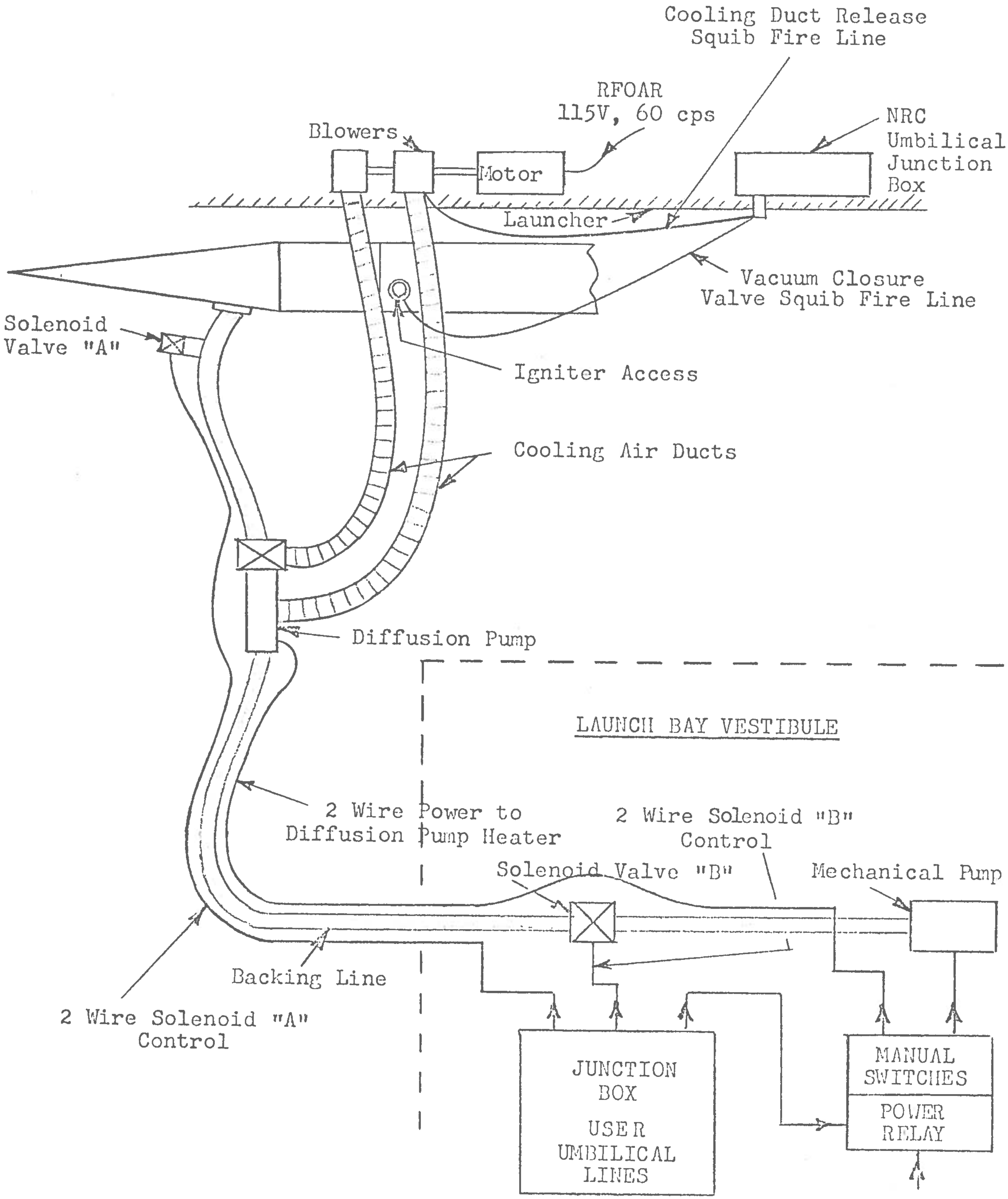
(SHEET 1)

DEC. 10/64



APPENDIX VII

VACUUM SYSTEM (SHEET 2 - LAUNCHER VERTICAL)



APPENDIX VII

VACUUM SYSTEM (SHEET 3 - ELECTRICAL)