(NASA-TM-85224) SONIC BOOM MEASUREMENT TEST PLAN FOR SPACE SHUTTLE STS-4 REENTRY (NASA) 32 p HC A03/MF A01 CSCL 20A
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PREFACE

This document relates to an overall plan which describes the Space Shuttle STS-4 Sonic Boom Measurement Program and is supplied as a detailed guide and formal documentation for measurement procedures, system specifications, and general information for others involved in the program. By way of review, the Space Shuttle STS-4 will be launched from complex 39A at the Kennedy Space Center, Florida, into a 165 nautical mile circular orbit with a 28.5 degree inclination. Deorbit is scheduled so as to provide the landing at a pre-selected, primary, secondary or contingency site. The nominal deorbit maneuver is initiated at 166 hours, 39 minutes ground elapsed time during the 112th orbit with a subsequent crosswind landing on runway 17, Rogers Lakebed, Edwards Air Force Base, CA. If the crosswind tests is not possible, then landing will occur on runway 22. Nominal end of flight, abort to orbit (ATO), and abort-once-around (AOA) landings will be on runway 22 at EAFB. In the event of deviations from the normal reentry plan, or if other abort landing sites are used, the subject sonic boom measurement test plan will not provide for the reentry sonic boom measurements.

PURPOSE OF TEST PLAN

This test plan is designed to provide information, guidance, and assignment of responsibilities for the acquisition of sonic boom and atmospheric measurements, timing correlation, communications and other necessary supporting tasks. Specifically included are details such as mobile data acquisition station locations, measurement systems calibration levels, predicted sonic boom overpressure levels, overpressure level assignment for each data acquisition station, data recording times on and off, universal coordinated time, and measurement system descriptions.

INTRODUCTION

The primary objective of the STS sonic boom measurement program is to fulfill the commitment made in the Space Shuttle Environmental Impact Statement to validate preflight sonic boom predictions by obtaining sonic boom data from actual over-flights. In addition, the experimental data base and theory validation will assist in defining the orbiter sonic boom impact on populated regions during reentry.

By way of brief review, sonic booms have been measured on a very wide range of aircraft types operating over a wide range of Mach numbers and altitude. (ref. 1). There have been a number of sonic boom measurements made during ascent and reentry of the Apollo and Skylab vehicles (ref. 2). Prediction of the sonic boom characteristics of aircraft using existing theory has been excellent. Good correlation has also been noted on Apollo and Skylab. The Shuttle vehicle geometry and operational characteristics differ from those of Apollo and Skylab and are significantly different from conventional aircraft. Although it is expected that the existing sonic boom theory is applicable to Shuttle, confirmation must await the generation of a suitable experimental data base. Presently, wind tunnel measurements are available for the orbiter (ref. 3). In addition, a series of sonic boom ground measurements associated with the reentry of STS-1 and STS-2 were successfully accomplished in April 1981 and November 1981 respectively. The STS-1 measurements were acquired using a total of 45 microphones located at eleven positions near the ground flight track from the Pacific coastline to the landing site at Edwards Air Force Base, CA. STS-2 measurements were acquired in the vicinity of the EAFB landing site at four positions. Sixteen microphones were concentrated near the reentry flight track approximately three nautical miles apart. Details of the STS-1 and STS-2 test plans are given in references 4 and 5. Results from STS-1 (Ref. 6) and STS-2 were very gratifying in that no surprises were noted and the character of the signature shapes, magnitudes of the overpressure levels, and the location of the area in which the higher overpressures were experienced was as expected.

The objective in the STS-3 test plan (Ref. 7) was to acquire sonic boom measurements to define the lateral extent of the ground exposure pattern along with the overpressure and signature characteristics. These measurements were not acquired on STS-3, because wet lake bed conditions at the primary landing site (Edwards Air Force Base, CA) diverted the orbiter Columbia to the contingency landing site at Northrup strip White Sands Missile Range, New Mexico. The present STS-4 sonic boom measurement plan is an update of the STS-3 plan with the same objective of acquiring information relative to lateral distribution of sonic boom from the orbiter originating from a Mach number near 3.3 and altitude of about 97000 feet. Four measurement positions will be located east of Bakersfield, CA about 70 n miles from touchdown at EAFB. These stations will be located from 7 to 39 n miles laterally and to the north side of the re-entry flight track. It is the purpose of this document to provide the necessary information to conduct the STS-4 sonic boom measurements.

MEASUREMENT PLAN

Presentation of the measurement plan includes discussion of the general scope, general flight plan, atmospheric measurements, time synchronization, communications, sonic boom measuring system, and station procedures.

General Scope

This measurement plan consists of deploying four data acquisition stations, contained in four mobile van units, in the Bakersfield, CA area at lateral locations of from 7 to 39 miles to the STS-4 reentry flight track into the Edwards Air Force Base area (see figure 1). Calculated sonic boom overpressure for each station along with corresponding STS-4 flight conditions and approximate station location is given in Table 1 and 2 respectively. Each of the four stations will provide six intermediate band FM channels of sonic boom data from four microphone systems, a channel for universal time synchronization, and, edge-track voice annotation. The sonic boom measurements will be supported with atmospheric measurements (rawinsonde system) at station No. 2 along with meteorological data obtained from the U.S. Air Force at Edwards Air Force Base, CA. All measurements will be correlated in time with the orbiter reentry flight track information. Program responsibilities are identified in figure 2.

General Flight Plan

The STS-4 is scheduled to be a 167.5 hour flight (approximately 7 days) launched from the Kennedy Space Center on June 27, 1982, at 17:00 Greenwich Mean Time (GMT). The flight test will be achieved in a 165 nautical mile circular orbit with a 28.5 degree inclination. The nominal deorbit maneuver is thrust initiated at 166 hours 39 minutes ground elapsed time during the 112th orbit, with entry interface occuring at 400,000 feet altitude with subsequent landing on Rogers Lakebed runway 17 or 22 at Edwards Air Force Base, CA at 9:35 a.m. Pacific time. A backup deorbit opportunity occurs during the 113th orbit. There will be landing opportunities at Edwards Air Force Base each day. Four orbits per day for 4 days, three orbits per day for 3 days and one orbit for the final day of the mission. No landing (nominal, abort, or contingency) will be earlier than 15 minutes prior to sunrise nor later than sunset plus 15 minutes. The above information is obtained from reference 8.

Atmospheric Measurements

Past experience gained on aircraft, Apollo, Skylab, STS-1, and STS-2 programs have shown that it is necessary to have atmospheric information since temperature and wind gradients and low level turbulence can significantly affect not only the sonic boom signature shape but also the ground exposure patterns.

Therefore atmospheric data at the surface and aloft will be obtained through rawinsonde observations taken at launch, and at 30 minutes and 90 minutes before STS-4 touchdown. This information will be used to establish the temperature, pressure and wind characteristics of the atmosphere from near the surface to altitudes up to 30 km. Rawinsonde systems furnished and operated by personnel from the Atmospheric Science Division at the Marshall Space Flight Center will be located at one of the four lateral sonic boom measurement stations (No. 2).

RAWINSONDE - The RAWIN System is a transportable radio direction finder. It is designed to track a balloon-borne radiosonde automatically. A radiosonde signal containing meteorological information in the form of amplitude or frequency modulation is received, amplified and detected by this system. The detected signal is passed to separate equipment in the system where it is recorded. By reference to calibration data for the radiosonde, this recorded information is converted to values of temperature, humidity, and pressure. Recording of time versus progressive changes of the elevation and azimuth positions of the ascending balloon package, as determined by tracking of the signal from the radiosonde, are made so that they can be later converted to wind speed and direction.

The radiosonde consists of a transmitter, modulator, antenna, battery, and pressure, temperature, and humidity sensing elements. The radiosonde, parachute and train weigh about four pounds and can be carried to an altitude of about 30 km by a helium-filled balloon. A battery furnishes power to the modulator and transmitter which operates in the 1660 - 1700 megahertz (MHz) band. Its carrier is amplitude modulated by an audiofrequency pulse, the rate of which is determined by the pressure, temperature and humidity sensing elements. The RAWIN set automatically tracks the balloon-borne radiosonde by continuous homing on the radiosonde signal to horizontal distances of about 125 miles and altitudes of up to 30 km. The equipment recorder records the azimuth and elevation angles of the position of the radiosonde versus time.

Time Synchronization

In order to enhance the value of the sonic boom measurements precision time synchronization is required. Specifically, a real-time track (range time) is necessary for later data interpretation processes (ray tracing, and shock wave arrival times, etc.) which require that the time, atmospheric conditions, vehicle operating conditions and the STS-4 reentry flight track information be known relative to the time the sonic boom was received at a particular measuring station. Therefore a time synchronization concept will be utilizied and is described in the following paragraph.

Precise time synchronization between the four lateral sonic boom data acquisition stations and the STS-4 reentry will be obtained from the "GOES" satellites (Geostationary Operational Environmental Satellite). These satellites are operated by the National Oceanic and Atmospheric Administration, which calls for the positioning of one satellite at approximately 135 degrees west longitude, another at 75 degrees west longitude, and a third to be an in-orbit spare. These satellites are in orbit 36,000 kilometers above the equator, they travel at about 11,000 kilometers per hour and remain continuously above the same spot on earth and thus are termed geostationary.

Since they always have the same regions of earth in view, they can provide 24 hour, continuous service.

The sonic boom measuring stations are equipped with satellite synchronized time code clocks which have been designed to receive and decode timing information from the NOAA "GOES" satellite which transmits on a frequency of 468 mHz. The displayed time as well as the electronically produced timing signal will be Universal Coordinated Time (UCT), more commonly referred to as Greenwich Mean Time (GMT). This time base will be recorded on magnetic tape using an IRIG-B format of day-of-year, hours, minutes, and seconds to an accuracy of ± 1.0 millisecond traceable to the National Bureau of Standards.

Communications

The sonic boom coordinator will have a dedicated hard line voice circuit communication link from the Space Radiation Analysis Group (SRAG) console No. 386 in mission control located at the Johnson Space Center to the sonic boom coordinator console position located in building 4800 at the Dryden Flight Research Facility. This will permit the program principal investigator to inform the sonic boom coordinator of any possible STS-4 reentry profile changes.

Primary voice communications between Dryden Flight Research Facility and the four sonic boom and one meteorological measurement stations will be provided by means of commercial telephone lines. All sonic boom related communications traffic will operate through the Sonic Boom Coordinator console position located in building 4800 at Dryden Flight Research Facility.

Sonic Boom Measurement System

Proven aircraft and large spacecraft sonic boom data acquisition systems are to be utilized for ground level sonic boom measurements during STS-4 reentry. These systems, already extensively performance proven, have been used in previous aircraft, Apollo, Skylab, and Shuttle sonic boom measurement programs and consist of pressure transducers, Dynagages (oscillator detector circuit), instrumentation amplifiers, FM magnetic tape recorders, and satellite time code receivers. Specifically, the pressure transducer is a commercially available condenser microphone with a high frequency response to 10 kHz when used with the model DG-605 Dynagage system, with the low end frequency response of approximately -5 dB at .01 Hz. The low end frequency response is made possible by modifying the static pressure equalization vent behind the microphone diaphragm. Basically, the size of the vent was diminished thereby reducing the atmospheric pressure bleed rate. This procedure will allow adequate provisions for system balancing, temperature, and atmospheric pressure changes during field operations.

The Dynagage consists of a radio frequency oscillator coupled to a diode detector circuit whereby small changes in capacity of the pressure transducer will produce relatively large changes in the diode detector. The output of the detector is therefore proportional to the pressure applied to the tranducer diaphram. The Dynagage output is fed into an instrumentation amplifier which provides a gain of 0 to 60 dB in steps of 2 dB with a flat frequency response of D.C. to 20 kHz.

The measurement system will utilize frequency modulated magnetic tape recorders operating at 30 ips in the intermediate band with a frequency response of D.C. to 10 kHz. Commercial AC power will be obtainable at some of the data acquisition sites, with the remaining sites utilizing portable gasoline generators. This instrumentation will be mounted in commercially available vehicles (vans). Each measuring station will utilize four microphones, three of which will be co-located in 4 x 4 ft board placed at ground level to obtain true ground pressures (i.e., incident and reflected shock waves are exactly in phase). At the request of the Marshall Space Flight Center investigator, a fourth microphone, positioned at ear level height (diaphram parallel tc the ground) will provide information on the subjective aspects of sonic booms relative to current standard measurements for aircraft flyover noise.

All microphones will be covered with wind screens consisting of two layers of cheesecloth which will minimize effects of surface winds on the microphone readings and also provide shade from the sun and protection from blowing sand particles. The output of the microphones will be routed through the instrumentation amplifiers thus allowing for the setting of a range of overpressure levels, about the predicted nominal. This precautionary measure is necessary in order to allow for discrepancies in the sonic boom predictive methods (verification established for aircraft but little data base on vehicles having blunt bodies and operating at high angles-of-attack), for variations resulting from unusual atmospheric conditions, or focusing due to the STS-4 reentry conditions. Each station will record 6 channels of overpressure data, time code signal, and edge track voice annotation.

All tape recorders are laboratory calibrated periodically; for proper record levels, speeds, and frequency response. The microphone systems are calibrated for frequency response according to factory specifications utilizing the infrasonic piston phone technique. In the field all tape recorder data channels are calibrated using a precision voltage source to verify center frequency stability, the microphones are calibrated using an acoustical calibrator which generates a known sound pressure level in a closed cavity at a fixed frequency of 1 KH_z. Calibrations are performed at both "pre" and "post" flight conditions and will establish the amplitude sensitivity of the system which will verify an end-to-end acoustical calibration.

Station Procedures

The following information applies to Stations 1 through 4.

a. Each day a fresh tape will be used for precals, annotated according to procedures. If reentry occurs this day the precal tape will also be used for post cals. After precals a fresh tape will be loaded for reentry data. This tape will be annotated only when "recorders on" command is given. If reentry does not occur this tape will be used for the next days precals.

b. Two hour warm-up for all instrumentation.

c. All sonic boom and meteorological measurement related activities will operate through the sonic boom coordinator console position located in building 4800 at Dryden Flight Research Facility.

d. The meteorological team will release three radiosondes.
   1st release at launch.
   2nd release at touchdown minus 90 minutes.
   3rd release at touchdown minus 30 minutes.

e. Voice communications between all measurement stations and the sonic boom coordinator console will utilize commercial dedicated telephone lines.

f. Utilization of communication circuits will be held to a minimum. There will be no communication between measurement stations unless your station is called. If an instrumentation failure exists, call sonic boom coordinator and the appropriate personnel will be notified.

g. All tape recorder data channels will be calibrated at both pre and post flight situations using a precision one volt RMS source to verify center frequency stability.

h. All microphones will be calibra   at pre and post flight conditions using 130dB sound pressure level at a fixed frequency of one kHz.

i. All information pertaining to calibrations, overpressure levels, and amplifier gains will be recorded on the assigned voice annotation channel.

j. Greenwich Mean Time (GMT) will be recorded on the assigned timing channel during all calibrations and while recording actual boom data.

k. Sonic Boom Coordinator will give "recorders on" and "recorders off" command for all sonic boom measurement stations during STS-4 reentry. Approximately 10 minutes has been incorporated between "recorders" on command and boom arrival.

l. All pertinent data will be recorded on data sheets; i.e., microphone number, tape channel number, calibration levels, weather conditions, aircraft in vicinity of station while calibrating instrumentation or during the actual landing, single or double, light or heavy sonic booms, and rumbles, etc.

m. Stations experiencing any problems affecting this sonic boom measurement program will notify Sonic Boom Coordinator as soon as possible.

n. There will be no radio frequency transmission during data recording.

o. A complete scan through all data channels will be repeated at regular intervals while the data acquisition station is operational.

● Specific details for each station, including event times, pressure level assignments, and calibration and overpressure level settings are contained on the following pages.

EVENT TIMES

STATION - 1

DAY 1 (LAUNCH)

Arrive at measurement station at launch time minus 3 hours.
Ready to record data, 1 hours, 15 min after launch.

DAY 2

Arrive at measurement station, 21 hours, 9 min after launch.
Ready to record data 23 hours, 09 min after launch.

Day 3

Arrive at measurement station, 45 hours, 15 min after launch.
Ready to record data 1 day plus, 23 hours, 45 min after launch.

Day 4

Arrive at measurement station, 67 hours, 47 min after launch.
Ready to record data 2 days plus, 22 hours, 17 min after launch.

Day 5

Arrive at measurement station, 91 hours, 53 min after launch.
Ready to record data 3 days plus, 22 hours, 23 min after launch.

Day 6

Arrive at measurement station, 115 hours, 58 min after launch.
Ready to record data 4 days plus, 22 hours, 28 min after launch.

Day 7

Arrive at measurement station, 140 hours, 04 min after launch.
Ready to record data 5 days plus, 22 hours, 34 min after launch.

Day 8

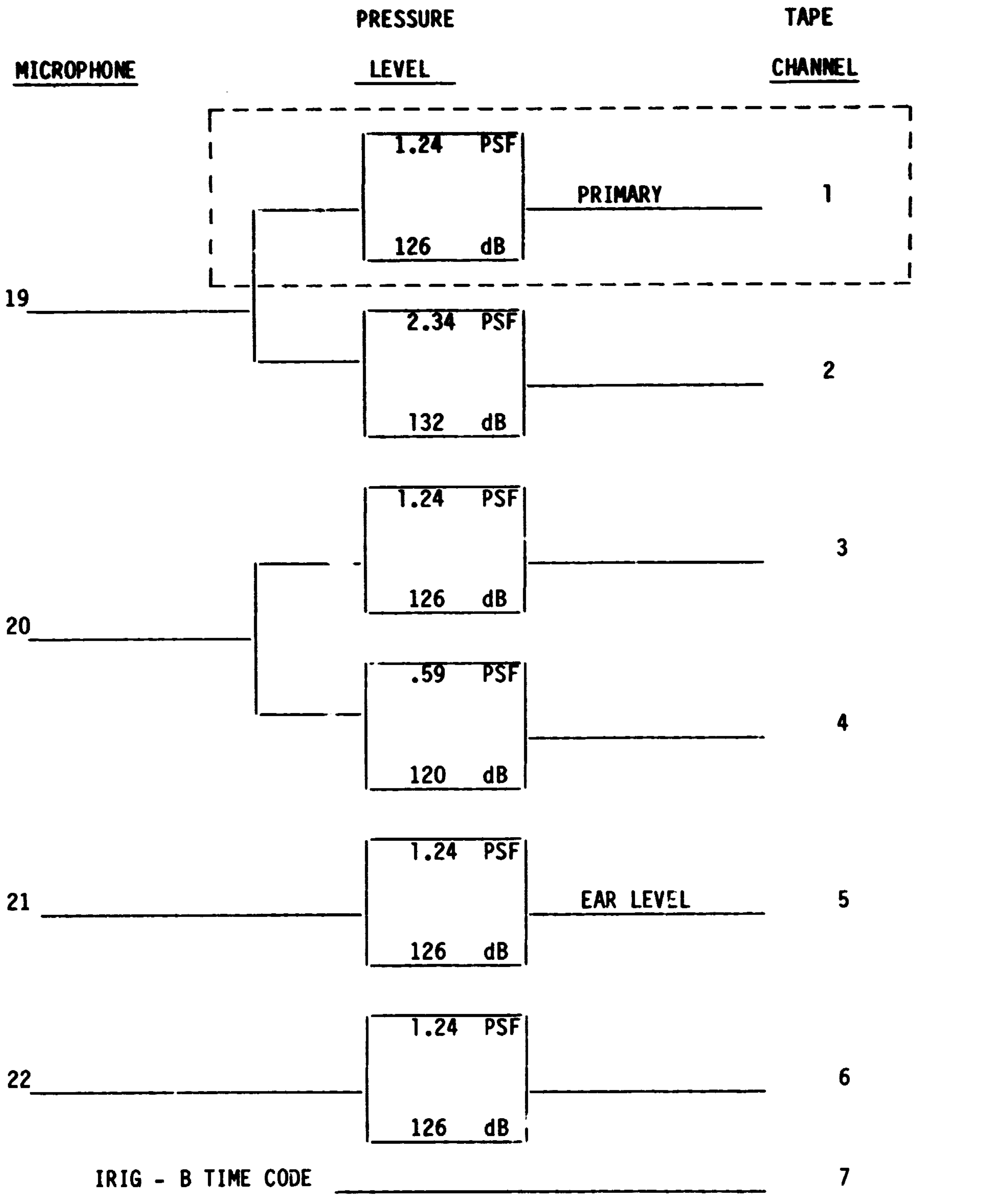
Arrive at measurement station, 162 hours, -- min after launch.
Ready to record data 6 days plus, 21 hours, 04 min after launch.

- "Recorders On" command will be given by Sonic Boom Coordinator.
- Sonic Boom Coordinator will advise station release time for each day.

Pressure Level Assignment

STATION - 1

PREDICTED OVERPRESSURE LEVEL 1.22 PSF (lb/ft^2)



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CALIBRATION AND OVERPRESSURE LEVEL SETTINGS

CONSOLE 5 DATE ______

STATION 1 OPERATOR ______

SYSTEM NUMBER	D.G TUNES	CAL. SETTINGS D.G ATTN. SETTING	CAL. SETTINGS B.B. AMP. SETTING	ASSIGNED RUN LEVELS	RUN SETTINGS D.G ATTN. SETTING	RUN SETTINGS B.B. AMP. SETTING	TAPE CH
19	3.4 at 52	21	1 6	126 dB	18	1 10	1
			2 6	132 dB		2 4	2
20	3.2 at 45	18	3 4	126 dB	9	3 8	3
			4 4	120 dB		4 8	4
21	3.2 at 44	21	5 6	126 dB	18	5 10	5
22	4.0 at 44	15		126 dB	15		6

Cal. Level 130 dB, set system gain for 2 vpp input to tape recorder.

NOTE: D.G. attn. setting must satisfy 2 B.B. amp settings where applicable.
Avoid setting D.G. attn. below 6 dB if possible.

EVENT TIMES

STATION - 2

DAY 1 (LAUNCH)

Arrive at measurement station at launch time minus 3 hours
Ready to record data,12 hours, 15 min after launch.

DAY 2

Arrive at measurement station, 21 hours, 9 min after launch.
Ready to record data 1 day plus, 23 hour, 09 min after launch.

Day 3

Arrive at measurement station, 45 hours, 15 min after launch.
Ready to record data 1 day plus, 23 hours, 45 min after launch.

Day 4

Arrive at measurement station, 67 hours, 47 min after launch.
Ready to record data 2 days plus, 22 hours, 17 min after launch.

Day 5

Arrive at measurement station, 91 hours, 53 min after launch.
Ready to record data 3 days plus, 22 hours, 23 min after launch.

Day 6

Arrive at measurement station, 115 hours, 58 min after launch.
Ready to record data 4 days plus, 22 hours, 28 min after launch.

Day 7

Arrive at measurement station, 140 hours, 04 min after launch.
Ready to record data 5 days plus, 22 hours, 34 min after launch.

Day 8

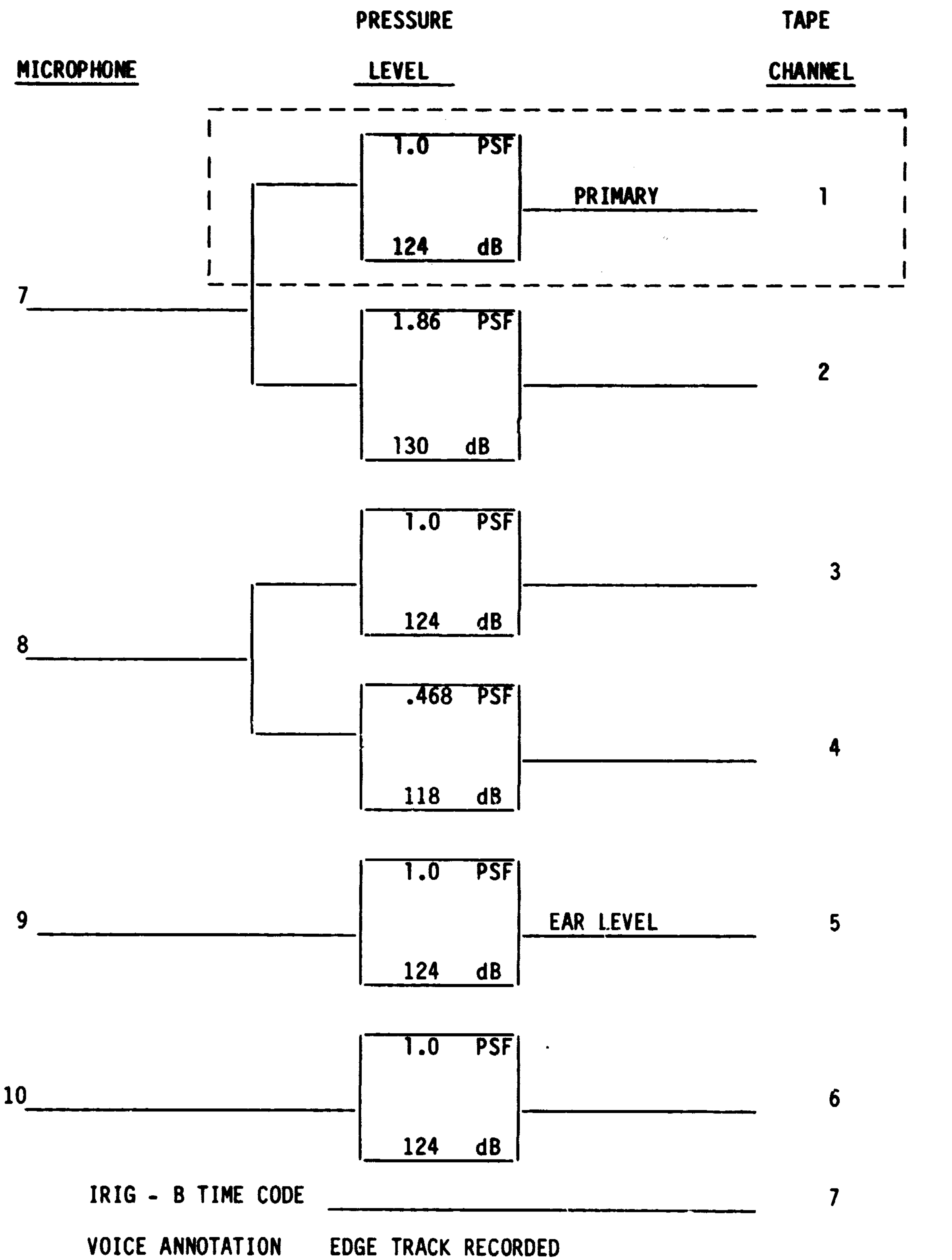
Arrive at measurement station, 162 hours, 40 min after launch.
Ready to record data 6 days plus, 21 hours, 04 min after launch.

- "Recorders On" command will be given by Sonic Boom Coordinator.
- Sonic Boom Coordinator will advise station release time for each day.

Pressure Level Assignment

STATION - 2

PREDICTED OVERPRESSURE LEVEL 1.01 (lb/ft^2)



CALIBRATION AND OVERPRESSURE LEVEL SETTINGS

CONSOLE 2 DATE ____________

STATION 2 OPERATOR ____________

		CAL. SETTINGS			RUN SETTINGS		TAPE CH
SYSTEM NUMBER	D.G TUNES	D.G ATTN. SETTING	B.B. AMP. SETTING	ASSIGNED RUN LEVELS	D.G ATTN. SETTING	B.B. AMP. SETTING	
7	3.2 at 44	18	1 4	124 dB	18	1 8	1
			2 4	130 dB		2 2	2
8	4.3 at 46	21	3 8	124 dB	15	3 12	3
			4 8	118 dB		4 12	4
9	3.3 at 47	21	5 6	124 dB	21	5 10	5
10	4.2 at 47	15		124 dB	18		6

Cal. Level 130 dB, set system gain for 2 vpp input to tape recorder.

NOTE: D.G. attn. setting must satisfy 2 B.B. amp settings where applicable.
Avoid setting D.G. attn. below 6 dB if possible.

EVENT TIMES

STATION - 3

DAY 1 (LAUNCH)

Arrive at measurement station at launch time minus 3 hours.
Ready to record data, 1 hour, 15 min after launch.

DAY 2

Arrive at measurement station, 21 hours, 9 min after launch.
Ready to record data 23 hours, 09 min after launch.

Day 3

Arrive at measurement station, 45 hours, 15 min after launch.
Ready to record data 1 day plus, 23 hours, 45 min after launch.

Day 4

Arrive at measurement station, 67 hours, 47 min after launch.
Ready to record data 2 days plus, 22 hours, 17 min after launch.

Day 5

Arrive at measurement station, 91 hours, 53 min after launch.
Ready to record data 3 days plus, 22 hours, 23 min after launch.

Day 6

Arrive at measurement station, 115 hours, 58 min after launch.
Ready to record data 4 days plus, 22 hours, 28 min after launch.

Day 7

Arrive at measurement station, 140 hours, 04 min after launch.
Ready to record data 5 days plus, 22 hours, 34 min after launch.

Day 8

Arrive at measurement station, 162 hours, 40 min after launch.
Ready to record data 6 days plus, 21 hours, 04 min after launch.

- "Recorders On" command will be given by Sonic Boom Coordinator.
- Sonic Boom Coordinator will advise station release time for each day.

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Pressure Level Assignment

STATION - 3

PREDICTED OVERPRESSURE LEVEL .74 PSF (lb/ft²)

MICROPHONE	PRESSURE LEVEL		TAPE CHANNEL
7	.74 PSF / 122 dB	PRIMARY	1
7	1.48 PSF / 128 dB		2
8	.74 PSF / 122 dB		3
8	.372 PSF / 116 dB		4
9	.74 PSF / 122 dB	EAR LEVEL	5
10	.74 PSF / 122 dB		6
IRIG - B TIME CODE			7

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CALIBRATION AND OVERPRESSURE LEVEL SETTINGS

CONSOLE 3 DATE ____________

STATION 3 OPERATOR ____________

SYSTEM NUMBER	D.G TUNES	CAL. SETTINGS: D.G ATTN. SETTING	CAL. SETTINGS: B.B. AMP. SETTING	ASSIGNED RUN LEVELS	RUN SETTINGS: D.G ATTN. SETTING	RUN SETTINGS: B.B. AMP. SETTING	TAPE CH
11	4.0 at 51	18	1 8	122 dB	12	1 8	1
			2 8	128 dB		2 10	2
12	4.2 at 46	18	3 8	122 dB	6	3 8	3
			4 8	116 dB		4 8	4
13	3.3 at 51	18	5 10	122 dB	12	5 10	5
14	4.3 at 46	9		122 dB	9		6

Cal. Level 130 dB, set system gain for 2 vpp input to tape recorder.

NOTE: D.G attn. setting must satisfy 2 B.B. amp settings where applicable. Avoid setting D.G attn. below 6 dB if possible.

EVENT TIMES

STATION - 4

DAY 1 (LAUNCH)

Arrive at measurement station at launch time minus 3 hours.
Ready to record data, 1 hours, 15 min after launch.

DAY 2

Arrive at measurement station, 21 hours, 9 min after launch.
Ready to record data 23 hour3, 09 min after launch.

Day 3

Arrive at measurement station, 45 hours, 15 min after launch.
Ready to record data 1 days plus, 23 hours, 45 min after launch.

Day 4

Arrive at measurement station, 67 hours, 47 min after launch.
Ready to record data 2 days plus, 22 hours, 17 min after launch.

Day 5

Arrive at measurement station, 91 hours, 53 min after launch.
Ready to record data 3 days plus, 22 hours, 23 min after launch.

Day 6

Arrive at measurement station, 115 hours, 58 min after launch.
Ready to record data 4 days plus, 22 hours, 28 min after launch.

Day 7

Arrive at measurement station, 140 hours, 04 min after launch.
Ready to record data 5 days plus, 22 hours, 34 min after launch.

Day 8

Arrive at measurement station, 162 hours, -- min after launch.
Ready to record data 6 days plus, 21 hours, 04 min after launch.

- "Recorders On" command will be given by Sonic Boom Coordinator.
- Sonic Boom Coordinator will advise station release time for each day.

Pressure Level Assignment

STATION - 4

PREDICTED OVERPRESSURE LEVEL .62 PSF (lb/ft^2)

MICROPHONE	PRESSURE LEVEL		TAPE CHANNEL
15	.62 PSF / 120 dB	PRIMARY	1
15	1.17 PSF / 126 dB		2
16	.62 PSF / 120 dB		3
16	.295 PSF / 114 dB		4
17	.62 PSF / 120 dB	EAR LEVEL	5
18	.62 PSF / 120 dB		6
IRIG - B TIME CODE			7

VOICE ANNOTATION EDGE TRACK RECORDED

CALIBRATION AND OVERPRESSURE LEVEL SETTINGS

CONSOLE 4 DATE ____________

STATION 4 OPERATOR ____________

SYSTEM NUMBER	D.G TUNES	CAL. SETTINGS D.G ATTN. SETTING	CAL. SETTINGS B.B. AMP. SETTING	ASSIGNED RUN LEVELS	RUN SETTINGS D.G ATTN. SETTING	RUN SETTINGS B.B. AMP. SETTING	TAPE CH
15	4.0 at 51	21	1 4	120 dB	15	1 10	1
			2 4	126 dB		2 4	2
16	4.0 at 52	18	3 2	120 dB	6	3 8	3
			4 2	114 dB		4 8	4
17	4.4 at 45	18	5 2	120 dB	6	5 2	5
18	3.1 at 47	15		120 dB	9		6

Cal. Level 130 dB, set system gain for 2 vpp input to tape recorder.

NOTE: D.G. attn. setting must satisfy 2 B.B. amp settings where applicable. Avoid setting D.G. attn. below 6 dB if possible.

Table 1.- Calculated Sonic Boom Overpressures for STS-4 Lateral Measurement Stations in the Bakersfield, California Area

STATION NUMBER	STATION NAME	Lateral Distance of Station from Ground Track (nmi)	Flight Mach Number	FLIGHT ALTITUDE, (ft)	$\Delta p_{calc.}$ *
1	Fort Tejon	7.0 north	3.3	97.040	1.22
2	Mettler	16.9 north	3.3	97.040	1.01
3	Panama Lane	29.4 north	3.3	97.040	0.74
4	Getty Tower	38.9 north	3.3	97.040	0.62

* Maximum pressure rise across bow shock wave measured at ground level (lb/ft^2)

Table 2.- Positioning Information for the Four STS-4 Sonic Boom Measuring Stations in the Bakersfield, California Area.

STATION, NO./NAME	LONGITUDE,* DEG, W	LATITUDE,* DEG, N	LONGITUDE ** DEG, W	LATITUDE** DEG, N
1 Fort Tejon	118.929	34.916	118.898	34.871
2 Mettler	118.932	35.123	118.963	35.082
3 Panama Lane	118.985	35.295	118.982	35.294
4 Getty Tower	118.996	35.461	119.018	35.465

* Theoretical predictions for Bakersfield, California area.

** Approximate positioning information obtained from 7.5 minute series topographic maps.

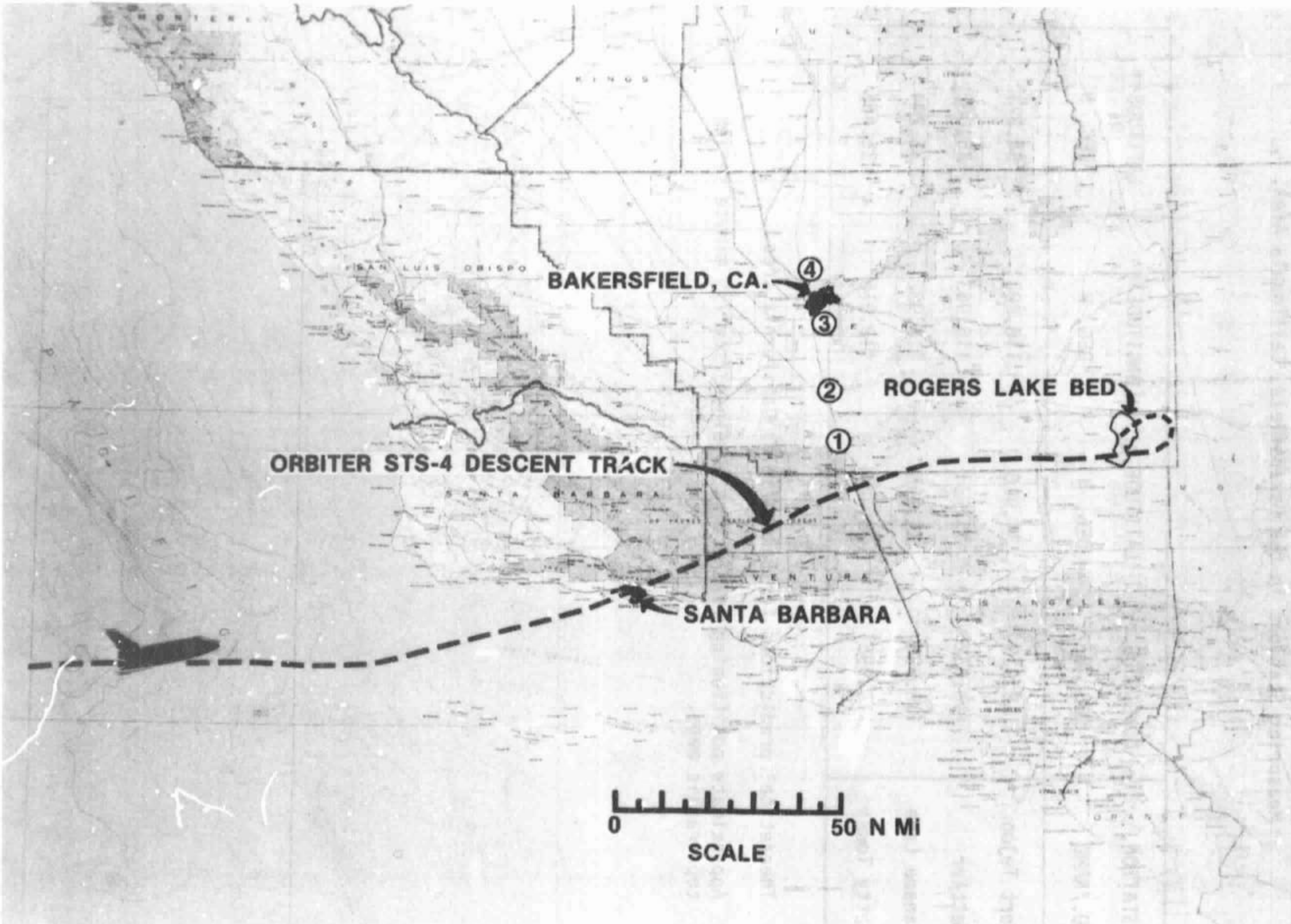

Figure 1.- Location of the four lateral sonic boom ground measuring sites in the Bakersfield area for the STS-4 reentry into Edwards Air Force Base, California.

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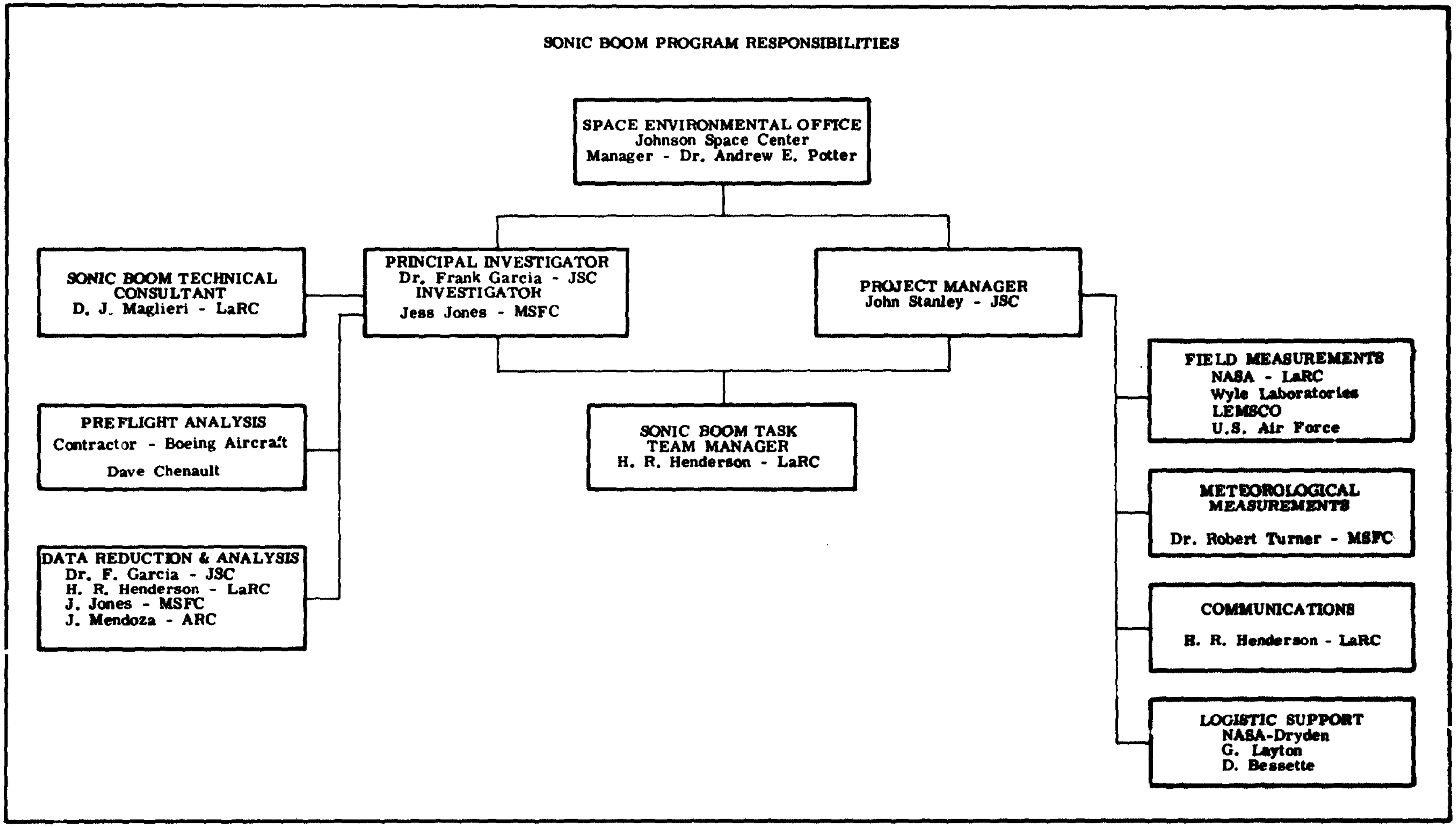

Figure 2.- Program responsibilities.

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