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URSALA IV GENERAL SYSTEM REQUIREMENTS AND PERFORMANCE SPECIFICATION

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Reviewed by: Reviewed by:

[redacted]

CSE System Integration

Reviewed by: Reviewed by:

[redacted] 25X1

Manager, Technical; and Manager, Advanced Techniques

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GLOSSARY

Residue	pulses or CW recognitions not associated into signals
PCM word group	any 80-bit word group
Intercept word group (IWG)	a PCM word group containing target signal descriptors
2σ	that accuracy attained for 95 percent of all combinations of parameters (e.g., frequency, amplitude, temperature)
EOB	Electronic Order of Battle
TT&C	Tracking, Telemetry, and Commanding subsystem
PE	programmable event
DBRT	data base retrieval tape
PA	pulse amplitude as measured in the receiver
Launch	liftoff of host vehicle
TOA	time of pulse arrival at spacecraft
TOM	time of CW "blip" measurement at spacecraft
TOI	time of intercept
Intercept	a single target signal contact ("blip") received in the pencil beam antenna

GLOSSARY (Cont)

burst	two or more blips received on a single spin
Intercept report	series of bursts

1.0 SCOPE

The general requirements and performance specifications for the URSALA IV (4431) satellite ELINT system are described in this document.

1.1 Mission Objectives

The URSALA IV system is composed of a space segment and a ground segment. The space segment consists of the spacecraft, payload with associated electric power and sensing antenna systems, and the command and control communications system with its associated antennas. [redacted] Satellite Control Facility with its associated communications through the STC [redacted] The entire system is to be used for general search and for general and directed surveillance by collecting and processing information in the 2 to 12 GHz range for both CW and pulsed emitters. 25X1

1.2 General System Requirements

The URSALA IV system peculiarization of basic P-989 spacecraft 4431 shall permit the use of low-altitude ELINT techniques for the collection, measurement, and processing of intercepted pulsed and CW signals in the 2 to 12 GHz range. The satellite segment shall be carried into low-altitude orbit on a Program 467 host vehicle. The subsatellite shall separate from the host vehicle, spin up, and fire orbital boost rockets to achieve a circular orbit at a nominal altitude of 340 nautical miles. Solar arrays and antenna systems shall be deployed to provide power for the spacecraft, to collect emitter signals, and for communication to and from ground stations.

The URSALA IV satellite system shall operate on-orbit as a spinning pencil-beam antenna system combined with an omni-antenna system with horizon-to-horizon coverage. The antenna system shall consist of arrays that will make the spectrum of 2 to 12 GHz available to a system of receivers to permit measurement of emitter pulse and CW parameters, and emitter location. The arrays shall consist of two high-gain, pencil-beam antennas to intercept target sidelobes, plus five omnidirectional antennas to provide inhibit protection for the sidelobes of the high-gain antennas. [redacted] 25X1 25X1 25X1

The collected digital data shall be stored on board to be read out to supporting SCF network ground stations. The system will be capable of delivering time-critical reports on data in the 2 to 12 GHz range. The SCF stations shall provide command capability and relay vehicle status and health information.

The payload data from the SCF shall be forwarded to the Central Data Processing Facility for analysis and reporting. Payload PCM data shall be transmitted to the facility from SCF remote tracking stations via wideband microwave/SATCOM links, [redacted] or DSIS 25X1 for digital processing. The data-processing facility shall have the capability to process data received via any of the above-described transmission systems.

The URSALA IV data processing system shall use ELINT data processing techniques to characterize and locate signals of interest based on the measured and computed parameters. Ground data processing techniques shall be used to determine the location of both pulse and CW types of emitters.

The system shall provide for the reporting of measured and derived signal parameters. In addition to the digital processing and analysis functions, the data processing system shall provide mission-independent software for mission planning support, spin-axis determination, history update and maintenance, and tasking history. Mission-dependent histories shall also be provided. Analysis of selected signals-of-interest shall combine digital data and prior knowledge to develop emitter technical intelligence characteristics.

The results of processing and analysis shall be incorporated into UNITRAN transmission messages, ELINT Technical Reports (ELT), ELINT Operational Reports (ELO), Telecommunications Reports (TEL), Tech Memos (TM), Signal Analysis Reports (SAR), and Signal Development Reports (SDR).

2.0 APPLICABLE DOCUMENTS

Requirements of the following documents in effect on 15 Jun 1978 form a part of this specification to the extent specified herein. In the event of conflict between documents referenced here and the contents of Sections 3 and 4, the detailed requirements of Sections 3 and 4 shall take precedence.

BIF003W/2-064585-72 1 April 1974	Detail Specification and Statement of Work for Spacecraft 4431/URSALA IV Antenna Systems (Revised)
BIF003W/2-013588-73 28 June 1974	Satellite Vehicle/Subsatellite Interface Control Document, Rev B
MIL-E-6051D 5 July 1968	Electromagnetic Compatibility Requirements, System
BIF003W/2-062620-76 19 January 1976	Spacecraft Description: Description of Units for Program PK-3, Rev E
BIF003W/2-076446-73 17 September 1973	Astrophysical Research Vehicles, Rev A
BIF003W/2-062619-76 10 April 1978	Program Test Plan for Program PK3, Rev C (15 July 1976), with Section 15 Change Sheets
NACSEM 5112 April 1975	NONSTOP Evaluation Techniques (U)
BIF003W/2-064585-72 15 December 72	URSALA III and URSALA IV Intercept System Statement of Work, Rev A

3.0 SYSTEM REQUIREMENTS

3.1 System Performance

URSALA IV shall provide a collection system using a low-altitude, spin-stabilized spacecraft flying in near-polar orbits. The processing of its intercept signal data shall be done with significant accuracy so as to characterize the emitters collected and to permit their location and identification. The system shall be designed to meet the requirements of the following paragraphs.

3.1.1 System Accuracy and Resolution

System accuracy for any measured or derived parameter shall be defined as the uncertainty in the reported value of that parameter caused by all sources of error in the system. It shall be exceeded no more than 5 percent of the time when averaged over all measurements or derivations. All accuracies stated in the following sections shall have 95 percent confidence accuracy.

The minimum quantum size at which any measured or derived parameter can be reported is the system reporting resolution.

3.1.1.1 Location Accuracy (2 Sigma). The emitter location accuracy shall be defined as the ability with which the total system is capable of determining the angles between the spacecraft reference axes and the vector from the true target site. The location accuracy shall be [redacted] 25X1

25X1

3.1.1.2 PRI Measurement. The system shall be capable of determining and reporting pulse repetition interval (PRI) of a signal with a nominal accuracy as stated in the following formula:

$$2\sigma \, PRI_{acc} = \frac{816 \text{ nsec}}{N-1}$$

where N is the number of pulses that occur in 1 sec or less. 25X1

[redacted]

3.1.1.3 Radio Frequency. System-level reporting of frequency shall be equivalent to that reported by the payload receivers. The pulse receiver shall measure intercepted single-frequency pulsed signals to an accuracy of $\pm$3.0 MHz with a resolution of 2.18 MHz. The CW receiver shall determine the frequency of CW emitters with an accuracy of $\pm$15 MHz peak-to-peak (10 MHz, 2-sigma, when averaging 10 or more samples) with a resolution of 8 MHz (see Table 3-3).

3.1.1.4 Pulsewidth. System-level reporting of pulsewidth shall be equivalent to that reported by the payload receiver. The pulse receiver shall measure the pulsewidth of intercepted pulse signals with an accuracy of $\pm$0.1 μsec or $\pm$10 percent of the pulsewidth, whichever is greater, for pulsewidths from 0.1 to 100 μsec with a resolution of 0.1 μsec (see Table 3-3).

3.1.2 Collection Geometry and Coverage

The two high-gain collection antennas will be installed with their axes at approximately 55 degrees from the -Y spin axis. This, together with the altitude of 340 nm and the spin-axis orientation within 10 degrees of parallel to the earth's axis will ensure optimum geopositioning of targets within 250 nm of ground track and from 10°N to 80°N on both ascending and descending passes. Coverage from 55°S to 90°N is provided with reduced accuracy. Switching to the down-looking antenna occurs each 180° of spin. This allows horizon-to-horizon coverage for targets below 32°N latitude. The swath is narrowed north of 32°, but in all cases is greater than ±19.5° longitude.

3.1.2.1 <u>System Tasking Capacity</u>. The system shall be designed to meet the tasking requirements of Table 3-1, which lists the number of collection minutes possible per day under best and worst conditions.

Table 3-1

TASKING CAPABILITY (WATT HR/DAY)

Gamma (deg)	% Sun	P_g	Power Available for R/O and/or Transpond (watt hr/day)
60	100	40.5	626.2
60	63.6	40.5	325.5
100	100	56.7	956.7
100	63.6	56.7	535.6

All calculations assume 85% efficiency of solar arrays and 200 watt hr/day continuous power.*

P_g = Solar array power output for the specified gamma angle based on the URSALA III shadow study.

$$\text{*Power Available} = 24\ \text{hr} \times \frac{\%\ \text{sun}}{100} \times 0.85\ \text{(S/A Eff)} \times P_g - \text{continuous power}$$

3.1.3 Target Environment

3.1.3.1 Target Radar Beam and Scan Characteristics. The system design shall not place additional constraints on the collection of data from emitters with various types of scan patterns and beam shapes beyond those constraints necessarily placed by orbit geometry, collection system sensitivity, and collection system antenna gain patterns.

3.1.3.2 System Sensitivity. The system sensitivity to pulsed signals shall be equal to or better than the requirements of Table 3-2.

Table 3-2
MINIMUM PULSE SYSTEM SENSITIVITY

Frequency (GHz)	Sensitivity (dBm)
2-4	-90 to -96
4-8	-96 to -99
8-12	-100

The system sensitivity to CW signals shall be -110 to -120 dBm from 2 to 8 GHz and -120 dBm from 8 to 12 GHz.

3.1.4 Orbit Parameters

The space segment shall be placed at an orbital altitude between 325 and 360 nm, with an orbit inclination ranging from 82 to 110 degrees.

3.1.5 Payload General Requirements

The payload system shall consist of a four-channel pulsed-signal receiver and a single-channel CW receiver. The four-channel receiver shall consist of a sum and a delta channel that are connected to a high-gain DF antenna, plus two inhibit channels that are each connected to a low-gain, quasi-omnidirectional antenna.

Signals detected in the CW receiver shall be measured and the frequency and TOM shall be reported.

The payload outputs shall be recorded on tape recorders for later transmission to a remote tracking station.

The payload shall satisfy the payload performance requirements specified in para 3.2.

3.1.6 Spacecraft General Requirements

The URSALA IV spacecraft segment shall provide the basic spacecraft structure and subsystems to house and operate the payload, the propulsion subsystem to achieve orbit, and a support and launcher subsystem to ensure reliable and safe separation from the host vehicle.

The spacecraft shall provide a physical support structure for the payload boxes and associated antenna systems; the power generation, control, and storage equipment; a command and data transmission subsystem; and a payload downlink encryption subsystem. Auxiliary spacecraft subsystems shall provide attitude sensing and control capability, spin-rate control capability, and passive thermal control.

The command and control subsystem, the payload downlink encryption system, and the data transmission equipment shall be compatible with the Satellite Control Facility to provide the necessary communication link.

The deployment subsystems for the antenna and power panels shall be part of the spacecraft and shall deploy the necessary attachments and solar arrays with suitable timers and realtime commands.

3.1.7 Data Processing General Requirements

The data processing segment shall process PCM data received from the spacecraft segment to produce intelligence reports on intercepted emitter signals. The data processing segment shall produce measured and computed parameter values for intercepted signals by in-line digital processing, or by special off-line processing and analysis.

In-line digital processing functions shall be applied to PCM data from read-ins, including calibration read-ins. These functions shall include conversion of PCM serial bit stream to computer words, separation of multiple read-ins in a single read-out, conversion from telemetry units to engineering units, reconstruction of intercepted signals based upon reports received from each payload receiver, geolocation and identification, selection/filtering of data automatically and/or by manual interaction based on prior knowledge, storage of selected data in history, printing of in-line digital processing results, summarization of receiver activity, and summarization of payload health.

Off-line processing and analysis functions shall be provided to support intelligence analysis, which shall include reprocessing of data utilizing the in-line digital processing capabilities, and retrieval and manipulation of intercept and tasking history data. In-line digital reprocessing and selection of data to be processed shall be initiated from an interactive graphics terminal.

3.1.8 Launch and Ascent

The URSALA IV spacecraft shall be designed for installation on a Program 467 host vehicle. The spacecraft payload antennas and TT&C antennas shall be designed to be stowed in the envelope defined in Figs. 3.4.1 and 3.4.3 of "Satellite Vehicle/Subsatellite Interface Document," BIF003W/2-013588-73, which also defines the interface of the spacecraft and launcher assembly with the host vehicle structure. The host vehicle shall provide the boost capability to lift the spacecraft into an initial orbit from which the spacecraft propulsion system is capable of achieving the final desired orbit.

3.1.9 Satellite Control Facility

The Satellite Control Facility shall provide the necessary tracking, command control, and data readout and processing capability to support the spacecraft on orbit. Suitable SCF software shall exist to process and transmit the necessary spacecraft status and health, plus associated payload data over existing facilities to effectively operate the system on orbit.

3.1.10 Data Transmission Performance

The payload data forwarded from the SCF [redacted] through the hardware preprocessor shall provide a first-time processing success rate of greater than 90 percent when averaged over a 7-day period as measured at the point of read-in file generation. This is to be accomplished within 60 days after the spacecraft is put into orbit. 25X1

3.1.11 On-Orbit Calibration

The URSALA IV payload performance shall be calibrated on orbit. This calibration shall be accomplished by an on-board test signal generator (TSG), by known radiations from the astrophysical research vehicles (ARV) and by known radiations from selected sites in the secondary data base (SDB). The purpose of the on-orbit calibrations shall be to verify nominal operation of the URSALA IV spacecraft as defined in para 3.1.1, to perform geopositioning bias analysis, to perform processing system verification, and to perform anomaly evaluation.

3.1.11.1 Test Signal Generator Calibration. A TSG shall be provided in the spacecraft. The TSG is a commanded RF source that shall provide spurious-free CW and pulse signals over the frequency range of 2 to 12 GHz.

3.1.11.2 Astrophysical Research Vehicle Calibration Requirements. The contractor shall provide on-orbit calibration from an ARV as described in the On-Orbit Calibration Plan For Vehicle 4431 (BIF TBD). The functions of the ARV on-orbit calibration are to verify the correct operation of all the payload measurement subsystems, to provide data for bias analysis, to determine geopositioning accuracy, and to aid in anomaly analysis.

The ARV shall be capable of generating pulsed and CW signals to verify the proper operation of the payload measurement subsystems. These signals (both pulse and CW) shall have adequate effective radiated power (ERP) to calibrate at least 15 dB above the system DF receiver threshold on at least one RF in each frequency band at a slant range of 600 nm. The ARV shall be capable of generating either pulsed or CW signals with parameter accuracies sufficient to verify the operation of each measurement subsystem (refer to Astrophysical Research Vehicle, BIF003W/2-135487-78).

3.1.11.3 Secondary Data Base Calibration Requirements. The GDPS system shall have the capability to utilize data from SDB sites as appropriate to supplement the calibration data base over what can be obtained from the ARVs alone.

3.2 Payload Performance

The URSALA IV payload shall consist of the sensing antennas plus the payload. (Specified values are nominal unless otherwise indicated.)

3.2.1 Payload Antennas

The payload sensing system shall meet all the requirements of the Detail Specification and Statement of Work for Spacecraft 4431/ URSALA IV Antenna Systems. The payload antenna system shall consist of two groups of antennas: (1) high-gain DF antennas; and (2) lower gain, broad-beam or omnidirectional coverage antennas. Each high-gain antenna shall have lower gain antennas associated with it to provide an inhibit function.

One DF antenna of the paraboloidal reflector type, with associated lower gain antennas, shall be provided for each of the following bands: (1) 2 to 8 GHz; and (2) 4 to 12 GHz.

The lower gain antennas for the 2 to 8 GHz band and the 4 to 12 GHz band shall be designed to allow rejection of signals outside the main beams of the high-gain antennas, and to minimize "poke-through" of unwanted signals over the maximum portion of the radiation sphere.

3.2.2 Payload Receiver Performance

The payload shall contain a pulse receiver plus a CW receiver to detect activity in a 2-GHz-wide segment of the 2 to 12 GHz band. The payload shall be programmable to select any sequence of segments over a four-spin period with a resolution of 0.5 spin.

3.2.2.1 <u>Pulse Receiver</u>. The pulse receiver shall be tuned to the selected 2-GHz band. This receiver shall consist of four channels: two DF channels plus two inhibit channels.

3.2.2.1.1 <u>Coarse Frequency</u>. The pulse receiver shall measure the frequency of each detected signal to a resolution of 31.25 MHz and an accuracy of ±18.6 MHz.

Multiple frequency signals shall have the frequencies of the strongest three components measured and reported, together with an indication of their relative amplitudes. However, signal components amounting to less than 10% of the total pulse power, and also any components that alone would be more than 8 dB below threshold, need not be reported.

3.2.2.1.2 <u>Fine Frequency</u>. The pulse receiver shall measure the frequency of detected signals to a resolution of 2.2 MHz and an accuracy, for a single-frequency pulse, of ±3.0 MHz.

3.2.2.1.3 <u>Sensitivity</u>. The pulse receiver sensitivity shall be defined as the power level at which a pulse has a 50 percent probability of exceeding the sum channel threshold when the threshold is set to have a false alarm rate of one per second.

Frequency (GHz)	Pulsewidth (sec)	Sensitivity (dBm)
2 to 4	1.0	-68 ±3
4 to 6 (B), 6 to 8 (B)	0.2	-70 ±3
4 to 6 (A), 6 to 8 (A)	0.2	-73 ±3
8 to 12	0.1	-73.5 ±3

(A) indicates using the 4 to 12 GHz parabolic antenna
(B) indicates using the 2 to 8 GHz parabolic antenna

A decrease of up to 5 dB may occur near 4 GHz with the B antenna and near 8 and 10 GHz with the A antenna because of the diplexers used, which act as power dividers at their crossover frequencies.

3.2.2.1.4 <u>Peak Power Measurement</u>. Received peak pulse amplitude in the sum channel shall be measured with a resolution of 0.8 dB to an accuracy of ± 3 dB, with 95 percent confidence, over a 35 dB dynamic range. Near the frequency crossovers of the diplexers (4 GHz with the 2-8 GHz antenna and 8 and 10 GHz with the 4-12 GHz antenna), there may be up to an additional 5 dB of uncertainty in the peak power measurement.

[redacted] 25X1

The accuracy of the payload clock is five parts in 10^5. Its short-term stability is one part in 10^8 using a frequency deviation of 10 sec. The long-term stability is one part in 10^6.

3.2.2.1.6 <u>Pulsewidth</u>. The pulse receiver shall measure the pulsewidth of reported signals with a range of 0.1 to 100 μsec and accuracy of ± 0.1 μsec or ± 10 percent, whichever is greater, with a resolution of 0.1 μsec.

3.2.2.1.7 <u>Dynamic Range</u>. All system requirements shall be met with any signal the amplitude of which is between threshold and threshold +35 dB.

3.2.2.1.8 <u>DF Antenna Sidelobe Inhibit</u>. The DF channel shall be inhibited when the sum of the detected inhibit channel outputs exceeds the DF channel output amplitude by a calibrated margin. An additional 5-dB bias favoring the inhibit channels shall be command selectable.

3.2.2.1.9 <u>Outputs</u>. Signals detected in the sum channel of the pulse receiver shall be measured and the parameters listed in Table 3-3 shall be reported unless inhibited.

Table 3-3

PULSE RECEIVER OUTPUT DATA

Data	Bits	Range	Resolution
Coarse Frequency	6	2 GHz	31.25 MHz
Fine Frequency	5	63.125 MHz	2.18 MHz
Amplitude	6	40 dB	0.625 dB
Pulse Width	6	0.1 to 1.6 μsec	0.1 μsec
		1.6 to 100 μsec	±10% or better
[redacted]			
Sum/Delta Ratio	6	-4 to +28 dB	0.5 dB
A/B Ratio	6	-16 to +16 dB	0.5 dB
C/D Ratio	6	-16 to +16 dB	0.5 dB
Flags			
$\Sigma > G\Delta$	1	-	-
Δ > Threshold	1	-	-
A and B > Threshold	1	-	-
C and D > Threshold	1	-	-
Buffer Overflow	1	-	-
RTl	3	0 to 16 dB	2 dB
RF Band	3	-	-

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3.2.2.2 CW Receiver. The CW receiver shall be tuned to the same 2-GHz band between 2 and 12 GHz as the pulse receiver.

3.2.2.2.1 Frequency Measurement. The CW receiver shall determine the frequency of CW emitters with a resolution of 8 MHz and an accuracy of ±15 MHz peak-to-peak (10 MHz, 2-sigma, when averaging 10 or more samples).

3.2.2.2.2 Sensitivity. The CW receiver sensitivity shall be -93 ±2 dBm from 2 to 8 GHz, and -94 ±2 dBm from 8 to 12 GHz. With this input power, the probability of detection shall be 0.5 or greater and the false alarm rate shall be one per second or less.

3.2.2.2.3 Dynamic Range. All system requirements shall be met over a dynamic range of 40 dB.

3.2.2.2.4 Time of Measurement. The CW receiver shall report the time of measurement with a resolution of 1 μsec. The accuracy of the payload clock is five parts in 10^5. Its short-term stability is one part in 10^8 using a frequency deviation of 10 sec. The long-term stability is one part in 10^6.

3.2.2.2.5 Output. The CW receiver shall output digital data as listed in Table 3-4.

Table 3-4
CW RECEIVER OUTPUT DATA

Data	Bits	Range	Resolution
Frequency	8	0-2 GHz	8 MHz
Time of Measurement	20	0-1 sec	1 sec
TSG Calibration Flag	1	-	-
Sweep Polarity	1	-	-
Buffer Overflow Flag	1	-	-
RF Band	3	-	-

3.2.2.3 Rejection of Undesired (Spurious) Signals

3.2.2.3.1 Out-of-Band Signals. Pulsed and CW signals that are 500 MHz or more below the selected RF band of 2 to 4, 4 to 6, 6 to 8, or 8 to 12 GHz shall be rejected by 50 dB or more.

3.2.2.3.2 In-Band Signals. The following shall not be processed: Any image frequencies, spurious frequencies, cross-modulation frequencies, mixer and/or local oscillator byproducts, and other undesired signals in-band in the selected 2-GHz band resulting from total input signal levels more than 35 dB above threshold into the pulsed receiver or more than 40 dB above threshold into the CW receiver.

3.2.2.3.3 <u>In-RF Band/Out-of-IF Band</u>. Any intermodulation product that lies within the selected RF band (2 to 4, 4 to 6, 6 to 8, or 8 to 12 GHz) but outside the selected 2-GHz IF bandwidth shall be rejected for total input signal levels up to 35 dB above threshold in the pulse receiver or 40 dB above threshold into the CW receiver.

3.2.2.3.4 <u>In-Band Downlink Signals</u>. Filters shall be provided to reject the various SGLS downlink frequencies that lie in Band 1.

3.2.2.4 <u>Test Signal Generator (TSG)</u>. A TSG shall be included that is capable of inserting test signals into each of the RF bands. The RF calibration signals shall provide a pulsed, swept frequency across each RF band. Both pulsed and CW signals shall be inserted. These signals shall permit verification of the amplitude, frequency, pulsewidth, and time of arrival (TOA) measurements, and verification of inhibits.

3.2.2.5 <u>Payload Command Memory</u>. The payload command memory shall provide unrestricted control of the payload receivers.

3.2.3 <u>Data Measurement and Conversion Subsystem</u>

The data measurement and conversion subsystem shall provide pulse signal measurement, CW signal measurement, and miscellaneous functions, including:

- o CW/pulse signal logic origin
- o TSG signal control and identification
- o Data/no data indication
- o Horizon sensor data
- o Solar aspect sensor (eye and word) data
- o Payload status data
- o Timing subsystem
- o Day counter (up to 256 days)

- o Readin counter to count each PE execution (up to 256 PEs)
- o Spacecraft number
- o Channel identification

The data conversion portion of the subsystem will convert the digital inputs from the two receivers into a continuous PCM output. It will also provide buffer storage for 512 each 80-bit PCM word groups. The bit rate shall be 128 kbps.

3.2.4 Payload Commanding Subsystem

A command storage subsystem and a programmer shall provide logical control of payload system operation.

3.2.5 Data Interface Subsystem

A data interface subsystem shall provide signal processing and tape recorder and transmitter selection. This subsystem shall encode the PCM in Biphase Mark.

3.2.6 Timing Subsystem

A time reference generator (TRG) is required to identify the exact time of data acquisition (TOA). Time will be reported as day count, read-in count, a TRG report related to time of day, and TOA report in seconds related to the last or previous TRG second. The time report format is to be the same as for URSALA III (Vehicle 4430).

3.2.7 Redundancy Requirement

The URSALA IV payload system shall have the following redundancy provisions:

a. Time Reference Generator. To be supplied by the contractor and incorporated into the system by the subcontractor. The redundant TRG shall be used on-orbit in an unpowered standby redundancy mode. The subcontractor shall provide the necessary circuitry for switching power and selecting the TRG output.

b. Sum Channel IF Backup. The intercept system shall pro vide mechanical switches to allow the difference channel IF amplifier to be switched in place of the sum channel IF amplifier.

c. Redundant Local Oscillators. The system shall provide redundant local oscillators for bands 2, 3, 4, and 5. The redundant local oscillators are to be used on-orbit in an unpowered, standby redundancy mode. The subcontractor shall provide the necessary circuitry for switching power and selecting the local oscillator out put.

d. Redundant Memory. A redundant memory shall be provided that shall perform the functions of command storage and payload data buffering. The memory shall be used in an unpowered, standby redundancy mode. The subcontractor shall provide the necessary circuitry for switching power and memory inputs and outputs.

e. Power Converters. The system shall provide redundant power converters. The redundant power converters are to be used on-orbit in an unpowered, standby redundancy mode. The subcontractor shall provide the necessary circuitry for switching power into and out of the power converters.

3.2.8 Payload Command Requirements

The payload subsystem shall be compatible with the spacecraft command subsystem defined in para 3.3.4.2.

3.2.9 <u>Data Storage and Transmission</u>

This system shall consist of three tape recorders, three digital interface units (DIUs), and four transmitters as detailed in the following paragraphs. Provision shall be included to encypher one of the downlink channels with a KGX-28B encryptor. The DIUs shall provide the clock signals for the KGX-28B.

The payload system shall combine its data output signals, along with specific spacecraft-generated signals, into forms suitable for recording on a two-channel spacecraft tape recorder. These data shall be transmitted to the ground via an E-band (also known as S-band) FM telemetry transmitter in the wideband mode, and via the same telemetry transmitter alternatively selected to phase modulation (PM) in the narrowband mode. The payload data shall be digitized and applied to the system outputs in a serial bit stream. The bit stream shall be encyphered on Downlink 1 with the provision to bypass the encryptor. Downlink 1 would then revert to plain text data. Downlink 2 shall always be plain text.

The primary tape recorder shall have an optional readin/readout ratio of 4:1 or 1:1, and shall be capable of reading out a digital data stream of 512 kbits/sec Biphase Mark code. This configuration is duplicated with a second tape recorder and transmitter. A third tape recorder shall be installed that can be interchanged with either of the other two tape recorders. A spare transmitter shall also be available that can be interchanged with either of the other two transmitters; however, this transmitter will be used to transmit only FM data - PM data will not be available. The complete tape recorder data format and spectra are detailed in Figs. 3-1 through 3-5.

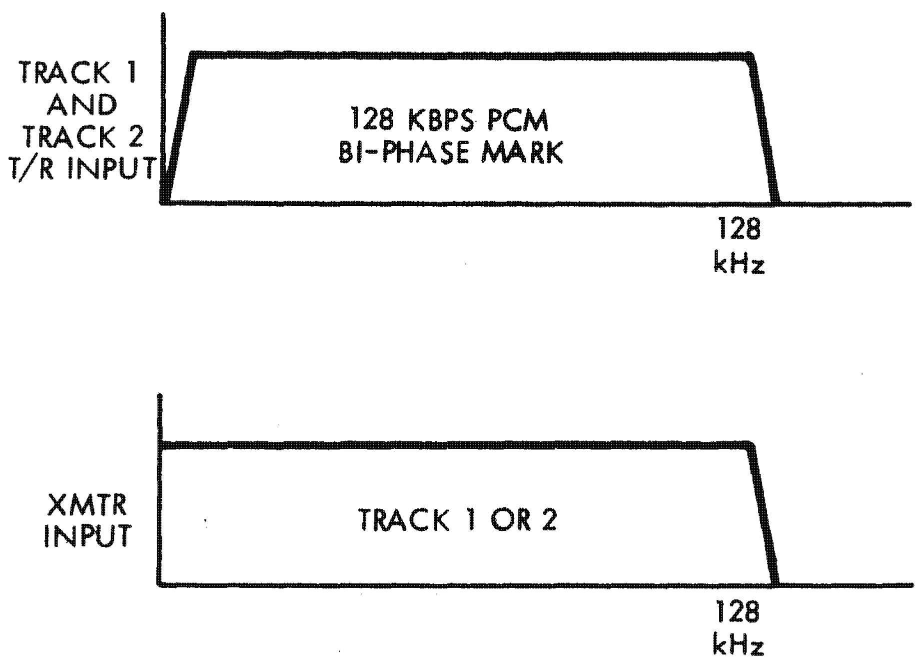

Fig. 3-1 Data Format: 1:1 Readout Mode (Wideband FM Mode)

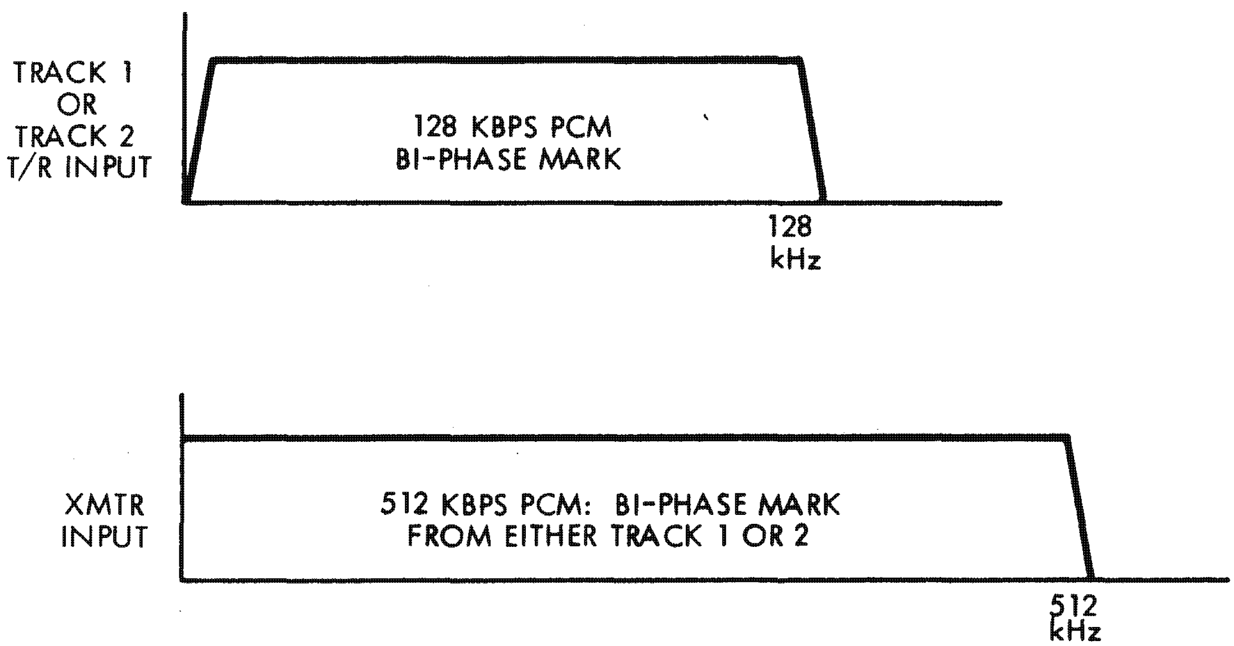

Fig. 3-2 Data Format: 4:1 Readout Mode (Wideband FM Mode)

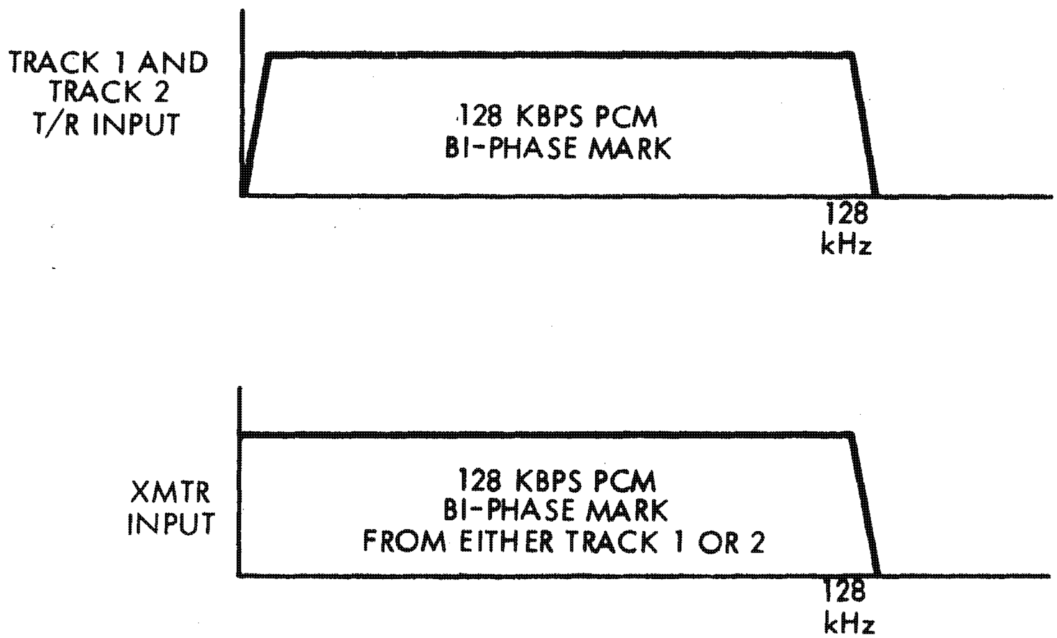

Fig. 3-3 Data Format: 1:1 Readout Mode (Narrowband PM Mode)

Fig. 3-4 Transmitter Input: Realtime Transpond Mode

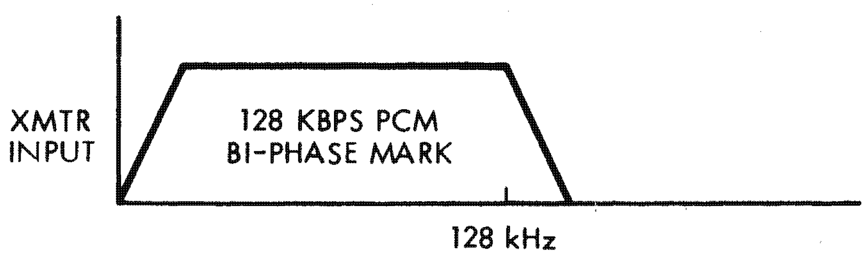

Fig. 3-5 Data Format: B&A Mode

In the 4:1 mode (wideband) the digital data on either track shall be command-selectable to be transmitted by itself via one of three FM transmitters.

When a narrowband data link is required, the tape recorders will be operated in the 1:1 mode. The data rate will be 128 kbps and will be transmitted with the data transmitter normally selected to the PM mode. Readouts are also possible in the 1:1 mode with the data transmitter selected to the FM mode.

The system will be redundant to the extent of having three tape recorders, three DIUs, and three transmitters capable of accepting payload data.

Any one of the three tape recorders shall be selectable to read out over one of two DIUs and any one of the three transmitters selected. Capability shall be provided so that two tape recorders can be read out simultaneously, or one tape recorder can be read out while simultaneously transponding. The capability for transpond operation or tape recorder readout via the encrypted channel shall be provided. The transmitter and tape recorder transfer capabilities and the transpond-readout selection shall be incorporated into the payload logic. Spacecraft status shall be transmitted at the same time via phase modulation of one of two status transmitters. One of the status transmitters will be selectable to the FM mode, to be used as the spare for payload data transmission.

3.2.10 Modes of Operation

The design of the spacecraft payload shall allow operation in the following modes:

a. Payload collection simultaneous with transmission of the collected data to the ground station. This mode is known as Realtime Transpond (bypass). The realtime transpond can be either encrypted or plain text and may be recorded for later readout if transpond is to a remote site.

b. Payload collection using a tape recorder to store data for later transmission to the ground station. The tape recorder readout can either be encrypted or plain text.

c. Tape recorder readout and realtime transpond shall be possible simultaneously. Either the readout or the transpond may be transmitted on the encrypted channel.

Note: Any tape recorder not being read out can read in the transpond data in item c. Also two tape recorders can be read out while a third is being read in.

3.3 Spacecraft Performance

URSALA IV shall use a standard assembly to provide a system to carry and support the URSALA IV payload. The standard power, propulsion, launcher, attitude control, and TT&C subsystems shall be used to support the payload operation. A support panel/launcher assembly (SPLA), compatible with a Program 467 host, shall provide ascent support and launch/separation capability. This system is described in "Spacecraft Description," BIF003W/2-062620-76.

3.3.1 Weight

The maximum weight of the URSALA IV ascent system, including the SPLA, shall not exceed 650 lb.

3.3.2 Spacecraft Attitude

The initial orientation of the spacecraft spin-axis relative to inertial space, which is controlled by specifying host-vehicle attitude and point of spacecraft separation, shall be determined only after the actual orbit parameters are known. Following separation, rocket burns, and deployment, the pointing direction of the spin axis shall be controllable via the attitude control system.

3.3.3 <u>Spacecraft On-Orbit Attitude</u>

The spacecraft shall provide an attitude measurement and control subsystem to permit control of the spacecraft spin axis orientation to an accuracy of ± 2 degrees in order to optimize the collection of emitter data. The attitude of the +Y end of the spin axis will be maintained at a declination (measured from the equator) of 80 to 90 degees. The attitude will be further constrained to keep the solar aspect angle (gamma) within the limits of 60 to 128 degrees.

3.3.4 <u>TT&C Subsystem Requirements</u>

3.3.4.1 <u>T/C-1 and T/C-2 Antenna Requirements</u>. The combined pattern of T/C-1 and T/C-2 shall provide essentially omnidirectional coverage for both up and down links over any SCF station and for downlink only over any remote site.

3.3.4.2 <u>TT&C Subsystem Performance</u>. A subsystem shall be provided to accept and distribute command information from the Satellite Control Facility (as defined in para 3.4), to format spacecraft status and health information into a PCM stream compatible with SCF capability, and to output a composite baseband to a suitable downlink RF system. The TT&C subsystem shall also include tape recorders for storing payload information to be transmitted on a suitable downlink RF system. The time base instability of stored PCM data shall be reduced through the use of an add-on de-jitter box (DIU) associated with each tape recorder. Isolation shall be provided for redundant commands so that a circuit fault will not cause both primary and backup command circuits to fail.

The DIU will be capable of accepting PCM bit streams with 128 and 512 kbps bit rates, and will provide an output bit stream with less than 1 percent peak-to-peak jitter for jitter frequencies from 10 Hz to 10 kHz. The DIU BER will be 1×10^{-6} maximum. The overall bit error rate will not exceed 2×10^{-6} when the DIU is being operated in conjunction with the Type 23 or Type 38 tape recorder. The DIU clock signal shall be used to clock the KGX-28B encrypter as previously mentioned.

Four basic command types are required to support the URSALA IV system. These commands shall be supplied by the spacecraft command receiver/decoder subsystem. The commands are as follows:

a. Magnitude Commands. Eight magnitude commands, 0-7, (each having 11 associated function bits) shall be used to provide the basic spacecraft command functions, to load the spacecraft timer, to select the payload configuration, and to provide special task identification and burst count information.

b. Basic Commands. Thirty six (36) basic commands, 18 normal and 18 alternate, all derived from magnitude command zero (0) shall be used for transmitter switching, tape recorder selection, data switching, etc.

c. Programmable Events (PEs). Since the target areas are not within range of tracking and command stations, four programmable turn-on events are provided to activate the URSALA IV system over the target area. Associated with these turn-on events are programmable companion events (CEs), which are used to turn the system Off.

d. Single Events (SEs). Single events are fixed time delay outputs provided by the timer. One SE is used to back up the turn-off of TLM at the end of a station acquisition (SE-1). SE-1 shall not turn the payload off if it is in a realtime read-in situation.

SE-1 is initiated by the TLM-ON command. The other event (SE-2) provides a delay prior to read-in of the tape recorder and payload on. This delay permits stabilization of the horizon-sensor signal. SE-2 is initiated by any PE, and actually starts a payload and tape recorder read-in. Once the systems are reading in subsequent PEs, increment the payload read-in counter and program other tape recorders to read in. SE-2 is not issued once the payload is on in a read-in and a PE is programmed. The read-in counter is incremented with the PE in this case.

3.3.4.3 RF Subsystem. An RF transmission subsystem shall be provided to supply the necessary data downlink to the SCF.

3.3.4.3.1 SGLS (Spacecraft Status) Downlink. A phase-modulated transmitter shall be used on SGLS Channel 1 to transmit the spacecraft status and health data to the ground. Link closure for this service shall be achieved at any SCF station for receiving antenna elevation of 5 degrees or greater.

3.3.4.3.2 Data Downlink (Payload). An FM modulated transmitter shall be used on SGLS Channels 7, 12, 17 for transmission of payload composite baseband to the SCF. One of the transmitters shall also be capable of being selected to provide a backup for the status and health data. The transmitter outputs shall be combined in a suitable multicoupler to operate over a single antenna. Link closure for the payload data downlink shall be provided to the extent necessary to read out the maximum system readin capability on a daily basis.

The link closure requirement for recovery of payload data is a signal strength of -87 dBm for the 1:1 and -92 dBm for the 4:1 tape recorder modes at the SCF tracking station for the duration of the tape recorder readout.

3.3.4.3.3 <u>Data Downlink (Narrowband PM)</u>. PM modulated transmitters shall be provided to transmit payload data on SGLS channels 12 and 17. The transmitter output shall be 5 watts or greater and multiplexed with the output of other transmitters on a single antenna.

3.3.5 Attitude Control System (ACS)

The system shall be capable of maneuvering the spin axis to any position. The maximum net motion shall not exceed 5 degrees per orbit period.

3.3.6 Electromagnetic Compatibility and System TEMPEST Requirements

3.3.6.1 <u>Electromagnetic Compatibility Requirements</u>. The spacecraft shall satisfy the requirements of MIL-E-6051, "Electromagnetic Compatibility Requirements, System," and applicable sections of "Satellite Vehicle/Subsystem Interface Control Document," BIF003W/2-013588-73.

3.3.6.2 <u>System TEMPEST Requirements</u>. The spacecraft TT&C subsystem and the payload equipment shall be designed such that any compromising emanations are reduced to levels where unauthorized interested observers are unable to extract extraneous energy related to the classified payload data being processed and transmitted to designated ground stations. The design goal shall be to meet the satellite downlink limits for non-synchronous satellites as delineated in NSA document NACSEM 5112, para 7.10.1.2b.

3.3.7 Mean Mission Duration

For a spacecraft equipped with three (Type 38) recorders, the space segment mean mission duration shall be at least 24 months when based upon the following:

a. Three hours per day average operations (readin plus readout)

b. An average of eleven (11) tape recorder cycles per day

c. 50% confidence level

3.4 Satellite Control Facility

The RF uplink and downlink services for URSALA IV shall, except for the payload narrowband link, be compatible with the Air Force Satellite Control Facility (AFSCF) for commanding, ranging, and telemetry (TLM) readout of spacecraft status data and payload data. Standard SGLS and ASGLS communication links shall be utilized for these services. Provisions will exist at the designated remote tracking stations (RTS) to:

a. Transmit command messages (FSK), combined with a pseudo-random noise (PRN) ranging code into composite signals, to the spacecraft by phase-modulating the uplink RF carrier.

b. Receive the PRN code multiplexed with the status TLM data, and the payload data on standard down-link RF carriers from the spacecraft. At the remote tracking stations, the received telemetry data and payload data shall be recorded and processed for transmission to the Satellite Test Center (STC) in Sunnyvale, California.

Data transmissions from the remote tracking stations to the STC will be accomplished via the AFSCF IWB/DSIS communications system.

The SCF shall have the capability to:

a. Determine the orbit of the spacecraft and generate actual and predicted ephemeris data.

b. Generate specific command messages to satisfy detailed tasking plan.

c. On special request, revise the command messages for a given station pass up to 1.5 hr prior to estimated time of spacecraft acquisition.

d. Identify and resolve conflicts between SCF resources.

3.5 Data Processing Performance

One ground data processing system (GDPS) shall satisfy the processing requirements of the existing URSALA II (4426) and III (4430) vehicles and the URSALA IV vehicle (4431). The data processing segment shall consist of a prelaunch, in-line digital, and off-line digital processing system plus a Program 989 mission planning function interface.

3.5.1 Prelaunch Processing

The prelaunch processing function shall include antenna and payload calibration data reduction and simulation. Software and software products shall be provided to perform the following functions.

3.5.1.1 Preflight Calibration Data Processing. A capability is required to process antenna and payload preflight calibration data to establish a concise representation of the collection system's calibration. Said data will be prepared for use by the in-line and off-line processing system. Preparation of these data shall employ the same techniques and models as developed for Vehicle 4430; that is, URSALA III GDPS software shall be modified to accommodate URSALA IV GDPS, with new model software developed only as necessary to accommodate those characteristics unique to URSALA IV.

3.5.1.2 Preflight Validation. The in-line processing system shall be capable of processing actual data collected by URSALA III, reformatted to simulate URSALA IV data.

3.5.1.3 Spacecraft/Payload Inputs. Tests and prelaunch calibration data shall be provided. The GDPS shall provide for the conversion of raw data to engineering units.

3.5.2 Mission Planning

The GDPS shall be compatible with the Program 989 mission planning function. The mission planning function shall consist of maintaining a tasking history and providing a target collection summary.

3.5.3 Data Processing Inputs

The GDPS shall be capable of processing data from all of the types of readin segments and data inputs as specified in the following paragraphs.

3.5.3.1 Payload PCM Inputs. The payload PCM stream shall be received as modulated PCM signals via SATCOM, microwave, [redacted] 25X1
DSIS, or station tape. The parameters included in the payload PCM stream are defined in paras 3.2.2 and 3.2.3.

3.5.3.2 Government Inputs. The customer [redacted] shall 25X1
provide the GDPS with necessary emitter parametric data, such as EPL, SDB, and political boundaries.

3.5.3.3 <u>Satellite Control Facility (SCF) Inputs</u>. The STC shall provide the GDPS with RDEL and DBRT tapes and other vehicle-associated data in accordance with para 3.4. The SCF shall provide the following information daily to the data processing segment:

a. <u>Ephemeris Data</u>. Actual ephemeris data for URSALA IV shall be provided for the past day; predicted ephemeris data shall be provided for the next two days. Ephemeris data may be updated more than once a day to maintain the required accuracy.

b. <u>Time Correlation</u>. SCF system time in milliseconds shall be correlated to vehicle time.

c. <u>Command Data</u>. Predicted commands and a history of actual commands sent to the vehicle shall be delivered.

d. <u>Attitude Data</u>. Sun sensor data and horizon sensor data collected during station passes shall be delivered.

e. <u>Mission Planning Inputs</u>. Those specific targets/areas planned for receiver collection will be delineated in advance on a DBRT delivered nominally 3 times per week by the STC.

f. <u>Data Processing Interface</u>. Information regarding the schedule, location, and contents (inluding Task ID) of planned read-ins and read-outs, of spin rate and altitude maintenance events, and of spacecraft/payload configuration charges will be made available to the [redacted] management of the data processing subsystem. 25X1

3.5.4 In-Line Digital Processing

The in-line system shall automatically detect, characterize, and correlate the signals intercepted by the two receivers. The in-line digital processing software shall provide intermediate outputs to aid an analyst in determining signal parameters.

3.5.4.1 General. The following requirements are applicable to processing of both pulsed and CW data from the payload PCM stream:

a. The capability shall be provided to process payload PCM data from microwave, M-22, or SATCOM microwave transmission to the data processing facility or from station tapes (SCF RTS analog tapes). Station tapes (or taped data) shall be retained for one year.

b. The in-line digital processing system shall be capable of receiving and inputting a peak data rate of 512 kbps.

c. The in-line processing system shall be capable of interrogating the payload tasking mode to process the data in accordance with the tasking requirements.

d. A data selection capability shall be provided for reruns. Selection shall consist of any combination of at least the following:

  o GMT time span (within readin)
  o Percent of spin over a selected spin span
  o Data type (e.g., pulse DF and CW)
  o Values or ranges of any directly measured parameter or parameters, expressed in engineering units

3.5.4.2 Preprocessing Functions

a. The PCM data shall be extracted, decommutated, and stored for processing.

b. Preprocessing capability is required to separate readouts into readins from microwave, M-22, and SATCOM transmissions.

c. PCM command and status data will be routinely processed to monitor payload health and to establish spacecraft and payload configurations for subsequent in-line processing.

d. Test signal generator (TSG) data shall be recognized and processed.

3.5.4.3 Signal Processing. Signal processing shall consist of the reconstruction of signals from intercepted data in the forms described below.

For all pulsed DF intercepts, the pulsed reports will be deinterleaved and the following will be determined:

TOA (up time and duration)
PRI(s)
RF(s)
PW(s)
PA (max)
Ident (most probable)

For all CW intercepts, the CW reports will be deinterleaved and the following will be determined:

TOM (up/duration/centroid)
RF
Ident (most probable)

For each pulsed or CW DF signal, a geolocation computation will be performed and the following will be determined:

Latitude
Longitude
Error ellipse; semi-major axis, semi-minor axis, orientation relative to north, slant range
Country code (most probable)
Land-sea/boundary/area name

3.5.4.4 <u>Digital History</u>

a. A comprehensive summary of signals reconstructed by data processing shall be maintained.

b. Provision shall be made for intercept working histories.

c. A summary of receiver activity shall be maintained.

3.5.4.5 <u>List Outputs</u>. For each readin segment, an ELK list of all signals shall be provided.

3.5.4.6 <u>Tape Output</u>. The in-line system shall provide for the semi-automatic generation of UNITRAN magnetic tapes formatted for transmission via the SOCOMM transmission link. Each tape will contain readin segment information in File 1 and emitter parameter information in File 2. Each tape can contain one or more readin segments.

3.5.4.7 <u>On-Orbit Calibration Data</u>. The capability shall be provided to process data obtained as a result of an on-orbit calibration through the same software modules used for intercept data. These calibration parameters shall be sufficient to determine vehicle operational health and quantify time-constant and time-varying system biases. This capability shall be sufficient to measure and report how well the system meets the overall system accuracy and resolution requirements of para 3.1.1.

3.5.4.8 <u>Performance Standards</u>. The in-line digital processing system shall be required to satisfy certain performance standards during prelaunch validation. Validation shall be based upon test cases specified in the GDPS Validation Plan.

In general, the goal of the in-line system shall be to successfully recognize all emitters represented in the intercept data stream, to segregate the pulse/CW samples of these distinct signals, further to characterize the operating parameters of the emitter such that the parameter accuracies inherent in the collection system are not degraded and the overall system accuracies (see 3.1.1) are satisfied. To this end, the in-line system shall be required to satisfy the performance criteria stated below for data that meet shipping criteria. These performance standards apply to the entire set of test cases as a whole; that is, they reflect the average results that may be expected from a random sampling of passes through the emitter data base.

a. <u>Probability of Detection</u>. At least 95 percent of the emitters generating the signals contained in the intercept data stream shall be detected and shall be presented as line items in the in-line system output.

b. <u>Mixing</u>. At least 90 percent of the emitter signal line items shall be sufficiently free of data from other emitters that the characteristics required for identification of the emitter being described by the line item are not misrepresented.

c. Fragmentation. The rate of occurrence of two or more emitter signal line items representing the same emitter shall be less than 10 percent.

d. Signal Parameter Characterization Success. The in-line system shall be capable of correctly characterizing per para 3.5.4.3 to within the system overall accuracy requirements (3.1.1) for no less than 90 percent of the emitter signal line items.

3.5.5 Off-Line Digital Processing

The off-line system developed for URSALA III, extant at the time of launch of URSALA IV, shall provide the means to perform processing functions on selected data. Off-line digital processing provides computational and plotting capabilities in support of manual analysis. Analysis support shall consist of the following requirements:

a. Special histories shall be provided to store all intercepts of any signals. These special histories shall be created by the analyst and shall include access to all intercepts collected during the system lifetime.

b. The off-line processing system shall be compatible with the software of the CDC 252-2 Analyst Processing System and the ADAGE-130 Analyst Processing System.

c. Capability to plot analyst specified data (via interactive displays and/or hard copy) is required. Measured, derived, or assigned parameters shall be plottable.

d. Plot presentation formats shall include parameter-independent two-dimensional and three-dimensional orthogonal and polar coordinates.

e. The capability to rerun part of the in-line processing system for signals isolated via interactive graphics, and/or card deck, and the generation of product level data files therefrom is required. (Pulse Processing Report, ELK, Composite ELK, Density Plot, etc.)

3.5.6 Data Processing Outputs

EOB results will be reported via standard and special reports (e.g., ELT, ELO, TECH MEMO, SAR, SDR). The following parameters or signal characteristics can be derived from the URSALA IV mission:

a. Pulse Data

RF
PRI
Stagger ratio (if applicable)
PRI stability - short term (intra spin/scan)
PRI stability - long term (inter spin/scan)
Pulse width
Signal amplitude (ERP)
Location (latitude and longitude)
Location uncertainty measure
Emitter identification (if known)

b. CW Data

RF
Location (latitude and longitude)
Location uncertainty measure
Emitter class (if known)

All derivable items shall be reported via computer listings, plots, or CRT displays and shall be retained in history for later or further analysis.

3.6 Spacecraft Environment Requirements

This spacecraft assembly shall comply with the environmental requirements specified in "Program Test Plan for Program PK3," BIF003W/2-062619-76. Individual subsystems and components shall meet the requirements of their individual specifications.

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4.0 VERIFICATION PROVISIONS

System requirements specified in Section 3 shall be formally verified by the provisions of this section. Formal verification of those requirements delineated in Table 4-1 establishes acceptance of design, development, and operation of the system. The system consists of a space segment and a ground segment.

4.1 System Verification

System-level requirements of Section 3 shall be verified in two basic phases: prelaunch and postlaunch. The developmental and preflight verification phases shall, to the maximum possible extent, verify that the elements of the overall system will perform to satisfy the subsystem and interface specifications. The post-launch test shall verify those items that cannot be tested prior to launch, confirm preflight verification results, and in conjunction with prelaunch test results verify the capability of the system to satisfy mission objectives. For the purpose of this paragraph and its subparagraphs, the following verification method definitions shall apply:

a. Inspection. The requirement can be verified by observing the design or by hardware or software formats/listings.

b. Test/Demonstration. The requirement is verified by demonstrating it during a test.

c. Test/Analysis. The requirement is verified by analysis based on test results.

d. Analysis. The requirement is verified by analysis of existing data.

e. Operations/Demonstration. The requirement is verified in the normal course of the mission operations.

f. Operations/Analysis. The requirement is verified by analysis based on normal mission operations data.

4.1.1 Prelaunch Verification

The prelaunch verification shall verify to the maximum extent possible that the entire system is in a state of readiness prior to launch. The space segment shall be operated to simulate on-orbit collection sequences and exercise the spacecraft subsystems. The ground segment, including the data processing facility and SCF, shall be exercised in sequences and combinations to demonstrate system compatibility. The test results which form the basis of verification by "test/analysis" shall be derived from tests performed on final system elements during formal unit or subsystem qualification and during acceptable test phases. In general, the highest level of testing that best verifies the parameter values shall be used for the verification. The highest level of testing refers to the completeness of assembly at the time the test is performed, when in the schedule the test is performed, and the quality of data collected. When two tests have been performed at the same level of assembly, the test performed last is considered a higher level of testing.

4.1.2 Postlaunch Verification

On-orbit verification shall demonstrate to the maximum extent possible all system level requirements of para 3.1. The postlaunch period shall commence at the time of launch and shall continue until completion of para 3.1 verification.

4.2 Subsystem and Interface Verification Requirements

The system-level requirements of Section 3 shall be apportioned to subsystem or interface specifications for formal prelaunch verification. These shall be verified during the process of design, development, fabrication, and checkout of each applicable subsystem segment and interface. The requirements shall be verified prior to launch in accordance with each subsystem's test program.

4.2.1 Space Segment Verification

The spacecraft preflight test program shall consist of three categories of tests:

- o Development
- o Qualification
- o Acceptance

These preflight tests shall be performed at unit through system levels of the spacecraft.

4.2.1.1 Subsystem Development Tests. Development tests shall be conducted on critical, new subsystem designs.

4.2.1.2 Subsystem Qualification Tests. The qualification tests shall be conducted to qualify previously unqualified designs to conditions more severe than the mission environment.

4.2.1.3 Subsystem Acceptance Tests. Acceptance tests shall be conducted on all flight hardware and spares to disclose workmanship defects and to verify proper performance. The environmental test levels shall be for the expected or predicted mission levels. Acceptance tests include ambient, vibration, thermal, vacuum, and the necessary calibrations.

4.2.2 Ground Segment Verification

The data processing prelaunch test program consists of three categories of test:

a. Development
b. Acceptance
c. Validation

The prelaunch tests shall be performed at subprogram (subroutine or function) through system levels of the ground data processing segment.

4.2.2.1 Data Processing Development Tests. Development tests shall be conducted on all new data processing designs. The software to be tested shall be subjected to selected test cases to verify functional design.

4.2.2.2 Data Processing Acceptance Tests. Acceptance tests shall be conducted on all previously unqualified designs, including modifications of previously qualified designs, to verify that the design meets design requirements.

4.2.2.3 Data Processing Validation Tests. Data processing validation tests shall be conducted in representative system environment to verify interface and system performance. Validation tests encompass digital ground equipment and software. Only those portions of the ground data processing system that are applicable to URSALA IV shall be validated; that is, those areas that are common to the overall processing system but different between URSALA III and URSALA IV shall be validated.

Table 4-1

SYSTEM VERIFICATION

Paragraph Reference		Pre-launch*	Post-launch*	Remarks **
3.0	SYSTEM REQUIREMENTS			N/A
3.1	SYSTEM PERFORMANCE		f	
3.1.1	System Accuracy and Resolution			N/A
3.1.1.1	Location Accuracy (Two Sigma)		c	4-1
3.1.1.2	Amplitude Measurement		c	4-1
3.1.1.3	PRI Measurement		c	4-1
3.1.1.4	Radio Frequency		c	
3.1.1.5	Pulsewidth		c	
3.1.2	Collection Geometry and Coverage	a&d		
3.1.2.1	System Tasking Capacity		c	
3.1.3	Target Environment			N/A
3.1.3.1	Target Radar Beam and Scan Characteristics	e		4-2
3.1.3.2	System Sensitivity		c	
3.1.4	Orbit Parameters		e	
3.1.5	Payload General Requirements			4-3
3.1.6	Spacecraft General Requirements			4-4
3.1.7	Data Processing General Requirements			4-5

*The letters a through f shall have meaning as defined in para 4.1.

** 4-1 = To be demonstrated by ARV tests and/or SDB sites under controlled conditions producing comparable data

4-2 = By similarity to URSALA III

4-3 = Verified by para 3.2

4-4 = Verified in para 3.3

4-5 = Verified in para 3.5

Table 4-1 (Cont)

Paragraph Reference		Pre-launch*	Post-launch*	Remarks **
3.1.8	Launch and Ascent	d		
3.1.9	Satellite Control Facility	d	e	
3.1.10	Data Transmission Performance		e	
3.1.11	On-Orbit Calibration		c	
3.1.11.1	TSG Calibration	c		
3.1.11.2	ARV Calibration Requirements	d		
3.1.11.3	Secondary Data Base (SDB) Calibration Requirements	e		4-2
3.2	PAYLOAD PERFORMANCE			N/A
3.2.1	Payload Antennas	c		
3.2.2	Payload Receiver Performance	a		
3.2.2.1	Pulse Receiver	b		
3.2.2.1.1	Coarse Frequency	c		
3.2.2.1.2	Fine Frequency	c		
3.2.2.1.3	Sensitivity	c		
3.2.2.1.4	Peak Power Measurement	c		
3.2.2.1.5	TOA	c		
3.2.2.1.6	Pulsewidth	c		
3.2.2.1.7	Dynamic Range	c		
3.2.2.1.8	DF Antenna Sidelobe Inhibit	c		
3.2.2.1.9	Outputs	c		
3.2.2.2	CW Receiver	b		
3.2.2.2.1	Frequency Measurement	c		
3.2.2.2.2	Sensitivity	c		
3.2.2.2.3	Dynamic Range	c		
3.2.2.2.4	Time of Measurement	c		
3.2.2.2.5	Output	c		

Table 4-1 (Cont)

Paragraph Reference		Pre-launch*	Post-launch*	Remarks **
3.2.2.3	Rejection of Undesired (Spurious) Signals			N/A
3.2.2.3.1	Out-of-Band Signals	c		
3.2.2.3.2	In-Band Signals	c		
3.2.2.3.3	In-RF Band/Out-of-IF Band	c		
3.2.2.4	Test Signal Generator (TSG)	b		
3.2.2.5	Payload Command Memory	c		
3.2.3	Data Measurement and Conversion Subsystem	c		
3.2.4	Payload Commanding Subsystem	c		
3.2.5	Data Interface Subsystem	c		
3.2.6	Timing Subsystem	c		
3.2.7	Redundancy Requirement	c		
3.2.8	Payload Command Requirements	b		
3.2.9	Data Storage and Transmission	b		
3.2.10	Modes of Operation	b		
3.3	SPACECRAFT PERFORMANCE	a		
3.3.1	Weight	b		
3.3.2	Spacecraft Attitude		f	
3.3.3	Spacecraft On-Orbit Attitude	c	f	
3.3.4	TT&C Requirements			N/A
3.3.4.1	T/C-1 and T/C-2 Antenna Requirements	c		
3.3.4.2	TT&C Subsystem Performance	b		
3.3.4.3	RF Subsystem	c		
3.3.4.3.1	SGLS (Spacecraft Status) Downlink	c		
3.3.4.3.2	Data Downlink (Payload)	c		
3.3.4.3.3	Data Downlink (Narrowband PM)	c		

Table 4-1 (Cont)

Paragraph Reference		Pre-launch*	Post-launch*	Remarks **
3.3.5	Attitude Control System (ACS)	c	f	
3.3.6	Electromagnetic Compatibility and System TEMPEST Requirements			4-2
3.3.6.1	Electromagnetic Compatibility Requirements			4-2
3.3.6.2	System TEMPEST Requirements			4-2
3.3.7	Mean Mission Duration	d		
3.4	SATELLITE CONTROL FACILITY	c		
3.5	DATA PROCESSING PERFORMANCE	b		
3.5.1	Prelaunch Processing			N/A
3.5.1.1	Preflight Calibration Data Processing	c		
3.5.1.2	Preflight Validation	b		4-2
3.5.1.3	Spacecraft/Payload Inputs	b		
3.5.2	Mission Planning	b		4-2
3.5.3	Data Processing Inputs		e	
3.5.3.1	Payload PCM Inputs	b		
3.5.3.2	Government Inputs	b		4-2
3.5.4.3	Satellite Control Facility (SCF) Inputs	b&c		4-2
3.5.4	In-Line Digital Processing	b		4-2
3.5.4.1	General	b&c		4-2
3.5.4.2	Preprocessing Functions	b		
3.5.4.3	Signal Processing	b		4-2
3.5.4.4	Digital History	b		
3.5.4.5	List Outputs	b		4-2
3.5.4.6	Tape Output	b		4-2

Table 4-1 (Cont)

Paragraph Reference		Pre-launch*	Post-launch*	Remarks **
3.5.4.7	On-Orbit Calibration Data	b		4-2
3.5.4.8	Performance Standards	b		4-2
3.5.5	Off-Line Digital Processing	a		4-2
3.5.6	Data Processing Outputs	a		4-2
3.6	SPACECRAFT ENVIRONMENT REQUIREMENTS	c		