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A STUDY OF PROGRAM 989

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WARNING NOTICE
SENSITIVE INTELLIGENCE SOURCES
AND METHODS INVOLVED

HANDLE VIA
BYEMAN-TALENT-KEYHOLE-COMINT
CONTROL SYSTEMS JOINTLY

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LIST OF FIGURES

I. EXECUTIVE SUMMARY

1. (S/E) The study of Program 989, taken in the context of SIGINT requirements and capabilities, includes the description of recent requirements and P-989 history, the current status, and the possible future of the program. The capabilities of P-989 systems are examined in some detail in Section V, and are related to the capabilities of other programs to contribute to the satisfaction of requirements. The Appendices include detailed information on the various missions past, present, and future, and an examination of program cost growth. A somewhat surprising conclusion of this examination is that cost growth has been almost exclusively due to inflation (see Appendix 5, Figure 13). Thus the steady growth in program capability represents an improvement in program cost effectiveness.

2. (S/E) Four specific program options are considered in the study:

A. A complete and immediate termination of the program.

B. A greatly reduced program which involves no new development starts, only the launch and operation of systems now approved.

C. A slightly reduced program which equates to starting development on one new system per year in addition to the launch and operation of systems now approved.

D. Continuation of P-989 at the current program level. In the context of estimated intelligence impact, this option differs from option C in that it reduces the need to employ [redacted] Section VI provides 25X1 a detailed examination of the options in terms of potential funds to be released and potential impacts on intelligence collection capability.

3. (S/E) The capabilities lost if the program is terminated are sufficiently important to make that option unacceptable. Program termination would involve a substantial loss of capability to collect and geoposition pulse and CW emitters in the 2-18 GHz RF range, and would immediately reduce, by over half, the collection supporting operational ELINT requirements and the EOB update. Also

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lost would be current support to sustained COMINT collectors and the worldwide [redacted] capability. 25X1

4. (S/E) Under the option which involves no new development starts, there is no short term effect on capabilities because of the systems now under development (RAQUEL, URSALA III, and URSALA IV). The major impacts are on Technical Intelligence capability (beginning in FY-77) and on operational ELINT capability (beginning in FY-80). The technical intelligence capability is of the greatest concern since only low orbiting systems access emitter mainbeams with the frequency and variety of aspect angles required to make precision measurement of such parameters as polarization type, ERP, scan type, rate and limits, and beam dimensions. [redacted] 25X1 Since these measurements are vital in support of analysis of emitter function and capability, and to the development of counter-measures the option of no new starts is unacceptable.

5. (S/E) The recommended option is to put P-989 on a one-new-start per year basis, with the FY-75 and FY-76 new starts devoted to mainbeam Technical Intelligence. As is evident in

Section VI, paragraph 5, this reduction in new starts is more apparent than real since the program has been averaging well under 2 new starts per year in the recent past. The risk involved in this option is that it may be necessary to increase the program in FY-77 to start another URSALA system, or else delay a Technical Intelligence mission by one year. The decision regarding the need for another URSALA will be based on the support which [redacted] and must be made by FY-77.* [redacted] there should be adequate information available in time to permit that decision.

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* This assumption entails a slight change from current URSALA launch planning which requires that an URSALA system be available for the next host launch in the event of catastropic failure.

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II. SIGINT SATELLITE REQUIREMENTS

1. (TSZU/E) General:

A. The requirement for the collection of SIGINT by satellite systems, including P-989, has resulted primarily from the lack of any other feasible capability to consistantly penetrate into the interior of the Soviet Union and the PRC. Satellite collection has been further driven by the need to provide coverage of additional areas of the world which could not be monitored as effectively, or without risk, by other surveillance systems.

B. SIGINT satellite vehicles launched during the early years of the NRP SIGINT Program were primarily concerned with technical SIGINT collection against the Soviet Anti-Ballistic Missile/Anti-Earth Satellite (ABM/AES) weapons systems. As is still the case, data were sought to permit the assessment of systems in the development and testing phases, before they were deployed in quantity. SIGINT satellites were tasked with requirements for general search, directed search (including COMINT), and EOB, with collection against the ABM/AES requirement assigned the highest priority in the SIGINT satellite program.

C. In 1969, these broad requirements were revised and a new ELINT requirement was formulated to provide for the collection of data under the headings of ELINT search, technical measurement, EOB, and surveillance. These requirements are still valid today and are designed to provide information under four functional analysis categories of ELINT information needs, i.e., information needed to isolate, identify, and determine gross role and performance of weapons systems; information needed to obtain a detailed assessment of weapon system performance; information for development of ECM equipment and techniques; and information needed to maintain an adequate EOB.

D. The surveillance requirement has subsequently been adopted into the overall operational ELINT requirement, in support of the conduct of military operations. This operational requirement calls for timely collection and reporting of data which may contribute to local and national understanding of opposing force doctrine, tactics, disposition and surveillance, and which will permit effective operational planning and decision making. EOB maintenance is a by-product of Operational ELINT collection.

E. The COMINT requirement for a P-989 search/mapping vehicle has remained relatively unchanged since the late 1960's. This requirement arose because, in many cases, there were insufficient or no data available on emitter locations, links, types, antenna orientation or other technical factors which were necessary for the design, development and operation of a sustained COMINT collection vehicle. The resulting mapping requirement has generally called for the collection of sufficient data to provide location, technical parameters and operational status of Soviet/PRC line-of-sight and troposcatter communications in order to determine those priority targets most susceptible to and exploitable by sustained collection vehicles.

2. (TSZU/E) Specific Requirements:

A. Technical ELINT Requirements

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1) Since at least 1969, the USIB has provided the NRO and NSA with detailed listings of those ELINT [redacted] systems. These parametric listings represent general USIB guidance for overhead technical ELINT collection and specify the accuracies required for measurement in satisfaction of technical requirements under the broad headings of carrier frequency, modulation (pulsed and non-pulsed), antenna scan, antenna characteristics, power, and location. In 1973, the requirement was formally structured, prioritized and published as the SORS Priorities for ELINT Guidance (PEG). The categories of measurements remained virtually the same, however, the basic elements to be measured under these headings increased from 38 broad line items to 113 specific items. In addition, the measurement accuracy requirements per se have increased greatly since 1969 and are in some measure responsible for changes which have taken place in the configuration of the P-989 program over the years.

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2) Figure 1 displays general guidance on intelligence community needs and generally reflects the "tightening" of accuracy requirements that has taken place over the years.

3) Figure 2 displays the outstanding ELINT Technical Requirements (ELTECs) and line numbers during the 31 December 1972 - 31 March 1974 time period. December 1972 is the earliest date for which figures are available. Technical ELINT reports (ELT's) based on P-989 mission data which contributed to the satisfaction of these requirements are reflected in Appendices 2 and 3.

4) The SORS Priorities for ELINT Guidance (PEG) document was introduced in mid-1973, and contains specific ELTEC entries for which satellites are tasked, in addition to other signals which may not be included in the ELTEC subsystem. There were 257 PEG technical requirements outstanding as of 31 March 1974.

B. EOB Requirements

1) The present EOB requirement, as defined in USIB guidance to the NRO and NSA, derives from the EOB Specific

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FIGURE 1

TECHNICAL INTELLIGENCE GUIDANCE

	1969		1974	
	G	D	G	D
RF	2%	1%	2.0%	0.1%
PRI	5%	1%	1.0%	0.1%
PW	20%	10%	± 1 USEC	.2 USEC
MODULATION	DETERMINE	DETERMINE	DETERMINE	DETERMINE
SCAN RATE	20%	20%	1.0%	0.1%
SCAN DIMENSION	20%	10%	N/A	10%
ERP	6DB	3DB	± 3DB	± 1DB
POLARIZATION	DETERMINE	DETERMINE	±10%	±10%
LOCATION	25NM	25NM	±5NM	N/A

G - ACCURACY REQUIRED FOR GROSS WEAPONS SYSTEMS ASSESSMENT.

D - ACCURACY REQUIRED FOR DETAILED WEAPONS SYSTEMS ASSESSMENT.

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FIGURE 2

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ELINT TECHNICAL REQUIREMENTS

	31 DEC 72	31 MAR 73	30 JUL 73	30 SEP 73	31 DEC 73	31 MAR 74
ACTIVE ELTECs	194	215	248	254	253	262
ACTIVE LINE ITEMS	2534	3131	3633	4034	4125	4529

NOTE: EACH QUARTER REFLECTS ELTEC LINE ITEMS ACTIVE DURING THE PRECEDING 12 MONTHS

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Intelligence Collection Requirement (SICR) of the late 1960's. The objective of this requirement was to maintain a dynamic EOB data base of the worldwide military non-communications electronic environment, equipment deployment, and associated electromagnetic activity through recurring multi-sensor observations. This requirement has generally remained the same throughout the years; however, minor changes in priorities, target categories, frequency coverage, frequency of update, and reporting requirements have been effected as the data base expanded and as crisis situations threatened.

2) Against this requirement, certain SIGINT satellites were tasked to provide EOB support for [redacted] 25X1
[redacted] During 25X1
the years specified, the requirement has emphasized EOB coverage within the following frequency ranges:

1969: 70-9500 MHz

1970: 70-14,900 MHz

1971: 70-18,000 MHz

1972: 70-18,000 MHz

1973: 150-18,000 MHz plus 32,000-37,000 (future)

1974: As determined by command requirements for Collection/Processing Task A, Operational ELINT Requirements Procedure. (Generally the same as for 1973).

3) The periodicity and extent of coverage and reporting required for peacetime EOB support initially called for quarterly-to-annual updates. With changing world conditions and the need to be more responsive to the needs of the intelligence community, the concept of EOB Time Critical Requirements (TCR's) for threat weapons systems was introduced. These TCR requirements are continuously reviewed for modification and may gradually, along with routine EOB support, be incorporated into the Operational ELINT Requirements Procedure. As of 31 March 1974 there were four TCR report series active: Projects FLAVOR, GRANADA, WINEGLASS and MILLBOARD, results of which are reflected in Appendices 2 and 3.

C. Operational ELINT Requirements

1) The Operational ELINT Requirements Procedure (JCS SM-145-73), approved in March 1973, outlines the procedures

to be followed by consumers in requesting Operational ELINT support. Since the publication of this manual, each of the U&S Commands have updated their requirements for worldwide time-critical intelligence, revolving around the identification and location of high threat emitters and the association of several emitters as indicators of on-going hostile force activities.

2) The combination of a reduction in conventional ELINT collection resources and the need to gain access to denied geographic areas makes it imperative that satellite resources be employed as necessary to contribute to the satisfaction of tactical/operational ELINT requirements. As it now stands, the requirements procedure encompasses a need for collection against 18 different site/set functions and 24 land and sea areas, with specific requirements to be defined by the requesting command. Satisfaction of the Ops ELINT requirement necessitates a closely integrated mix of several ELINT satellites and conventional collectors.

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III. HISTORY OF P-989

1. (TSR/E) Historically, the overhead photo programs designed large safety margins into their boost capability to prevent late discovery of overweight situations causing major delays. When it became certain this capability was not needed by the photo mission, SIGINT missions became the prime candidate for use of this excess capability. Initially, the SIGINT missions remained attached to the photo spacecraft but the drawbacks of this platform for SIGINT missions (including spacecraft instability after photo mission termination and limited downlink, command and record capability) led to development of the P-989 subsatellite. The first SIGINT subsatellite was launched 29 October 1963 (a scientific mission subsatellite preceded on 26 June 1963). A total of 29 SIGINT subsatellites have been carried into orbit up to now (all but one by photo systems). One host vehicle failed to achieve orbit.

2. (S/E) Significant program changes or milestones that have occurred during this period include use of dual rocket

motors to circularize orbit, development of a 1 MHz bandwidth data storage and transmission system, on-orbit weight increase from 180 to over 500 pounds, major improvements in power system, addition of attitude and spin rate control systems, conversion from exclusively analog data output to predominately digital data output, transfer of most data processing [redacted] and development of rapid data transmission capability from readout station to processor. 25X1

3. (U) The period to be covered in this brief history is January 1968 through March 1974. The 1968 date was chosen because the beginning of the APS program is the earliest period for which costs can be identified, and the March 1974 date was chosen because it is the last month for which all management data are available.

4. (S/E) Counting FV 4410* (FACADE) which was already on orbit in January 1968, there were eight satellites of Program 989 which were flown against the Soviet ABM radar problem, three

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* See Figure 3 for identification of mission number, Flight Vehicle number and mission names.

COMINT satellites, one missile telemetry satellite, and four EOB/General Search satellites, for a total of sixteen flight vehicles.*

5. (TSZU/E) The vehicles which were to collect information on Soviet ABM radars were of two general types:

A. Search, such as FV 4410 (FACADE), FV 4411 (LAMPAN I/ SAMPAN II), FV 4413 (VAMPAN), and FV 4417 (LAMPAN II/SAMPAN III).

B. Technical Intelligence, such as FV 4412 (TIVOLI I), FV 4418 (TIVOLI II), FV 4422 (TIVOLI III) and FV 4424 (MABELI). Primarily as a result of these eight vehicles, the U.S. intelligence community has progressed from a position of nearly total ignorance to one of remarkably detailed technical knowledge on several of the Soviet ABM radars. As one might expect, and as is evident in Appendices 2 and 3, the information derived from ABM radar missions includes other ELINT (such as on the SAM's), as well as COMINT.

6. (TSU/E) The three COMINT satellites were FV 4407 (WESTON), FV 4423 (TOPHAT I), and FV 4427 (ARROYO). The performance of

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* See Appendices 2 and 3 for a more detailed description of the individual vehicles and the results of their collection.

WESTON was disappointing since most of the COMINT signals collected were of poor quality or short duration. Were it not for the significant DOG HOUSE and TOP ROOST ABM radar intercepts, WESTON would be considered a failure. ARROYO lived only one month on orbit before catastrophic failure. The disaster of such a short life was slightly mitigated by two facts:

A. It collected a remarkable quantity of information during the one month period (see Appendix 2).

B. [redacted] 25X1

Of the COMINT missions only TOPHAT can be considered a total success. It collected those signals for which it was designed, has enjoyed the longest operational life of any P-989 mission, and has even played a role in identifying users of the [redacted] 25X1 25X1

7. (S/E) The lone telemetry satellite was FV 4419 (SAVANT II). Its mission was to collect [redacted] 25X1 and it succeeded, (see Appendix 3). 25X1

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8. (S/E) The four EOB/General Search satellites were FV 4420 (TRIPOS III/SOUSEA II), FV 4421 (TRIPOS IV/SOUSEA III), FV 4425 (URSALA I) and FV 4426 (URSALA II). All of these missions were successes in that they have provided excellent EOB support, discovered new signals, and made Technical Intelligence contributions. The two URSALA missions have routinely met the Time Critical Requirement (TCR) criteria for EOB from crisis areas.

9. (S/E) Figure 3 gives an overview of the period, showing launch sequence, on-orbit operational life, and the association between Flight Vehicle numbers and mission numbers.

10. Appendix 5 reflects the program cost history and growth and describes specific improvements made to the program during the same period. The evidence indicates that improvements to the program have provided an increase in value with no corresponding increase in cost.

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FIGURE 3

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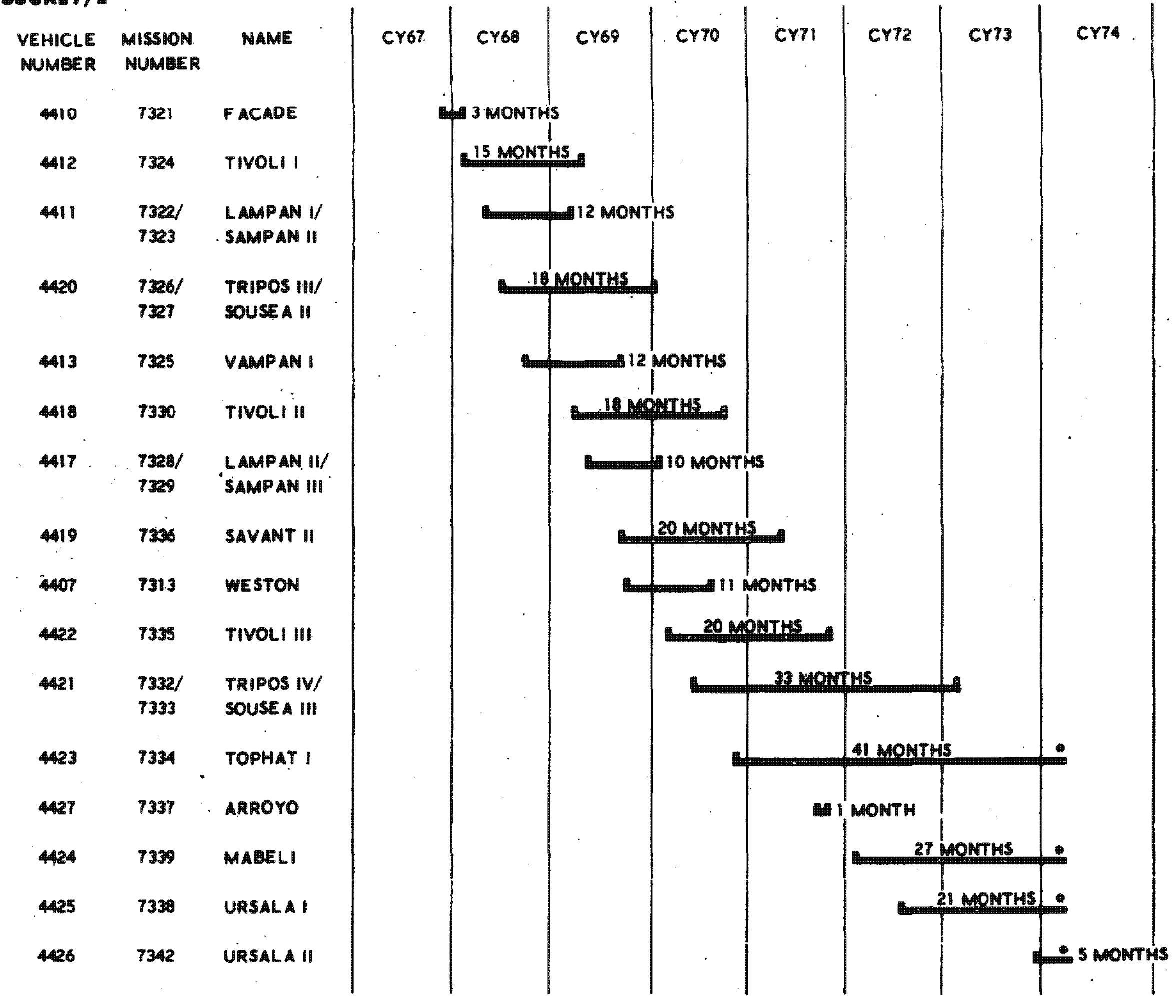

• VEHICLE IS STILL ALIVE.

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IV. CURRENT SYSTEMS

1. (S/E) Current systems are those systems now on-orbit and those systems under development for future launches. These are MABELI, URSALA I-IV, TOPHAT I and II, and RAQUEL. Appendix 3 describes their technical characteristics and capabilities, and briefly describes the results of the on-orbit systems.

2. (TSUZ/E) These systems will be discussed relative to their capabilities to contribute to four specific problem areas of intelligence need:

A. Technical Intelligence: MABELI (now on-orbit) has the capability to contribute unique mainbeam information on those emitters in its range of frequencies. Its greatest strengths are its capabilities to make precision measurements of ERP and polarization. MABELI has demonstrated the feasibility of constructing detailed beam structures from overhead data. RAQUEL, which is scheduled for launch in the fall of 1974, will not have the capability for precision power or polarization measurements. It will, however, have a 14 GHz frequency range within which it is capable of precision pulse width measurements and gross power measurements. It also has the capability to make precision frequency measurements on CW signals, obtain pre-detection recordings, and make some mainbeam related measurements such as scan and beamwidth. URSALA III and IV will contribute precision frequency measurements on pulsed emitters.

B. Operational ELINT and EOB Support: The URSALA systems (two now on-orbit) are the main source of overhead data supporting the EOB in the 2-12 GHz range (see Section V). These systems are capable of geolocating pulse and CW emitters from sidelobe intercepts. They also routinely contribute operational ELINT information to NSA within 6 hours of intercept. The RAQUEL system will provide support to operational ELINT and the EOB in the 12-18 GHz range. As with the URSALA systems, RAQUEL will be capable of geolocating both pulse and CW emitters.

C. Search: Both RAQUEL and the URSALA systems are excellent search vehicles in that they have wide RF ranges and 2 GHz instantaneous bandwidths while maintaining high system sensitivity. The RAQUEL system is sufficiently sensitive to meet the USIB requirement for collecting low powered ELINT signals, so the low power environment will be searched when RAQUEL becomes operational. Although both URSALA and RAQUEL can search for pulsed and CW signals, RAQUEL has the added capability to obtain a pre-detection sample of a signal, and precisely specify the radio frequency of CW signals. Due to the near polar orbits and store-and-dump characteristics of P-989 vehicles, they have the capability to search any area of the world.

D. COMINT Mapping: The TOPHAT systems perform COMINT mapping in the 450-1000 MHz range. TOPHAT II not only maps [redacted] 25X1 signals, but captures the entire signal for COMINT analysis. The URSALA systems have demonstrated their capability to do COMINT mapping in the 2-12 GHz frequency range, and RAQUEL will add the 12-18 GHz range. RAQUEL will also provide greater sensitivity in the 4-12 GHz frequency range and, due to the pre-detection capability, will provide more detailed information about the signals intercepted.

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V. PROGRAM 989 CAPABILITIES

1. (S/E) The first priority objective of the overhead systems dealing with ELINT is to "Provide for the collection and measurement of precise signal parameters with the accuracy necessary to establish: the characteristics and performance of the associated weapon systems; the operational characteristics and employment mode of the weapon systems involved through ELINT collection during R&D and operational testing."* These assessments cannot be accurately made without knowledge of such mainbeam parameters as precision ERP, polarization type and diversity, scan type, scan rate and limits, and beam dimensions. Only low altitude systems access mainbeams with the frequency and variety of aspect angles required to make these determinations. These capabilities have been demonstrated by the MABELI system. Collection against all other technical data requirements related

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* Reference USIB Guidance for the National Reconnaissance SIGINT Program (FY1975-FY1979), Attachment 1, TAB D, Paragraph B.1.

to detailed weapon system assessment can be achieved within Program 989. With the exception of a one second 5 MHz pre-detection sample, those capabilities not yet demonstrated on orbit can be achieved with low technical risk.

2. (S/E) The second priority objective is to "provide for an improved capability to intercept simultaneously (within 100 milliseconds) and to exploit multiple signals, operating in the same or different frequency bands, from a single weapon system."* Wide instantaneous RF bandwidths are characteristic of most P-989 ELINT systems. Both URSALA and RAQUEL have 2 GHz instantaneous bandwidths while maintaining good sensitivity. URSALA also has the capability to examine a different 2 GHz band every 500 milliseconds. No other overhead system will provide these wide instantaneous RF coverages which are an asset to the search for multiple signals. URSALA and RAQUEL also have the advantage of being able to intercept and geolocate both pulse and CW signals simultaneously.

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* op. cit. Attachment 1, Tab D, Paragraph B.2.

3. (S/E) The third priority objective is to "provide a capability to search for and identify new/unusual signals and signals from new/modified weapons systems."* Capability to contribute to this objective is greatly enhanced by the wide instantaneous bandwidths referred to in the previous paragraph, and the capability to intercept and geolocate both pulse and CW signals. Another advantage enjoyed by P-989 collectors is their capability to detect low powered signals (see Figure 7, Section VI). Thus in the search for new signals, P-989 collectors suffer the disadvantage of not being able to dwell on an area of interest, but they have compensating advantages in RF, power, and geographic coverage.

4. (S/E) The fourth priority objective is to "provide for sufficient system flexibility to rapidly respond to crisis situations."** Though all overhead systems have mechanisms to redirect tasking within a short period, P-989 collectors have the unique capability to apply coverage to any area of the world.

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* op. cit. Attachment 1, Tab D, Paragraph B.3.
** op. cit. Attachment 1, Tab D, Paragraph B.4.

5. (S/E) The fifth priority objective is to "provide operational ELINT support to commanders."* At present URSALA provides most of the overhead data to support the surveillance requirement (see Section VI, Figure 4). URSALA is also the only on orbit collector which can routinely support ELINT Time Critical Requirements. RAQUEL will have similar capability in the 12-18 GHz frequency range. Due to the store-and-dump method of operation, P-989 collectors cannot support reporting requirements much more stringent than 6-hours-from-intercept without major modifications to the program. However, the store-and-dump method of operation has the advantage that the collection may be performed over any area of the world.

6. (S/E) The sixth priority objective is "in the near term provide an improved ELINT collection capability covering the 8,000-18,000 MHz frequency band and in the long term provide for a long dwell time ELINT capability in the same frequency range."** The program will, with the launch of RAQUEL, provide the near term coverage. Due to the low orbit, the program cannot contribute to

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* op. cit. Attachment 1, Tab D, Paragraph B.5.
** op. cit. Attachment 1, Tab D, Paragraph B.6.

the long dwell objective.

7. (S/E) The seventh priority objective is to "develop a capability to intercept and exploit low power ELINT signals. Low power ELINT signals are those signals that provide an effective radiated power of about 50 dbm at 3,000 MHz, 70 dbm at 9,000 MHz and 75 dbm at 15,000 MHz."* This requirement will be met by the RAQUEL system. In general, the advantage in space loss which P-989 has over synchronous collectors (30-35 db) makes it attractive as a collector against low powered signals.

8. (S/E) The eighth priority objective is to "provide a capability for geopositioning within [redacted] for pulsed or CW ELINT signals from 380-18,000 MHz transmitting for short periods [redacted] and within [redacted] for longer duration."** 25X1 25X1

P-989 systems locate pulse and CW signals equally well and the short periods as defined are much longer than needed to perform geopositioning. Location accuracy is within [redacted] only on ground track and grows to [redacted] at 250 n.m. off ground track.

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* op. cit. Attachment 1, Tab D, Paragraph B.7.
** op. cit. Attachment 1, Tab D, Paragraph B.8.

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9. (TSU/E) There are several overhead COMINT objectives to which Program 989 can contribute; they are:

A. "Improve the capability to predict points of access to [redacted] targets for the most effective deployment of overhead collection systems."* (Fourth priority for the USSR, and fourth priority for the PRC.) In that the program is capable of providing geolocations, radio frequencies, modulation types, and samples of basebands, it supports this objective. This information can be provided on any area of the world. 25X1

B. [redacted] 25X1
[redacted] (Fifth priority for the USSR.) This capability has been demonstrated by TOPHAT II which is now on-orbit and both geopositioning and recording the [redacted] 25X1 25X1

C. "Search for and identify emissions as communications signals with emphasis on emissions above 3.4 GHz."* (Tenth priority for the USSR.) This capability exists on orbit as demonstrated by URSALA. RAQUEL will provide greater sensitivity and increased RF coverage.

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* op. cit. Attachment 1, Tab B, Paragraph B.

D. "Search for and identify communications signals with emphasis on emissions in the [redacted] 25X1

[redacted] 25X1

the P-989 collectors can operate in any geographic area where tasked, the capabilities discussed in the previous paragraph apply equally well to this objective.

[redacted] 25X1

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* op. cit. Attachment 1, Tab B, Paragraph B.

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[redacted]

25X1

11. (S/E) Some required SIGINT capabilities, while not uniquely achievable by the program, are reasonable missions for P-989 because of their cost. Two of these capabilities are as follows:

A. The search of RF bands which previously had little or no exploration is occasionally required to support decisions on sustained collectors. A P-989 system can be deployed at an order of magnitude lower cost than a major change to a sustained collector. The current question of whether or not to extend the RF of high altitude systems [redacted] will be easier to resolve when the results of the RAQUEL mission become available. Similarly, a more knowledgeable decision on the extension of [redacted] can now be made in light of the URSALA CW intercepts.

25X1

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B. Collection to support the surveillance mode of operational ELINT, and general EOB is easily achievable within the program. The URSALA systems are now providing the bulk of this collection, and it seems prudent to wait until the combined [redacted] can be observed before making a decision to terminate such missions. It is not unlikely that an URSALA should be kept on orbit in order to allow [redacted] 25X1

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VI. PROGRAM 989 OPTIONS

1. (S/E) Four options will be considered (See Appendix 1 for an explanation of mission duration calculations. They are:

A. Immediately terminate the program.

B. Begin no new mission development, but complete, launch, and support those systems now in development (RAQUEL, URSALA III, and URSALA IV).

C. Reduce the program to the level of starting development on one new system per year, while supporting those already on orbit as under development.

D. Continue at the current program level.

Each of these options will be considered in the context of estimated financial savings and estimated intelligence impact.

2. (S/E) The option of terminating the program involves turning off all missions on orbit, and stopping all development, processing, and procurement. The funds released under this option are (in millions of dollars):

FY	75	76	77	78	79	80
NRP	(14.2)*	23.8	24.1	26.1	26.6	27.5
APS	(7.9)*	8.7	8.8	8.8	8.7	9.9

* The FY-75 figures are not realistic because contract termination costs could not be estimated. All fund estimates are those of the NSA program office.

The estimated intelligence impact is as follows:

A. URSALA provides the majority of the collection which supports the EOB and operational ELINT requirement. Figure 4 shows the number of signals reported from NSA in support of the EOB, by collector, for the second and third quarters of FY-74--the period during which URSALA, POPPY [redacted] providing collection. Figure 5 shows the actual set updates reported by DIA for the same period.

1) From these two figures it is evident that over 60% of the EOB support is provided by URSALA. In some geographic areas, e.g., China and Southeast Asia, URSALA provides nearly all of the collection supporting the EOB. The short term effect of program termination is the loss of this collection support. Additionally, no capability to geoposition CW emitters for EOB update would exist in the near term.

2) The intermediate term (FY-77-FY-79) effect of program termination depends on the [redacted] 25X1

FIGURE 4

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AREA	1 SOVIET UNION AND MONGOLIA	2 SATELLITE BLOC	3 CHINA	4 SOUTH-EAST ASIA	5 MED.	TOTAL
POPPY	12,777	725	624	140	577	14,843
URSALA	70,122	5,390	16,172	10,942	31,685	134,311
[redacted]						
TOTAL	[redacted]					

25X1

TOTAL SIGNALS REPORTED FROM NSA, BY AREA

AREA	1	2	3	4	5	OVERALL
POPPY	12.8	10.3	3.3	1.2	.7	6.8
URSALA	70.0	76.5	84.6	96.4	39.3	61.5
[redacted]						

25X1

PERCENTAGE OF SIGNALS REPORTED FROM NSA, BY AREA

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-35-

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FIGURE 5

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EOB SET UPDATE

SECOND QUARTER - FY - 74

COLLECTOR	SETS UPDATED
POPPY	1212
URSALA I AND URSALA II	3410

[redacted]

THIRD QUARTER - FY - 74

COLLECTOR	SETS UPDATED
POPPY	624
URSALA I AND URSALA II	5283

[redacted]

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d. [redacted]

[redacted]

25X1

e. [redacted]

[redacted]

3) Program termination will eliminate support to the EOB which is to be provided by RAQUEL in the 12-18 GHz range in both the near and intermediate term.

B. The capability to support Time Critical Requirements (TCR's) will suffer the degradations described for the EOB problem. There is an additional near term degradation. Currently, only URSALA is capable of routinely providing processed TCR data to NSA within six hours of intercept. RAQUEL will also be capable

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of such timeliness, providing TCR support in the 12-18 GHz range. Termination of the program will dramatically reduce both current and expected TCR support and will eliminate TCR support in the 8-18 GHz range.

C. The capability to provide the required mainbeam data in the support of weapon system analysis (see Section V, Paragraph 1) would be lost under this option. MABELI is the only collector which now provides precision measurements on mainbeam power and polarization. The loss of MABELI would not be much of an impact since it has substantially completed its mission. Cancellation of P-989 would, however, eliminate the mainbeam Technical Intelligence systems which are planned for development within current program levels.

D. The capability to intercept and exploit multiple signals from a single weapon system would be greatly reduced if the program is terminated. As discussed in Section V, Paragraph 2, the capabilities of URSALA and RAQUEL regarding wide instantaneous RF, good sensitivity, and geolocation of both Pulse and

CW signals are unique, and are important in support of this objective.

E. The capability for overhead collection in any area of the world will be lost with program termination. The areas not coverable in a crisis situation would include most of the Southern hemisphere, and some low Northern latitude areas.

F. The near term requirement to provide a collection capability in the 8-18 GHz range will not be satisfied if the program is terminated. URSALA now provides both pulse and CW collection capability in the 8-12 GHz range, and RAQUEL is to provide pulse and CW capability in the entire 8-18 GHz band. Without RAQUEL and URSALA there will be no CW coverage in the band. There will be a pulse capability due to POPPY coverage of 8-10.5 and 14.4-17.0 GHz, but no geopositioning capability in the following RF ranges: 10.54-14.43 GHz, 15.15-15.95 GHz, 16.07-18 GHz. [redacted] 25X1

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G. The capability to intercept low power ELINT signals will be denied if RAQUEL is not launched (see Section V, Paragraph 7).

H. The capability to locate CW ELINT emitters will be seriously degraded if the program is terminated. Above 8 GHz there will be no capability. In the .1-8 GHz RF range there will be a near term impact [redacted] 25X1

I. COMINT support currently being provided by TOPHAT and URSALA to the sustained collectors will be lost if the program is terminated. The worldwide [redacted] capability currently being demonstrated by TOPHAT II would be eliminated. The COMINT support expected from RAQUEL would also be lost. 25X1

3. (S/E) The option of beginning no new mission development but completing, launching, and supporting those systems under development* would allow the release of the following funds (in millions of dollars):

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* Projected launch and termination dates are shown in Appendix 3.

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FY	75	76	77	78	79	80
NRP	6.0	18.8	19.6	21.6	23.3	27.5
APS	.3	1.4	2.4	2.5	4.4	8.7

The estimated intelligence impact is as follows:

A. The impact on EOB and Operational ELINT support described in the program termination option (paragraph 2.A. above) would be delayed until FY-80 in the 2-12 GHz frequency range and FY-78 in the 12-18 GHz frequency range. After those years the impact would be identical to the impact under mission termination.

B. The dramatic drop in TCR support described in the termination option (paragraph 2.B. above) would be felt in FY-78 in the 12-18 GHz range and in FY-80 in the 2-12 GHz range.

C. The capability to provide the required mainbeam data in support of weapons system analysis would be lost under this option. The effect of implementing this option would be exactly the same as under the program termination option in the area of mainbeam technical intelligence.

D. The greatly reduced capability to intercept and exploit multiple signals from a single weapons system (see paragraph 2.D. above) would be felt in FY-78 in the 12-18 GHz range and FY-80 in the 2-12 GHz range.

E. The capability for overhead collection in any area of the world would be lost in FY-80.

F. The requirement to provide near term capability to collect in the 8-18 GHz range will be met until FY-78. After [redacted] 25X1 No other overhead collector is programmed to fill the gap.

G. The capability to intercept low power emitters will be lost after FY-78.

H. After FY-78 in the 12-18 GHz range there will be no capability in the overhead program to locate CW emitters. [redacted] 25X1 the capability will be severly degraded in the 2-12 GHz range after FY-80.

4. (S/E) Reduction of the program to the level of starting

the development of one new system per year would allow the release of the following funds:

FY	75	76	77	78	79	80
NRP	.1	5.5	3.4	2.8	2.8	2.9
APS	0	0	0	0	0	0

The estimated intelligence impact is as follows:

A. This option permits the development of a mainbeam technical intelligence mission each year. Beginning in FY-77 these missions would provide the only precdsion main beam data from overhead.

B. Under this option, RAQUEL and URSALA III and IV would be launched as scheduled. Thus the impact on EOB, Operational ELINT, and TCR support would be identical to the impact described in 3.A. and 3.B. above.

C. The capability to intercept and exploit multiple signals from a single weapons system could be included in the new missions developed depending on the frequency range of those missions. Additionally, this capability would continue to exist as described in paragraph 3.D. above.

D. The capability to collect in any area of the world would continue to exist, but processing and reporting in a rapid manner would not be done for technical intelligence missions.

E. The impact on the requirement to collect in the 8-18 GHz range would be nearly the same as described in paragraph 3.F. above. The new missions developed under this option would cover different frequency ranges so there would be some times after FY-78 when the 8-18 GHz range would be covered and sometimes when it would not.

F. The capability to collect low power emitters would continue.

G. The capability to locate CW emitters would be much the same as described in paragraph 3.H. above. Again, the new missions developed might or might not collect in the required frequency range; they will have CW location capability.

5. (S/E) The option of continuation at the current program level needs some explanation. Under this option the program would continue at the currently approved fiscal level.

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A. While generally thought of as a two-new-starts-per year program, program budget guidance has not allowed this. In the recent five year period, the average number of new missions started per year has been 1.4. As costs continue to rise, the number of new starts per year would continue to drop.

B. The number of launches per year has been two, but as missions currently under development are launched, this number, too, would drop, reflecting the drop in new starts.

C. Continuation at the current level would have the same impact on main beam collection as described in paragraph 4.A. above.

D. The major impact of this option over the option described in paragraph 4. above would be the continuation of the URSALA missions, [redacted] 25X1

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VII. CONCLUSIONS AND RECOMMENDATIONS

1. (S/E) One (perhaps surprising) conclusion is that the inflation-adjusted costs of Program 989 are nearly constant (see Appendix 5, Figure 14). Since, during this same period, the program grew in terms of capability, mission duration, and ability to respond to changing requirements, there was an increase in the value received for dollars spent.

2. (S/E) The examination of P-989 options must be set in the context of SIGINT requirements and a strategy for meeting those requirements in the near, intermediate and long terms. The requirement to provide timely support to operational commanders, and near real-time support in crisis areas, necessitates a high [redacted] 25X1 In the long term we must assume that the current [redacted] 25X1

[redacted] 25X1

In the short term (FY-75, 76) an URSALA is needed on orbit since it is the only overhead ELINT collector existing which routinely geopositions CW emitters and provides processed ELINT data within the six-hour Time Critical Requirement period. It is also the main collector supporting the EOB. The intermediate term (FY-77 through FY-79) may also require an URSALA on orbit, but since enough URSALAS have been purchased to provide coverage through approximately March 1979 the interim decisions concern only their launch.

3. (S/E) The ELINT technical intelligence requirement cannot be met without knowledge of such [redacted] 25X1

[redacted] 25X1

dimensions. Only low orbiting systems access mainbeams with the frequency and variety of aspect angles required to support these determinations. [redacted] Thus, until such time as a viable option is proposed, Program 989 will be required for Technical Intelligence. 25X1

4. (S/E) In terms of today's SIGINT requirements, the intelligence loss* incurred by termination of the program is unacceptable. The intelligence loss experienced would not be compensated to any great degree in the short term, and probably not even in the long term unless large expenditures were made on other SIGINT overhead programs. In the interim, the collection gaps experienced, particularly in the area of Operational ELINT and EOB support, would cause a considerable setback to intelligence production and requirements satisfaction.

5. (S/E) The intelligence price of prohibiting new P-989 system developments** is not as severe in the short term, but

* See Section VI, Paragraph 2.
** See Section VI, Paragraph 3.

produces more impact as systems now on orbit and in development are expended. In the long term, the effect would be felt in all areas of ELINT collection, and would not be compensated without extensive changes to other overhead SIGINT programs. Even if modifications were accomplished, several gaps would probably still remain (e.g., mainbeam TI and low powered emitter capability) and the quick reaction capability to rapidly respond to new requirements would be lost.

6. (S/E) The net effect of reducing the program to one new development start per year is the possible creation of a gap in the collection coverage which supports operational ELINT and the EOB. The following assumptions are necessary* if one

[redacted] 25X1

* See Section VI, paragraph 2.A.

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[redacted]

[redacted] since another URSALA mission will have to be started with FY-77 funds to avoid a planned gap in URSALA coverage. 25X1

7. Recommendations:

A. Based upon present and anticipated intelligence requirements and the ability of P-989 to uniquely satisfy or to contribute to satisfaction of these requirements, it is recommended that no consideration be given to immediate total program termination or to a prohibition on new program development efforts.

B. Launch and operate those systems presently under development (RAQUEL and URSALA III/IV).

C. Starts on new mission development in FY-75 and FY-76 should be devoted to Technical Intelligence, and should proceed at the rate of one new start per year.

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D. [redacted] If it is acceptable, continue P-989 at one new start per year devoted to Technical Intelligence. If it is unacceptable then either increase the program funding to provide for another URSALA start, or cancel a Technical Intelligence start in favor of URSALA.

25X1

E. COMINT mapping missions should not be developed as a part of the P-989 baseline program. COMINT mapping is not a true intelligence objective in the sense that the information derived from such missions is of use almost exclusively to the SIGINT community. At the time one needs answers to questions involving locations, frequencies, or types of modulation in order to design or task a sustained collector, a specific mission may be proposed. The funding of such a mission should be through the program or programs being supported by the mission.

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APPENDIX 1

COST AND MISSION DURATION CALCULATION

1. (S/E) Any attempt to examine program growth must take the form of comparison. For ease of comparison, all cost figures have been converted to 1974 dollar equivalents. Costs were converted using DOD escalation factors. Processing and support costs were converted based on the escalation factors for the year in which the work was performed. Spacecraft costs were converted using the escalation factor for the year in which the majority of the work on the spacecraft was accomplished. Figures 8 and 9 show actual spacecraft and yearly processing costs for the period covered by this study.

2. (S/E) Spacecraft costs were provided by [redacted] 25X1

3. (S/E) Processing costs were calculated using NSA Program Office figures. Processing costs include APS costs attributed to P-989 and 28% of C-Complex costs. (The NSA Office of Programs and Budget attributes 28% of C-Complex costs to P-989.) Support costs include NRO costs less spacecraft and development costs.

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FIGURE 8

FV 44XX

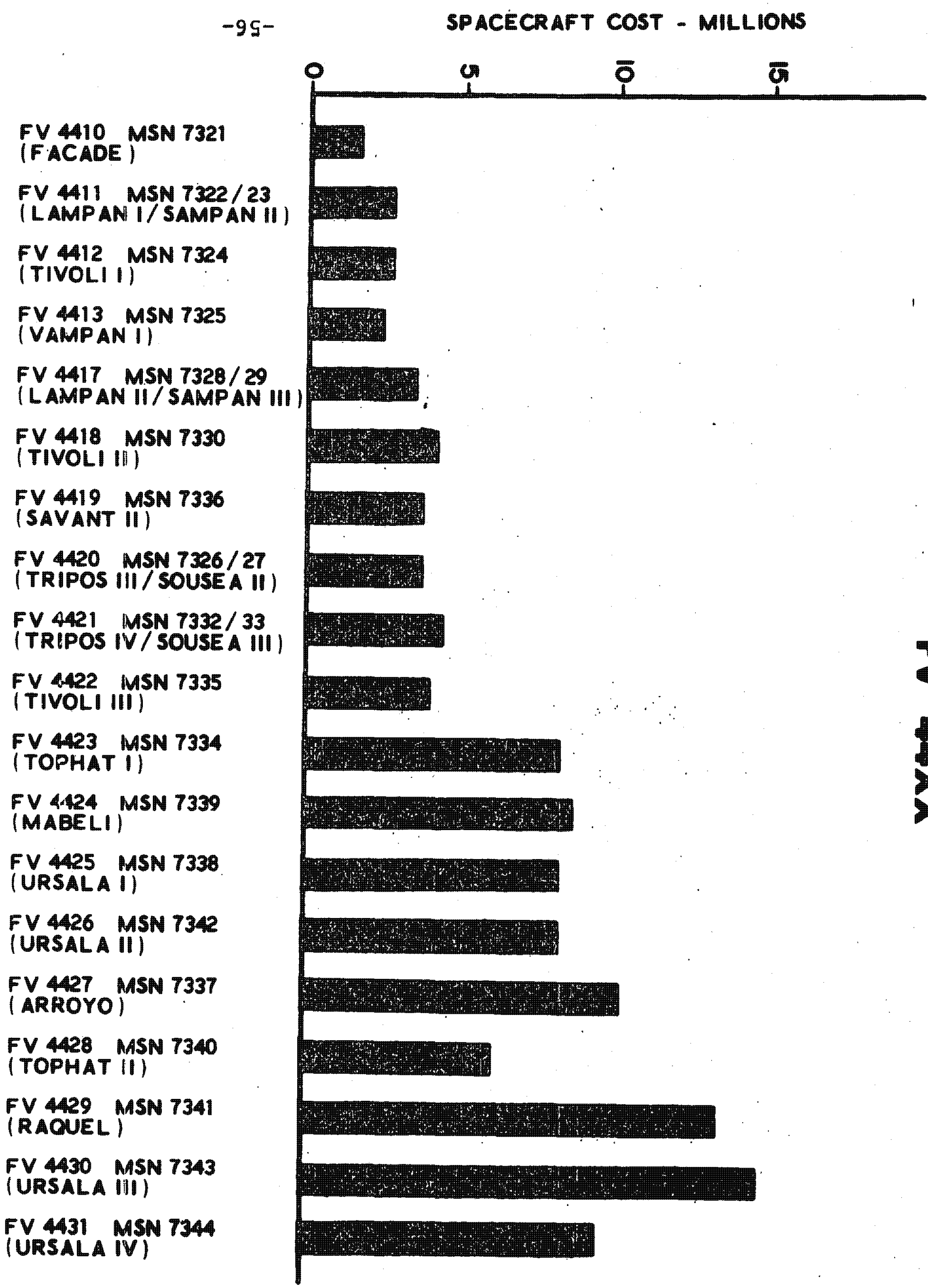

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FIGURE 9

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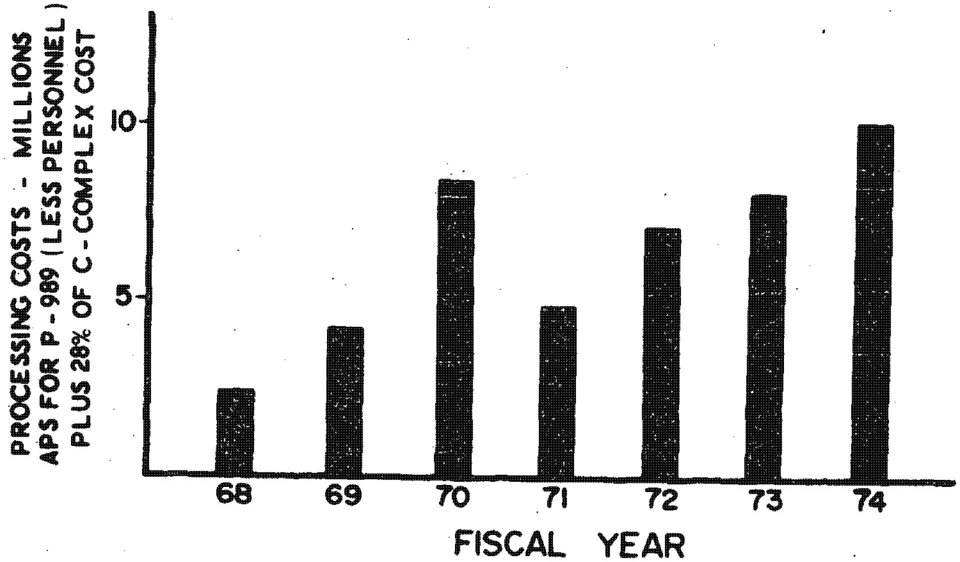

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4. (S/E) In order to figure total cost of terminated missions, processing and support costs for the entire study period were totaled and an average monthly mission support cost calculated using the total on-orbit months of all missions combined. The total mission cost consists of:

A. Spacecraft cost.

B. Average monthly processing and support costs times on-orbit life.

C. $1.5 Million software development cost.

5. (S/E) The total mission cost for on-orbit and future missions were figured the same as terminated missions through 31 March 1974. After this time average monthly processing costs were figured using FY-74-80 budget estimates and anticipated on-orbit months.

6. (S/E) For those missions still on orbit or to be launched in the future, it was necessary to estimate the operational life of each mission. [redacted] calculates Mean Mission Duration (MMD) for each mission. The MMD has proven to be a 25X1

conservative figure. Historically, missions have remained operational approximately twice the MMD.* For the purpose of this study, missions have been projected to have an operational life of two times MMD. It can be expected that useful collection (though not 100% effectiveness) will continue for this amount of time. MMD for those systems currently under development and for future new starts is estimated to be 24 months.

7. (S/E) Some discrepancy may be observed in the case of URSALA launch projections. Since the objective is to have one URSALA on orbit at all times, launch projections have been made based on the conservative estimate (MMD). This does not mean that launch on the projected date will occur. As the launch date approaches, a decision must be made whether an URSALA launch is needed at that time or whether the vehicle health of the on-orbit URSALA is such that launch can be delayed six months until the next host vehicle is launched.

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* It should be noted that missions do not tend to be 100% effective right up to mission termination.

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APPENDIX 2

TECHNICAL DETAILS ON TERMINATED P-989 MISSIONS

1. (S/E) This appendix displays details on those P-989 missions terminated between 1 January 1968 and 31 March 1974.

2. (TSRZU/E) The REPORTS section of each mission is a list of numbers of various types of reports which were written based partially or wholly on intercepts from the mission. The "UNIQUE" column of the REPORTS section indicates the numbers of each type of report which were based exclusively on intercepts from the mission. The following types of reports are listed:

25X1

A. [redacted]
B.
C.
D.
E.
F.
G.
H.
I.

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J. [redacted] 25X1

K. TEL - Telecommunications Report

L. TSR - Technical SIGINT Report

3. (S/E) ELINT Order of Battle (EOB) inputs shown indicate the number of signals which were reported for EOB update.

4. (S/E) Time Critical Requirements (TCRs) are listed by the number of signals reported in a TCR series. The FLAVOR (F) reports are TCR's from the Middle East and the MILLBOARD (M) reports are TCR's from Eastern European Communist nations. GRANADA and WINEGLASS reports are not tallied in this appendix because they are generally sent out in a sanitized version, thus the source cannot be identified.

5. (S/E) The costs shown are the total mission costs, including hardware, software development, processing and on orbit support, for each mission. The support costs include APS Program 989 costs (less personnel), 28% of APS C-COMPLEX costs, and NRO Program 989 costs.*

*See Appendix 1 for an explanation of cost and mission life data.

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APPENDIX 2

VEHICLE: 4407 NAME: WESTON MISSION: 7313

LAUNCH DATE: 30 September 1969

MISSION TERMINATION: 17 August 1970

OBJECTIVES: COMINT Collection

TECHNICAL CHARACTERISTICS:

Receivers: 2 VHF (60-70 MHz)
1 UHF (360-420 MHz)

Sensitivity: -110 dbm

Intercept Antennas: 2.5' x 3' flat spiral window shade (60-70 MHz)
2' log periodic (360-420 MHz)

Technique: Stepped receiver recognized 300 or 500 Hz tones, teletype and/or two channel baseband voice energy spectrum to lock receiver.
Count cycles at 21.4 MHz IF for precision RF.

ESTIMATED TOTAL MISSION COST: $6.0 Million

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
TEL	4	4
[redacted]	1	1
ELT	6	1

25X1

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HIGHLIGHTS:

A. COMINT signals collected by WESTON were mostly of poor quality or short duration and, as a result, only identification of signals could be made; almost no intelligence information could be extracted.

B. While it was not an ELINT mission, WESTON data contributed greatly to initial analysis of the operating characteristics of the DOG HOUSE and TOP ROOST radars.

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VEHICLE: 4410 NAME: FACADE MISSION: 7321

LAUNCH DATE: 2 November 1967

MISSION TERMINATION: 7 February 1968

OBJECTIVES: ABM Search

TECHNICAL CHARACTERISTICS:

Frequency Range: 250-2250 MHz

Measurements : Pulse width
Pulse repetition frequency
Scan rate
Modulation type
Location

ESTIMATED TOTAL MISSION COST: $4.5 Million

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	16	10
[redacted]	1	-

HIGHLIGHTS:

A. First determination that DOG HOUSE was CW.

B. Determination of the number of DOG HOUSE beams and the scan sequence.

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C. Determination that DOG HOUSE was frequency steered, and established the frequency-to-azimuth relationship.

D. Measurement of the PW of the TRY ADD doublet and measurement of the frequency to ± 1 MHz.

E. First PART TIME intercept in four years.

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VEHICLE: 4411 NAME: LAMPAN I MISSION: 7322
SAMPAN II 7323

LAUNCH DATE: 14 March 1968

MISSION TERMINATION: 7 March 1969

OJBECTIVES: General Search for ABM radars.

TECHNICAL CHARACTERISTICS:

Frequency Range: 1-4 GHz

Intercept Antennas: 2 Conical spiral
6' Parabolic

Receiver: 2 crystal video

Sensitivity: -73 dbm (plus antenna gains as follows:)

1 GHz	13 db
1.5 GHz	16.6 db
2.0 GHz	17.8 db
2.6 GHz	20 db
3.1 GHz	21.5 db
3.5 GHz	21.5 db
4.0 GHz	23.9 db

Measurements: Frequency
Pulsewidth
Received Power
Pulse Repetition Frequency
Location

ESTIMATED TOTAL MISSION COST: $7.2 Million

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REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	19	13
ELO	1	-
[redacted]	3	1
	1	1
EOB	16,075	-

25X1

HIGHLIGHTS:

A. New pulse repetition frequency mode defined for [redacted]

25X1

B. PAT HAND signal parameters defined.

C. Frequency and scan characteristics of BEER CAN defined.

D. First intercept of the Large TRY ADD in double and single pulse modes.

E. Large TRY ADD pulse amplitude differences defined.

F. 16,075 signals contributed to EOB update.

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VEHICLE: 4412 NAME: TIVOLI I MISSION: 7324

LAUNCH DATE: 24 January 1968

MISSION TERMINATION: 23 April 1969

OBJECTIVES: General Search and Technical Intelligence Collection on ABM Radars and Predetection Collection on ABM Radars.

TECHNICAL CHARACTERISTICS:

Frequency Range: 100-4020 MHz

Frequency Accuracy: Maximum: .01% of input
Nominal: .005% of input

Intercept Antennas: 2.5' x 5' windowshade spiral
18" conical spiral
2 6" conical spirals

Technique: Tunable to any integer frequency within RF range or stepping in selected sector in 1 or 4 MHz steps.

ESTIMATED TOTAL MISSION COST: $8.0 Million

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	33	26
[redacted]	1	-
TEL	2	1

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HIGHLIGHTS:

A. First intercept of DOG HOUSE sectors 1 and 2.

[redacted] 25X1

C. First intercept of 13 new signals.

D. Determination of DOG HOUSE frequency limits, dwells, scan type and scan rate.

E. Intercepted most of the early signals used for technical development of the SHOCK SING radar signal.

F. Confirmed upper frequency limit of BIG SCREEN; intercepted BIG SCREEN in an abnormal scan mode.

G. Intercepted TRY ADD in a mode change.

H. Intercepted HEN HOUSE I and II simultaneously.

I. Intercepted PAT HAND in a new format.

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VEHICLE: 4413   NAME: VAMPAN   MISSION: 7325

LAUNCH DATE: 18 September 1968

MISSION TERMINATION: 28 September 1969

OBJECTIVES: General Search for ABM radars.

TECHNICAL CHARACTERISTICS:

Frequency Range: 100-1000 MHz

Intercept Antennas: 2 pair planar spiral

Receivers: 2 crystal video
4 superheterodyne

Measurements: Received Power
Frequency
Pulse Repetition Frequency
Pulse width
Scan Rate
Location

ESTIMATED TOTAL MISSION COST: $7.0 Million

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	14	9
ELO	15	-
[redacted]	1	-
	1	-
TEL	1	-
EOB	55,828	-

25X1

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HIGHLIGHTS:

A. Parametric interrelationships between the HEN HOUSE I radars defined.

B. Frequency coverage and elevation details of the TOP SAIL radar defined.

C. TALL KING parameters defined.

D. BIG SCREEN frequency and scan angle characteristics defined.

E. PART TIME radar and associated data links analyzed.

F. 5,828 signals contributed to EOB update.

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VEHICLE: 4417 NAME: LAMPAN II MISSION: 7328
SAMPAN III 7329

LAUNCH DATE: 2 May 1969

MISSION TERMINATION: 16 February 1970

OBJECTIVES: General Search for ABM Radars

TECHNICAL CHARACTERISTICS:

Frequency Range: 1-4 GHz

Antennas: 2 conical spirals
6' Parabolic

Sensitivity: -73 dbm plus antenna gains as follows:

1 GHz	13 db
1.5 GHz	16.6 db
2.0 GHz	17.8 db
3.1 GHz	21.5 db
3.5 GHz	21.5 db
4.0 GHz	23.9 db

ESTIMATED TOTAL MISSION COST: $8.0 Million

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	4	2
ELO	1	1
[redacted]	1	1
EOB	35,982	-

25X1

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HIGHLIGHTS:

A. Parameter refinements on the HEN EGG, PAT HAND and TRY ADD radars.

B. 35,982 signals reported for EOB update.

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APPENDIX 2

VEHICLE: 4418 NAME: TIVOLI II MISSION: 7330

LAUNCH DATE: 19 March 1969

MISSION TERMINATION: 23 September 1970

OBJECTIVES: General Search and Technical Intelligence on ABM Radars. (A 50-100 MHz band was included to search for PRC Telemetry.)

TECHNICAL CHARACTERISTICS:

Frequency Range: 50-4020 MHz

Intercept Angennas: 2 Monopole
1 Planar Spiral
1 Conical Spiral

Receiver: 1 Superheterodyne

Measurements: Frequency
Pre-Detection recordings

ESTIMATED TOTAL MISSION COST: $10.4 Million

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE	
ELT	32	18	
[redacted]	1	-	25X1
ELO	1	1	
[redacted]	1	1	25X1

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HIGHLIGHTS:

A. First intercept of HEN HOUSE from Mishelevka.

B. DOG HOUSE format modifications analyzed.

C. TOP ROOST operating characteristics described.

D. BIG SCREEN studies including operating mode, frequency, and scan angle characteristics, and intrapulse frequency modulation.

E. Large TRY ADD intercepts.

F. [redacted] 25X1

G. HEN HOUSE I and II studies [redacted] 25X1 frequency modulation, sector coverage expansion and parameter definition.

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APPENDIX 2

VEHICLE: 4419   NAME: SAVANT II   MISSION: 7336

LAUNCH DATE: 22 September 1969

MISSION TERMINATION: 16 May 1971

OBJECTIVES: Receive, recognize and copy Soviet telemetry.

TECHNICAL CHARACTERISTICS:

[redacted] 25X1

Intercept Antennas: 1 Monopole
1 Planar Spiral

Receivers: 10 Superheterodyne

ESTIMATED TOTAL MISSION COST: $10.0 Million

REPORTS

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
RUGM	7	7

HIGHLIGHTS:

[redacted] 25X1

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APPENDIX 2

VEHICLE: 4420 NAME: TRIPOS III MISSION: 7326
SOUSEA II 7327

LAUNCH DATE: 20 June 1968

MISSION TERMINATION: 11 January 1970

OBJECTIVES: General Search and EOB update on pulsed radars.

TECHNICAL CHARACTERISTICS:

Frequency Range: 4-12 GHz

Intercept Antennas: 3' Parabolic
18" Parabolic
4 Omni directional inhibit

Receivers: 3 Crystal Video

Measurements: Frequency (± 30 MHz accuracy)
Pulse width (± .25 usec accuracy)
Pulse Repetition Frequency
Location (± 25 n.m. accuracy)

Sensitivity: -65 dbm plus antenna gains as follows:

TRIPOS III

4 GHz	26 db
6 GHz	29 db
8 GHz	32 db

SOUSEA II

8 GHz	29 db
10 GHz	31 db
12 GHz	32 db

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ESTIMATED TOTAL MISSION COST: $10.0 Million

REPORTS:

TOTAL	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	17	13
ELO	26	4
[redacted]	9	4
EOB	77,891	-

25X1

HIGHLIGHTS:

A. First intercept of 21 new signals.

B. First association of [redacted] signals to the same system. 25X1

C. Refinement of the [redacted] parameters. 25X1

D. 77,891 signals contributed to EOB update.

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APPENDIX 2

VEHICLE: 4421 NAME: TRIPOS IV/ SOUSEA III MISSION: 7332/ 7333

LAUNCH DATE: 20 May 1970

MISSION TERMINATION: 20 February 1973

OBJECTIVES: EOB Support and General Search for Pulsed Radars.

TECHNICAL CHARACTERISTICS:

Frequency Range: 4-12 GHz

Intercept Antennas: 3' Parabolic
18 " Parabolic
2 Conical Spirals
2 Waveguides For inhibit

Antenna Gain:

TRIPOS IV

4 GHz	26 db
6 GHz	29 db
8 GHz	32 db

SOUSEA III

8 GHz	29 db
10 GHz	31 db
12 GHz	32 db

Receivers: 6 crystal video

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V Pulse System:

Sensitivity: -65 dbm (± 3 db) (plus antenna gain)
Dynamic Range: 35 db
Frequency: ± 30 MHz
Pulsewidth: Range .25 to 11.5 usec
Accuracy ± .5 usec

CW System:

Sensitivity: -90 dbm (± 3 db) (plus antenna gain)
Dynamic Range: 35 db
Frequency Accuracy: ± 30 MHz
Resolution: 30 MHz

Geopositioning Accuracy: C Band: 3 degree system (see
X Band: 2 degree system Appendix 4)

ESTIMATED TOTAL MISSION COST: $13.2 Million

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	17	4
ELO	100	7
[redacted]	8	2
EOB	18,833	-

25X1

HIGHLIGHTS:

A. Identification and location of the [redacted] 25X1

B. Definition of RF and PRF parameters of the [redacted] 25X1

D/E.

C. First detection of [redacted]

D. First detection of [redacted] District. 25X1

E. Discovered that the Soviets were expanding the use of the RF spectrum into the 4000 MHz band.

F. Identification of the [redacted] to the SQUARE PAIR radars. 25X1

G. Refinement of the [redacted] parameters. 25X1

H. Confirmation of the association of the STRAIGHT FLUSH radar [redacted] 25X1

I. 18,833 signals contributed to EOB update.

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APPENDIX 2

VEHICLE: 4422 NAME: TIVOLI III MISSION: 7335

LAUNCH DATE: 4 March 1970

MISSION TERMINATION: 10 November 1971

OBJECTIVES: General Search and Technical Intelligence on ABM Radars

TECHNICAL CHARACTERISTICS:

Frequency Range: 50-4020 MHz

Pre-Detection Collection

Intercept Antennas: 1 Planar Spiral
2 Conical Spiral

Sensitivity: -106 dbm - -94 dbm (depending on band and mode)

ESTIMATED TOTAL MISSION COST: $10.4 Million

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	43	31
ELO	3	-
TEL	2	-

HIGHLIGHTS:

A. Refinement of the TRY ADD parameters including azimuthal beamwidth and range solution.

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B. Intercepted Moscow TRY ADD tracking a group D,

[redacted] 25X1

C. Refinement of TOP ROOST parameters including beamwidth, dual scanning beam, extended frequency scan, complex dwells, multiple frequencies transmitted simultaneously and sector details.

D. Intercepted a true high frequency grating lobe on TOP ROOST.

E. PART TIME signal details including 3 PRF's, frequency step modulation, and a possible Far East site.

F. Determination of the FULL TIME power level.

G. BIG SCREEN intercepts.

H. Details of HEN HOUSE I and II operations.

I. DOG HOUSE south face intercepts.

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APPENDIX 2

VEHICLE: 4427 NAME: ARROYO MISSION: 7337

LAUNCH DATE: 10 September 1971

MISSION TERMINATION: 10 October 1971

OBJECTIVES: General Search for Microwave Signals

TECHNICAL CHARACTERISTICS:

Frequency Range: 1200-2200 MHz
3400-3900 MHz

Intercept Antennas: 6' Parabolic
2 pairs Conical Spirals

Sensitivity: -110 dbm less antenna gains as follows:

1.2 GHz	17 db
1.7 GHz	20 db
2.2 GHz	23 db
3.65 GHz	27 db

Time to Cover Area of Interest: 22 days (lowest frequency of interest)
77 days (highest frequency of interest)

Measurements: Frequency (accuracy ± 100 KHz in CW Bands, ± 500 KHz in Pulse Band)
Sum and Difference Power (± 3 db accuracy)
Location (± 3 n.m. accuracy)

ESTIMATED TOTAL MISSION COST: $13.9 Million

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REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
TEL	16	16
TSR	5	-

HIGHLIGHTS:

A. Initial detection and confirmation of [redacted] 25X1

25X1

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TECHNICAL DETAILS ON CURRENT AND FUTURE P-989 MISSIONS

1. (S/E) This Appendix displays details on the P-989 missions on orbit after 31 March 1974 and those which have been approved and built for future launch.

2. (U) The reports section parallels the same section in Appendix 2.

3. (S/E) The cost until mission termination is the support cost (on-orbit support and processing) for each mission.

4. (U) The HIGHLIGHTS section describes significant intelligence already derived from the mission.

5. (U) The ANTICIPATED CONTRIBUTIONS section describes what can be expected in the future if the mission is successful.

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APPENDIX 3

VEHICLE: 4423 NAME: TOPHAT I MISSION: 7334

LAUNCH DATE: 18 November 1970

MISSION TERMINATION: Still operational

PROJECTED TERMINATION: 30 June 1974

OBJECTIVES: Map Russian [redacted] communications environment. 25X1

TECHNICAL CHARACTERISTICS:

Frequency Range: 450-1000 MHz

Flight Time in Main Beam: 3.8 sec at 1000 MHz
26.8 sec at 450 MHz

Flight Time in 3 db Side lobe: 8.6 sec at 1000 MHz
65.0 sec at 450 MHz

Intercept Antennas: 1 north pointing and 1 south point array. (An array consists of 2 conical spirals, 40" apart)

Receivers: 2 dual channels
1 main beam

Measurements: Frequency (± 100 KHz accuracy)

Location: 7.5 nm average

Sensitivity: -95 dbm

ESTIMATED TOTAL MISSION COST THRU 31 MARCH 1974: $18.9 Million
(Estimated additional cost through mission termination: $.445 Million)

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REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
TEL	33	-
TSR	14	-
RUK	2	-

HIGHLIGHTS:

A. Determination of RF and transmitting direction of every [redacted] station. 25X1

B. [redacted]

C. Initial intercepts of 35% of [redacted] 25X1

D. Detection of 90% of [redacted] 25X1

E. [redacted] 25X1

F. [redacted]

G. Identification and location of half of the Soviet [redacted] 25X1

ANTICIPATED CONTRIBUTION:

A. Continued mapping of [redacted] 25X1

B. Continued location and identification of Soviet [redacted] 25X1

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USIB Guidance, Tab B, lists search and identification of COMINT signals from the USSR as priority 1j.

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VEHICLE: 4424 NAME: MABELI MISSION: 7339

LAUNCH DATE: 20 January 1972

MISSION TERMINATION: Still Operational

PROJECTED TERMINATION: 31 December 1974

OBJECTIVES: Perform precision power and polarization measurements on Soviet ABM radars.

TECHNICAL CHARACTERISTICS:

Frequency Range: 151-165 MHz
387-426 MHz
861.-964.2 MHz
1500-2500 MHz

Intercept Antennas: 4 pairs of contrawound spirals (each pair consisting of 1 RHCP and 1 LHCP)

Pre-Detection Recording

Receivers: 4 dual channel receivers to cover the four bands.

Sensitivity: Band 1: -57 dbm
Band 2: -57 dbm
Band 3: -76 dbm
Band 4: -61 dbm

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Measurements: Power (accuracy ± 1 db)
Frequency (± 100 KHz accuracy in bands 1-3, 500 KHz step increment in band 4)
[redacted] 25X1
Polarization (± 12 degrees accuracy)

ESTIMATED TOTAL MISSION COST THRU 31 MARCH 1974: $16.4 Million
(Estimated additional cost thru mission termination: $1.8 Million)

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	43	41
ELO	2	1

HIGHLIGHTS:

A. Discovery of polarization diversity of TRY ADD.

B. Definition of TOP ROOST ERP and polarization.

C. Refinement of TOP ROOST beam structure and scan details.

D. Definition of DOG HOUSE ERP and polarization.

E. Discovery of multiple main beams of DOG HOUSE.

F. Definition of DOG HOUSE vertical beam structure.

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G. Discovery of multiple RF dwells on DOG HOUSE.

H. Definition of ERP and polarization of HEN HOUSE II.

I. Definition of azimuthal and elevation beam structures of HEN HOUSE II.

J. Definition of track and scan procedures of HEN HOUSE II.

K. Early intercepts of Chekov ABM radar.

L. Calculation of scanning equations for TOP ROOST, DOG HOUSE, HEN HOUSE I and HEN HOUSE II.

ANTICIPATED CONTRIBUTIONS:

A. Power profiles modeled for all target emitters except BIG SCREEN and TRY ADD.

B. [redacted] 25X1

C.

D.

E.

Sufficient main beam intercepts are currently available to complete these tasks. (These contributions will satisfy USIB Guidance, Tab D, Priority 1 for the target emitters.)

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APPENDIX 3

VEHICLE: 4425 NAME: URSALA I MISSION: 7338

LAUNCH DATE: 7 July 1972

MISSION TERMINATION: Still Operational

PROJECTED TERMINATION: June 1975

OBJECTIVES: EOB support and general search

TECHNICAL CHARACTERISTICS:

Frequency Range: 2-12 GHz

Intercept Antennas: 6' Parabolic

Gain: 24 db at 2 GHz
29 db at 4 GHz
32 db at 6 GHz
35 db at 8 GHz

3' Parabolic

Gain: 27.6 at 8 GHz
28.5 db at 10 GHz
27.3 db at 12 GHz

4 conical spirals (for inhibit)

Instantaneous Bandwidth: 2 GHz

Pulse System:

Sensitivity: -69 dbm plus antenna gain
Dynamic Range: 40 db
Single Pulse Frequency: Resolution 31.25 MHz
Accuracy ± 18.6 MHz

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Pulse Width: Range: .1 to 100 usec
Accuracy: larger of .1 usec or 10% PW
Pulse Time of Arrival: ± 1 usec
Power: ± 3 db

CW System:

RF Accuracy: ± 15 MHz
2 GHz Band swept every 3.33 msec.

Geopositioning Accuracy: 1 degree system (see Appendix 4)

ESTIMATED TOTAL MISSION COST THRU 31 MARCH 1974: $14.8 Million
(Estimated additional cost through mission termination: $3.2 Million)

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	15	3
ELO	31	18
[redacted]	2	-
	1	-
MEJ	1	-
MTEL	1	-
TSR	4	-
[redacted]	1	-
TCR (M)	1,336	-
TCR (F)	2,904	-
EOB	213,762	-

25X1
25X1

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HIGHLIGHTS:

[redacted]

25X1

M. Major contributor to EOB update. (In some areas, e.g., Southeast Asia, provided nearly all of EOB update.)

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ANTICIPATED CONTRIBUTIONS:

A. Continue role as major input to EOB update and Operational ELINT requirements (Operational ELINT Plan, Collection Processing Task A.)

B. Continue to be the only ELINT collector which can routinely provide processed Time Critical Requirement (TCR) data to NSA within six hours of intercept. (USIB Guidance, Tab D, Priorities 4 and 5.)

C. Continued capability for COMINT collection and [redacted] 25X1

D. Can search for new and unusual ELINT signals. (USIB Guidance, Tab D, Priority 3.)

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APPENDIX 3

VEHICLE: 4426 NAME: URSALA II MISSION: 7342

LAUNCH DATE: 10 November 1973

MISSION TERMINATION: Still Operational

PROJECTED TERMINATION: November 1976

OBJECTIVES: EOB Support and General Search

TECHNICAL CHARACTERISTICS: Same as URSALA I

ESTIMATED TOTAL MISSION COST THRU 31 MARCH 1974: $11.8 Million
(Estimated additional cost thru mission termination:
($7.0 Million)

REPORTS:

TYPE	TOTAL NUMBER	NUMBER OF UNIQUE
ELT	1	-
ELO	10	-
TCR (M)	887	-
TCR (F)	1,657	-
EOB	69,698	-

HIGHLIGHTS:

[redacted]

25X1

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D. [redacted] 25X1

E. Contributed 69,698 signals for EOB update.

ANTICIPATED CONTRIBUTIONS:

Same as URSALA I.

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APPENDIX 3

VEHICLE: 4428 NAME: TOPHAT II MISSION: 7340

LAUNCH DATE: 10 April 1974

MISSION TERMINATION: Still Operational

OBJECTIVES: Map troposcatter communication links

TECHNICAL CHARACTERISTICS:

Frequency Range: 450-1000 MHz

Intercept Antennas: 1 North pointing array
1 South pointing array
(an array consists of two conical spiral antennas mounted 40" apart)

Frequency Coverage: Accuracy: ± 100 KHz
Number of steps: 1024
Step spacing: 545 KHz
Step size: 750 KHz

Dynamic Range: 40 db

Sensitivity: -95 dbm (dual channel receiver)
-108 dbm (fine tuned receiver)

ESTIMATED TOTAL MISSION COST: $14.0 Million

HIGHLIGHTS:

A. [redacted] intercepts. 25X1

ANTICIPATED CONTRIBUTIONS:

Same as TOPHAT I plus continued [redacted] (USIB Guidance, Tab B, Priority 5.) 25X1

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APPENDIX 3

VEHICLE: 4429 NAME: RAQUEL MISSION: 7341

LAUNCH DATE: Proposed - September 1974

PROJECTED TERMINATION: September 1978

OBJECTIVES: General Search and Technical Intelligence

TECHNICAL CHARACTERISTICS:

Frequency Range: 8-18 GHz

Intercept Antennas: 2 3' Parabolic
1 2' Parabolic
4 Spiral
2 Waveguide

Location: 1.5 degree system (see Appendix 4)

Pulse System:

Frequency: Resolution 50 MHz
Accuracy $\pm$ 30 MHz

Pulsewidth: Range: .1-12.7 usec
Accuracy: $\pm$ .1 usec (.1-2.4 usec)
$\pm$ .2 usec (2.4-12.7 usec)

Time of Arrival: $\pm$ 1 usec

Power: $\pm$ 3 db

Sensitivity: -74 dbm plus antenna gain of 25.30 db in 4.8 GHz range and 35.40 db in 8.18 GHz range.

Dynamic Range: 32 db

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CW Search System:

Frequency: Resolution: 30 MHz
Accuracy: ± 15 MHz

Sensitivity: -97 dbm plus antenna gain

Dynamic Range: 40 db

Power: ± 3 db

CW TI System:

Power: ± 3 db

Dynamic Range: 40 db

Sensitivity: -97 dbm plus antenna gain

Frequency: Resolution: 100 KHz
Accuracy : ± 200 KHz

Spectral Width: Resolution: 100 KHz
Accuracy : ± 200 KHz

Pre-Detection: 750 KHz bandwidth

ESTIMATED TOTAL MISSION COST: $24.5 Million

ANTICIPATED CONTRIBUTIONS:

A. Capable of making measurements with accuracy for weapon systems assessment. (UISB Guidance, Tab D, Priority 1)

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B. Capable of supporting EOB update and TCR exercises. (EOB update is Operational ELINT Plan, Collection/Processing Task A.)

C. Only mission capable of collecting and geopositioning in the entire 12-18 GHz frequency range. POPPY can only locate pulsed emitters in the 14.5-15.1 and 15.95-16.07 GHz ranges. [redacted]

25X1

D. Only mission capable of meeting requirements for collecting low power emitters. (USIB Guidance, Tab D, Priority 7.)

E. Can search for and identify new telemetry and foreign instrumentation signals. (USIB Guidance, Tab A, Priority 2.)

F. Can search for and identify COMINT signals. (USIB Guidance, Tab B, lists search and identification of COMINT signals from the USSR as Priority 1j and those from the Mid-East, South Asia, Southeast Asia, North Korea and Eastern Europe as Priority 3a.)

G. Can search for new and unusual ELINT signals. (USIB Guidance, Tab D, Priority 3.)

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APPENDIX 3

VEHICLE: 4430 NAME: URSALA III MISSION: 7343

LAUNCH DATE: Proposed - March 1975

PROJECTED TERMINATION: March 1979

OBJECTIVES: EOB Support and General Search

TECHNICAL CHARACTERISTICS:

Frequency Range: 2-12 GHz

Antennas: 6' Parabolic

Gain: 24 db at 2 GHz
29 db at 4 GHz
32 db at 6 GHz
35 db at 8 GHz

3' Parabolic

Gain: 27.6 db at 8 GHz
28.5 db at 10 GHz
27.3 db at 12 GHz

5 widebeam (to provide inhibit protection for the high-gain antennas)

Pulse System:

Dynamic Range: 40 db

Sensitivity: -73.5 dbm plus antenna gain

Single Pulse Frequency (coarse): Resolution 31.5 MHz
Accuracy ± 18.6 MHz

Single Pulse Frequency (fine): Resolution ± 2.1 MHz
Accuracy ± 2.5 MHz

Pulse Width: Range: .1-100 usec
Resolution: larger of ± .1 usec or 10% PW

Power: ± 3 db

Time of Arrival: ± 1 usec

CW System:

Frequency: Resolution 8 MHz
Accuracy ± 15 MHz

Time of Measurement: ± 1 usec

ESTIMATED TOTAL MISSION COST: $25.9 Million

ANTICIPATED CONTRIBUTIONS:

Same as URSALA I.

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APPENDIX 3

VEHICLE: 4431 NAME: URSALA IV MISSION: 7344

LAUNCH DATE: Proposed - March 1977

PROJECTED TERMINATION: March 1981

OBJECTIVES: EOB Support and General Search

TECHNICAL CHARACTERISTICS: Same as URSALA III

ESTIMATED TOTAL MISSION COST: $20.6 Million

ANTICIPATED CONTRIBUTIONS:

Same as URSALA I.

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APPENDIX 4

GEOPOSITIONING WITH SPINNING PENCIL BEAM ANTENNAS

1. (S/E) One of the difficulties in talking about geopositioning with an URSALA-type system is that the geopositioning accuracy is very much a function of the off-track distance of the emitter. With systems, like URSALA, that geolocate by knowing when during a spin of the spacecraft the target emitter is illuminated by the intercept antenna, it is more convenient to describe geolocation accuracy in terms of an "X-degree" system. The origin of the term "X-degree" system requires some explanation; if one knew the following quantities precisely, one could geoposition emitters exactly:

A. Location of spacecraft in orbit

B. Spin axis of the spacecraft

C. Electrical boresight of the antenna

D. Time that the electrical boresight breaks the earth-sky horizon

E. Time that the electrical boresight of the antenna is pointed at the emitter

F. Topography of the earth.

2. (S/E) Since one cannot precisely know any of those quantities, there exists an area on the earth's surface within which the emitter is located. If one lumps all of the error sources together and describes them in terms of a cone (vice a line) emanating from the spacecraft and intersecting the earth, one can quantify the magnitude of these combined errors by specifying the size of the cone; e.g., a 1 degree system is one for which you project a 1 degree half-angle cone from the spacecraft - the area of the earth's surface intersected by that 1 degree cone is the "error ellipse" within which the emitter is located.

3. (S/E) Figure 10 graphically displays the relationship between geopositioning accuracy and off-track distance, for several "X-degree" systems.

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25X1

25X1

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APPENDIX 5

PROGRAM COST GROWTH

1. (S/E) Figure 11 shows the spacecraft cost history for FV's 4410-4431. From this Figure four program hardware cost periods are apparent. These periods are:

A. FV 4411 - 4413

B. FV 4417 - 4422

C. FV 4423 - 4428

D. FV 4429 - 4431

(FV 4410, although falling within the time frame of this study, resembles the earlier missions in the program rather than those in group A above.) Figure 12 shows the average spacecraft cost, the average spacecraft weight, and average mission life for each of the four cost periods.

2. (S/E) During the first cost period (FV's 4411-4413) several improvements were made over the earlier missions in the P-989 program.

~~SECRET/E~~

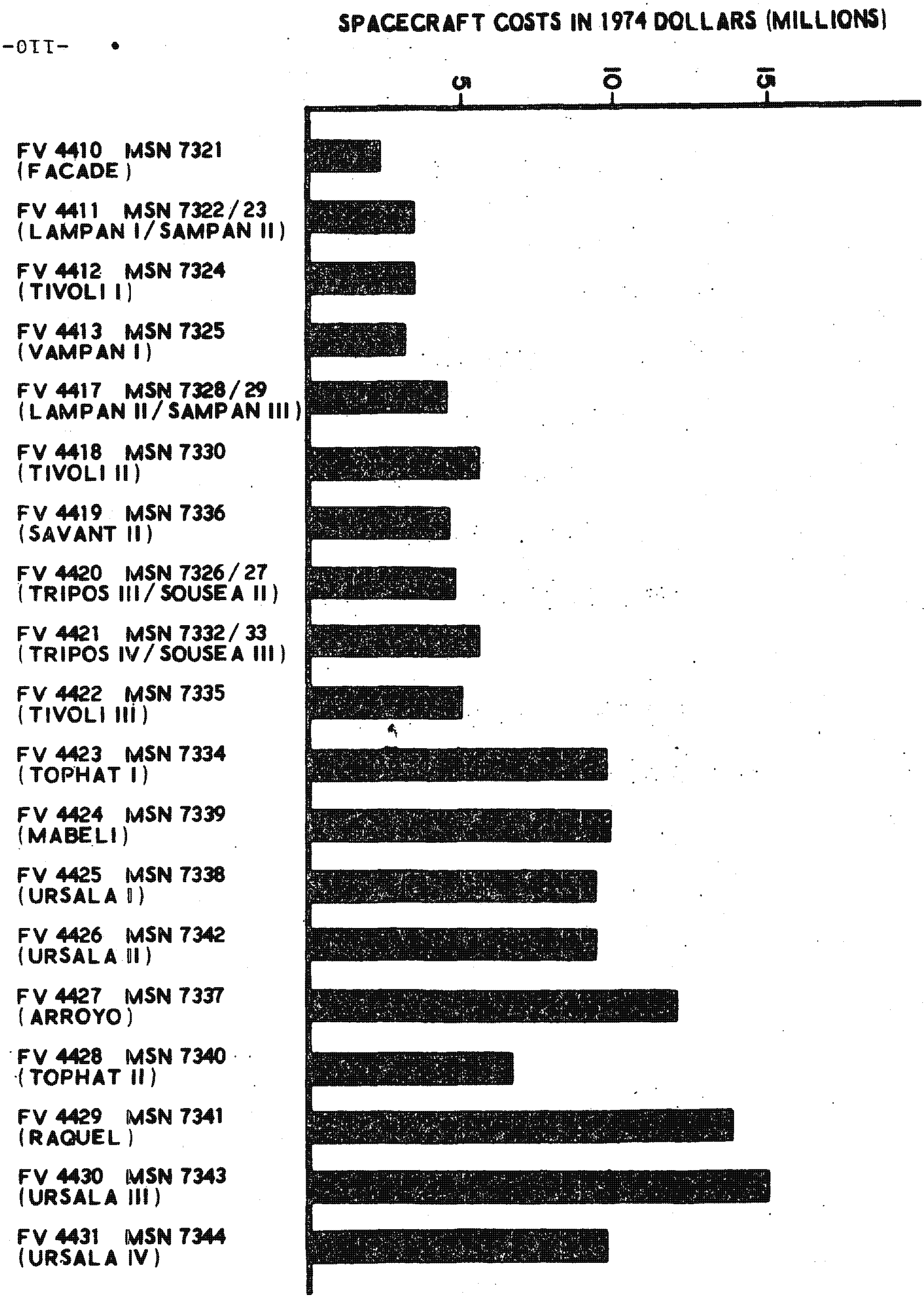

FIGURE 11
FV 44XX

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FIGURE 12

~~SECRET/E~~

COST PERIOD	A FV 4411- FV 4413	B FV 4417- FV 4422	C FV 4423- FV 4428	D FV 4429- FV 4431
AVERAGE COST IN 1974 DOLLARS	3.1 M	5.0 M	9.5 M	12.9 M
AVERAGE SPACECRAFT WEIGHT (LBS.)	262	329	375	570
AVERAGE ORBIT LIFE (MONTHS)	13	20	31	48

P-989 SPACECRAFT BY COST PERIOD

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A. Prior to this period the spacecraft components were shipped to Vandenberg AFB and the spacecraft were assembled and tested there under a special launch services contract. The cost of this contract did not show up as a P-989 Program cost. During this period the assembly and test functions were transferred to LMSC, Sunnyvale, the program prime contractor, and costs of assembly and testing appeared as program costs.

B. The program test plan was expanded during this period to include system level thermal vacuum testing as well as other tests. Approximately 10,000 more man hours were expended in testing each vehicle.

C. These improvements added $1.3 Million to the average spacecraft cost and increased the average mission life from 9.5 months to 13 months.

3. (S/E) During the second period (FV's 4417-4422) a major spacecraft change included adding a battery, adding a solar array and a redesign of the structure for increased payload weight and volume. These changes added about 27 pounds to the

average spacecraft weight, increased the average mission life from 13 to 20 months and added an average of $1.9 Million to spacecraft cost.

4. (S/E) During the third cost period (FV's 4423-4428) dramatic changes in spacecraft design occurred.

A. Introduction of integrated circuits made possible a vastly improved technological capability.

B. In an effort to increase the mission life, a third 1 MHz tape recorder replaced the second battery. Prior to this, mission life was limited by the life of the data storage subsystem.

C. During this period it was necessary to convert to a new host program for piggyback rides. This necessitated the development of a new launcher system and modification of the basic spacecraft structure.

D. Attitude and spin rate control systems were added.

E. The testing plan was again expanded to accomodate the increased system complexity.

F. These improvements added nearly 50 pounds to average spacecraft weight, $4.5 Million to average cost and 11 months to average mission life.

5. (S/E) The fourth cost period (FV's 4429 - 4431) again shows significant changes in spacecraft design.

A. The complexity of the RAQUEL TI payload caused a move to complementary metal oxide semiconductor (CMOS) technology in order to provide more capability in the same payload volume.

B. The major spacecraft utility subsystems were upgraded to high reliability pieceparts. (The catastrophic failures of ARROYO, [redacted] just before this period resulted in pressure for more reliable spacecraft.) 25X1

C. The spacecraft structure was redesigned to allow for redundancy in the utility subsystems.

D. Again, the program test plan was expanded in an effort to obtain higher reliability and because of the increased complexity of the spacecraft.

E. These changes added nearly 200 pounds to spacecraft weight, $3.4 Million to spacecraft cost and 17 months to expected

FIGURE 13

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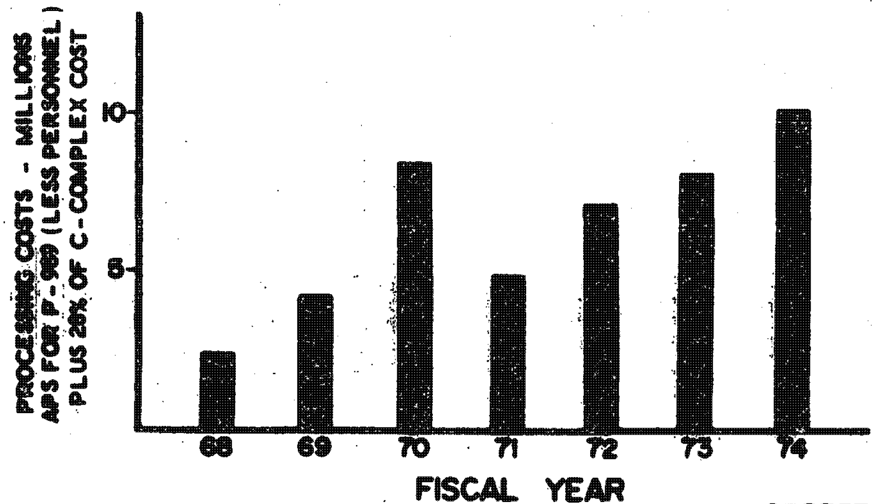

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average mission life.

6. (S/E) The cost of processing the data from Program 989 has also grown significantly over the years. Figure 13 displays that cost growth by fiscal year. The cost growth is attributable to several phenomena.

A. The sharp peak in FY-70 was due to a major computer acquisition in C-Complex.

B. The sharp rise in FY-72/73 marks the end of the STRAWMAN program which paid a large share of the overhead costs for funding the MADS program, and coincided with a more equitable division of the processing costs between the NRP and the APS programs.

C. The processing of the data has become more complex (due to sophistication of the collectors) and at the same time more timely, while the volume of data is increasing.

D. A greater share of the processing has been shifted [redacted] where it shows up as increased contract costs. 25X1

7. (S/E) What has this cost increase bought? The preceding

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paragraphs show that the program cost increases have brought about increases in spacecraft weight and operational life. The important point to consider is the intelligence value of these increases. Essentially, the cost increase has allowed more data to be processed more accurately in less time.

A. The capabilities of Program 989 and the requirements against which it is tasked are outlined in Section V. The capabilities of the program have been greatly improved from the early missions which could not locate, could not intercept main beams, could not perform fine grained measurements and could store a minimum amount of data. The program improvements increased the capabilities to the point where now detailed technical intelligence requirements can now be satisfied, emitters can be located and data provided in a timely fashion.

B. A major advancement has been the capability for converting data from analog to digital form aboard the spacecraft. The early missions collected, stored and transmitted back to the tracking stations only analog data. As a result, not as much data could be handled and the time required to get processed data back

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APPENDIX 5

to NSA was too great to provide TCR support. Currently, measurements made aboard the spacecraft are sent back in digital form, allowing for more data to be processed faster. (Compare, for example the EOB and TCR results of FV 4421 with FV 4425 in Appendices 2 and 3.)

C. The Quick Reaction Capability (QRC) of the program has also improved as a result of the growth in capabilities. In the early years of the program, unanticipated SIGINT problems were solved by designing, building and launching a new mission. This process consumed as much as 9 months. Since the missions which currently make up the program have such improved capabilities, an unanticipated problem can typically be solved by re-tasking an existing system. Thus, the time to respond to unanticipated problems has been reduced from the 9 months it used to take to launch a new mission to the few hours it now takes to redirect tasking.

8. (S/E) Interestingly, although spacecraft and processing costs have risen, the total program cost has remained almost

unchanged since 1968 (see Figure 14). Except for 1970 when $5 Million was spent on computer acquisition for C-Complex, the cost of the program has been about $31 Million per year in 1974 dollar equivalents. Although NSA costs have risen, NRP costs have decreased since 1968. This is due to two factors:

A. Fewer new starts per year have been required because of the longer on-orbit lives of current missions.

B. NRP on-orbit support costs have decreased.

9. (S/E) The 989 Program has grown considerably in capability, spacecraft weight and size and mission life. This growth has not been reflected in the cost of the program. While certain parts of the program (individual spacecraft and processing) have risen in cost, the total program costs have risen only as a result of inflation. In 1974 dollar equivalents the program improvements have been made with no increase in cost.

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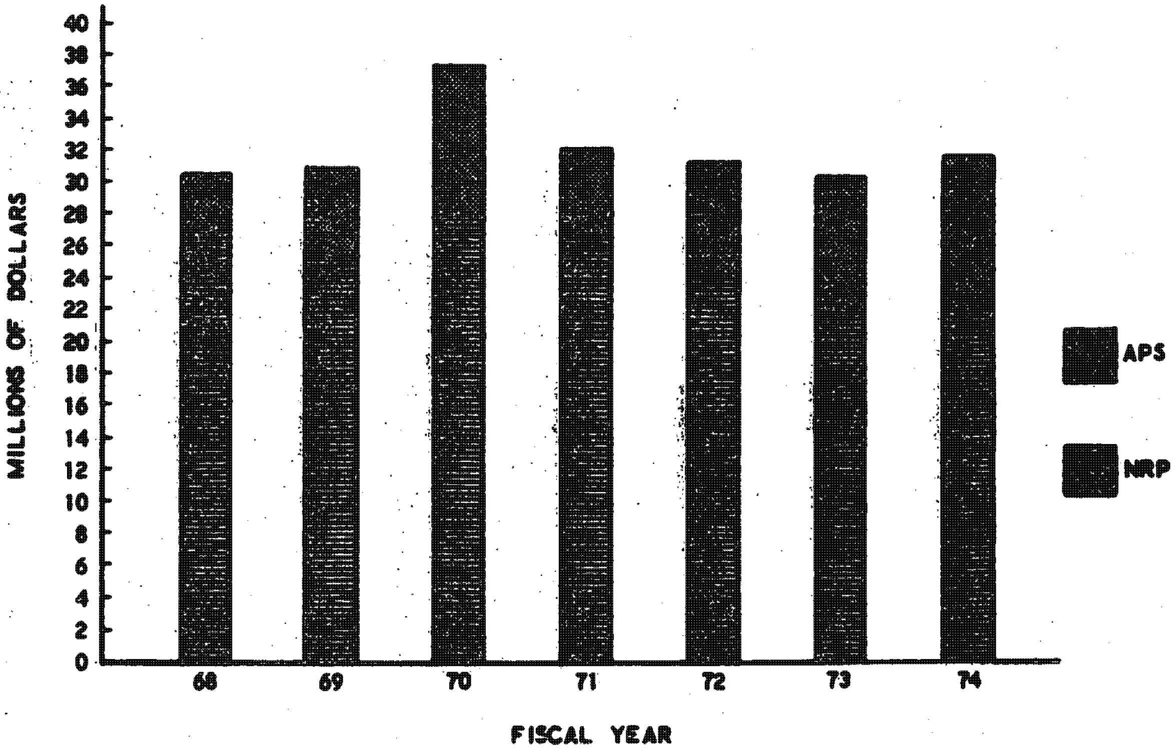
FIGURE 14

TOTAL PROGRAM COSTS
1974 DOLLAR EQUIVALENT



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