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PROGRAM 989

RELATED HISTORY DATA

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REVIEW ON 10-27-2002

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Section 1

CONTRACT IDENTIFICATION

Program Name:

(P-989)

[redacted] 25X1

Contract Numbers:

[redacted]

Acquisition Phase:

Preliminary design, development, and operations efforts are currently in process.

Government Program Manager:

Lt. Col. Paul Drinnon, [redacted]

Procurement Contract Officer:

H. C. Potts, [redacted] 25X1

Contract Type: CPIF/AF

[redacted] Cost incentive of 5 percent of target cost with a 90/10 share ratio straight line to minimum fee of 3.5 percent.

Award Fee at 4 percent of target cost, awarded at six-month intervals.

[redacted] Performance Incentive – 15 percent downward, for -1046 and -3104, and CPAF for -3172 with a base fee of 3 percent less COM and an award fee of 9 percent.

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Scope:

LMSC has been responsible for the design and development for a series of Air Force SIGINT satellite vehicles, the first of which was placed in orbit more than two decades ago. Missions and satellites of increasing complexity have been developed over the years, [redacted]

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[redacted]

The flight performance record achieved to date is excellent and has resulted in several citations in recognition of this fact. Presently four vehicles are in orbit, of which three are well beyond their expected design life and continuing to support the community. The most recent vehicle, FARRAH I, was just placed into orbit in May of this year. This vehicle combines the mission capability previously requiring two separate spacecraft and does so with significant increase in product yield.

To date a total of 32 free-flying spacecraft and one pallet (remains on the host) missions have been attempted. The average useful life has been 197 percent in excess of design life for those vehicles where the mission has terminated. The mature on-orbit vehicles have achieved 185 percent in excess of vehicle life. Their remaining useful life is a function of the operational tasking that is yet to be executed. Vehicle 4433 (FARRAH I) is 4 1/2 months into an operational design life of 36 months and has already been acclaimed a major success in view of very recent support given the community during the Falkland Island War.

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Inasmuch as there have been many contracts involved in this program the data included below will relate only to the modern missions (last ten years) both in terms of cost and performance.

Table I

PROGRAM 989 CONTRACT DATA SUMMARY

($ IN 000s)

(AS OF SEPT 1982)

CONTRACT	NUMBER OF VEHICLES	ACTUAL OR ESTIMATED COST @ COMPLETION	EARNED/PROJECTED FEE @ COMPLETION	AWARD/PERFORMANCE EARNED
	5*	$89,630	$ 9,822	100%
	1	$ 3,788	$ 370	100%
	1*	$81,216	$ 1,832	*
	1	$61,337	$ 6,830	PLANNED TO LAUNCH IN 1984
		$43,143	$ 762 AWARD $ 3,336 TARGET	76%
		$42,127	$ 325 AWARD $ 1,885 TARGET	81% TO DATE OF A POSSIBLE $1,498,000
	1	$28,304	$ 1,204	PLANNED TO LAUNCH IN 1985
	NOT APPLICABLE, PROVIDES PRELIMINARY DESIGN PHASE SUPPORT FOR THE NEXT GENERATION OF VEHICLES	$ 3,798	$ 337 AWARD	PLANNED TO START DEVELOPMENT PHASE IN ANY OF 1983

NOTE:

THE SPACECRAFT BUS KIT WAS TRANSFERRED FROM THE 0026 CONTRACT TO THE 0308 AS GFE. THE REMAINING PERFORMANCE FEE OF $483,000 WILL BE EARNED ON THE NEW CONTRACT.

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On-Orbit Systems presently in use include RAQUEL 1A, URSALA IV, and FARRAH I.

On 16 March 1978, RAQUEL 1A was launched into orbit. Although the design life of the spacecraft was only 18 months, RAQUEL 1A is still operational. The mission of RAQUEL 1A includes TI, General Search, and EOB for pulsed and CW emitters in the 4 to 18 GHz Band.

Exactly one year later, on 16 March 1979, URSALA IV was launched into orbit. Design life of this spacecraft was 24 months; it is still operational as of this writing. The basic mission of URSALA IV is General Search, EOB and Tactical Support against pulsed and CW emitters in the 2 to 12 GHz band. The URSALA IV spacecraft has an encyphered data link, permitting realtime transponding to remote tactical ELINT vans. A near realtime data processing system has been installed in [redacted] permitting intelligence data to be reported directly to remote users within tens of minutes from intercept. 25X1

FARRAH I is the latest in a long series of SIGINT spacecraft designed by Lockheed Missiles & Space Company, Program 244, for the Air Force SAFSP. Launched 12 May 1982, this low altitude, spin stabilized spacecraft is performing General Search, Technical Intelligence, EOB, and directed surveillance SIGINT missions against pulsed and CW emitters in the 2 to 18 GHz band.

[redacted] through the remote tracking stations of the Air Force Satellite Control Facility. 25X1

B. KEY FEATURES

- MISSION INTEGRATION

  LMSC is reponsible for the overall mission integration and systems engineering for the Air Force Program 989. This effort was initiated in the early 1960s and is continuing at this time.

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As the complexity of the SIGINT mission increased and as the evolving design of the spacecraft became more sophisticated and as the Air Force Program 989 assumed greater and greater value to the intelligence community, it became imperative that a centralized facility be established to be responsible for the operational control of on-orbit spacecraft and for the processing, analysis, and reporting of its output data. [redacted]

The high level of performance of this facility was a major factor responsible for the maturing of the Program 989 during the 1970s. Although the amount of [redacted] increased significantly 25X1 during the 1970s, the reporting time (from intercept to product message to the user) was reduced from tens of days to tens of minutes. This was accomplished by improvements in computer speed, processing algorithm speed, data transfer [redacted] speed, and by strict attention to efficient data system management. At present [redacted]

- VEHICLE ASSEMBLY AND TEST

The spacecraft design is such that it is adaptable to a variety of missions through the utilization of a common bus approach with the facility to utilize various payloads and collection antennas. The vehicle per se is ejected from the host vehicle by a support panel launcher assembly that remains with the host. Due to the volume and weight constraints associated with riding piggyback as a subsatellite to the host, the vehicle is extremely compact until deployed, at which time various extending and articulating devices change its dimension

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from an approximate structural rectangle of 42 x 48 x 16 in. to a spinning satellite with a diameter of 14 feet. The vehicle consists of seven subsystems with a total of 39 different designs of major testable components; however, many of the items are duplicate or triplicate in the vehicle assembly. System test of the spacecraft is end-to-end and is computer driven and as such provides a highly perceptive test. The test software has been improved continuously as the program has matured.

- MISSION HIGHLIGHTS

The recent mission history and highlights are reflected in Table II and summary below.

Table II

PROGRAM 989 RECENT MISSION PERFORMANCE

MISSION NO.	VEHICLE NO.	CONTRACTUAL ON-ORBIT PERIOD IN MONTHS	ACTUAL ON-ORBIT PERIOD IN MONTH	PERCENT OF PERFORMANCE EARNED
7342	4429 R-1	18	63.7	100
7343	4430 U-3	18	75 TO DATE	100
7344	4431 U-4	24	54 TO DATE	100
7345	4432 R-1A	18	66 TO DATE	100
7346	4433 F-1	36	4.5 TO DATE	93*
7241	L-1	6	8	100

*THE VEHICLE IS PERFORMING AT 93 PERCENT OF SPECIFIED REQUIREMENTS; HOWEVER, IT WAS LAUNCHED WITH THIS DEFICIENCY KNOWN. OVERALL SYSTEM PERFORMANCE TO DATE IS 76 PERCENT AND STEPS ARE IN PROCESS TO CORRECT REMAINING DEFICIENCIES THROUGH CHANGES IN THE GROUND PROCESSING SEGMENT. IT IS EXPECTED THAT 100 PERCENT PERFORMANCE WILL BE REALIZED BY THE 42ND MONTH OF OPERATION.

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- MISSION HIGHLIGHTS

  - 7341 – EOB, General Search, and TI for Pulsed and CW Emitters in the 4.0 to 18.0 GHz Band (Sidelobes and Mainbeams). To perform this mission, Vehicle 4429-RAQUEL I was launched 29 October 1974 and operated for 63 months. This spacecraft was designed with three high-gain DF antennas and a compliment of low-gain mainbeam collection antennas. The position of the spin axes in inertial space was controlled to maximize time on target for TI analysis.

  - 7343 – EOB, General Search, and Operational Support Against Pulsed and CW Emitters in the 2.0 to 12.0 GHz Band. The vehicle assigned to perform this mission was 4430-URSALA III. It was launched 8 July 1976 and has been operating up through 19 August 1982. It is now in a standby state, but is available to support the community in a transpond mode as required. The monopulse DF aspects of this mission were improved over the URSALA I and II performance. A total system angle-of-arrival measurement error less than [redacted] percent confidence) was achieved. This resulted in error ellipses that averaged [redacted] Best case was [redacted] 25X1

  - 7344 – EOB, General Search, and Operational Support Against Pulsed and CW Emitters in the 2.0 to 12.0 GHz Band. Vehicle 4431-URSALA IV was launched to support this mission on 16 March 1979. Added mission capabilities included in URSALA IV were an encyphered data link permitting realtime transponding to remote tactical ELINT vans. Also, a near realtime data processing system was installed in the [redacted] permitting intelligence data to be reported. Geolocation accuracy was improved to [redacted] percent confidence). 25X1 25X1

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- 7345 – EOB, General Search, and TI for Pulsed and CW Emitters in the 4.0 to 18.0 GHz Band (Sidelobes and Mainbeams). Launched on 16 March 1978, Vehicle 4432 – RAQUEL 1A had essentially the same design as RAQUEL I; however, a number of improvements were included in order to improve the TI mission satisfaction and the tasking and reporting timeliness.

- 7346 – EOB, General Search, TI, and Directed Search for Pulsed and CW Emitters in the 2.0 to 18.0 GHz Band (Sidelobes and Mainbeams).

  This major design improvement in the 989 vehicle family, designated Vehicle 4433 – FARRAH I, has the combined capabilities of both the URSALA and RAQUEL spacecraft on a single platform. Improved DF and parameter measurement accuracies are expected. Major increases in the power subsystem and the command and control subsystem have been included. The spacecraft contains an on-board general purpose digital computer to be used for realtime ELINT processing and readout direct to remote tactical support vans.

  It was launched on 12 May 1982 and has been tasked extensively in the period since that event. Expectations for this vehicle and the system as a whole are very optimistic.

- 7241 – General Search, EOB and TI for Pulsed and CW Emitters in the 26 to 42 GHz Band.

  This was the first satellite collector of SIGINT in this frequency range. The LORRI system was designed as a pallet to the host spacecraft, and unlike the P-11 spacecraft, remained with the host for its entire mission life of eight months. Target geoposition as well as signal externals were measured.

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- GROUND SEGMENT

The [redacted] which supports the Program 989 spacecraft consists of the following key efforts:

- Mission Planning – provides the tasking and mission planning functions.

- Ground Station/Direct Data Transfer – prepares data readout from each spacecraft for computer processing. Separates data for direction Finding (DF) from mainbeam data for Technical Intelligence (TI) processing.

- Computer Operations – provides and operates the large scale CDC computers used for data processing and data display interface.

- Flight Data Processing – processes the data prepared by the Direct Data Transfer stations. Computes all signal parameters as measured by the payload, along with geolocation of the intercepted signals, by applying payload and spacecraft calibration data.

- Mission Analysis – prepares reports on individual signals and associated weapon systems for operational and technical intelligence users. Provides signal search, signal exploitation and emitter system performance analysis including an all source analysis capability. Prepares reports for tactical reporting within one hour of data receipt.

- Communications – allows direct input of analyst reference data to data base storage, and shipment of [redacted] product to intelligence users.

- Facilities – provides for electromagnetic protection of all critical hardware and provides power and environmental control for new hardware.

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- On-Orbit Calibration – prepares an on-orbit calibration plan. Designs, operates and maintains calibration equipment. Conducts on-orbit calibration including radiation of calibration signals, analysis of received calibration data, discrepancy analysis, and special analysis of the payload or spacecraft operation using calibration data.

- SUBCONTRACT MANAGEMENT

The Program 989 utilizes the LMSC Subcontract Management Team approach. The vehicles noted in Table II have an average of 40 percent of their hardware provided by subcontractors. Of major importance is the need to provide close management involvement with the subcontract activities. Members of the Program Management Team are assigned as Responsible Subcontract Individuals on each of the various subcontracts and as such, directly interact with the cognizant team members in directing, monitoring and statusing subcontractor efforts. All aspects of the subcontract are under team control, i.e., cost, schedule and technical performance. Table III reflects the major subcontractors associated with the vehicles and ground station efforts.

Table III

MAJOR SUBCONTRACTORS

P-11#	MISSION #	SPACECRAFT	ANTENNAS	PAYLOAD	TAPE RECORDERS
4429	7341	LMSC	LMSC	E-SYSTEMS	LEC*
4430	7343	LMSC	LMSC	MOTOROLA	LEC
4431	7344	LMSC	LMSC	MOTOROLA	LEC
4432	7345	LMSC	LMSC	E-SYSTEMS	LEC
4433	7346	LMSC	LMSC	MOTOROLA	LEC
4434	7347	LMSC	LMSC	MOTOROLA	LEC
LORRI	7241	LMSC	LMSC	ARGO SYSTEMS**	LEACH

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*LEC = LOCKHEED ELECTRONICS CO., PLAINFIELD, N.J.

**ARGO SYSTEMS WAS AN ASSOCIATE CONTRACTOR ON THIS MISSION.

During this phase, major subcontracts have represented 41 percent of the total program cost. Of this effort, shown in Table III, the payload supplier (E-Systems Motorola) represents 80 percent of the subcontract cost, the tape recorder supplier (LEC) represents seven percent, and the balance is distributed to the very small subontracts involved with the remaining purchased flight units.

- Stated in dollars:
  - E-Systems/Motorola $83 million
  - LEC $ 7 million
  - Other $13 million

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Section 2

COST AND SCHEDULE

The following tables represent summary level data relative to the Program 989 most recent 10 years of activity. Due to the diversity of efforts, periods of performance, quantity of vehicles, and services, each of the eight major contracts and an aggregate summary are displayed.

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Table IV

989 SUMMARY

($ IN 000s)

COST & SCHEDULE PERFORMANCE		
COST	**SCHEDULE**	**FEE REALIZATION**
Initial Value: $171,047	Period of Performance	Contract / Actual
Changes: $108,369	Original: SEE DETAIL	Target* $30,539 / $24,261
Target Cost: $279,416	Revised: SHEETS	Award** $ 2,502 / $ 1,087
Actual Cost To Date: $282,963	Percent Items Delivered on Time: 93	Other (Explain)
Projected Cost To Complete: $338,643	Number of Delivery Schedule Changes:	Reasons: (Describe Key Reasons For Fee Losses)
% over/underrun: 21.1		* Cost Variances Only
Reasons: Payload Subcontract Variances, Rates, Tape Recorder, Solar Array and Antenna System Development.	Reasons: Payload deliveries were late in several instances.	** Award periods are in the future.

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Table IV-I

[redacted] 25X1

($ IN 000s)

COST & SCHEDULE PERFORMANCE		
COST	**SCHEDULE**	**FEE REALIZATION**
Initial Value: $11,500	Period of Performance	Contract / Actual
Changes: $56,331	Original: 12/16/71 to 12/31/74	Target $9,821 / $7,336
Target Cost: $67,831	Revised: 12/16/71 7/15/79	Award N/A /
Actual Cost To Date: $82,202	Percent Items Delivered on Time: 88	Other (Explain)
Projected Cost To Complete: $82,202	Number of Delivery Schedule Changes:	Reasons: (Describe Key Reasons For Fee Losses) Cost variance only
% over/underrun: 22		
Reasons: Subcontract (Payload) was 35% of the variance, rates 22%, Tape Recorders 12% and Labor & Material and Other were 31%.	Reasons: Payload deliveries were late on 3 of the systems.	

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Table IV-2

[redacted]

25X1

($ IN 000s)

COST & SCHEDULE PERFORMANCE		
COST	**SCHEDULE**	**FEE REALIZATION**
Initial Value: $1,953	Period of Performance	Contract / Actual
Changes: $ 938	Original: 6/1/77 to 4/30/80	Target $370 / $254
Target Cost: $2,891	Revised: 6/1/77 to 4/30/81	Award
Actual Cost To Date: $3,504	Percent Items Delivered on Time: 100	Other (Explain)
Projected Cost To Complete: $3,504	Number of Delivery Schedule Changes:	Reasons: (Describe Key Reasons For Fee Losses) Cost variance only
% over/underrun: 21		
Reasons: Material was 17% of this variance, Rates another 32% and Labor and Other were an additional 51%	Reasons: Revised launch date due to host vehicle problem.	

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Table IV-3

[redacted] 25X1

($ IN 000s)

COST & SCHEDULE PERFORMANCE		
COST	**SCHEDULE**	**FEE REALIZATION**
Initial Value: $34,165	Period of Performance	Contract / Actual
Changes: $ 7,254	Original: 2/1/78 to 3/15/81	Target $4,480 / $1,832
Target Cost: $41,419	Revised: 2/1/78 10/1/82	Award N/A /
Actual Cost To Date: $79,399	Percent Items Delivered on Time: 100	Other (Explain)
Projected Cost To Complete: $79,399	Number of Delivery Schedule Changes: 1	Reasons: (Describe Key Reasons For Fee Losses) Cost Variance Only
% over/underrun: 91.6		
Reasons: Payload subcontract was 47%, the tape recorder IPO was 3%, Rates were 6% and the labor and material volume was 44%.	Reasons: Revised launch to facilitate opportunity to rework payload.	

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Table IV-4

[redacted] 25X1

($ IN 000s)

COST & SCHEDULE PERFORMANCE		
COST	**SCHEDULE**	**FEE REALIZATION**
Initial Value: $38,058	Period of Performance	Contract / Actual
Changes: $19,527	Original: 7/1/80 to 4/30/83	Target $7,201 / $6,222
Target Cost: $57,585	Revised: 7/1/80 to 5/30/84	Award N/A /
Actual Cost To Date: $41,141	Percent Items Delivered on Time: 95	Other (Explain)
Projected Cost To Complete: $63,848	Number of Delivery Schedule Changes: 1	Reasons: (Describe Key Reasons For Fee Losses) Late delivery of transmitter and cost variance
% over/underrun: 9		
Reasons: Minor delays with payload and transmitter subcontracts and rate growth.	Reasons: Delayed launch date by direction	
Rates=42% Labor and Mtl. =11% Other = 27% S/C =20%		

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Table IV-5

[redacted] 25X1

($ IN 000s)

COST & SCHEDULE PERFORMANCE		
COST	SCHEDULE	FEE REALIZATION
Initial Value: $19,553	Period of Performance	Contract / Actual
Changes: $20,221	Original: 4/1/79 to 9/30/80	Target $3,336 / $3,336
Target Cost: $39,774	Revised: 4/1/79 to 9/30/81	Award $1,003 / $ 762
Actual Cost To Date: $39,774	Percent Items Delivered on Time: N/A	Other (Explain)
Projected Cost To Complete: $39,401	Number of Delivery Schedule Changes:	Reasons: (Describe Key Reasons For Fee Losses)
% over/underrun: .099		
Reasons:	Reasons:	

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Table IV-6

[redacted] 25X1

($ IN 000s)

COST & SCHEDULE PERFORMANCE		
COST	**SCHEDULE**	**FEE REALIZATION**
Initial Value: $37,318	Period of Performance	Contract / Actual
Changes: $ 4,098	Original: 10/1/81 – 8/30/83	Target $2,016 / *
Target Cost: $41,416	Revised: Same	Award $1,162 / **
Actual Cost To Date: $19,585	Percent Items Delivered on Time: N/A	Other (Explain)
Projected Cost To Complete: $41,416	Number of Delivery Schedule Changes: N/A	Reasons: (Describe Key Reasons For Fee Losses)
% over/underrun: -0-	Reasons:	* Earned on % of complete, no loss anticipated
Reasons:		** Awarded on 6-month evaluation periods. $325K awarded through first period.

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Table IV-7

[redacted]

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($ IN 000s)

COST & SCHEDULE PERFORMANCE		
COST	**SCHEDULE**	**FEE REALIZATION**
Initial Value: $25,100	Period of Performance	Contract / Actual
Changes: None	Original: 3/1/82 to 12/31/85	Target $3,204 / N/A
Target Cost: $25,100	Revised: N/A	Award N/A /
Actual Cost To Date: $ 3,958	Percent Items Delivered on Time:	Other (Explain)
Projected Cost To Complete: $25,100	Number of Delivery Schedule Changes:	Reasons: (Describe Key Reasons For Fee Losses)
% over/underrun:	None	Program is just underway
Reasons: Program is just underway, however, no major risks have identified.	Reasons:	

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Section 3

LESSONS LEARNED – TECHNICAL

Key Technical problems encountered by LMSC [redacted] have involved the command control, mission planning and tasking of SIGINT spacecraft under dynamic changes in world situations. LMSC has computed the required changes in spacecraft attitude, spin rate, and collection geometry to optimize collection over specific geographic areas and locations. Changes in the processing methods and computer facility have brought the processing time-line for this time-critical data from seven hours in 1973 to one hour in 1982.

The major problem encountered in the development of the most recent spacecraft has been that of packaging such an extensive system as the FARRAH I in such a small volume. A new host has been assigned which will allow the opportunity to develop a design which will enable the technicians to have good physical access during fabrication, assembly and test at both the component as well as the integrated spacecraft level. Furthermore, this will allow the opportunity to broaden the use of redundancy and cross strapping to extend mission life.

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LESSONS LEARNED – CONTRACTUAL

Recent O&M contracts have generally encountered few contractual problems. Cost performance has consistently remained close to target.

The present and previous contracts have included award fee. The experience with award fee has been positive to this point and has resulted in higher overall contract fee than achieved when the O&M Contracts were CPFF.

Development contracts of the recent past and those presently active provide an adequate vehicle with which to achieve the combined goals of the customer and contractor. Inasmuch as there are concurrently several Program 989 contracts in process, steps are being taken to eliminate duplication in reporting and services through the redefinition of a Project Support Level which will support all of the several contracts.