PL-TR-
96-1161

R&D Engineering Support, Operation, and Maintenance - Malabar Annex, Palm Bay, Florida

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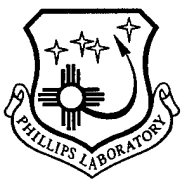
February 1997

Final Report



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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	February 1997	Final Report; Nov 92 - Apr 96

4. TITLE AND SUBTITLE
R&D Engineering Support, Operation, and Maintenance -
Malabar Annex, Palm Bay, Florida

5. FUNDING NUMBERS
C: F29601-93-C-0013
PE: 62601F
PR: 3326
TA: LQ
WU: 03

6. AUTHOR(S)
Joseph E. Barfoot

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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Albuquerque, NM 87110

8. PERFORMING ORGANIZATION REPORT NUMBER

TR96-004

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Phillips Laboratory
Optical Sensing Division (LIM)
3651 Lowry Ave SE, Bldg 499
Kirtland AFB, NM 87117-5776

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

PL-TR-96-1161

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for Public Release; Distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 Words)*

This is the final report for USAF Phillips Laboratory contract F29601-93-C-0013, Research and Development, Engineering and Operations, and Maintenance Support to the Malabar Test Site adjacent to Palm Bay, Florida. During the term of the contract, the government/contractor team was able to assemble the expertise and experience to make Malabar one of the premier observation and tracking stations in the Air Force inventory. The activities conducted at Malabar included space object (satellites, debris, etc.) identification through active and passive imaging, tracking missile launches from Cape Canaveral (at times illuminating the plumes with lasers of various wavelengths), support to spacecraft laser communication programs, and research and development of related technologies (laser ranging, hyperspectral imaging, advanced technology cameras, atmosphere characterizations, etc.). Ancillary to the observation activities, but of high visibility, was the successful completion of an existing project to develop and install a tracking mount control system for the Western Test Range Santa Ynez Peak Optical Site (SYPOS). If there was a hallmark for the Malabar Site during the term of this contract, it would be the maintenance of high quality and responsive support to site customers in the face of ever declining budgets.

14. SUBJECT TERMS

Eye-safe, Raman shifting, Solid-state Lasers, Barium Nitrate, Space Object Identification, Tracking, Active Imaging, Lasers, Infrared, Laser Communication, Laser Ranging

15. NUMBER OF PAGES
16

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18
28-102

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SUMMARY

The ORION Team, consisting of ORION International Technologies, Inc. as the prime contractor with United Technologies Optical Systems (UTOS) and Florida Institute of Technology (Florida Tech) as subcontractors provided Research and Development Engineering and Operations and Maintenance Support to the U.S. Air Force Phillips Laboratory LIMI Directorate at the Malabar Test Site on the Malabar Annex to Canaveral Air Force Station from November 1992 through April 1996. The contract was awarded in competition among 8(a) contractors with ORION's proposal having beaten some 13 others that were submitted. The contract type was Cost Plus Award Fee (CPAF). During the kickoff meetings on the contract, the Government Site Manager (and father of Malabar), Mr. Harold Newby, indicated that it was the promise of innovation and anticipation of government/site needs that were among the factors that led to the selection of ORION.

Through the term of the contract, we attempted to live up to that promise with the result of continuously improving award fees (starting out as good the first quarter, moving to very good the second quarter, and a string of nine excellent ratings thereafter) and commendations for the performance of site personnel.

The ORION Team bonded with the on-site government personnel to form a Partnership in Excellence. In spite of severe funding constraints, the partnership overcame adversity and cut through the red tape to conduct excellent science, to provide flexible and responsive support to customers, and to continuously improve the capabilities of the site to anticipate and support mission requirements.

INTRODUCTION

The Malabar Annex to Canaveral Air Force Station, located in Palm Bay Florida, housed the Malabar Test Facility operated by the Lasers and Imaging (LI) Directorate of the U.S. Air Force Phillips Laboratory (PL). The site was equipped with a variety of telescopes and other optical equipment that allowed operators at the site to visualize objects of interest. Lasers of various wavelengths allowed the site to illuminate selected targets which enhanced visibility, often allowed significant characterization of the targets, and for some systems provided for communication with targets (objects). The Malabar Test Facility employed highly sensitive optical sensors in the ultraviolet, visible, mid-infrared and far-infrared in conjunction with its telescopes and computerized mount control systems. Missions included tracking launches from Cape Canaveral, tracking space objects (satellites, debris, etc.) in a variety of orbits, laser communications experiments, and others.

The Malabar Test Facility supported many user organizations within the DoD. In the face of shrinking budgets and increased competition from other sites, the Malabar Test Facility consistently was lauded for the results obtained and for its responsiveness to customer needs. This was primarily due to the dedication of the Government/Contractor team which, for the most part, had been intact through many years of site operation and, as a result, were able to extract maximum performance from the high quality but aging facility equipment.

This report covers the activities of the government/contractor team from the perspective of the contractor, ORION International Technologies, Inc. from the inception of Contract Number F296401-93-C-0013 from November 1992 through April 1996 - at which time all funding allocated to the contract had been spent. For all practical purposes, the site ceased functioning as an operational site in September of 1995. The period from September 1995 through April 1996 was essentially for the orderly shutdown of the facility and relocation of major elements of its equipment to other government sites, primarily the Phillips Laboratory Starfire Optical Range and the Air Force Maui Optical Site (AMOS).

The contractor team consisted of ORION International Technologies, Inc. as the prime contractor with United Technologies Optical Systems (UTOS) and Florida Institute of Technologies (Florida Tech) as subcontractors. This team with highly complementary with UTOS providing resources for significant improvements in the optical systems and Florida Tech providing an element of research and development from an academic perspective. The involvement of the subcontractors decreased over the term of the contract due to severe funding constraints and the resultant emphasis on maintaining the core competencies of the site.

RESULTS AND DISCUSSION

The term of the ORION Team contract at the Malabar Test Site was marked by the need to always do more with less. Due to funding constraints, many of the site upgrades were held in abeyance, work arounds were provided, and, at times, the site contractor support had to persist at a funding allocation sufficient to cover the direct labor at only 75%. In consensus with the government site manager, government and contractor personnel on site and the PL Contracting Officer and to retain the most capability to support missions, ORION chose to reduce the allotted time for each individual during those periods from 40 hours per week to 30 hours per week. Though this worked hardship on both the personnel and the ability to support site maintenance and upgrades, it did provide the threshold capability to support site user needs and assure continued funding from those sources.

Tracking and object identification missions were more or less continuous. Improvements in site processes and procedures were also continuous - enhanced by the frequency of mission support. Significant programs supported by the site (and the supported organizations included):

- ALGS - the Atlantic Laser Ground Station communication project for the DSP satellite system (McDonnell Douglas/USAF)
- HSI - Hyperspectral Imaging for use in space object identification (Phillips Lab/ORION)
- LIT - Laser Illumination of Targets - active imaging of launched targets, plumes and hardbodies (BMDO/NRL and Lockheed)
- NRL -laser ranging experiments in support of the Naval Research Laboratory (NRL)
- Red Tigress II - launch observation experiments in support of RT2 (BMDO)
- ONE- Optical Networking Experiment (PL/USSPACECOM)
- SOI - Space Object Identification (USSPACECOM)
- TAOS - Technology for Autonomous Survivability (TAOS)
- WAVE - Water Vapor Experiment (Aerospace Corporation)
- LOS - Launch Observation Support (Malabar Initiative - customers pay for specified products - images, tapes, analysis, etc.)
- SDMC - Space Debris Measurement Campaign (PL/Malabar)
- GEOS - Geosynchronous Satellites Photometry (USSPACECOM CIC)
- JOVIAN - Joint Optical Venture in Advanced Networking (United Kingdom Defense Research Agency)
- BLAST - Battlefield Laser Aboard Shuttle Test (U.S. Army)

Enhancement of site equipment and resources was also continuous. In addition, Malabar was responsible to the Western Test Range for a major upgrade to one of their launch tracking sites. Significant projects supported by site personnel included:

- C-Focus - designed, fabricated, installed and characterized an optical bench with translators, collimating lens, focusing lens, optical filters, sensors, control cables, and purge lines for use at the R1 C-focus station. Purpose was to support the USSPACECOM Optical Networking Experiment (ONE) initiative. The system was optimized to produce high resolution imagery in the 10 to 1000 km range (full FOV in that range).
- SYPOS - Santa Ynez Peak Optical Site - Malabar designed, fabricated, tested, and installed mount control system - (Western Test Range - 30SPW). Problems associated with poor quality assembly (by previous contractor), with long term storage at site since activity on prior contract, inadequate documentation, mistakes

in the software, and poorly planned logistics concerning relocation of mount control system to SYPOS were overcome by the government/contractor team during this project. The MCS upgrade with all installation, testing, documentation and training has been delivered to and accepted by the 30SPW.

- NDS - Nuclear Detonation (NUDET) Detection System, installed Clear Com System in NDS Building, tested and evaluated Alexandrite laser (AFTAC) for potential use by contractors competing for the Air Force AFTAC Laser Facility (AALF) contract - procurement suspended by AFMC. Numerous problems with Alexandrite laser design - primarily with water cooling of cavity mirrors and cavity mirror coating degradation. Worked with vendor to improve coating.
- KM2 - Evaluated and modified the Kodak KM2 camera purchased by previous contractor. KM2 is a megapixel class focal plane array camera intended to improve resolution of Malabar imaging (and destined to be used at the R1 C-Focus station). Many problems were identified and resolved including dynamic range limitations due to the camera firmware (reprogrammed by ORION), thermal sensitivity of components on the PC card (solved by purging with thermally conditioned nitrogen), inadequate thermoelectric cooling of the focal plane array (installed a cooling water system and optics purge to obviate condensation), incorrect prescription of camera optics (replaced by manufacturer), problems with the fiber optic control link (noise in the input electronics/filtered out and bad terminations of FO connectors/redone)
- HSI - besides being a mission in itself, hyperspectral imaging supported a variety of other missions, and was a development project at the site. Primary funding for HSI came from the Phillips Laboratory but significant funding for the project also was derived from IR&D funding from within ORION and Florida Tech.

Malabar Systems

The essence of the Malabar support capability came from its major systems. The site had two receiver mounts, R1 and R2, and two transmitter mounts, T1 and T2. The characteristics of each were as follows:

- R1 - 48" diameter telescope, visible wavelengths classical imaging system
- R2 - 20" telescope MWIR and LWIR (at times) imaging system
- T1 - the workhorse Laser Beam Director (utilized a variety of IR, visible and UV laser systems
- T2 - a Laser Beam Director (inactive) intended for use with a large 1Kj/pulse gas dynamic CO_2 Laser System

Malabar Issues

Initial Staffing - among the activities that received accolades from the government during ORION's tenure was the initial staffing of the site. ORION was notified of award on the 13th of November (a Friday by coincidence - and, perhaps, portending future events) with instructions to begin work on Monday. The indication was that there would be a mission of critical importance beginning very soon after contract start. ORION personnel (a Technical Director, the Principal Engineer, the Head of Corporate Administration and Personnel and the Contract Administrator) traveled to Melbourne Florida that day, interviewed more than 20 prospective employees, extended offers to 14 and had thirteen employees on site for the Monday start-up. By the end of the week, ORION had increased its staff to 17 out of the allocation of 19. By the end of the first month, all positions were filled. Through its marketing efforts, ORION had identified highly desirable previous employees of prior site contractors and had made overtures to them relative to employment. Since many of the personnel had lent their names to other proposals, there was no exclusivity relative to ORION's offer but, even in the proposal, many had expressed a desire to work for the ORION Team (commitment letters).

Macintosh-based AutoCAD System - Macintosh computers had been selected (prior to ORION) as the site standard. Malabar had purchased a Macintosh version of AutoCAD which purportedly was compatible with the IBM PC

versions of AutoCAD. Much of the work that the site had produced for SYPOS and other projects had been produced in the PC versions of AutoCAD or other PC-based CAD systems. Much of the site as-built documentation was in PC-based CAD files. Neither ORION nor the AutoCAD support staff at AutoDesk Corporation could effectively import or translate the PC files into files usable on the Macintosh system. Eventually, ORION purchased a high end PC workstation for the site and traded the Macintosh version of AutoCAD to AutoDesk for a PC version. There were no problems experienced after that time with the CAD system. In addition to project drawings, ORION engineers and technicians spent considerable effort in recasting many of the hard copy (only) site drawings into electronic files such that changes would be easier, configuration management more effective, changes to reflect the as-built configuration more efficient and fabrication of new equipment more responsive to site needs.

Configuration Management (established w/CCB) - Prior to the ORION tenure, there was virtually no contractor provided configuration management/control. Much of the site as-built configuration had not been documented, original site drawings were improperly stored (placing them in jeopardy) and software changes had been patched with inadequate documentation (and no user documentation revisions to reflect the changes). In conjunction with site personnel (and in particular Major Frantom and Mr. Knox), ORION prepared a site specific Configuration Management Plan, instituted a Configuration Control Board (CCB) and implemented the process to bring the site up to speed from a configuration/documentation perspective. Some of this discipline had to be abandoned in the latter days of the contact due to the severe limitations of funds and personnel resources to support the CM Plan.

Procurement/Logistics - When ORION arrived at Malabar, there were two portable buildings full of piece parts and subassemblies for the equipment on site and for project site upgrades. Virtually none of this inventory was cataloged so that the practice was to buy new to service the emergencies on-site rather than sift through what was on hand. Under the stewardship of ORION, all serviceable equipment was inventoried, all unserviceable equipment was disposed of and the shelving/space organized such that supplies could be easily accessed. A system was set up which attempted to anticipate site needs and to decrement inventory when stores were used. A streamlined procurement system was implemented in which the highest ORION authorization required was that of the on-site Program Manager - there were no burdensome corporate approvals needed as long as the purchase was for direct support to the contract.

Contract Administration - We (ORION) appreciate the proactive and supportive relationship that the Phillips Laboratory PKLB organization maintained with us. We know that with the funding constraints and strong personalities among the government technical personnel, there were many difficult to resolve issues. From ORION's perspective, the Contracting Officer and Contracts Specialists associated with this contract were highly perceptive to the plight of the contractor, the personnel and site operations, in general. They tried as best they could to mitigate hardships and to facilitate activities that allowed the site to function as long as it did.

Cost/Schedule for SYPOS. SYPOS was a completion CLIN within the overall structure of the Malabar Contract. Our cost proposal for this effort was based on the status of the system as described by the RFP and in briefings from site personnel during the site visit prior to the proposal submittals. The system had been represented to be

essentially complete except for documentation, test and delivery. The actual status items that differed materially from this representation were:

- the engineering drawings produced by CSR (a range contractor) prior to ORION's arrival were in an AutoCAD versions that resided on an IBM PC compatible computer. These could not be read into the site Macintosh-based AutoCAD.
- the A&E work for installing the equipment at SYPOS was essentially a set of conceptual sketches. These had to be completely generated from scratch (and much of the engineering had to be accomplished under the ORION effort)
- the software required numerous corrections to just establish basic functionality. Many more were needed to meet contract specifications (between the site and the 30SPW)
- rather than relatively complete draft documentation, much of the documentation was very rough or was just the documentation of a previous similar system (the Anderson Peak Optical Site, APOS). Documentation required for SYPOS turned out to be significantly different than that provided for APOS and the 30SPW customer demanded that the contract requirements (30SPW to Malabar) be adhered to.
- SYPOS optics required refurbishment prior to installation with the new MCS. The artisan that had historically maintained these optics on an contract basis was very ill at the time the work was to be done and the work was delayed until he was well to complete the work. From the perspective of the 30SPW, there was no alternative to using this contractor.
- Much of the cabling had to be reworked, rerouted and labeled due to poor workmanship of previous contractor

Optical Laboratory - In spite of the criticality of a high quality optical laboratory to support an optical tracking station such as Malabar, funding was never available to support build-up of the optics lab and sensor calibration facility to a level commensurate with the requirements of the site. The contract SOW called for the calibration and alignment of all electro-optical sensors on a routine basis. Calibrated test equipment to effectively perform these tasks were simply not available. Because of the lack of sufficient resources in this area, an inordinate amount of time was required to accomplish even the marginal calibration and alignments by using makeshift systems.

Contract Funding

The funding provided by the original contract and amendments through P0054 is $9,370,964.00 as shown in Table 1.

MOD LIST

9013 PHILLIPS LABS F29601-93-C-0013
CONTRACT MOD LIST

	FUNDING	TOTALS	CEILING	TOTALS	
ORIGINAL	500,000.00	500,000.00	3,151,039.00	3,151,039.00	
P00001	0.00	500,000.00	0.00	3,151,039.00	
P00002	426,180.00	926,180.00	174,500.00	3,325,539.00	
P00003	272,728.00	1,198,908.00	0.00	3,325,539.00	
P00004	25,580.00	1,224,488.00	0.00	3,325,539.00	
P00005	0.00	1,224,488.00	25,767.00	3,351,306.00	
P00006	66,354.00	1,290,842.00	40,354.00	3,391,660.00	*
P00007	200,000.00	1,490,842.00	0.00	3,391,660.00	
P00008	17,825.00	1,508,667.00	0.00	3,391,660.00	
P00009	70,000.00	1,578,667.00	0.00	3,391,660.00	
P00010	18,000.00	1,596,667.00	0.00	3,391,660.00	
P00011	0.00	1,596,667.00	0.00	3,391,660.00	
P00012	0.00	1,596,667.00	0.00	3,391,660.00	
P00013	50,000.00	1,646,667.00	0.00	3,391,660.00	
P00014	169,178.00	1,815,845.00	0.00	3,391,660.00	
P00015	174,000.00	1,989,845.00	0.00	3,391,660.00	
P00016	0.00	1,989,845.00	0.00	3,391,660.00	
P00017	46,372.00	2,036,217.00	46,372.00	3,438,032.00	*
P00018	236,097.00	2,272,314.00	0.00	3,438,032.00	
P00019	13,000.00	2,285,314.00	0.00	3,438,032.00	
P00020	15,300.00	2,300,614.00	0.00	3,438,032.00	
P00021	71,600.00	2,372,214.00	0.00	3,438,032.00	
P00022	33,388.00	2,405,602.00	33,388.00	3,471,420.00	*
P00023	0.00	2,405,602.00	0.00	3,471,420.00	
P00024	26,000.00	2,431,602.00	0.00	3,471,420.00	
P00025	23,000.00	2,454,602.00	0.00	3,471,420.00	
P00026	30,000.00	2,484,602.00	5,367,086.00	8,838,506.00	
P00027	0.00	2,484,602.00	0.00	8,838,506.00	
P00028	158,272.00	2,642,874.00	0.00	8,838,506.00	
P00029	71,000.00	2,713,874.00	0.00	8,838,506.00	
P00030	0.00	2,713,874.00	0.00	8,838,506.00	
P00031	(25,000.00)	2,688,874.00	0.00	8,838,506.00	
P00032	20,000.00	2,708,874.00	36,457.00	8,874,963.00	
P00033	16,000.00	2,724,874.00	0.00	8,874,963.00	
P00034	0.00	2,724,874.00	92,362.00	8,967,325.00	
P00035	36,000.00	2,760,874.00	0.00	8,967,325.00	
P00036	104,000.00	2,864,874.00	0.00	8,967,325.00	
P00037	103,650.00	2,968,524.00	30,177.00	8,997,502.00	*
P00038	0.00	2,968,524.00	0.00	8,997,502.00	
P00039	138,572.00	3,107,096.00	0.00	8,997,502.00	
P00040	30,000.00	3,137,096.00	0.00	8,997,502.00	
P00041	47,177.00	3,184,273.00	0.00	8,997,502.00	
P00042	51,000.00	3,235,273.00	0.00	8,997,502.00	
P00043	52,000.00	3,287,273.00	0.00	8,997,502.00	
P00044	57,898.64	3,345,171.64	0.00	8,997,502.00	
P00045	49,335.00	3,394,506.64	49,335.00	9,046,837.00	*
P00046	55,000.00	3,449,506.64	0.00	9,046,837.00	
P00047	30,000.00	3,479,506.64	0.00	9,046,837.00	
P00048	28,218.00	3,507,724.64	0.00	9,046,837.00	
P00049	45,056.81	3,552,781.45	324,127.00	9,370,964.00	
P00050	7,000.00	3,559,781.45	0.00	9,370,964.00	
P00051	20,000.00	3,579,781.45	0.00	9,370,964.00	
P00052	52,000.00	3,631,781.45	0.00	9,370,964.00	
P00053	4,000.00	3,635,781.45	0.00	9,370,964.00	
P00054	20,000.00	3,655,781.45	0.00	9,370,964.00	

*** AWARD FEE**

Table 1. Contract Modification Listing and Funding/Ceiling History

Conclusion

Through the term of the contract, the government/contractor team continuously strived to conduct scientific experiments and technology evaluations that were highly credible and added to the relevant knowledge bases. Upon initiation of contract performance, ORION (with UTOS and Florida Tech) were able to reassemble most of the team that had made Malabar one of the most highly respected and utilized observation facilities on the eastern coast of the United States. The term reassemble is used because the site had been without effective contractor support for in excess of 6 months prior to the initiation of this contract. During that time, utilization of the site had severely declined and reimbursable revenues had all but disappeared. After the start of the contract, concerted efforts were made by Mr. Harold Newby and members of the contractor team to bring many of the customers that had gone to other facilities back to Malabar. These efforts bore some fruit but the resultant was inadequate to establish the self-sufficiency that had been recently imposed by Phillips Laboratory management.

All who dealt with Malabar would agree that the government/contractor team was among the most dedicated and skilled at a facility of that type anywhere. Many of the team had spent most or all of their careers at Malabar - at first learning as apprentices and later operating as experts the diverse systems at Malabar. Though there was never much money for facility upgrades, the entire staff (government and contractor) did the best they could to keep the existing equipment in top operating condition. Many of the staff would come in on their own time to clean and adjust the systems under their purview. At times due to limited budgets, they would come in on their own time to support observation missions that were of value to the site but were unfunded by customers. The viewing conditions were highly variable at Malabar due to the frequent occurrence of cloud cover and the occasional high wind condition with considerable airborne particulate. However, on a clear calm night/early morning (especially after a refreshing rain that eliminated most of the scintillation sources), there are few locations where the viewing is better. This is evidenced by some of the most impressive imaging results ever obtained - in the judgment of site customers.

Because of conditions and because of the skills and dedication of the Malabar Team, results were almost continuously above and beyond expectations. Often when there were multiple participating sites, Malabar was the only site or one of the few with successful results. When there were sufficient resources and when we were servicing customer needs effectively, Malabar was an exciting and satisfying experience. As funding declined, there was a significant effort to retain the core competencies for the site. At first, subcontractor support was reduced and later, the staff, at times, had to be placed on a reduced work schedule to avoid the necessity for the layoff of personnel with critical skills. With the decreased funding came a decision to close the site and parcel out site resources to other government (primarily Phillips Laboratory) facilities. Many of the resources including, the 48" optical telescope with an extremely high quality primary mirror, were relocated to the Starfire Optical Range at Kirtland AFB (with ORION assistance) and others were sent to the Air Force Maui Optical Site (AMOS) in Hawaii.

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