

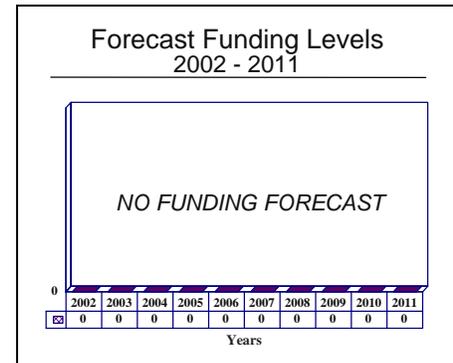
# ARCHIVED REPORT

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## Advanced Electro-Optical System (AEOS) - Archived 09/2003

### Outlook

- Modifications continue to be made to the US Air Force Maui Optical Station
- Increased civilian/scientific projects being promoted
- Most funding to come from “renting” the site to scientific projects
- This report will be archived in the near future



### Orientation

**Description.** The US Advanced Electro-Optical System (AEOS) is an electro-optical telescope at the US Air Force Maui Optical Station (AMOS) in Hawaii.

#### Sponsor

US Air Force  
Air Force Research Laboratory  
3550 Aberdeen Avenue SE  
Kirkland AFB, New Mexico (NM) 87117-5776  
USA  
Tel: +1 505 846 1911  
Fax: +1 505 846 0423  
Web site: <http://www.de.afrl.af.mil/pa>  
(Overall management)

US Air Force  
Air Force Materiel Command  
Electronic Systems Center  
Hanscom AFB, Massachusetts (MA)  
USA

US Air Force Materiel Command  
Space & Missile Systems Center  
Los Angeles, California (CA)  
USA

US Air Force Maui Optical Station

AMOS AFS  
Maui, Hawaii (HI)  
USA

#### Prime Contractors

Raytheon Co  
Electronics Systems  
(formerly Hughes Electronics Corp)  
Electro-Optical & Data Systems Group  
PO Box 902  
2000 East El Segundo  
El Segundo, California (CA) 90245-0902  
USA  
Tel: +1 310 647 1000  
Web site: <http://www.raytheon.com/es>  
(Original AEOS Development, EO units sold to Goodrich Corporation – formerly BFGoodrich, Long Wave Infrared Images)

#### Contractors

COMSAT RSI  
(JEFA Wireless Systems)  
2100 Couch Drive  
McKinney, Texas (TX) 75069  
USA  
Tel: +1 972 547 4455

Fax: +1 972 542 4557  
Web site: <http://www.dallas.net/~jefa/home.html>  
(AEOS Telescope Enclosure System)

Goodrich Corporation  
Optical & Space Systems  
(formerly Raytheon Co)  
(formerly Hughes Danbury Optical Systems)  
100 Wooster Heights  
Danbury, Connecticut (CT) 06810  
USA  
Tel: +1 203 797 5000  
Fax: +1 203 797 5113  
Web site: <http://www.sfs.goodrich.com>  
(AMOS Optical Telescope, Visible Imager)

Logicon Advanced Technology  
(a Northrop Grumman company)  
222 West 6th Street  
PO Box 471  
San Pedro, California (CA) 90733-0471  
USA  
Tel: +1 310 831 0611  
Web site: <http://www.logicon.com>  
(Optical Systems Design and Analysis, Technical Support)

Rocketdyne Technical Services  
(a Boeing Company)  
Albuquerque, New Mexico (NM)  
USA  
Web site: <http://www.boeing.com/space/rdyne>  
(Technical Support)

**Status.** Full operational capability achieved in July 2000.

**Total Produced.** Not applicable.

**Application.** Electro-optical space surveillance.

**Price Range.** Indeterminate

## Technical Data

**Design Features.** AEOS is a 3.67-meter electro-optical telescope upgrade to replace the existing 1.6-meter telescope at the Air Force Maui Optical Station (AMOS) on the island of Maui in Hawaii.



Advanced Electro-Optical System  
(AEOS)

Source: US Air Force



US Advanced Electro-Optical System (AEOS) Telescope Facility.

Source: US Air Force

## Variants/Upgrades

AEOS itself is an upgrade/enhancement project involving the development and installation of a more advanced electro-optical telescope.

### Program Review

**Background.** Under a congressional directive, the Advanced Electro-Optical System (AEOS) project was started in FY91. The Preliminary Design Review was completed during FY92, as was site selection and the acquisition of a 3.67-meter mirror blank from a canceled US Army research program. Facility design and environmental reports were initiated. A contract was awarded for the AEOS telescope in December 1992.

Facility design was completed in FY93. Also during that time period, the adaptive optics design was started, while the Critical Design Review (CDR) of the telescope was finalized. Additionally, work on the short wavelength infrared graph design was begun as per Congressional direction.

Acquisition for the adaptive optics started in FY94. At that time, Hughes Danbury Optical Systems (now part of Goodrich) was awarded a US\$12.1 million contract in August 1994 to provide Adaptive Optics Systems to be incorporated into the 3.5-meter telescope at Kirtland County, New Mexico, and the 3.67-meter telescope at the Air Force Maui Optical Station in Hawaii. (The delivery to AMOS was a complete system. The Hughes contract was finished by April 1997.) Other contract work included developing telescope control systems, continuing telescope development incremental funding, and beginning instrumentation acquisitions.

NASA conducted an independent design review during FY95. In March of that same year, a US\$6.1 million contract was awarded to COMSAT RSI for the construction and installation of the AEOS Telescope Enclosure System. Efforts and funding for telescope development, sensor instrumentation acquisitions, and lab support extended through FY97.

The agenda for FY98 continued the development of adaptive optics, sensors, and integration of the telescope system, purchase pre-operational spares, ongoing development of AEOS and Maui Space Surveillance System (MSSS) observatory control systems, and research and development upgrades to the MSSS. Other activities included further atmospheric characterization studies and spectrograph research.

Plans for FY99 included further development of the efforts in progress during FY98, completion of the MSSS observatory control system, R&D upgrades to it and operational transition of AEOS and visitor programs. Full operational capability was reached in July 2000. Additional site testing and integration of the adaptive optics system, procurement of spares, and the transition of the facility management system from Air Force Space Command to Air Force Research Laboratory was accomplished by the end of year 2000.

Other work in FY00 included the integration and test upgrade of the MSSS observatory control system, and continued research and development efforts for, and upgrades to, the MSSS, such as AEOS enhancements to instrumentation and beam, development of advanced daylight imaging techniques, and tool development. The FY01 agenda focused on enhancing operational utility of MSSS data products. The space-object identification tools for AEOS sensors were updated during this time. Other work included conducting daylight optical imaging studies and analyses as research in optimization of multiple channels for the 1.6-meter telescope, with a demonstration of high accuracy metrics through high accuracy orbit maintenance. Techniques were developed to detect and maintain orbits for small objects below current Space Surveillance Network (SSN) capabilities. Upon completion of these updates, a demonstration of them was held for AEOS during FY02.

Work continued during FY02, and included a continued follow-up role on AEOS, and additional work on lost-satellite search and non-imaging space-object identification to detect and chart smaller and fainter objects. Work on the Pan-STARRS effort also began, with a technical conception for execution of Pan-STARRS to include the development of advanced charged-coupled devices to detect very dim space objects up to the 24th magnitude, a telescope system that uses charged-coupled devices, and the hardware and procedures to collect and display the data.

Program plans for FY03 call for enhancing operational and research utility of the MSSS data products. Work will also center on developing improved exploitation tools and new data-fusion techniques to provide real-

time information and optimize system for small satellite data collection. Also on the agenda are upgrades for MSSS. A demonstration of AEOS/MSSS enhancements in daylight imaging will include partial daylight operations on the AEOS to increase availability for high priority tasks, as well as new areas of research.

Optics. In April 1999, AEOS received its US\$40 million adaptive optics system developed by Raytheon Optical Systems (formerly Hughes) for the telescope atop Haleakala. These were the last sensors reportedly needed to make AEOS fully operational. Mounted in a vibration-free, temperature-controlled room 60 feet below the telescope, the new sensors use 20 aligned optics to take a large beam of light gathered by the 3.67-meter telescope dish and shrink its focal length and diameter to a tighter and more precise beam. This helps to cancel any distortion introduced by movements of the atmosphere, thereby making the images sharper to view.

Scientific Community. In FY00, the US Department of Defense (DoD) and the National Science Foundation, Division of Astronomical Sciences (NSF/AST) agreed on a joint initiative to make AEOS, with its adaptive optics system, available to civilian astronomers. The agreement made 100 observing nights available over the two-year period during FY00 and FY01.

On February 8, 2001, the NSF/AST issued an opportunity for the science community to propose science projects on the AEOS telescope. The solicitation was first issued in FY00 as Program Solicitation NSF 00-70 for proposals due in June 2000, and was reissued for FY01 as Program Solicitation NSF-1-66. A total of US\$800,000 reportedly was available for four to six grants in total.

## Funding

		<u>US FUNDING</u>							
		<u>FY01</u>		<u>FY02</u>		<u>FY03</u>		<u>FY04</u>	
		<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>
<b>RDT&amp;E (US Air Force)</b>									
PE#0603444F <sup>(a)</sup>									
Maui Space Surveillance Systems		-	28.9	-	27.0	-	6.4	-	6.4
		<u>FY05</u>		<u>FY06</u>		<u>FY07</u>		<u>FY08</u>	
		<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>	<u>QTY</u>	<u>AMT</u>
<b>RDT&amp;E (US Air Force)</b>									
PE#0603444F									
Maui Space Surveillance Systems		-	6.4	-	6.5	-	6.6	-	N/A

All US\$ are in millions.

Source: US Department of Defense FY2003 RDT&E Budget Item Justification (R-2 Exhibit)

<sup>(a)</sup>Beginning in FY01, the Air Force Research Laboratory (AFRL) assumed management of AEOS and funding appears in PE#0603444F Maui Space Surveillance Systems (MSSS), Budget Activity 3, Advanced Technology. Additionally, starting in FY01, the AMOS portion became self-supporting, with operation and maintenance costs being generated through various program funding and user fees. The US Air Force still funds some AEOS maintenance and operation as part of its AMOS facility.

## Recent Contracts

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
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<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Hughes	12.1	Aug 1994 – CPAF contract to provide for Adaptive Optics Systems to be incorporated into the 3.5-meter telescope at Kirtland County, New Mexico, and the 3.67-meter telescope at the Air Force Maui Optical Station in Hawaii. The delivery to AMOS will be a complete system. Contract completed April 1997. (F29601-94-C-0111)
COMSAT RSI	6.1	Mar 1995 – FFP contract for construction and installation of the AEOS Telescope Enclosure System for the Air Force 3.67-meter electro-optical telescope on Mount Haleakala, Maui, Hawaii, at the Air Force Maui Optical Station. (F29601-95-C-0175)
Rocketdyne Technical Services	17.9	Sep 1998 – Contract is for FY99 operation, maintenance, support, research, and development at the MSSS. Contract completed September 1999. (F05604095-C-9011)
Rocketdyne Technical Services	7.7	Sep 1999 – Option to CPAF contract, F05604-95-C-90110P00072, to provide for FY00 operation, maintenance, support, research, and development at the MSSS. Contract completed September 2000.
Rocketdyne Technical Services	N/A	May 2000 – Five-year support contract with an established ceiling at US\$86.5 million. Services includes contractor employees for day-to-day operations, including telescope and support equipment, research projects, safety, security, and routine housekeeping. Contract number not available.
Boeing	86.5	May 2000 – An indefinite delivery/indefinite quantity contract to provide for operation and maintenance and R&D services through Sep 2005 for the MSSS. Funds will be obligated as individual delivery orders are issued. The Air Force may issue delivery orders totaling up to the maximum amount indicated above, though actual requirements may necessitate less than that amount. Contract is expected to be completed by September 30, 2005. (F29601-00-D-0204)
Logicon	18.6	Jul 2000 – An indefinite delivery/indefinite quantity contract to provide for system and engineering analysis, modeling, experiment design and analysis, and critical review through July 2005 of Air Force Technology Development & Tests programs. The program areas involved in this effort will include active and passive imaging, optical components, laser devices, advanced technology applications (weapons class laser applications) and the Maui Space Surveillance System (MSSS). Further funds will be obligated as individual delivery orders are issued. The Air Force can issue delivery orders totaling up to the not-to-exceed amount indicated above, though actual requirements may necessitate less than that amount. Contract is expected to be completed by July 31, 2005. (F29601-00-D-0202)

## Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	FY91	AEOS project initiated
Dec	1992	Contract for AEOS telescope awarded
	FY93	Adaptive Optics Systems development begun
Aug	1994	Contract for Adaptive Optics Systems procurement awarded
	FY95	NASA independent design review
Mar	1995	Contract for AEOS Telescope Enclosure System awarded
	FY99	Tentative time frame for full operational capability
Apr	1999	Adaptive optics system delivered for installation
Jul	2000	AEOS fully operational

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Oct	2000	Facility management transitioned from Air Force Space Command to Air Force Research Laboratory
	2001	Civilian/scientific community usage increases, which will partially augment future operational funding
	2005	Totally self-sufficiency planned to commence

## Worldwide Distribution

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The AEOS effort is funded and managed by the **US Air Force Research Laboratory**, but it is most likely used by all branches of the US Armed Forces, US Department of Defense, as well as selected Allied Nations. Additionally, the facility is available for use by civilian scientists on an approved project or contract basis.

## Forecast Rationale

Construction of the telescope is now complete. Any future operational funding will likely come from a variety of sources, as the US Air Force Research Laboratory wants to make the facility self-supporting and is currently soliciting ideas and research projects to achieve this goal by 2005. Some operations and maintenance funding is still provided by the US Air Force, as AEOS is part of the US Air Force Maui Optical Station (AMOS) and Maui Space Surveillance System (MSSS).

## Ten-Year Outlook

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The forecast chart has been omitted, as production has been completed and funding is for operation and maintenance only. Barring any sudden surge of activity, such as a major upgrade or enhancement, this report will be archived in the near future.

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