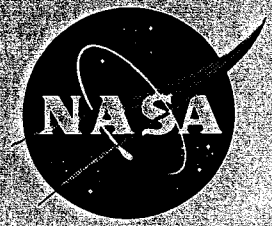
IG-97-022

AUDIT REPORT

USE OF EARTH OBSERVING SYSTEM (EOS) GROUND STATIONS IN LIEU OF THE TRACKING AND DATA RELAY SATELLITE SYSTEM (TDRSS)

MAY 30, 1997



National Aeronautics and Space Administration

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National Aeronautics and
Space Administration

Headquarters
Washington, DC 20546-0001

MAY 30 1997

Reply to Attn of: W

TO: Goddard Space Flight Center
Attn: 100/Center Director

FROM: W/Acting Assistant Inspector General for Auditing

SUBJECT: Use of Earth Observing System (EOS) Ground Stations in lieu of the Tracking and Data Relay Satellite System (TDRSS)
Assignment No. A-GO-96-010
Report No. IG-97-022

Enclosed is a final report on our survey on the Use of EOS Ground Stations in lieu of the TDRSS. The NASA Administrator approved the program based on incorrect financial information which does not reflect the full cost of operating the ground stations. The survey showed that the EOS ground stations' communication cost estimates are understated ranging from $8.3 to $15.9 million. We recommend that NASA reevaluate future projected funding requirements and, if necessary, take actions to ensure sufficient funding is available for ground station communication costs in the out years.

A draft report was issued on April 14, 1997. The Center's official response was received on May 12, 1997. The Center's response is included after the report's recommendation and is presented in its entirety as Appendix A to the report. The response indicates that management has planned corrective actions that are considered responsive to the intent of the recommendation. We, therefore, consider the recommendation closed for reporting purposes.

If you have any questions, please contact Kevin Carson, Acting Program Director for MTPE and Communications, at 301-286-0498, Daniel Samoviski, Acting Director, Audit Division-A, or me at 202-358-1232.

Robert J. Wesolowski

Enclosure

cc:
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INTRODUCTION

On September 24, 1996, the NASA Administrator approved the use of ground stations in lieu of the Tracking and Data Relay Satellite System (TDRSS) for Earth Observing System (EOS) polar orbiting spacecraft. Using ground stations requires less mass, power, and volume on the spacecraft, and the overall cost through fiscal year 2005 is estimated to be less than a TDRSS supported EOS spacecraft. The Space Operations Management Office (SOMO), the Office of Mission to Planet Earth (MTPE), and the MTPE Program Office at the Goddard Space Flight Center, all believe the decision to use the ground stations is beneficial.

The EOS ground network requires two ground stations. The Space Network (SN)/Ground Network (GN) study, conducted from 1994 through 1996 by a team of NASA personnel, recommended Fairbanks, Alaska and Spitsbergen, Svalbard (Norway) as the prime locations for the ground stations. These ground stations must be operational by June 2000 to support the EOS PM-1 spacecraft launch scheduled for December 2000.

NASA is pursuing commercialization of the EOS ground stations. It should be noted that the contractor will not be required to use the two sites recommended by the SN/GN study.

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OBJECTIVES, SCOPE, AND METHODOLOGY

OBJECTIVES

The four objectives of the survey are to determine whether:

1. Having separate EOS ground stations, and not using the TDRSS, will result in less cost to the program, an increase in the science area, or both.

2. Not having dual communications capability increases the risk factors.

3. Using EOS ground stations will have an impact on the current TDRSS constellation and the three new satellites being built.

4. Programmatic, technical, or policy issues are impacting the decision to use ground stations.

SCOPE AND METHODOLOGY

We performed the survey in accordance with generally accepted government auditing standards. The scope of this survey included reviewing:

- The SN/GN study results including options considered, cost estimates, and locations.

- The composition of the SN/GN study group.

- The Sounding Rocket Memorandum of Understanding with Norway including provisions for satellite operations.

MANAGEMENT CONTROLS REVIEWED

The significant management controls reviewed include:

- Steps taken to establish the SN/GN committee.

- Steps taken to compare the space network to the ground network.

- Briefings presented to various levels of NASA management for their information and concurrence.

- Establishment of cost estimates for the ground network. (TRW, Inc. completed the space network cost estimates under the common spacecraft contract.)

We identified a management control weakness in the area of full cost disclosure during the survey. This weakness is discussed in detail in the Observation and Recommendation section of the report.

SURVEY FIELD WORK Survey field work was conducted from July through November 1996 at the GSFC.

OBSERVATION AND RECOMMENDATION

RESULTS OF SURVEY

The survey showed that (1) using ground stations may cost less and may provide service to the high data rate instruments more effectively than TDRSS, (2) risk factors are not increased when using a ground network even though they do not have dual communications capabilities, (3) using ground stations will not significantly impact the current TDRSS constellation and the procurement of three new satellites, and (4) internal NASA issues exist which are impacting the decision to go to a ground solution. The survey did identify that communication costs in the SN/GN study cost estimates are understated. Management needs accurate cost estimates to ensure sufficient funding is available for ground station communication costs in the out years.

EOS GROUND STATION COMMUNICATION COST ESTIMATES ARE UNDERSTATED

The cost estimates associated with establishing the EOS ground stations are understated as presented in the July 23, 1996, SN/GN study package. Specifically, communication cost estimates for T-1 service from Alaska and Svalbard, and the Norway microwave service cost estimates are understated between $8.3 and $15.9 million. As a result of these omissions, the NASA Administrator approved the program based on incorrect financial information, which does not reflect the full cost of operating the ground stations.

The SN/GN study team used full cost principles when completing its review. The draft NASA Full Cost Initiative Agencywide Test Implementation Guide, dated October 9, 1996, states, "In its simplest terms, the concept of full cost ties all Agency costs . . . to major activities." A project's full cost is defined as "the sum of all direct costs, service costs, and G&A [general and administrative] costs associated with the project." In the EOS ground station cost estimates, the sum of all "costs associated with the project" was underestimated in the study conclusions. (Even though the full cost principles guidance was not final at the time the SN/GN study was conducted, the team applied the principles because the alternative eventually chosen will require their use.)

Our survey showed that EOS ground station communication cost estimates are understated between $8.3 and $15.9 million when compared to the original cost estimate of $118.7 million[1] (see Exhibit 2, Table 1.1). Specifically, T-1 and microwave services are understated.[2] The understated amounts and their components are discussed in detail below.

T-1 Service Cost Estimates are Understated

T-1 service is a telecommunication standard used for relaying tracking, telemetry, and command data between GSFC, Alaska or Svalbard, and the spacecraft. The T-1 capability is full duplex, meaning communications occur in both directions, and may be completed through satellite connections between GSFC and the two ground station locations or using a series of land-based communication lines.

The T-1 cost estimate of $100,000 used in the SN/GN study was mistakenly included as a yearly estimate, when in actuality it was a monthly estimate. As a result, actual costs for T-1 services are $1.2 million per year rather than $100,000 per year as indicated in the study. Through fiscal year 2005, T-1 services are understated by $8.3 million (adjusted for inflation).

Norway Microwave Service Cost Estimates are also Understated

Microwave service is only required for the Svalbard portion. The actual EOS ground station will be located in Longyearbyen on the island of Spitsbergen. Because this is mountainous country, a direct communication link cannot be easily established to the telecommunications satellite. Microwave repeaters (a passive device requiring no power) are therefore used to transport the signals across both a coastal and mountainous route to Isfjord Radio, where all communications for the territory are received and sent via satellite.

The Norway microwave service cost estimate updates were received after the Administrator gave approval for the ground stations on September 24, 1996. These cost updates, while untimely, showed that the original cost estimates were understated. Specifically, microwave service costs could potentially range from $120,000 (amount in original cost estimate) to $1,125,000 per year. The Project Manager for EOS Ground Stations estimated that NASA would most likely pay an amount approximating 60 percent of the full cost (60 percent of $1,125,000). The actual yearly costs will not be known until negotiations are complete between NASA and

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[1]The original cost estimate of $118.7 million represents ground network unique costs only.

[2]In the original cost estimate, T-1 costs were estimated at $100,000 per year and microwave services were estimated at $120,000 per year.

Norway. Depending on the amount eventually negotiated, we estimate that microwave service cost estimates are potentially understated up to $7.6 million (adjusted for inflation) through fiscal year 2005. Based on the range of microwave service costs, the total cost understatements are presented in Exhibits 1 and 2.

SUMMARY

In summary, the cost estimates associated with establishing the EOS ground stations are understated between $8.3 and $15.9 million. The amounts consist of $8.3 million in understated T-1 service costs and up to $7.6 million in understated microwave service costs through 2005. Management actions to address this condition will ensure that sufficient funding for EOS ground stations' communications costs are available through 2005.

RECOMMENDATION 1

MTPE management should reevaluate future projected funding requirements and, if necessary, take actions to ensure sufficient funding is available for ground station communication costs in the out years.

MANAGEMENT'S RESPONSE

Concur. Mission to Planet Earth management has evaluated the costs for realism and adjusted the funding profiles to ensure that all costs are covered within the Project's presently approved Program Operating Plan (POP) budget guidelines.

EVALUATION OF MANAGEMENT'S RESPONSE

The actions planned are considered responsive to the intent of the recommendation.

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SUMMARY OF UNDERSTATED T-1 AND MICROWAVE SERVICE COST ESTIMATES

Based on the range of microwave service costs, the total cost understatements are presented below.

- **Norway microwave service at $120,000 per year**

At the original estimate of $120,000 per year for microwave services, total costs are understated by approximately $8.3 million (see Exhibit 2, Table 1.2). This amount, adjusted for inflation, includes no change in the cost of microwave services plus the $8.3 million understated amount for T-1 services through 2005.

- **Norway microwave service at 60 percent of full cost**

When the microwave service costs are estimated at 60 percent of full cost (defined below) or approximately $700,000 per year, total costs are understated by approximately $12.7 million (see Exhibit 2, Table 1.3). This amount, adjusted for inflation, includes $4.4 million for microwave services plus the $8.3 million for understated T-1 services through 2005.

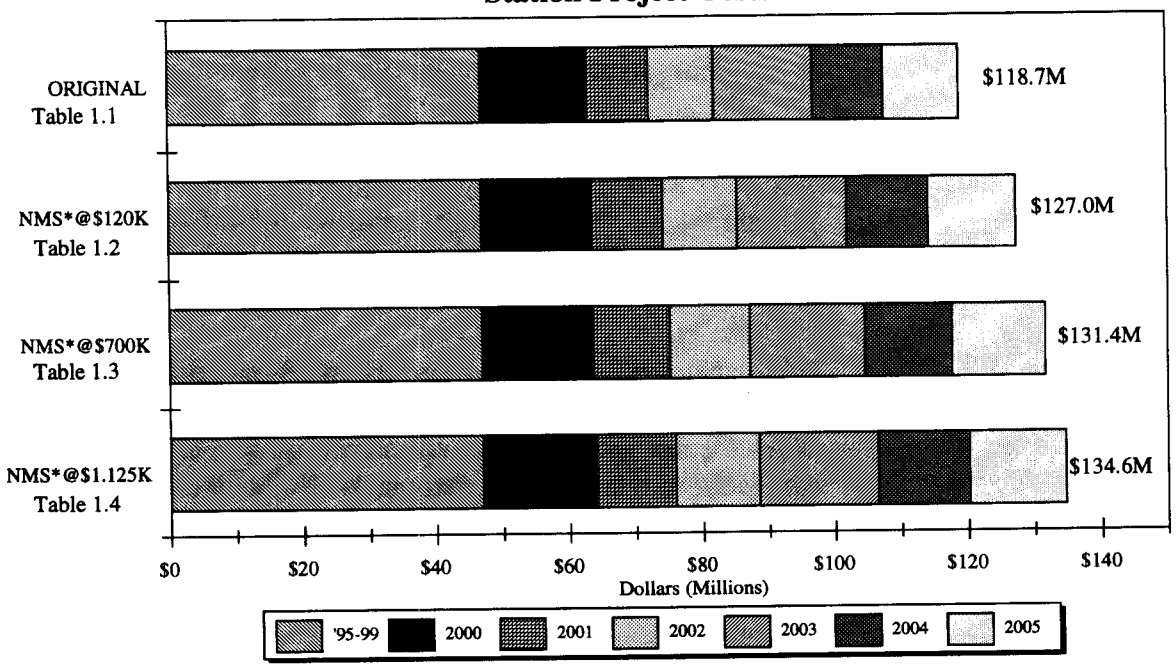
- **Norway microwave service at full cost of $1,125,000**

Norway provided microwave service cost estimates to the EOS Ground Stations Project Manager at $50,000 per year per two megabits. The T-3 service requires 45 megabits of microwave service, which results in a cost of $1,125,000 per year. At this amount, total costs are understated by approximately $15.9 million (see Exhibit 2, Table 1.4). This amount, adjusted for inflation, includes $7.6 million for microwave services and $8.3 million for understated T-1 services through 2005.

The chart represents the differences between the original cost estimate of $118.7 million and the possible estimates based on the range of understated communication costs (microwave and T-1).

EXHIBIT 1

Comparison of Estimated Ground Station Project Costs



** The T-1 service estimates have been corrected to $1.2M per year. The Norway Microwave Service (NMS) costs are updated per the cost estimates identified on the graph.*

Ground Station Project and Communication Cost Estimate Comparisons

Original SN/GN Data with Inflation - in $K

	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05
Inflation Factors	*1*	*1.045*	*1.092*	*1.1412*	*1.19252*	*1.2462*	*1.3023*	*1.3609*	*1.4221*	*1.4861*	*1.55297*
EOS Operations Center SN	$0	$171	$268	$97	$0	$0	$0	$0	$0	$0	$0
EOS Operations Center GN	$0	$254	$372	$223	$0	$0	$0	$0	$0	$0	$0
Ground Stations	$112	$687	$717	$11,946	$31,182	$4,436	$2,842	$2,969	$7,924	$3,243	$3,389
Communications Expenses	$0	$0	$0	$0	$1,002	$11,480	$6,475	$6,766	$7,071	$7,389	$7,721
Subtotal (by year)	**$112**	**$1,112**	**$1,357**	**$12,266**	**$32,184**	**$15,916**	**$9,317**	**$9,735**	**$14,995**	**$10,632**	**$11,110**
Cumulative Total	**$112**	**$1,224**	**$2,581**	**$14,847**	**$47,031**	**$62,947**	**$72,264**	**$82,000**	**$96,994**	**$107,626**	**$118,737**

Table 1.1

SN/GN Data with Norway microwave service at original $120,000 per year and increased T-1 service - in $K

	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05
Inflation Factors	*1*	*1.045*	*1.092*	*1.1412*	*1.19252*	*1.2462*	*1.3023*	*1.3609*	*1.4221*	*1.4861*	*1.55297*
EOS Operations Center SN	$0	$171	$268	$97	$0	$0	$0	$0	$0	$0	$0
EOS Operations Center GN	$0	$254	$372	$223	$0	$0	$0	$0	$0	$0	$0
Ground Stations	$112	$687	$717	$11,946	$31,182	$4,436	$2,842	$2,969	$7,924	$3,243	$3,389
Communications Expenses	$0	$0	$0	$0	$1,002	$11,937	$7,908	$8,263	$8,635	$9,024	$9,430
Subtotal (by year)	**$112**	**$1,112**	**$1,357**	**$12,266**	**$32,184**	**$16,373**	**$10,750**	**$11,232**	**$16,559**	**$12,267**	**$12,819**
Cumulative Total	**$112**	**$1,224**	**$2,581**	**$14,847**	**$47,031**	**$63,404**	**$74,154**	**$85,386**	**$101,945**	**$114,212**	**$127,030**
Delta	**$0**	**$0**	**$0**	**$0**	**$0**	**$457**	**$1,433**	**$1,497**	**$1,564**	**$1,635**	**$1,708**	**$8,294**

Table 1.2

Ground Station Project and Communication Cost Estimate Comparisons

SN/GN Data with Norway microwave service at $700,000 per year (60%) and increased T-1 service - in $K

	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	
Inflation Factors	*1*	*1.045*	*1.092*	*1.1412*	*1.19252*	*1.2462*	*1.3023*	*1.3609*	*1.4221*	*1.4861*	*1.55297*	
EOS Operations Center SN	$0	$171	$268	$97	$0	$0	$0	$0	$0	$0	$0	
EOS Operations Center GN	$0	$254	$372	$223	$0	$0	$0	$0	$0	$0	$0	
Ground Stations	$112	$687	$717	$11,946	$31,182	$4,436	$2,842	$2,969	$7,924	$3,243	$3,389	
Communications Expenses	$0	$0	$0	$0	$1,002	$12,178	$8,663	$9,053	$9,460	$9,886	$10,330	
Subtotal (by year)	**$112**	**$1,112**	**$1,357**	**$12,266**	**$32,184**	**$16,614**	**$11,505**	**$12,022**	**$17,384**	**$13,129**	**$13,719**	
Cumulative Total	**$112**	**$1,224**	**$2,581**	**$14,847**	**$47,031**	**$63,645**	**$75,150**	**$87,172**	**$104,556**	**$117,684**	**$131,404**	
Delta	**$0**	**$0**	**$0**	**$0**	**$0**	**$698**	**$2,198**	**$2,286**	**$2,389**	**$2,497**	**$2,609**	**$12,667**

Table 1.3

SN/GN Data with Norway microwave service at $1,125,000 per year and increased T-1 service - in $K

	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	
Inflation Factors	*1*	*1.045*	*1.092*	*1.1412*	*1.19252*	*1.2462*	*1.3023*	*1.3609*	*1.4221*	*1.4861*	*1.55297*	
EOS Operations Center SN	$0	$171	$268	$97	$0	$0	$0	$0	$0	$0	$0	
EOS Operations Center GN	$0	$254	$372	$223	$0	$0	$0	$0	$0	$0	$0	
Ground Stations	$112	$687	$717	$11,946	$31,182	$4,436	$2,842	$2,969	$7,924	$3,243	$3,389	
Communications Expenses	$0	$0	$0	$0	$1,002	$12,355	$9,216	$9,631	$10,064	$10,517	$10,990	
Subtotal (by year)	**$112**	**$1,112**	**$1,357**	**$12,266**	**$32,184**	**$16,791**	**$12,058**	**$12,600**	**$17,988**	**$13,760**	**$14,379**	
Cumulative Total	**$112**	**$1,224**	**$2,581**	**$14,847**	**$47,031**	**$63,822**	**$75,880**	**$88,480**	**$106,468**	**$120,229**	**$134,608**	
Delta	**$0**	**$0**	**$0**	**$0**	**$0**	**$874**	**$2,741**	**$2,865**	**$2,994**	**$3,128**	**$3,269**	**$15,871**

Table 1.4

Management's Response

National Aeronautics and
Space Administration
Goddard Space Flight Center
Greenbelt, MD 20771

MAY 12 1997

Reply to Attn of: 201

TO: NASA Headquarters
Attn: W/Acting Assistant Inspector General for Auditing

FROM: 100/Director

SUBJECT: GSFC Response to Office of Inspector General (OIG) Draft Report on Use of Earth Observing System (EOS) Ground Stations in lieu of the Tracking and Data Relay Satellite System (TDRSS), A-GO-96-010

We appreciate the opportunity to review and respond to the findings and recommendation in the OIG's draft report dated April 14, 1997, and appreciate the consideration that the OIG gave to the information we provided during the April 4, 1997, exit conference.

We agree with the OIG's recommendation that Mission to Planet Earth management should re-examine the cost estimates for the ground station communications for the EOS polar stations. We have evaluated the costs for realism and adjusted the funding profiles to ensure that all costs are covered within the Project's presently approved Program Operating Plan (POP) budget guidelines. Based on this assurance, we request that this recommendation be closed for reporting purposes.

Dr. Robert Price is the Action Official. Please call Dr. Price at 301-286-2041 or call Ms. Barbara Sally, GSFC Audit Liaison Specialist, at 301-286-8436 if you have any questions or need further assistance related to this audit.

Joseph H. Rothenberg

cc:
170/Dr. R. Price
201/Ms. B. Sally
HQ/JM/Mr. J. Werner
HQ/YM/Mr. D. Norton
HQ/W/Mr. K. Carson

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APPENDIX B

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Kevin J. Carson	Acting Program Director, Mission to Planet Earth and Communications
Diane R. Choma	Auditor-in-Charge
Iris Purcarey	Program Assistant

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