



035636

~~1.14.10~~

16

11-0094



Administration Of Certain Programs For Developing Space Nuclear Auxiliary Power Systems B-164105

Atomic Energy Commission

UNITED STATES
GENERAL ACCOUNTING OFFICE

~~700604~~ 095638

JUNE 3, 1971



UNITED STATES GENERAL ACCOUNTING OFFICE

WASHINGTON, D.C. 20548

CIVIL DIVISION

B-164105

Dear Dr. Seaborg:

This is our report on the administration of certain programs for developing space nuclear auxiliary power systems.

Copies of this report are being sent to the Director, Office of Management and Budget; the Chairman and the Vice Chairman, Joint Committee on Atomic Energy; the Secretary of Defense; and the Administrator, National Aeronautics and Space Administration.

Sincerely yours,

A. T. Samuelson

Director, Civil Division

The Honorable Glenn T. Seaborg
Chairman, Atomic Energy Commission

D I G E S T

100 743

WHY THE REVIEW WAS MADE

Since the initiation of the U.S. scientific space effort in the mid-1950's, the Atomic Energy Commission (AEC) has been developing nuclear electrical power Systems for Nuclear Auxiliary Power, called SNAP systems. SNAP systems have been developed using isotopic and reactor heat sources to supply electrical power for space, land, and sea uses.

More than \$380 million has been expended by AEC in developing SNAP systems for space use. Some of the systems were developed for specific mission requirements, others as demonstration devices, and others under a technology-readiness philosophy.

In consideration of the funds expended and the significance of SNAP systems to the space program, the General Accounting Office (GAO) made a review of AEC's management activities in developing a variety of SNAP systems for space use.

FINDINGS AND CONCLUSIONS

AEC has developed five SNAP systems that have been launched and operated in space. These systems have generally met or exceeded mission requirements.

GAO's review of selected SNAP development programs did not identify any unnecessary costs or other adverse effects that resulted from AEC's management of the program. GAO did find, however, that improvement of certain administrative and management practices was needed to ensure more effective and economical conduct of these programs. These practices are summarized below.

AEC procurement regulations provide that contracts be negotiated in a timely manner. GAO found, however, that the scope of work, estimated costs, and fixed fees for changes to the cost-plus-fixed-fee contracts for the development of the SNAP-19 and SNAP-27 generator systems, involving proposed costs of \$18.7 million, were negotiated after completion of all, or a substantial portion of, the related work. (See p. 11.)

Also the SNAP-29 program was conducted under a letter contract for 31 months of the 36-month contract period, during which contract obligations

Tear Sheet

totalled about \$17.3 million. While AEC provided technical direction during this period--including the establishment of interim levels of effort and cost ceilings--most of the work under this letter contract was performed before a definitized statement of work, estimated costs, and fixed fees were negotiated. (See p. 13.)

GAO believes that after-the-fact negotiations of contracts can result in increased contract costs, because the contractors have potential advantages in the negotiations and have less incentive to keep costs to a minimum. AEC advised GAO that it believed that its close technical direction of the SNAP contractors minimized the opportunity for unnecessary contract work and for increased contract costs.

AEC's SNAP-27 generator was developed at the request of the National Aeronautics and Space Administration (NASA) to supply electric power to experiments left on the lunar surface by astronauts. The system was deployed by the Apollo 12 astronauts and has exceeded its power output and operational lifetime goals. Another SNAP-27 generator was deployed on the lunar surface by the Apollo 14 astronauts, and it too has performed successfully.

GAO found, during its review of the SNAP-27 generator development program, that generally close coordination existed between AEC and NASA, the SNAP-27 user. GAO did note, however, that closer coordination during the early phase of the program of the development of a satisfactory fuel cask--a component that houses the SNAP-27 fuel capsule containing plutonium-238--might have revealed certain problems at an earlier date and might have precluded the necessity for a crash program to develop a satisfactory fuel cask. (See p. 17.)

AEC initiated the SNAP-29 program with the objective of developing a multihundred-watt, short-lived, radioisotope thermoelectric generator for space use. This program was conducted under AEC's technology-readiness philosophy. Under this philosophy, technology which has a high probability of being needed in the future is developed to the point at which mission planners have a basis for confidence that it will work.

Technical problems which arose early in the SNAP-29 program made it likely that AEC could not meet its established time schedules and cost estimates for developing a generator to demonstrate flight technology. Later, due to budget reductions, the program was phased out after the fabrication of an electrically heated engineering model in June 1969. Total program costs were about \$20 million. (See p. 20.)

AEC informed GAO that the Department of Defense, the system's primary potential user, had been fully informed of the SNAP-29 program status through periodic progress reports, formal meetings, and personal contacts and had continued to express interest in the program. AEC, however, did not maintain records showing the various factors considered in reaching decisions.

GAO believes that, consistent with good management practices, AEC's Division of Space Nuclear Systems should maintain records showing the factors considered in reaching decisions involving substantial Government expenditures and the bases for such decisions.

RECOMMENDATIONS OR SUGGESTIONS

GAO suggested that:

- AEC's Division of Contracts emphasize to its contracting officers the importance of complying with AEC's regulations which provide for timely negotiations of definitized contracts and for taking action to minimize delays in such negotiations. (See p. 16.)
- AEC's Division of Space Nuclear Systems include in its records documentation of discussions with potential users regarding development programs, the factors considered in reaching decisions, and the bases for actions taken. (See p. 25.)

AGENCY ACTIONS AND UNRESOLVED ISSUES

AEC agreed with GAO's suggestions and took appropriate steps to implement them.

C o n t e n t s

	<u>Page</u>
DIGEST	1
CHAPTER	
1 INTRODUCTION	4
2 CONTRACT ADMINISTRATION OF SNAP PROGRAMS	9
Contract change proposals and state- ments of work negotiated after com- pletion of all or most of the work	11
Lack of effective contracting practices on SNAP-29 contract	13
Conclusions	16
3 MANAGEMENT OF SNAP-27 AND SNAP-29 PROGRAMS	17
SNAP-27	17
SNAP-29	19
Conclusions	24
4 SCOPE OF REVIEW	26
APPENDIX	
I Excerpts from attachment to letter dated October 7, 1970, from contractor to the General Accounting Office	29
II Letter dated September 29, 1970, from Iso- topes, Incorporated, to the General Ac- counting Office	33

ABBREVIATIONS

AEC	Atomic Energy Commission
DOD	Department of Defense
GAO	General Accounting Office
NASA	National Aeronautics and Space Administration
SNAP	Systems for Nuclear Auxiliary Power

D I G E S T

WHY THE REVIEW WAS MADE

Since the initiation of the U.S. scientific space effort in the mid-1950's, the Atomic Energy Commission (AEC) has been developing nuclear electrical power Systems for Nuclear Auxiliary Power, called SNAP systems. SNAP systems have been developed using isotopic and reactor heat sources to supply electrical power for space, land, and sea uses.

More than \$380 million has been expended by AEC in developing SNAP systems for space use. Some of the systems were developed for specific mission requirements, others as demonstration devices, and others under a technology-readiness philosophy.

In consideration of the funds expended and the significance of SNAP systems to the space program, the General Accounting Office (GAO) made a review of AEC's management activities in developing a variety of SNAP systems for space use.

FINDINGS AND CONCLUSIONS

AEC has developed five SNAP systems that have been launched and operated in space. These systems have generally met or exceeded mission requirements.

GAO's review of selected SNAP development programs did not identify any unnecessary costs or other adverse effects that resulted from AEC's management of the program. GAO did find, however, that improvement of certain administrative and management practices was needed to ensure more effective and economical conduct of these programs. These practices are summarized below.

AEC procurement regulations provide that contracts be negotiated in a timely manner. GAO found, however, that the scope of work, estimated costs, and fixed fees for changes to the cost-plus-fixed-fee contracts for the development of the SNAP-19 and SNAP-27 generator systems, involving proposed costs of \$18.7 million, were negotiated after completion of all, or a substantial portion of, the related work. (See p. 11.)

Also the SNAP-29 program was conducted under a letter contract for 31 months of the 36-month contract period, during which contract obligations

totalled about \$17.3 million. While AEC provided technical direction during this period--including the establishment of interim levels of effort and cost ceilings--most of the work under this letter contract was performed before a definitized statement of work, estimated costs, and fixed fees were negotiated. (See p. 13.)

GAO believes that after-the-fact negotiations of contracts can result in increased contract costs, because the contractors have potential advantages in the negotiations and have less incentive to keep costs to a minimum. AEC advised GAO that it believed that its close technical direction of the SNAP contractors minimized the opportunity for unnecessary contract work and for increased contract costs.

AEC's SNAP-27 generator was developed at the request of the National Aeronautics and Space Administration (NASA) to supply electric power to experiments left on the lunar surface by astronauts. The system was deployed by the Apollo 12 astronauts and has exceeded its power output and operational lifetime goals. Another SNAP-27 generator was deployed on the lunar surface by the Apollo 14 astronauts, and it too has performed successfully.

GAO found, during its review of the SNAP-27 generator development program, that generally close coordination existed between AEC and NASA, the SNAP-27 user. GAO did note, however, that closer coordination during the early phase of the program of the development of a satisfactory fuel cask--a component that houses the SNAP-27 fuel capsule containing plutonium-238--might have revealed certain problems at an earlier date and might have precluded the necessity for a crash program to develop a satisfactory fuel cask. (See p. 17.)

AEC initiated the SNAP-29 program with the objective of developing a multihundred-watt, short-lived, radioisotope thermoelectric generator for space use. This program was conducted under AEC's technology-readiness philosophy. Under this philosophy, technology which has a high probability of being needed in the future is developed to the point at which mission planners have a basis for confidence that it will work.

Technical problems which arose early in the SNAP-29 program made it likely that AEC could not meet its established time schedules and cost estimates for developing a generator to demonstrate flight technology. Later, due to budget reductions, the program was phased out after the fabrication of an electrically heated engineering model in June 1969. Total program costs were about \$20 million. (See p. 20.)

AEC informed GAO that the Department of Defense, the system's primary potential user, had been fully informed of the SNAP-29 program status through periodic progress reports, formal meetings, and personal contacts and had continued to express interest in the program. AEC, however, did not maintain records showing the various factors considered in reaching decisions.

GAO believes that, consistent with good management practices, AEC's Division of Space Nuclear Systems should maintain records showing the factors considered in reaching decisions involving substantial Government expenditures and the bases for such decisions.

RECOMMENDATIONS OR SUGGESTIONS

GAO suggested that:

- AEC's Division of Contracts emphasize to its contracting officers the importance of complying with AEC's regulations which provide for timely negotiations of definitized contracts and for taking action to minimize delays in such negotiations. (See p. 16.)
- AEC's Division of Space Nuclear Systems include in its records documentation of discussions with potential users regarding development programs, the factors considered in reaching decisions, and the bases for actions taken. (See p. 25.)

AGENCY ACTIONS AND UNRESOLVED ISSUES

AEC agreed with GAO's suggestions and took appropriate steps to implement them.

CHAPTER 1

INTRODUCTION

We have examined into selected aspects of the Atomic Energy Commission's Systems for Nuclear Auxiliary Power development programs. The objective of AEC's SNAP program is to develop compact nuclear power sources for specialized space, land, and sea uses. Our review was limited to certain selected power sources developed for space use.

The responsibility for the development of various space reactor and radioisotopic systems for the production of electric power is vested in the Space Electric Power Office of AEC's Division of Space Nuclear Systems. For the period covered by our review, the Director, Division of Space Nuclear Systems, also served as the Manager, Space Nuclear Propulsion Office, a joint National Aeronautics and Space Administration and AEC organization. Subsequent to the completion of our review, all AEC and NASA space systems activities were consolidated in a joint AEC-NASA organization under the Director, Space Nuclear Systems.

AEC enters into contracts with commercial firms for research and development of SNAP systems. AEC's Division of Contracts is responsible for developing and maintaining policies, standards, and procedures for an AEC-wide program for the management of personal property and supplies. Contract administration of SNAP development programs is vested in AEC's various operations offices. At the time of our review, Sandia Corporation, an AEC operating contractor, served as technical advisor to AEC on SNAP development programs.

In carrying out its responsibility for development of electric power systems for space use, AEC has developed five power systems that have been launched and operated in space. These power systems have generally met or exceeded mission requirements. While these power systems were developed as a result of user agency requirements, AEC has also developed other power systems for potential space mission applications and as demonstration devices as defined by the user agency. More than \$380 million has been expended by AEC in developing SNAP systems for space use.

The power systems developed under AEC's SNAP program are of two types: one (radioisotope generator) using the decay of certain radioisotopes, such as plutonium-238, as a heat source and the other (reactor system) using nuclear fission reactors as a heat source. All SNAP systems launched to date have utilized a thermoelectric power conversion system. The power conversion system converts heat into an electric current flow as a result of the differences in temperature of two different metals joined together, called thermocouples. Other conversion systems which will have higher conversion efficiency are being developed primarily for use with SNAP reactors.

AEC began its SNAP program in 1955, about the same time as official U.S. scientific space efforts were initiated, to meet the anticipated power requirements of large satellites planned at that time. Concurrent development of power sources using isotopic and nuclear fission reactor heat sources was initiated.

The first successful power system using a radioisotopic heat source, polonium-210, was assembled and tested in January 1959. This generator, designated SNAP-3,¹ utilized a thermoelectric power conversion system and produced 5 watts of electricity. SNAP-3A, a modified SNAP-3, was first launched on June 29, 1961, to supply supplemental electric power for a Department of Defense satellite and thus became the first atomic power unit to operate in space. AEC announced in June 1970 that the SNAP-3A was heading into its 10th year in orbit, 5 years beyond its 5-year design life. Although it is no longer in operational use, SNAP-3A transmits signals regularly. Since the launch of SNAP-3A, a number of generators have been developed and launched into space.

As noted earlier, development of SNAP power systems utilizing nuclear fission reactors as heat sources was also initiated. To date only one such SNAP power system, SNAP-10A, has operated in space. It was launched in April 1965, and it operated for 43 days.

¹All odd-numbered SNAP power plants use radioisotopic fuel. Even-numbered SNAP power plants use nuclear fission reactors as a source of heat.

This report contains our comments concerning the SNAP-19, SNAP-27, and SNAP-29 programs. Background information on each of these SNAP systems follows.

SNAP-19--The SNAP-19 program was initiated in 1963 under a cost-plus-fixed-fee contract with Martin Marietta Corporation to supply auxiliary power to NASA's Nimbus B meteorological satellite. Responsibility for the SNAP-19 program was transferred to Isotopes, Incorporated, a Teledyne company, as a result of its acquisition of the Nuclear Division of Martin Marietta Corporation on August 4, 1968.

Two SNAP-19's, each supplying about 25 watts of electrical power, were launched on the Nimbus B satellite in May 1968. This mission aborted shortly after lift-off due to booster guidance problems unrelated to the SNAP-19 system. Two additional SNAP-19's were successfully launched on the Nimbus B-2 spacecraft on April 14, 1969, and have been providing supplemental power continuously to the Nimbus weather satellite since that time. Initial power output from the two SNAP-19 generators was 56 watts. The SNAP-19 was designed to operate for a 1-year period. Subsequent to its launch, power decreased to approximately 40 watts by February 1971.

SNAP-27--In November 1963 NASA requested AEC to investigate the use of radioisotope generators on the lunar surface. After completing feasibility and engineering studies, AEC awarded a cost-plus-fixed-fee contract for the development of a generator for use in the NASA-Apollo program as a power source for the Apollo Lunar Surface Experiments Package. This experiments package consisted of a series of instruments and subsystems for deployment on the lunar surface for transmission of environmental information back to earth.

The SNAP-27 is a plutonium-238-fueled generator designed to provide about 65 watts of electrical power on the lunar surface for a period of 1 year. The plutonium fuel capsule is transported in a separate fuel cask attached to the exterior of the lunar module, while the generator itself is stored within the lunar module. After the lunar module has landed on the lunar surface, the fuel capsule is removed from the fuel cask and inserted into the SNAP-27 generator by the astronauts.

Original plans called for deployment of the SNAP-27 system on the lunar surface in the initial lunar landing by the Apollo 11 astronauts. Due to concern over the amount of astronaut time and energy necessary for deployment of the experiments package, however, only very simple experiments which required little power were used. Therefore the SNAP-27 system was not used until the Apollo 12 mission.

The SNAP-27 system was successfully deployed on the lunar surface by the Apollo 12 astronauts in November 1969, and has transmitted electric power at a relatively constant level of about 73 watts. Another SNAP-27 generator was deployed on the lunar surface by the Apollo 14 astronauts on February 5, 1971, and is performing successfully.

SNAP-29--The SNAP-29 program was undertaken to develop a short-lived, multihundred-watt, radioisotope thermoelectric generator utilizing polonium-210 as a fuel. This development program was initiated in July 1966 under a letter contract with Martin Marietta Corporation as a result of interest expressed in the program by DOD. Responsibility for the SNAP-29 program was transferred to Isotopes, Incorporated, as a result of its acquisition of the Nuclear Division of Martin Marietta Corporation on August 4, 1968.

Because of budget reductions, the SNAP-29 program was phased out at the end of fiscal year 1969. The program was terminated after the delivery of an engineering model of the SNAP-29 generator, along with several thermoelectric modules which were tested with a conventional electric heat source.

- - - -

AEC's SNAP development programs have required extending the state of the technology to meet the increasing demands of user agencies for space electric power capability. The objectives of AEC in this program are: (1) to provide the long-lead-time technology necessary for user agency designers to select and use nuclear power systems with confidence for future missions and (2) to develop, qualify, and deliver nuclear power systems for specific missions. It is anticipated that power requirements in the 100- to 1,000-watt range, as well as in the 10- to 100-kilowatt range, will be forthcoming in the 1970's.

Certain systems have mission requirements at the time of development; other systems are developed to a state of technology readiness in anticipation of future mission requirements. Technology readiness is defined by AEC as that point in time when major problems of a particular system have been generally defined and solved and a demonstration of the solution has been conducted. According to AEC, technology readiness is being pursued so that mission planners can have a better indication of the state of technology of a specific system and thereby be in a better position to assess its ability to meet program goals. AEC has stated also that technology readiness is necessary to minimize the need for crash programs and to provide meaningful cost and schedule data for flight system development projections.

CHAPTER 2

CONTRACT ADMINISTRATION OF SNAP PROGRAMS

Although AEC procurement regulations provide that contracts be negotiated in a timely manner, the scope of work, estimated costs, and fixed fees for changes to the cost-plus-fixed-fee contracts for the development of the SNAP-19 and SNAP-27 generator systems, involving proposed costs of about \$18.7 million, were negotiated after completion of all, or a substantial portion of, the related work.

Also the SNAP-29 generator development program was conducted under a letter contract for 31 months of the 36-month contract period, during which contract obligations totaled about \$17.3 million. AEC provided technical direction to the program during this period and established interim levels of effort and cost ceilings. Most of the work under this contract, however, was performed before a definitized contract statement of work, total estimated costs, and fixed fees were negotiated.

We did not determine that unnecessary costs had been incurred as a result of these after-the-fact negotiations. We believe, however, that after-the-fact negotiations of contracts can result in increased costs, because the contractors have potential advantages in the negotiations and have less incentive to keep costs to a minimum.

Under a cost-plus-fixed-fee contract, the contractor receives a fixed fee and is reimbursed for allowable costs. Under normal circumstances the negotiations of a contract--scope of work, estimated costs, and fixed fee--precede the undertaking of the contract work. The fee is not adjusted for variations from estimated costs of performing the work but may be adjusted for increases or decreases in the scope of work. Since the contract fee is fixed, in part, in relation to the original estimated costs and is not increased as a result of cost overruns, the contractor has no incentive to incur unnecessary costs in order to increase its fee.

A delay in the negotiation of a contract's scope of work, estimated costs, and fixed fee until all or most of the work has been accomplished, however, can result in the

fee's being based largely on actual costs, rather than on estimated costs, and can have the undesirable effect of cost-plus-percentage-of-cost contracting, which can provide contractors with positive incentives to inflate contract costs in order to increase their profit.

Such after-the-fact negotiation of a contract also allows for the possibility of performing work which might not have been authorized if the negotiations had preceded commencement of work. Failure to negotiate statements of work prior to the initiation of work, or at least prior to the completion of a significant amount of the work, also could have an adverse effect on the technical direction of the program, because the contractor is not bound to a statement of work until it has been negotiated. As noted above, however, AEC provided technical direction of the work and established levels of effort and cost ceilings.

Delays in definitizing contracts also can affect the manner in which the contractor administers the work performed under the contract. Late negotiation of definitized contracts makes it more difficult for the contractor to employ good management practices, such as long-range planning and budgeting of manpower and capital equipment requirements.

We were advised by AEC that it believed that its approach involving close technical direction of the SNAP contractors minimized the opportunity for unnecessary contract work and for increased contract costs.

AEC's Division of Contracts is responsible for developing and maintaining policies, standards, and procedures for an AEC-wide program for the management of personal property and supplies. The responsibility for the contract administration of SNAP programs is delegated to certain of the AEC operations offices. AEC's New York Operations Office had initial contract administration responsibility for the SNAP-19 and SNAP-27 programs. The responsibilities for these programs were transferred to the Albuquerque Operations Office on April 29, 1966, and May 13, 1966, respectively. Contract administration for the SNAP-29 program was the responsibility of the Albuquerque Office from the effective date of the contract--July 1, 1966.

CONTRACT CHANGE PROPOSALS AND
STATEMENTS OF WORK NEGOTIATED AFTER
COMPLETION OF ALL OR MOST OF THE WORK

Our review of certain aspects of the contract administration of the SNAP-19 and SNAP-27 contracts showed that, for many contract change proposals, the statements of work, the estimated costs, and the fixed fees had been negotiated after all, or a substantial portion of, the work had been completed.

The number of contract changes increasing the scope of the work under the SNAP-19 and SNAP-27 contracts that were negotiated by the Albuquerque Office and the extent to which the fees for the changes were based on actual costs are shown below.

	SNAP-19 (note a)	<u>SNAP-27</u>
Number of contract changes negotiated	33	41
Fee base for contract changes (note b)	\$2,665,387	\$16,048,774
Actual costs included in fee base	\$2,360,101	\$12,924,496
Percent of actual costs included in fee base	88.6	81

^a SNAP-19 statistics are those relating to contract change proposals submitted by Martin Marietta Corporation, the original SNAP-19 contractor.

^b The fee base is the allowable contract costs that were used as a basis for negotiation of the contract fee.

For 24 of the 41 contract changes which increased the scope of work under the SNAP-27 contract, the contractor's fees were negotiated after more than 80 percent of estimated costs had been incurred. The average fee rate on these 24 contract changes was 6.21 percent, the same average rate as that negotiated on the 13 contract changes for which the fees were negotiated prior to commencement of the work.

All fees negotiated were within AEC's established fee policy limitations.

Undefinitive contract changes were used to initiate work, increase fund obligations, and extend the time for negotiation of definitive contract changes under both the SNAP-27 and SNAP-19 contracts. For example, contract change 4 to the SNAP-27 contract, effective April 21, 1966, authorized the performance of work on a "thermoelectric leg product specification." This change authorized funds of \$200,000 for the work and stated that a definitive contract change would be negotiated and executed within 60 days from the date the contracting officer signed the change (June 22, 1966).

Revision 1 to change 4, dated August 22, 1966, authorized an additional \$200,000 for this work. Revisions 1 through 9 to change 4 extended the time for negotiation of a definitive change to a total of 750 days, and contract change 17 increased the total funds authorized to \$430,000. The definitive change, including a statement of work, estimated cost, and fixed fee, was not negotiated until June 1968, after the work had been completed at a cost of \$545,660.

The contractor was reimbursed for the full costs of \$545,660 incurred in completing the work authorized under contract change 17. Because the contractor had failed to comply with the contract provision requiring that the contracting officer be notified when 90 percent of the obligated funds had been committed or expended, however, the fee was based on the \$430,000 authorized by the contract change. The negotiated fee of \$27,000, which was considered by the contract negotiation panel to be consistent with the fee rate of 6.26 percent for other efforts under the contract, was equivalent to an effective rate of 4.95 percent on actual costs incurred.

In another instance, contract change 5, effective June 1, 1966, authorized funds of \$423,000 for phases III and IV of the SNAP-27 program. A memorandum dated December 5, 1967, by the chairman of the contract negotiation panel for phases III and IV work stated that funds authorized for phases III and IV had been increased by contract

changes 5, 9, 13, 14, 16, 17, 18, and 19 to a total of \$11,107,811. Contract change 5 provided 120 days, beginning September 9, 1966, for the negotiation and execution of a definitive change to the contract. The seven subsequent changes extended the time for execution of a definitive modification to March 1968, a total of 600 days. Actual costs constituted 86 percent of the negotiated cost of the contract changes on which the fee of 6.26 percent had been computed.

Our review of the SNAP-19 and SNAP-27 contracts showed that in no instance had the statement of work been negotiated before the contractor was authorized to commence work. For the 33 change orders to the SNAP-19 contract, the average time between the authorization to commence work and the negotiation of the statement of work was 433 days; the actual time ranged from 40 to 847 days. Similarly, for 40 change orders to the SNAP-27 contract, the time averaged 197 days and ranged from 14 to 579 days.

The Albuquerque Office informed us that improvements had been made in administrative practices for negotiating contracts. Our analysis of SNAP-19 and SNAP-27 contract changes for work initiated in fiscal years 1966 through 1969 indicated that the amount of actual costs used in negotiations had been reduced along with the number and funding level of contract change proposals, as shown below.

<u>Year</u>	<u>Number of contract changes</u>	<u>Negotiated costs (fee base)</u>	<u>Actual costs included in fee base</u>	<u>Percent of actual costs included</u>
1966	39	\$14,314,719	\$12,150,356	84.9
1967	15	2,548,780	2,180,544	85.6
1968	12	1,811,684	973,949	53.7
1969	6	237,339	87,497	36.7

LACK OF EFFECTIVE CONTRACTING PRACTICES
ON SNAP-29 CONTRACT

The SNAP-29 generator development program was conducted under a letter contract initially to be effective for

90 days, but it continued in effect for 31 months of the 36-month contract period. Most of the work under the contract was completed before the level of effort, total estimated costs, and fixed fees were negotiated and made a part of the contract.

We believe that the delays in definitizing the SNAP-29 contract made effective administrative control over contractor operations and technical direction of the program more difficult. AEC informed us that insufficient and incorrect information supplied by the contractor had resulted in delays in negotiating a definitized contract and contract change proposals.

The contract administration of the SNAP-29 contract is highlighted below.

- AEC, on May 10, 1966, authorized the Albuquerque Office to negotiate a contract for SNAP-29 generator development.
- A letter contract was approved by AEC Headquarters on August 18, 1966, and backdated to July 1, 1966. It authorized \$2.2 million for the 90-day letter-contract period. The letter contract stated that a definitive contract calling for the contractor's best efforts to produce a flight-qualified generator at the end of a 39-month period at a total estimated cost of \$20.6 million would be negotiated within 90 days.
- The letter contract was subsequently modified 30 times to authorize additional funds and/or to increase the time for negotiation and execution of a definitive contract.
- Funds authorized under the letter contract were increased from \$2,200,000 to \$17,255,000 during the period July 1, 1966, through January 31, 1969.
- Negotiation of the level of effort, estimated costs, and fixed fee for the contract period July 1, 1966, through October 31, 1967, was completed on October 6, 1967.

- Isotopes, Incorporated, purchased the Nuclear Division of Martin Marietta Corporation and assumed responsibility for the SNAP-29 program on August 4, 1968.
- Negotiation of the level of effort, estimated costs, and fixed fee for the contract period November 1, 1967, through January 31, 1969, was completed on January 16, 1969.
- Negotiation of the scope of work, estimated costs, and fixed fee for the remaining 5 months, February 1 through June 30, 1969, was completed on March 28, 1969.

According to AEC, the major problem in the negotiation of a definitized contract with Martin Marietta Corporation, the original SNAP-29 contractor, was reaching agreement on the contractor's proposed formula for allowability of independent research and development costs and related patent rights. Before this matter could be resolved, technical problems developed necessitating revisions to the proposed scope of work.

AEC advised us that problems had also been caused by (1) disagreement between AEC and Martin Marietta Corporation on how the level of effort was to be expressed and (2) difficulty in obtaining meaningful and accurate data from both contractors.

Delays in definitizing contracts can affect the contractors' administration of the program. We were advised by Isotopes, Incorporated, which assumed contract responsibilities for the SNAP-19 and SNAP-29 programs on August 4, 1968, that the lack of definitized contracts made it more difficult for the contractor to employ good management practices, such as long-range planning and budgeting of manpower and capital equipment requirements.

AEC stated that the original SNAP-29 contractor had complicated negotiations by changing its organization and instituting a new accounting system in mid-1967. These changes required a complete reanalysis of costing under the new accounting system and necessitated a review of cost allocations

made to reflect the organizational change. A review of the contractor's accounting system also was necessary.

CONCLUSIONS

We believe that AEC should have placed greater emphasis on the timely negotiation of definitized SNAP-19, SNAP-27, and SNAP-29 contracts, to preclude the potential advantages to the contractors that can result from after-the-fact negotiations and to provide for generally improved overall program administration.

We therefore suggested to AEC that its Division of Contracts emphasize to AEC contracting officers the importance of complying with AEC's regulations which provide for timely negotiations of definitized contracts and for taking action to minimize delays in such negotiations.

AEC agreed with our suggestion and took steps to implement it, including the issuance of letters emphasizing the need for timely negotiation of contracts to the various AEC operations offices which have contract administration responsibilities. These operations offices have been requested to report annually on the timeliness of negotiation of contracts.

CHAPTER 3

MANAGEMENT OF SNAP-27 AND SNAP-29 PROGRAMS

SNAP-27

Our review of AEC's program for the development of the SNAP-27 generator as a power source for NASA's Apollo Lunar Surface Experiments Package showed that generally there was close coordination between AEC and NASA on interface design problems. We believe, however, that closer coordination during the early phase of the program could have precluded a delay of several months in determining that the fuel cask mounting structure on the lunar module that was being developed by NASA would not permit the necessary free body reentry of the fuel cask into the earth's atmosphere in case of an abort of a mission. When a satisfactory mounting scheme could not be developed, a crash program was initiated to develop a fuel cask having reentry capability under all circumstances. The fuel cask houses the SNAP-27 fuel (plutonium-238 microspheres).

The original design of the fuel cask was based on its reentry as a free body in the event of mission abort; that is, it would detach from the lunar module and return to the earth's surface separately. AEC informed us that, in the early stages of the program, it was believed that such free body reentry might occur naturally as a result of the lunar module's burning up early in reentry and thus rendering the cask a "free body."

The first SNAP-27 design called for integrated shipment of the generator system to the lunar surface. To provide additional safety, however, it was decided in November 1965 to transport the SNAP-27 fuel separately in a fuel capsule enclosed in a fuel cask attached to the exterior of the lunar module. Because of this design change, the astronauts must insert the fuel capsule into the SNAP-27 generator when it is deployed on the lunar surface.

The safety criteria established for the SNAP-27 system required the intact reentry of the fuel cask into the earth's atmosphere in case of a mission abort. These

safety criteria, which were directly applicable to the development of the fuel cask since it contained the plutonium-238 fuel, were established to prevent any undue radiation hazards to the populace.

To meet these safety criteria, the SNAP-27 contractor designed a fuel cask having at one end a reentry heat shield capable of withstanding environments resulting from earth orbit aborts. This design required orientation of the fuel cask in a preferred direction so that the heat shield would prevent release of the fuel from the fuel capsule. The cask was designed so that this required orientation could be achieved when in a free body environment; that is, not attached to or hindered by any other hardware, such as the lunar module.

According to the SNAP-27 contractor, the free body objective might be accomplished by (1) passive release of the fuel cask from the lunar module as a result of lunar module breakup during reentry or (2) forced separation by use of an eject mechanism. AEC informed us that, initially, design work on the SNAP-27 fuel cask had been based on the passive release concept.

An interface control document prepared by AEC's SNAP-27 contractor on March 23, 1966, and sent to NASA stated that NASA was to be responsible for development of the system for mounting the fuel cask on the lunar module. AEC believed that in the event of an abort this system would permit release of the cask as a free body near the start of reentry into the earth's atmosphere. In August 1966, however, AEC learned that the method of attachment being devised would not permit separation of the fuel cask from the lunar module to which it was attached. The NASA contractor stated that it had utilized titanium bands to ensure that the cask would not leave the lunar module under any circumstances.

On August 15, 1966, NASA, in an effort to resolve the reentry problem, initiated design studies to determine the practicality of developing an active release mechanism which would allow the cask to be separated from the lunar module early in an abort and fall as a free body. In October 1966, the AEC contractor was directed to initiate backup design work on a release mechanism.

The contractor and Sandia Laboratory conducted 2-week feasibility studies on a new fuel cask concept, because NASA informed AEC in December 1966 that a 2-month delay in the Apollo program would occur if a fuel cask ejection system had to be installed on the lunar module. NASA considered such a delay to be very serious.

On January 5, 1967, during a meeting at AEC Headquarters, AEC, after consultations with NASA, decided to develop a new fuel cask. This fuel cask was designed as an omnidirectional body not requiring separation from the lunar module or orientation during reentry. Its development was undertaken on a crash-program basis.

The January 1967 decision to change the fuel cask design resulted in an increase in weight from 7.5 pounds to approximately 25.5 pounds. As a result of this change, according to NASA records, certain modifications were necessary to the Apollo Lunar Surface Experiments Package and the lunar module. These modifications resulted in additional costs estimated at about \$1 million for the experiments package and about \$385,000 for the lunar module.

In our opinion, closer coordination between AEC and NASA during the early phase of the program could have precluded the delay in determining that the fuel cask mounting structure on the lunar module that was being developed by NASA would not permit the necessary free body reentry of the fuel cask in case of an abort and might have precluded the need for the crash program to develop a satisfactory fuel cask for the SNAP-27 generator system.

We believe that, with the exception of the fuel cask problem, adequate coordination existed between AEC and NASA. This matter is being reported on, however, to emphasize to AEC and its contractors the continued need for close coordination between AEC and user agencies in carrying out development programs, such as SNAP-27.

SNAP-29

AEC's SNAP-29 development program was conducted under its technology-readiness philosophy--a philosophy also followed by NASA in its programs. Under this philosophy,

technology which has a high probability of being needed in the future is developed to the point at which mission planners have a basis for confidence that it will work, for estimating the costs, and for scheduling it for flight system development. The technology-readiness approach is geared to making the technology available when it is needed and to avoiding excessively costly and otherwise ineffective crash programs to meet a need on a short schedule.

In the SNAP-29 program, technical problems arose early in the program that made it likely that AEC could not meet the established time schedules and cost estimates for developing a generator to demonstrate flight technology. At the time the problems arose, about \$5 million of the estimated \$20 million cost of the program had been incurred.

According to AEC's Division of Space Nuclear Systems, DOD, the system's potential user, had been fully informed of program status through periodic progress reports, formal meetings, and personal contacts. During these meetings and contacts, reconfirmation of DOD's interest in the SNAP-29 system was obtained. The AEC Division, however, did not maintain a record showing various factors considered and the bases for decisions reached.

We did not identify any adverse effects to the program resulting from the lack of records. We believe, however, that, consistent with good management practices, AEC's Division of Space Nuclear Systems should have maintained records showing the factors considered in reaching decisions involving substantial Government expenditures and the bases for such decisions.

Initiation of SNAP-29 program

On March 31, 1966, the AEC General Manager transmitted to DOD the results of feasibility studies for integration of a generator system having SNAP-29 capabilities into certain DOD missions. This correspondence indicated that such a radioisotope generator would be feasible and could be developed in 30 to 36 months at a cost of about \$20 million. Also AEC stated that its proposed development program would include the delivery of flight systems to demonstrate the degree of reliability required.

On April 1, 1966, the AEC Chairman sent a similar letter to the Director, Defense Research and Engineering, DOD. The Director's reply, dated May 21, 1966, expressed interest in radioisotope generators in three categories, one of which related to the SNAP-29 proposed capability.

The Director stated that spacecraft which were expected to fly in the 1972-73 time period would require power supply commitments in the 1968-69 period and that a decision to use the SNAP-29 would be based heavily on AEC's interim work on isotope system safety, cost, and weight characteristics. The Director noted that certain potential development problems identified by AEC would have to be resolved and indicated that resolution of these problems was primary and that meeting the 30- to 36-month development schedule was secondary. He stressed, however, that the development effort probably was essential for future generator development.

On June 17, 1966, AEC decided to award a 90-day letter contract for development of the SNAP-29 generator to allow additional time to more definitively establish the entire program and to provide further opportunity for DOD to state a firm requirement for the SNAP-29 end product.

In a letter dated June 30, 1966, DOD advised AEC that a review of the SNAP-29 contractor's proposal had been completed and that conclusions had been reached. The letter emphasized "key program goals which must be met to enhance the probability that SNAP-29 can be used." A statement of goals and their effect on the probability of mission applications was expressed. These goals included:

- "a. Reliability remains a factor of utmost importance and must be demonstrated by adequate ground and flight test ***.
- "b. Compatibility of the SNAP-29 with space system requirements must be insured in several areas. *** We would expect a flight test to demonstrate that such considerations have been met prior to actual application to a space system."

* * * * *

"e. Although the most immediately apparent applications are estimated to reach flight status in the 1968-1970 time period, I believe that the concerns expressed by [the Director of Defense Research and Engineering, DOD, in his May 21, 1966, letter] relative to the 30-36 month development schedule should be considered in your program planning."

DOD recommended that the development of the SNAP-29 proceed on a schedule compatible with ensuring that the goals would be met and concluded by stating, "We will not commit a unit to a specific mission until the development is well along and probably not before flight demonstration." According to AEC, in view of paragraph e above and subsequent communications with DOD, achievement of technical goals was primary and schedule was secondary.

AEC's Albuquerque Operations Office awarded a 90-day letter contract to Martin Marietta Corporation on August 18, 1966, backdated to July 1, 1966. The report of negotiations for this letter contract stated that a definitive contract would be negotiated requiring the delivery of flight units by September 1969, the end of the 39th month. This delivery date was later revised to December 31, 1969.

Technical problems in SNAP-29 development

Late in calendar year 1966, technological developments showed that the material selected for use for the fuel block was not adequate to meet the intact reentry safety criteria. According to the AEC technical advisor, the Sandia Project Director, the fuel block problem resulted in additional program costs and delays in program schedules. The SNAP-29 contractor estimated that a fuel block material change would result in a cost increase of \$5 million and an extension of the completion date by about 8 months, which would have delayed the delivery of flight units to early in fiscal year 1971.

Because of the fuel block problem, the SNAP-29 development had to be reoriented to provide a concentrated effort on the critical materials matter. Resumption of most of the development work was deferred pending resolution of the problem since the program schedule was not critical to DOD.

In January 1967 AEC modified its program objectives to accommodate this increased fuel block development effort. The contractor was informed that hardware effort would be limited to that necessary to demonstrate SNAP-29 system technology in 1969, that flight hardware would not be required, and that fixed hardware schedules had been eliminated. At that time about \$5 million of the total estimated program costs of \$22 million had been expended.

We were advised by AEC that the January 1967 program objective revision had been a temporary decision so that emphasis could be placed on solving the fuel block material problems. According to AEC, this revision meant that the delivery of flight-tested hardware would probably not be possible within the time constraints of the initial development schedule.

AEC records show that in June 1968 other problems were experienced in developing a satisfactory fuel block material, which required consideration of a fuel dispersal safety criteria in July 1968. A task force was formed in September 1968 at the direction of the Director, Division of Space Nuclear Systems, to expedite the study of the fuel dispersal approach. By November 1968 essentially all work on the fuel block had been suspended pending resolution of the safety criteria to be used.

The Director of AEC's Division of Space Nuclear Systems advised us in December 1970 that from the time of his appointment in March 1967 through late 1968,

*** On several occasions, I personally met with
*** a member of the principal staff of the Director, Defense Research and Engineering, DOD. Even though we had letters from the high management levels of DOD *** stating a definite desire for the development of the SNAP-29 technology, the

express purpose of those meetings was to advise DDR&E of SNAP-29 program status and to obtain reconfirmation of the continuing potential need for the SNAP-29 technology. In each of those meetings, with the exception of the last, *** [the DOD official] reiterated the need for the SNAP-29 and strongly urged us to continue with the work."

Records showing the various factors considered and the bases for decisions reached were not maintained by the AEC Division.

Termination of SNAP-29 development

In November 1968 DOD advised AEC that a specific system requirement of the type for which a SNAP-29 generator could be utilized had failed to evolve as previously anticipated; however, DOD continued to foresee potential applications for a generator of the SNAP-29 type which could compete with other power sources.

Fiscal year 1970 budgetary reductions necessitated the termination of the SNAP-29 program at the end of fiscal year 1969. To effect the orderly closeout of the program, the contractor, at AEC's request, fabricated an electrically heated engineering model of the SNAP-29 system which was delivered to AEC in June 1969. The total cost of the SNAP-29 program was about \$20 million.

CONCLUSIONS

We believe that, in view of the magnitude of the estimated development work remaining to be performed at the time the technical problems with the SNAP-29 were encountered, the likely adverse effect on meeting program time schedules and cost estimates and the technology-readiness philosophy under which AEC was proceeding without a specific requirement from the potential user, AEC's Division of Space Nuclear Systems should have maintained records showing the factors considered in reaching decisions involving substantial Government expenditures and the bases for such decisions.

We therefore suggested to AEC that its Division of Space Nuclear System's records include documentation of discussions with potential users regarding development programs, the factors considered in reaching decisions, and the bases for actions taken. AEC agreed with our suggestion and took action to implement it.

CHAPTER 4

SCOPE OF REVIEW

Our review was performed at AEC Headquarters in Germantown, Maryland; at its Albuquerque Operations Office, Albuquerque, New Mexico; at its contractor-operated Sandia Laboratories, Albuquerque, New Mexico; at its Canoga Park Area Office, Canoga Park, California; and at NASA's Manned Spacecraft Center, Houston, Texas. We visited various AEC contractors during the review.

Our review was directed primarily toward examining into the contracts for the development of the SNAP-19, SNAP-27, and SNAP-29 generator programs and the management of the SNAP-27 and SNAP-29 programs. We also conducted a limited review of AEC's zirconium hydride reactor development program.

We also reviewed AEC's policies, procedures, and available records and obtained the views of knowledgeable AEC, NASA, and contractor personnel.

APPENDIXES

COMMENTS OF THE SNAP-27 CONTRACTOR

[See GAO note, p. 32.]

DEVELOPMENT OF THE SNAP-27 FUEL CASK

The design and development of the fuel cask is the key element in the discussion of the SNAP-27 program in the draft report. Our records disclose facts not reflected in the GAO report, and we will attempt to clarify certain aspects and expand upon the report in the following paragraphs.

The cask in which the SNAP-27 fuel capsule is transported to the moon represented, for its time, a unique development. It was required to furnish reentry protection to a high temperature body which could approach the earth's atmosphere in a random fashion with no active orientation systems.

It was determined early in the program that this objective might be accomplished in either of two ways: 1) passive release of the cask from the LEM as a result of its breakup during reentry, or 2) forced separation by use of an eject mechanism.

In order to determine the acceptability of depending on the Lunar Module breakup, it was necessary to conduct a complicated analytical program. This analysis demonstrated that the Lunar Module breakup could not be depended upon to occur quickly enough to generate free body reentry at a sufficiently early stage in case of an abort, to give assurance of the necessary high degree of nuclear safety confidence. Accordingly, an active ejection mechanism was adopted as the design concept to assure free body reentry, and active ejection was determined by AEC and NASA to be feasible. Under that approach, an ejection mechanism with appropriate performance characteristics would separate the cask from the LEM. The significance of this feature is that the cask was designed to orient itself when it encountered the atmosphere as a free body, so that reentry protection materials were needed only on those surfaces exposed to heating. This approach not only would have yielded a light-weight cask, but also took maximum advantage of configurations and materials thoroughly characterized in previous NASA and DOD programs.

APPENDIX I

Without provisions for ejection, the cask could remain attached to the Lunar Module and would have no way of reentry in a preferred direction. Accordingly, omni-directional reentry shielding was required, and this created a problem involving a greater extension of the state-of-the-art. For these reasons, the free body approach was incorporated into the design specifications for the cask.

[See GAO note, p. 32.]

After completion of the design of the free body cask, the evolution of the Apollo program plans indicated a serious design and schedule problem in incorporating the ejection system, especially the required sensory equipment, and *** [the contractor] was instructed to proceed with the design of an omni-directional reentry capability.

[See GAO note, p. 32.]

[See GAO note, p. 32.]

DELAYED NEGOTIATIONS - CCN PROPOSALS

This is a widespread and difficult problem, particularly on programs which contain research such as the SNAP-27. We agree that every effort should be made by contractor and procurement agency alike to conduct prompt and reasonable negotiation of revised and additional costs generated under contract change notices.

[See GAO note, 32.]

APPENDIX I

The report mentions that a fixed fee of 6.2% was negotiated consistently. We negotiated a total of \$1,497,000 in fixed fees. This equates to a fee percentage of 5.32% on total program costs of \$28,160,000.

The profit realized by the contractor will be significantly reduced during post-contract audit because of certain disallowances required in the AEC regulations (e.g., unallowable bid and proposal expenses, et al).

GAO note: Material deleted from the letter was concerned with information included in the report draft which is not included in the final report. At the contractor's request, its name has been deleted from the report and the above comments.

ROBERT KLEINER
Vice President



A TELEDYNE COMPANY

ISOTOPES
WESTWOOD LABORATORIES
3000 BURKMAN BLVD.
WESTWOOD, NEW JERSEY 07645
TELEPHONE: (201) 261-1000

September 29, 1970

Mr. Daniel F. Stanton
Assistant Director
United States General Accounting Office
Washington, D. C. 20548

Dear Mr. Stanton:

Reference is made to your letter addressed to Dr. J. Laurence Kulp, President of Isotopes, Incorporated, dated August 21, 1970. As you may recall Mr. Peter Vogelberger, Vice President in charge of our Nuclear Systems Division in Timonium, and I visited with you and your staff on Thursday, September 17, 1970, to review the matters contained in your report as they pertained to Isotopes, Incorporated. We were extremely pleased at the courteous and attentive treatment we were given in your office.

You asked us to forward our comments to you in writing. This letter briefly outlines the position of Isotopes, Incorporated with respect to your proposed report to Congress.

At the outset, it is our corporate position that these comments be incorporated into your report as an attachment thereto and that various factual matters which will be specifically referred to herein be inserted into the body of the report. We also hope that you will take these comments into account in your final revisions to the report. We have no objections to your making reference to our corporate name in connection with these comments.

Turning first to the specific revisions to be made to the body of the report, we indicated to you that your report should make a clear distinction between the tenure of Martin Marietta Corporation with respect to its responsibility for the SNAP-29 and SNAP-19 programs and Isotopes, Incorporated's subsequent management of these programs. As you know, Isotopes, Incorporated (a wholly owned subsidiary of Teledyne, Inc.) acquired the Nuclear Division of Martin Marietta Corporation on August 4, 1968 and the responsibility for the SNAP-29 Contract was transferred to Isotopes, Incorporated by a novation agreement, Contract AT-(29-2)-2660 executed on 31 August 1968. Hence, your analysis of the contractors' performances vis-a-vis the period during which Martin Marietta Corporation was the contractor and Isotopes, Incorporated was the contractor should be clearly delineated.

Referring to the second paragraph on page 10 which relates to SNAP-29, you should insert in the fourth sentence between "1966" and "because" the words "with Martin Marietta Corporation".

APPENDIX II



Mr. Daniel F. Stanton

September 29, 1970

On page 30, you have printed a table with respect to SNAP-19. You agreed to revise this table to show the relative portions allocable to Martin Marietta Corporation and Isotopes, Incorporated with respect to SNAP-19.

On page 34, paragraph 3, you should add the following: "...and covered contractually by Contract AT-(29-2)-2062 executed in July 1968 by Martin Marietta Corporation and the AEC." Also on page 34, there should be a sentence between the third and fourth paragraphs which reads substantially as follows: "The original contractor, Martin Marietta Corporation, sold its Nuclear Division to Isotopes, Incorporated (a wholly owned subsidiary of Teledyne, Inc.) on August 4, 1968 and this Contract was novated to Isotopes, Incorporated by Contract AT-(29-2)-2660 dated 31 August 1968." Page 34, paragraph 5, you should add the following: "...and definitized by Modification 2 to Contract AT-(29-2)-2062 executed in June 1969." Further on page 34, in the paragraph which reads, "According to AEC....", between the words "definitized contract" and "was reaching" you should insert the words "with Martin Marietta Corporation".

We are seriously concerned with the implications and inferences which will be drawn from the Albuquerque self-justification for the delays in negotiation on page 34 which reads as follows: "We were informed by Albuquerque that delays in negotiation were caused by (1) disagreement between AEC and the contractor on how the level of effort was to be expressed and (2) difficulty in obtaining meaningful and accurate data from the contractor." Point one ostensibly involves Martin Marietta Corporation but that is not made clear in the context of the paragraph. Point two presumably involves both Martin Marietta Corporation and Isotopes, Incorporated. The facts are these: On December 27, 1968, Albuquerque finally was able to define the desired SNAP-29 statement of work for the period November 1, 1967 to January 31, 1969 and requested a cost proposal which was expeditiously submitted by Isotopes, Incorporated's letter number 3110-201A on December 27, 1968. Negotiations were conducted during the period January 6, 1969 to January 16, 1969 at Albuquerque, and Modification No. 1 to Contract AT(29-2)-2062 covering the period November 1, 1969 to January 31, 1969 was executed in early February 1969. Modification No. 1 to AT(29-2)-2062 required that a further Modification be negotiated by February 28, 1969 to cover the balance of SNAP-29 work through June 30, 1969. Again Isotopes, Incorporated responded immediately. The detailed sequence of requests, responses and negotiations was as follows: In its letter of January 29, 1969, Albuquerque requested a cost proposal for the period February 1, 1969 to June 30, 1969 to be submitted by February 7, 1969 (nine days). On February 7, 1969, Isotopes, Incorporated submitted the requested cost proposal. Albuquerque reviewed the cost proposal for a week and then requested additional information by TWX of February 14, 1969. Isotopes, Incorporated provided the additional information on February 19, 1969 and February 21, 1969. Further



Mr. Daniel F. Stanton

September 29, 1970

proposal revisions were provided at Albuquerque's request on March 4, 1969 and March 5, 1969. Negotiations were completed during the periods March 10 to March 14, 1969 and March 26 to March 28, 1969. The total elapsed time from request for cost proposal to completion of negotiations was approximately two months. The AEC forwarded a signed Modification No. 2 for execution by Isotopes, Incorporated on June 2, 1969 and the executed contract was returned to Albuquerque on June 25, 1969.

In view of the broad and non-specific nature of the Albuquerque information to the GAO, it is our recommendation that the entire paragraph quoted above viz., ("We were informed....") should be deleted. If you desire to retain it, we request that the information contained in our proposed paragraph be added on page 34 following the "We were informed...." clause.

The first paragraph of the history of the SNAP-19 program, on page 9 of your report, should be revised to read as follows: "The SNAP-19 program was initiated in 1963 under Contract AT(30-1)-3607 with the Martin Marietta Corporation for the purpose of supplying auxiliary power to the NASA Nimbus B meteorological satellite. Two SNAP-19's each supplying about 25 watts of electrical power were launched on the Nimbus B satellite in May 1968. This mission aborted shortly after lift-off due to booster guidance problems unrelated to the SNAP-19. Two additional SNAP-19's each supplying about 28 watts of electrical power were fabricated by Isotopes, Incorporated under a new Contract AT(29-2)-2650 and successfully launched on the Nimbus B-2 satellite on April 14, 1969. Isotopes, Incorporated delivered the generators for the April 1969 launch ahead of schedule and for nearly 10% less than the estimated cost. Initial power output for the two SNAP-19 generators on the Nimbus B-2 space craft was 56 watts. The SNAP-19 was designed to operate for a one year period. Since its launch, power has decreased to approximately 48 watts as of February 1970.

Reference is made to your review of SNAP-29 on pages 14, 15 and 16. Based upon our oral conversation, you agreed to clarify that section to indicate that the production of an "engineering model" of a SNAP-29 generator was not to be interpreted as an unsatisfactory conclusion to the SNAP-29 program. You should add the words "...due to a change of safety philosophy of preliminary studies" to the end of the second sentence beginning "We found that...." and ending with the word "encountered", in the second paragraph on page 14 of your review of the SNAP-29 program.

Isotopes, Incorporated feels that the substance of the above comments should be incorporated in the final report. Additionally, we feel that there are other aspects of a subjective nature with respect to your report which should be seriously considered.



Mr. Daniel V. Stanton

September 29, 1970

Most important is the GAO analysis of the supposed advantages the contractor received as the result of AEC's issuing of letter contracts and the delay in obtaining the final contract. We can assure you, as we did orally, that the contractor suffers far more than the government with respect to a letter contract. First, the contractor cannot properly follow good business management practices such as long range planning, sales forecasting, budgeting manpower requirements, forecasting capital equipment requirements and the like. Contract requirements can be changed by the governmental agency at will. There is no protection for the contractor in the event of Termination for Convenience by the government and employees are in a temporary status. Additionally, no fixed fees are payable or awarded and in the event a final contract is never executed, there is no fixed fee. As a matter of fact in the SNAP-29 program, nearly one million dollars of unbilled fee had accumulated while Martin Marietta Corporation had the program and this could not be billed until the contract was finally executed. The loss in interest alone amounted to many thousands of dollars. Even more important is the disparity in the respective positions of the government and the contractor at the time the contract is finally negotiated. At these negotiations, since the work has already been completed, the contractor is entirely at the mercy of the governmental agency with respect to fixed fee since the government can literally dictate the fee to be allowed. It should be pointed out that once the contract was novated to Isotopes, Incorporated, numerous visits were made to the General Manager of the AEC and to Albuquerque urgently requesting a contract for the total period of performance.

[See GAO note, p. 37.]



Mr. Daniel F. Stanton

September 29, 1970

With respect to your third recommendation, we also agree with the general statement but many times such after-the-fact negotiations at times are inevitable due to the internal agency changing of priorities. This approach implies a very heavy responsibility on the part of the AEC to maintain strong planning and budgeting functions so as not to introduce major delays and work interruptions in the contractor's efforts and jeopardize the user's mission.

[See GAO note.]

On page 16, regarding the third paragraph of the chronology, the real reason for reverting to consideration of fuel dispersal safety criteria in April 1968 was not the problem of satisfactory heat block material development but rather a combination of scheduling problems at the fueling facility and a developing awareness that the gadolinium polonide fuel form developed by the AEC was probably inadequate to meet intact/impact safety criteria.

If you have any questions, please do not hesitate to contact me at any time at the above address and I will be happy either alone or with Mr. Vogelberger to discuss the matter with you again.

Sincerely,

Robert Kleiner

RK: jm

GAO note: Material deleted from the letter was concerned with information included in the report draft which is not included in the final report.