REPORT TO

JOINT COMMITTEE ON ATOMIC ENERGY

REVIEW OF

ACCOUNTABILITY CONTROLS GAINED

SPECIAL NUCLEAR MATERIALS

NUCLEAR MATERIALS AND EQUIPMENT CORPORATION

[redacted]

BY

THE COMPTROLLER GENERAL

OF THE UNITED STATES

[redacted]

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

JUN 2 0 1967

B-157767

Dear Mr. Chairman:

The General Accounting Office has made a review of policies, procedures, and practices of the Atomic Energy Commission and of Nuclear Materials and Equipment Corporation, a Commission licensee, relating to accountability of special nuclear materials. The review was made pursuant to a request made by letter dated September 7, 1966, from the Chairman of the Joint Committee on Atomic Energy. Also, in accordance with this request we have completed similar reviews of two other licensees and plan to report to you in the near future on the results of these reviews.

The Commission has recently made a number of revisions to its program for domestic safeguarding of special nuclear material, and we have been advised that additional actions are planned which have been designed to strengthen the program. We are therefore making no recommendations regarding existing regulations, contracts, and procedures.

The Commission and the licensee have had an opportunity to comment on the matters presented in this report, and their comments have been considered in the report. The licensee's written comments and our evaluation thereof are included as an appendix to the report.

A copy of this report is being sent today to the Vice Chairman of the Joint Committee on Atomic Energy. As agreed to by your staff representatives, we are making copies of this report available to the Commission and to the licensee. We plan to make no further distribution of this report unless copies are specifically requested, and then distribution will be made only after your approval has been obtained or public announcement has been made by you concerning the contents of the report.

Sincerely yours,

Comptroller General
of the United States

The Honorable John O. Pastore, Chairman
Joint Committee on Atomic Energy
Congress of the United States

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REPORT ON REVIEW

OF

ACCOUNTABILITY CONTROLS OVER

SPECIAL NUCLEAR MATERIALS

NUCLEAR MATERIALS AND EQUIPMENT CORPORATION

ATOMIC ENERGY COMMISSION

INTRODUC 'ION

The General Accounting Office has made a review of policies, procedures, and practices of the Atomic Energy Commission and of Nuclear Materials and Equipment Corporation (NUMEC), Apollo, Pennsylvania, relating to accountability of special nuclear materials owned by the Atomic Energy Commission (AEC) and held by NUMEC, an AEC licensee, at its Apollo facility. We did not examine into accountability practices at NUMEC's plutonium facility located at Leechburg, Pennsylvania.

Our review which was made pursuant to a request by the Chairman, Joint Committee on Atomic Energy, dated September 7, 1966, was directed toward an examination of the adequacy of AEC policies, procedures, and practices relating to accountability as they were applied to NUMEC's operations. Also, we examined NUMEC's written accountability procedures, past and current accountability and financial records, and certain production records.

BACKGROUND

During the period from the establishment of the Atomic Energy Commission in 1947 until the enactment of the Atomic Energy Act of 1954 (42 U.S.C. 2011), all special nuclear material in this country was owned by the United States Government and, with certain exceptions, was held by AEC and its cost-type contractors operating Government owned or controlled plants and laboratories. Under these circumstances, AEC, responsible for program direction and contract administration, was in a position to require its cost-type contractors to establish systems for control over special nuclear material.

Therefore, through a body of policies, guides, instructions, and standards, AEC developed a system of control for cost-type contractors, designed to demonstrate, through appropriate measurement and recording of receipts, production, and removals, and through physical inventories, the quantity and location of material on hand at the various facilities. The system was designed to localize, within a given plant, where losses were occurring, in order to provide a basis for investigation and possible corrective action. Additional controls were provided through AEC surveillance activities and personnel and physical security requirements.

One of the purposes of the Atomic Energy Act of 1954 was to provide:

> "*** a program to encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public."

From the time of the passage of the 1954 act until the enactment of legislation in 1964 permitting private ownership of special

nuclear material, all such material within or under the jurisdiction of the United States continued to be under mandatory ownership of the United States Government, even though it was more widely held by cost-type and fixed-price-type Government contractors and licensees who were not Government contractors. Since 1964, private ownership of special nuclear material has been permissible. Although very little of this material has yet passed from Government to private ownership, all special nuclear material produced in privately owned nuclear reactors since the 1964 legislative amendment has been privately owned.

In furtherance of the Government's policy concerning the development of atomic energy, the 1954 act authorized, with certain restrictions, the distribution of special nuclear materials under licenses (Section 53). Regulatory authority is provided under section 161 which authorizes AEC to:

> "b. establish by rule, regulation, or order, such standards and instructions to govern the possession and use of special nuclear material, source material, and by-product material as the Commission may deem necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property;
>
> * * * * *
>
> "i. prescribe such regulations or orders as it may deem necessary *** (2) to guard against the loss or diversion of any special nuclear material acquired by any person pursuant to section 53 or produced by any person in connection with any activity authorized pursuant to this Act, and to prevent any use or disposition thereof which the Commission may determine to be inimical to the common defense and security, ***."

On April 6, 1955, AEC appr ved, for inclusion in the Code of Federal Regulations, 10 CFR 70. This regulation established the procedures and criteria for issuance of licenses and for the distribution by the Commission of special nuclear material to licensees and the terms and conditions for such distribution. The regulation is directed primarily to the protection of the health and safety of persons working with special nuclear material and of the general public, and provides that licensees maintain records showing the receipt, inventory, and transfer of special nuclear material.

In developing the regulations in 10 CFR 70, AEC considered the question of whether regulatory requirements for accountability and physical security of licensed material should be imposed in addition to the requirements for the protection of health and safety. AEC concluded that the physical protection and accountability controls which licensees, as prudent businessmen, would maintain over special nuclear material because of its intrinsic value and their financial responsibility for its loss or damage and the severe criminal penalties provided by AEC's governing legislation would adequately protect the national interest from the standpoint of unlawful diversion. Therefore, in 1955 a policy was adopted on the basis of this conclusion.

With regard to criminal penalties, the Atomic Energy Act of 1954, as amended, provides that:

> "Sec. 222. VIOLATION OF SPECIFIC SECTIONS.--Whoever willfully violates, attempts to violate, or conspires to violate, any provision of sections 57, 92, or 101, or whoever unlawfully interferes, attempts to interfere, or conspires to interfere with any recapture or entry under section 108, shall, upon conviction thereof, be punished by a

fine of not more than $10,000 or by imprisonment for not more than five years, or both, except that whoever commits such an offense with intent to injure the United States or with intent to secure an advantage to any foreign nation shall, upon conviction thereof, be punished by death or imprisonment for life (but the penalty of death or imprisonment for life may be imposed only upon recommendation of the jury), or by a fine of not more than $20,000 or by imprisonment for not more than twenty years, or both.

"Sec. 223. VIOLATION OF SECTIONS GENERALLY.--Whoever willfully violates, attempts to violate, or conspires to violate, any provision of this Act for which no penalty is specifically provided or of any regulation or order prescribed or issued under section 65 or subsections 161 b., i., or p. shall, upon conviction thereof, be punished by a fine of not more than $5,000 or by imprisonment for not more than two years, or both, except that whoever commits such an offense with intent to injure the United States or with intent to secure an advantage to any foreign nation, shall, upon conviction thereof, be punished by a fine of not more than $20,000 or by imprisonment for not more than twenty years, or both."

In May 1966, after reviewing its policy which was based on the "intrinsic value" concept, AEC concluded that a change should be made in the direction of placing more reliance on positive requirements, with respect to accountability controls over licensees. There was, among the actions taken to strengthen the program since that time, approval by AEC on January 25, 1967, of amendments to 10 CFR 70 which will require certain licensees to establish, maintain and submit to AEC written procedures for the control and accounting for special nuclear material in their possession and to take a physical inventory not less often than annually.

AEC authorized NUMEC to receive and process special nuclear material at its Apollo facility under license number SNM-145. As

an AEC licensee, NUMEC first received material by lease arrangement in December 1957. NUMEC received its first nuclear material as an AEC contractor in August 1959, and since that time has processed nuclear material which was received under lease for commercial work and which was received under various types of contracts and subcontracts with AEC and Government contractors.

NUMEC owns and operates a uranium processing facility at Apollo, Pennsylvania. The major emphasis of the facility is on the conversion of uranium hexafluoride to uranium oxide or carbides and the fabrication thereof into products for use in nuclear reactors, including commercial power, research and governmental applications. The Apollo facility also recovers uranium from various scrap and residue materials commercially and from its internally generated scrap.

NUMEC is not equipped at its Apollo plant to prepare uranium metal but is equipped for most operations involving uranium compounds. Separate processing and fabrication lines are operated for uranium enriched above 5 percent U-235 and for uranium of 5 percent U-235 or less. Also, NUMEC maintains a scrap reprocessing line for uranium of less than 5 percent enrichment which is separate from the line for uranium above 5 percent enrichment.

Over the years, NUMEC has had significant amounts of special nuclear materials under its control. NUMEC and AEC records show that NUMEC's receipts and shipments of special nuclear materials from start-up through December 31, 1966, amounted to about 21,750 kilograms U-235 and 19,865 kilograms U-235 respectively. NUMEC reported losses during this period amounting to about 260 kilograms U-235, or about 1.2 percent of total receipts, and an ending inventory at December 31, 1966 of about 1,625 kilograms U-235 with a value of about $19.5 million.

During its investigations of NUMEC's loss experience, AEC has noted that NUMEC performed a diversity of processes in its uranium operations, some of which were unique and had been untried commercially. On one "first of a kind contract" where a large loss was experienced, NUMEC described its operation as "an extremely dirty and dusty process." The difficulty of this job was confirmed by an official of Westinghouse Electric Corporation, the Government contractor; he advised AEC that there was insufficient experience with this type of process, none which was really comparable, on which to evaluate NUMEC's processing experience.

A list of the current principal officials of the Atomic Energy Commission responsible for the administration of activities discussed in this report is shown below.

	Tenure of office	
	From	To
Chairman:		
Glenn T. Seaborg	Mar. 1961	Present
Operating and Promotional Functions		
General Manager:		
R. E. Hollingsworth	Aug. 1964	Present
Assistant General Manager for Administration:		
John V. Vinciguerra	May 1966	Present
Licensing and Regulatory Functions		
Director of Regulation:		
Harold L. Price	Sept. 1961	Present

COMMENTS ON ACCOUNTABILITY CONTROLS OVER AEC-OWNED SPECIAL NUCLEAR MATERIALS FURNISHED TO NUMEC

The Commission in 1955 concluded that the accountability controls which licensees, as prudent businessmen, would exercise over special nuclear material because of its intrinsic value and their financial responsibility for its loss or damage and the criminal penalties provided by AEC's governing legislation would adequately protect the Government's interest. In our opinion, the problems regarding accountability of special nuclear materials at NUMEC relate directly to this policy and to the control mechanisms established to carry out the policy.

Under the Atomic Energy Act of 1954, as amended, AEC is authorized to prescribe such regulations or orders as it may deem necessary to guard against loss of special nuclear material. NUMEC's past procedures and practices for the accountability of special nuclear material were not sufficiently adequate to identify losses of uranium with specific jobs or process areas or with the period of time in which such losses occurred. Although NUMEC made periodic physical inventories and AEC performed a number of accountability surveys, a significant quantity of enriched uranium could not be accounted for in the spring of 1965 when NUMEC prepared to close out a large contract.

Because of the condition of NUMEC's records, we were similarly unable to identify the specific disposition of this material. AEC has stated that, although it could not be stated with certainty that diversion had not taken place, no evidence had been found to support the possibility of diversion and that other information did exist to reduce such possibility.

Considering the importance of having a reliable and accurate accounting of the use of special nuclear materials, we believe that, with regard to NUMEC, AEC has utilized its authority for control of such materials in a manner that has been less than clearly effective. Also, it appears to have been incumbent on NUMEC to ensure the effective implementation of system improvements, since, on the basis of the record, it should have been evident to NUMEC that its system was not providing a current and accurate accountability for the special nuclear materials for which it was responsible.

Although general guidance was provided by AEC in the form of recommendations or suggestions, we noted an absence of definitive standards to direct NUMEC in the formulation of an acceptable materials control system. AEC surveys over the years have repeatedly identified a need for improvements to NUMEC's materials control system, and, at various intervals, have resulted in concern as to the adequacy of NUMEC's controls over special nuclear materials. For the most part, in consistence with its policy, AEC has attempted to obtain improvements in NUMEC's system through encouragement and suggestions, rather than by more aggressive efforts to ensure the existence of an accurate and reliable materials control system.

In connection with this, AEC, in establishing its policy in 1955, noted that, if the policy proved inadequate, other means of ensuring adequate protection would be considered. Considering the concern evidenced at times by AEC, we feel that "other means," such as the institution of a resident inspection system at NUMEC, to provide assurance that an effective accountability system was being maintained and material was being adequately safeguarded, would have been appropriate.

AEC records indicate that NUMEC has generally responded to suggestions made as a result of the surveys. It appears, however, that NUMEC did not exert the sustained effort necessary to effect and maintain the accountability system improvements necessary for the localization and timely detection of losses. As late as November 1965, AEC reported that its survey of NUMEC records confirmed the findings of prior surveys that the records which purport to control internal movement of material were incomplete and inadequate.

With respect to the current situation at NUMEC, our review showed that, in the past year, NUMEC has made relatively significant progress in the development of a sound accountability system. We noted that improvements are still necessary in the area of localization and timely detection of losses. Also, on the basis of its most recent survey, AEC has yet to be satisfied as to the adequacy of the implementation of NUMEC's system.

By letter dated January 25, 1967, NUMEC advised AEC of the actions that had been and were being taken to comply with recommendations in AEC's most recent survey report, and NUMEC proposed March 31, 1967, as the date for a physical inventory of special nuclear material at NUMEC. By letter dated February 10, 1967, ORO advised NUMEC that it would observe the taking of the March 31, 1967, physical inventory and would conduct a survey and submitted for NUMEC's consideration a survey plan summary which had been developed by ORO as a means of arriving at a mutual understanding of the survey plans.

We were subsequently advised that, by mutual agreement between AEC and NUMEC, the survey was delayed until April 30, 1967, because it was expected that by that time the uranium inventory would have been reduced and a more accurate physical inventory could be taken. After considering the history of this case, we

expressed the view to NUMEC and AEC that this survey should be utilized as a basis for developing a mutual understanding and agreement on AEC requirements and for establishing jointly a fully acceptable materials control system on a timely basis.

We were subsequently advised by AEC that its planned April 30, 1967, inventory verification had been postponed because of the condition of NUMEC's uranium inventory. NUMEC had advised AEC that approximately half of its uranium inventory was in scrap residues.

NUMEC proceeded with its physical inventory on April 30, 1967, and so advised AEC during a meeting on May 4, 1967. We were informed that it had been agreed during the meeting that NUMEC provide AEC with (1) a detailed description of the steps it used to take the inventory, (2) all sampling, analytical, and other measurement data obtained from the physical inventory and NUMEC's interpretation of such data, and (3) NUMEC's statement of its April 30, 1967, inventory. We were further informed that an AEC survey team had arrived at NUMEC on May 10, 1967, to review the current situation.

AEC REGULATIONS AND PROCEDURES RELATING TO CONTROL OF SPECIAL NUCLEAR MATERIALS BY LICENSEES

AEC's principal regulations applicable to the issuance of licenses for handling special nuclear material are set forth in 10 CFR 70, "Special Nuclear Material," and 10 CFR 20, "Standards for Protection Against Radiation." These regulations are directed primarily to protection of the health and safety of persons working with radioactive material and of the general public and provide that licensees maintain records showing the receipt, inventory, and transfer of special nuclear material.

Under the provisions of the Atomic Energy Act of 1954, as amended, AEC is authorized under Section 53 to issue licenses and to distribute special nuclear material to licensees by sale, lease, or grant. Material distributed to lessees under this provision is generally referred to as Section 53 material. The act also provides that the Commission may make a reasonable use charge for material distributed by lease under Section 53. The act does not require a license for special nuclear material to be held under contract with and for the account of the Commission.

Material so held is generally referred to as non-Section 53 material. However, non-Section 53 material may also be held under a Section 53 license when there are circumstances in which the exemption from licensing is not applicable. Thus the same facility might hold at the same time Section 53 material under a Section 53 license, non-Section 53 material under a Section 53 license, and non-Section 53 material under a contract with and for the account of the Commission.

In developing the regulations in 10 CFR 70, approved in 1955, AEC considered the question of whether regulatory requirements for

accountability and physical security of licensed material should be imposed in addition to the requirement for the protection of health and safety. AEC concluded that the physical protection and accountability controls which licensees, as prudent businessmen, would maintain over special nuclear material because of its intrinsic value and their financial responsibility for its loss or damage and the severe criminal penalties provided by AEC's governing legislation would adequately protect the national interest from the standpoint of unlawful diversion.

With respect to accountability, AEC subsequently added provisions to part 70, requiring licensees to submit material transfer reports and periodic material status reports to AEC on forms prescribed by AEC. AEC's procedures provided that the material transfer forms be signed by both the shipper and the receiver to show agreement as to the data recorded. The shipper and receiver must resolve any differences or submit the matter to a referee for settlement.

During the early years of the program, Section 53 material was distributed to licensees under individual lease agreements. Effective May 1, 1960, AEC established a standard "Lease Agreement" for the distribution of Section 53 material. Terms of this agreement included, among other pertinent clauses, a provision that the lessee:

1. Have full financial responsibility for the consumption and loss of materials and for payment of use charges and services as applicable.

2. Submit to AEC transfer documents covering receipts and shipments of material and reports of losses and inventory.

3. Maintain and make available, for AEC inspection, adequate records pertaining to the receipt, possession, transfer, or use of material subject to the lease.

The agreement was revised July 1, 1963, to further provide that the lessee take at least one physical inventory a year and use his best efforts to segregate special nuclear material subject to the lease from any other nuclear material in his possession.

In addition to using the lease arrangements, AEC has over the years contracted with private industry for work related to AEC programs. As discussed previously, the Atomic Energy Act of 1954 provides that contractors holding special nuclear material "with and for the account of the Commission" can be exempted from licensing. AEC field offices and their prime contractors entered into contracts and subcontracts with licensed and nonlicensed facilities, which provided for the furnishing of the material as non-Section 53 material.

Originally, the terms of these contracts and subcontracts, which were for the most part fixed-price, differed from the terms of the Lease Agreement in that they generally did not provide for full financial responsibility or for the payment of use charges. In recent years, however, full financial responsibility has generally been required. Material transfer forms and periodic material balance reports are required by holders of non-Section 53 material.

Under fixed-price contracts, involving the use of non-Section 53 material, accountability and safeguards requirements existed to the extent that such requirements were contained in the contracts. We were informed that the provisions among different contracts varied considerably in this regard. To minimize the resulting problems, in September 1962 AEC issued instructions to field offices providing for the use of uniform terms and conditions

to be employed to the "maximum feasible extent" by the AEC and its cost-type contractors in connection with the furnishing of non-Section 53 material under fixed-price contracts involving the use of special nuclear material.

These uniform terms and conditions were generally similar to those set forth in the Lease Agreement. However, the uniform contract terms and conditions, unlike those of the Lease Agreement, specifically require the contractor to physically segregate material subject to the contract from other material in the contractor's possession and prohibit the blending of materials, unless the parties otherwise agree, and do not require the payment of a use charge.

Licensees who had cost-type contracts were subject to such accountability and safeguards requirements as might be established by the cognizant AEC field office. In these cases the field offices had AEC Headquarters' guidelines relating to accountability systems as well as their own experience with AEC's operating contractors for guidance in establishing requirements.

In addition to using the above lease and contracting arrangements, on July 22, 1964, AEC adopted the use of a standard Supply Agreement which followed closely the terms and conditions of the Lease Agreement. The Supply Agreement is for use in supplying non-Section 53 enriched uranium to contractors for use under AEC fixed-price contracts.

Although NUMEC is licensed and has held material under a lease agreement, the predominant quantities of special nuclear material held by NUMEC have been furnished under various fixed-price contracts either directly with AEC or under subcontract with Government contractors. Therefore, under the fixed-price contracts, NUMEC has been subject to the accountability provisions of each

contract, as well as to the requirements in the license and the regulations.

AEC maintains records concerning all Government-owned special nuclear material. Further, all special nuclear material licensees, except for a few which possess negligible quantities of material, are subject to periodic on-site accountability surveys under the terms of the regulations, the license, an AEC contract, or a lease agreement. The surveys were designed primarily to protect the proprietary interest of AEC, and they also provided a measure of protection against loss or unlawful diversion.

Criteria and procedures for conducting proprietary accountability surveys are in AEC Immediate Action Directive (IAD) 7400-4, "Surveys of Leased SS Material," dated May 12, 1962, and IAD 7400-8, "Surveys of Fixed Price Contractor and Subcontractor Facilities," dated July 18, 1963. The purpose of such surveys is to obtain an independent opinion on the validity of the data reported.[1] Each survey is to include an audit of the material records, a review of internal control measures, and independent verification of the special nuclear material inventory, including the element and isotopic content. Although general guidance was provided by AEC Headquarters, the specific procedures that were to be applied in carrying out the surveys were largely left to the discretion of the operations offices responsible for making the surveys.

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[1] In consistence with the determination to strengthen controls over special nuclear material in the hands of licensees, AEC by IAD 7402-11 dated April 5, 1966, provided for the expansion of the scope of surveys of special nuclear material, held under lease and under fixed-price contracts and subcontracts, to include a determination of the quantities and the probable causes of process losses, accidental losses, wastes, write-offs, and material unaccounted for, and an evaluation of the significance of these quantities.

In consistence with its philosophy of relying on the intrinsic value concept and severe criminal penalties for unlawful diversion, AEC did not promulgate to licensees specific criteria or standards of performance by which AEC would evaluate the licensees' operations. AEC had adopted the view that prudent business, having its own money invested, would take all necessary actions to ensure that its assets were appropriately known and utilized for the purposes acquired. In consistence with this philosophy, on the matter of licensee accountability surveys, a document prepared by the Division of Nuclear Materials Management and forwarded to field offices in January 1966 provided in part:

> "The opinions of the survey team may be affected by the type facility being surveyed. At an AEC-owned and controlled facility, inventory control deviations might not be permitted that could be tolerated at a fixed-price contract facility where the [licensee] is financially responsible for the material. At a fixed-price facility or a facility having leased material, the survey team may find itself in the position where overall control is adequate but some areas need improvement. Unless the survey team can demonstrate loss of control or other violation of contractual terms and conditions the facility may take the position that changes and improvements in the control system are not required or needed. However, the survey team may suggest changes that would improve control and at the same time assist the facility to reduce effort or provide more useful data. Also, at facilities other than cost-type contractors opinions, recommendations, and suggestions regarding inventory management are not appropriate."

CHRONOLOGICAL DESCRIPTION OF AEC
SURVEYS OF NUMEC'S APOLLO FACILITY

The New York Operations Office (NYO) performed the initial accountability survey of the Apollo plant in September 1960. In a letter dated October 26, 1960, the Director, Technical Services Division, NYO advised NUMEC that:

> "I am disturbed by the report of the survey made by our SS Nuclear Materials Management group of your plant, September 26-30, 1960. The report indicates that you did not have adequate control over the nuclear material, both licensed [Section 53] and accountable [non-Section 53], held at your site."

The letter thereafter enumerated a number of "suggestions and comments" regarding the need to establish responsibility for controls by material balance area, to maintain records to show the material inventory in each area, to improve inventory taking, and to improve weighing and labeling practices.

NYO, in concluding the letter, advised NUMEC that, because of the excellent cooperation received from NUMEC's staff in seeking to establish nuclear material control, the survey would be set aside and another survey would be mad early in the spring of 1961. It was stated that, at that time, NUMEC would be expected to have established workable procedures that would meet AEC standards. In this connection, NYO did not advise NUMEC, except by virtue of its suggestions and comments noted above, of the standards by which NUMEC procedures would be evaluated; the standards were those developed to apply primarily to AEC cost-type contractors.

By letter dated May 12, 1961, NYO advised NUMEC that it had completed its second survey of NUMEC and that its review had been made in accordance with principles intended primarily to govern operations of cost-type contractors. In a summary paragraph, the Director, Technical Services Division, NYO advised NUMEC:

"I am pleased with the great improvement in your operations since our earlier review last September. The comments made in my letter to you dated October 26, 1960 have been acted upon and implemented by your staff. As a result of the current survey, I find that NUMEC meets the AEC requirements for nuclear material accountability."

The letter also made several suggestions to assist NUMEC in its nuclear material control, which concerned the need for a current procedures manual, records for material controls, better weighing and labeling practices, and the need to recover uranium from waste on a more current basis.

During the period from May to August 1962, the AEC Headquarters staff, with assistance from NYO, performed a survey at NUMEC. In its survey report, which was not provided to NUMEC, AEC stated that NUMEC's system of internal control was extremely limited and did not provide a degree of control sufficient to meet AEC standards required for contractors of AEC-owned facilities. The report cited the following matters, among others, which were of concern to the survey team:

1. Losses could not be localized to specific process areas.
2. Ledgers were incomplete.
3. Records did not support monthly material balance reports.
4. A sizable backlog of internally generated uranium residues existed, much of which were not readily identifiable by contract and were stored without an assigned uranium content.
5. Physical inventories were not scheduled on a routine basis; no inventory had been taken between March 1961 and May 1962.

The survey report was reviewed in draft form by NYO. One of the more pointed comments by NYO was that Headquarters' criticism of NUMEC's internal control system appeared to be based upon AEC standards for contractor operation of AEC facilities under

cost-type contracts. NYO stated that it would be more meaningful to compare the internal control system "with that of generally accepted business standards." The precise significance that could be attached to this suggestion is not readily apparent inasmuch as such standards, as they relate to special nuclear materials, were, to our knowledge, nonexistent. The second facet appropriate for consideration is that the operations office, in conducting its survey made in 1961, in order to make the evaluation of NUMEC's activities, used the AEC standards intended primarily for its cost-type contractors.

AEC did not formally advise NUMEC of the results of the 1962 survey until October 26, 1962. For the interim, AEC records show that in a meeting early in October 1962, the Director, Division of Nuclear Materials Management (DNMM), informed a NUMEC official that he "was quite concerned over the situation which existed at NUMEC" and advised him of the principal corrective actions considered necessary.

The Oak Ridge Operations Office (ORO) had been made responsible for reviewing NUMEC activities effective June 30, 1962. Prior to the aforementioned October meeting, the Director, DNMM, forwarded the report to ORO for appropriate action. In transmitting the report, the Director advised ORO that the survey indicated that little further improvement seemed to have taken place since the 1961 survey and that "*** in fact, we suspect there has been retrogression." The Director also stated that the findings had been discussed with NUMEC but that no recommendations had been made by AEC.

In a letter dated October 26, 1962, communicating the Headquarters survey results to NUMEC, ORO stated:

"The recent survey of nuclear materials management *** disclosed a number of points which, if corrected by you, would improve your knowledge and control of special nuclear materials within your plant.

"It is suggested that your internal control system should be based on data developed during processing which would thus provide current and accurate information readily disclosing all special nuclear material physically on hand and all losses as they occur."

ORO suggested specific actions, including suggestions to install a general ledger to summarize accounts monthly and annually, maintain transfer journals currently, develop a subsidiary ledger to account for special nuclear material by job and by material balance area, establish control over internal transfer documents, and take periodic physical inventories and record the results thereof.

NUMEC responded in November 1962, advising ORO that a complete system of internal checks was being incorporated and that the functions of maintaining control records were being separated from the physical accountability functions.

On February 7, 1963, two AEC representatives visited NUMEC to review the progress made by NUMEC toward accomplishing the suggestions made in October 1962. On the basis of the representatives observations during this 1-day visit, ORO, by letter dated April 18, 1963, informed NUMEC:

"In view of the significant progress already made, and the work currently underway to achieve all of the objectives, we consider the performance to date as very commendable."

In July and August 1963, a detailed survey was made by ORO. The report prepared on this survey did not state the basis or standards which were used in performing the evaluation of NUMEC's controls over special nuclear materials. By letter dated July 12, 1963, ORO rejected NUMEC's June 30, 1963, inventory. NUMEC

reweighed certain inventory items at the suggestion of ORO, and was advised on September 23, 1963, that the June 30, 1963, inventory had been presented fairly. ORO also advised NUMEC that external material movements had been reasonably well controlled but that internal transactions reflecting movements of material within the plant apparently had been insufficiently documented and that the inventory as recorded in NUMEC's books had not been adjusted to reflect the results of the physical inventory.

In addition, ORO commented that there was a need for periodic reconciliation between the ledgers and the actual operating results. ORO stated that "it is strongly suggested" that, in order to have acceptable record support for the monthly material balance report, entries to the accountability records be supported by written documents and that transfers of material between jobs be avoided when the contracts specify that no commingling is to occur. ORO also stated that there was a general need for more expeditious closing of contracts, including proper disposition of residues.

ORO stated in its letter of September 23, 1963, that these matters were presented as suggestions for improvement of material management and the records thereof. A NUMEC record of a telephone conversation between ORO and NUMEC officials, in November 1963, showed that ORO officials indicated that they were satisfied that NUMEC was making a good effort toward improving its procedures.

In February 1964, ORO conducted a review of all special nuclear material held by NUMEC under scrap recovery contracts. By letter dated April 1, 1964, NUMEC was advised that its internal control procedures were inadequate. The physical inventory by ORO disclosed more uranium than NUMEC was accountable for under some contracts. ORO noted in its letter that containers of uranium were

not properly labeled, that NUMEC was mixing uranium from several contracts which prohibited commingling, and that NUMEC was not submitting complete and factual material balance reports to AEC.

ORO's letter contained the following comments pertinent to its findings:

> "If Jar No. 1271-2 was mis-labeled and the contained U_3O_8 is [NUMEC job no.] 4A051 material, then NUMEC has violated the recovery contract by (1) not informing this office when the material was processed, (2) by failing to dispatch samples to NBL for analysis, and (3) by failing to furnish batch weights and certified analyses for the dissolver solutions. A further violation of the contract was evidenced by NUMEC's mixing of uranium from several recovery contracts which prohibit commingling. This was brought to our attention by NUMEC's letter of March 16, 1964. We accept NUMEC's explanation that Container No. 1271-2 was mis-labeled and should be identified with Job. No. 4A051, however, since you have failed to furnish us with samples and dissolution data as required by the contract, we are establishing your financial responsibility for Job No. 4A051 at 3,106 grams of 92% enriched uranium, which is the quantity of highly enriched uranium found during our inventory, and 5,368 grams of 2.6% enriched uranium, which is the quantity of low enriched uranium for which you are responsible according to our records."
>
> * * * * *
>
> "Several containers of uranium were observed during the inventory which bore labels identifying the material as uranium assigned to NUMEC Account No. N-0426. This internal account is not being reported in NUMEC's Material Balance Report although we understand that a substantial quantity of uranium is being carried under it.
>
> "We have been advised that Account No. N-0426 contains lab. wastes, residues, and samples from lease accounts, whereas, another account Job No. N-04CPR28, is for station material. This differs with previous statements concerning N-0426 given the AEC Headquarters staff during the their audit of May-August 1962. We think it imperative

that, in order to clear up this apparent discrepancy, you give us a statement of your policy relative to entering material into internal accounts.

"The fact that NUMEC is maintaining internal accounts such as Job Nos. N-0426 and N-04CPR28 without our being informed of the transfers made into and out of the accounts is inconsistent with acceptable SS accounting procedures. You are hereby instructed to report these accounts in your Monthly Material Balance Report and to reflect any movement of material associated with these accounts.

ORO advised NUMEC that:

"In conclusion, the results of the subject Oak Ridge inventory confirm the opinion expressed in previous correspondence relating to other SS material surveys that NUMEC's internal control procedures are inadequate. The possession of more uranium than NUMEC is accountable for under some [scrap recovery] contracts casts doubt on the adequacy of the sampling and/or compositing techniques employed for certain types of scrap.

"We intend to visit your plant again in the very near future. We suggest that you take steps during the interim to correct the procedural inadequacies noted above. Failure to comply with acceptable scrap processing and special nuclear material accounting procedures may require the AEC to take appropriate action including that which would preclude your receipt and processing of special nuclear materials."

NUMEC's president replied to the AEC letter on April 28, 1964, and stated that NUMEC had a new accountability representative. He further advised that:

"We are currently undergoing a thorough review of NUMEC's accountability procedures and books and are trying to reconcile the records with which [the former accountability representative] left us. I shall report to you in detail upon completion of this review. In the meantime, I would greatly appreciate your patience so that we can dig into the matters discussed in your letter of April 1."

In a letter to us dated January 18, 1967, commenting on this survey, NUMEC stated in part:

"A careful review of the 1964 survey results as transmitted to NUMEC indicates that the underlying deficiency was the inability of the system to identify scrap material adequately by contract. In order to understand the significance of this finding it is necessary to have some appreciation of scrap recovery operations at NUMEC.

"NUMEC has undertaken, and continues to undertake, major first-of-a-kind jobs. Such developmental work generally results in low product yields with concomitant high scrap residues. During the period in question, there was a large amount of internally-generated scrap. Additionally, NUMEC was performing commercial scrap recovery operations on a large number of contracts, many of which involved less than 1 kg of uranium. NUMEC's scrap recovery facilities, as a practical matter, had to be operated in a continuous fashion to maintain system equilibrium. With material from different contracts entering the system on a 'heel to toe' basis, actual segregation of material by contract was physically and economically impracticable, if not impossible. It should be noted that scrap material was assayed by contract after dissolution but prior to processing and that recovered material and losses were allocated by contract to the best of our ability. The difficulty, however, in adequately identifying material by contract without total physical segregation is apparent. This is not to say that attempts could not and were not made to identify scrap by contract, but only that such identification was necessarily imprecise. This problem has received increasing recognition by AEC in recent years. Thus, for example, AEC now permits commingling of scrap after dissolution and establishment of accountability under scrap recovery contracts without prior approval. Indeed, the general direction of current accountability procedures is away from accountability by contract. (See, for example, the current Uranium Supply Agreement.) Understood in the context of current standards and requirements, it is clear that the findings of the April 1964 survey do not reflect a determination by AEC that NUMEC's system was inadequate to assure the proper safeguarding of special nuclear material."

Notwithstanding NUMEC's conclusions as to the seriousness of the findings when considered in the context of today's requirements, the survey team was of the opinion that NUMEC had expended insufficient thought and effort in the interests of establishing an acceptable and realistic accounting structure for the recording and reporting of "SS materials." Moreover, in our opinion, AEC's letter of April 1, 1964, evidenced serious concern over the adequacy of NUMEC's then existing accountability practices as they related to the scrap recovery operations.

ORO completed a physical inventory of special nuclear materials at NUMEC in September 1964. NUMEC was advised on October 15, 1964, that crossover of material between jobs had occurred but that, because the audit phase of the survey was delayed pursuant to NUMEC's request, ORO was not in a position to state the extent to which such actions were contrary to the provisions of the contracts for these jobs. ORO also advised NUMEC that the percent of material unaccounted for (MUF), shown by comparing the adjusted book inventory with the physical inventory, was in excess of that which was acceptable to AEC.

ORO's workpapers show that the largest single MUF figure related to NUMEC's contract with the Westinghouse Astronuclear Laboratory (WANL), a major subcontractor of the Government in the nuclear engine for rocket vehicle application program. The figures as presented in the workpapers showed the following:

	Grams of uranium
Adjusted book inventory	274,248
Physical inventory	185,809
MUF	88,439

ORO advised NUMEC that it was recognized that the physical inventory was undertaken while the processing of nuclear materials continued and that NUMEC might be able to readily dispose of a sufficient number of discrepancies to inform ORO, in the very near future, that the accounts were in condition for audit.

AEC records show that, in November 1964, the survey was postponed for an additional 30 days, in accordance with a telephone conversation between ORO and NUMEC, to allow a new accountability representative to assume and become familiar with his duties. The following month ORO and NUMEC officials agreed by telephone that the lapse of time precluded orderly completion of the survey and it was canceled. ORO planned to schedule a new survey in February or March 1965.

The planned survey was delayed, apparently because of circumstances which developed in the closing of the aforementioned WANL contract; this is discussed in another section of the report. In April and May 1965, a survey was made which included a physical inventory verification. By letter dated June 17, 1965, ORO advised NUMEC:

> "Our physical inventory verification at your facility, inclusive of listing, weighing, sampling, and ledger comparisons, has proven acceptable. A formal survey report containing certification that your SS material accounts are valid for all material types with expected and reasonable limits of uncertainty, will be forwarded to you in the near future.
>
> "In the meantime, please consider this letter as notification that our IBM listing of your facility inventory, a copy of which was furnished to you at an earlier date, is acceptable to the AEC."

AEC's physical inventory verification had disclosed a loss of 53 kilograms U-235 on the WANL contract; which indicated a

financial liability on NUMEC's part of about $735,000. In reply to the June 17, 1965, letter, NUMEC advised ORO on July 2, 1965 that:

> "In the referenced letter you requested that we notify you as to the acceptability of your IBM listing of our facility inventory. We cannot accept your IBM listing as fully representative of our facility inventory; for example, it fails to include the enriched material contained in wastes such as the pre and absolute filters we have in storage. As you know, we have approximately 700 such filters which we feel contain a substantial quantity of enriched material held under our WANL Contract 59-NP-12674. In view of this, and before we can accept your inventory listing, we feel that due credit should be given to this inventory item.
>
> "Also, it is our position that, due to the complexity and extreme cost of establishing an accurate inventory value on the material in these filters, the number assigned be the difference between receipts and shipments under the WANL Contract. As this material is reprocessed to the point where it may be assayed accurately, our books would be adjusted to reflect the new inventory."

This approach was not acceptable to ORO. In August 1965, ORO transmitted to NUMEC separate reports on the surveys covering materials obtained under lease agreement for commercial work and materials related to contracts for Government work. ORO expressed the opinion, in one report, that safeguards control of special nuclear materials at NUMEC was inadequate and, in the other report, that such control was less than adequate. In the report related to material held under contracts for Government work, ORO stated that this opinion was based on the following facts:

> "(1) Book physical inventory differences of U-235 developed as a result of the AEC physical inventory are excessive.

"(2) NUMEC refused to accept the AEC physical inventory and failed to provide an adequate physical inventory listing in lieu thereof.

"(3) SS material has been transferred between jobs without approval of the contracting officers.

"(4) Internal accounts maintained for recovery of residues have not been reported to the AEC."

Recommendations to improve specific control procedures were made in each report.

After a follow-up review to determine the status of matters noted in the April-May survey, ORO reported in October 1965 that NUMEC was in the process of investigating the contents of two burial pits for material that might have been inadvertently discarded and buried as unrecoverable waste to determine how much of the difference between the book inventories and the physical inventories on the WANL contract could be accounted for by this material.

The records show that, in each of the years 1961, 1962, and 1963, NUMEC made burials of contaminated wastes, apparently in the belief that the wastes contained insignificant amounts of uranium. AEC records indicate that NUMEC recognized that unacceptably high uranium losses were occurring in 1964 and that the company concluded that previous estimates of uranium in combustible wastes being buried were low. The records show that the 1962 and 1963 burial pits were exhumed in the fall of 1965 and that the recovery operations were witnessed by AEC personnel from several divisions and offices.

The ORO October status report states that the "1962 pit" had been opened and the contents of some drums had been handpicked for evaluation of uranium content and for determination as to its

recoverability. A group of drums of sludge from this pit reportedly had been sampled, analyzed, and shown to be of low uranium content.

A later report on the burials showed that soil samples taken from the 1963 burial pit indicated a U-235 concentration of about 2 parts per million to a depth of about ten inches below the bottom of the pit and the report contained an estimate that the U-235 content was about 2.2 kilograms.

According to NUMEC records, about 7.4 kilograms U-235 were ultimately recovered from the burial pits and subsequently returned to AEC for credit to the WANL contract.

On September 9 and 10, 1965, an ORO representative discussed in detail with NUMEC officials the status of the recommendations made by ORO in the survey reports. On the basis of the 2-day review, a status report, dated October 13, 1965, was issued which stated that the report dealt with changes made or finished since April 30, 1965--the cutoff date for the survey which formed the basis for the two August reports. The report also stated that the review of September 9 and 10, 1965, was not a quantitative audit in depth to determine the accuracy of the records presented, but was rather a qualitative review to determine the extent and coherency of the internal control records system. The report transmitted by ORO to NUMEC on October 14, 1965, presented the following summary opinion:

> "Based on the subject review of September 9-10, 1965, it is our opinion that the nuclear materials control system as currently constituted and operating at NUMEC, is <u>capable of generating</u> a satisfactory material control and safeguards report for nuclear material now being handled by NUMEC." (Underscoring supplied.)

The report also stated that the safeguards problem noted in one of the August reports still existed because the excessive difference between the NUMEC book inventory and the AEC physical inventory of the WANL job still existed. It was pointed out that this difference would be resolved as part of the settlement and closeout negotiations of the WANL contract, which would be reported separately.

A survey of NUMEC's controls was conducted by the AEC Headquarters staff, assisted by ORO and NYO personnel, in November 1965. The objectives of this survey were (1) to determine the total cumulative U-235 loss for NUMEC since plant start-up in 1957 and to evaluate the extent to which such losses could be accounted for in terms of known loss mechanisms, such as accidental losses, discharges into tanks, sewers, etc., and other known removals and (2) to attempt to find explanations for the unexpectedly high U-235 loss which was attributed by NUMEC to be material related to the WANL purchase order.

The report stated that the survey was performed in accordance with the standards intended to cover the operations of contractors functioning under cost-type contracts. As a footnote, the report stated that, normally, special nuclear material held by a fixed-price contractor (such as NUMEC) that was financially liable to AEC for payment of losses "*** would not have been subjected to such an intensive scrutiny; ***"; rather the survey would have followed the standards set forth in an AEC directive, IAD 7400-8. This directive included instructions for the determination of the accuracy of losses and/or consumption reported by material holders but did not provide for the evaluation of the causes, magnitude, and reasonableness of losses.

The report stated that, on the basis of the survey team's findings, the total cumulative loss was established at 178 kilograms U-235 as of October 31, 1965. According to the report, the inventory contained estimates of uranium in residues which were not amenable to representative sampling; therefore, the loss figure was subject to some adjustment either upward or downward upon recovery of this uranium. The report stated that, on the basis of NUMEC's records, it was possible to support a loss through known loss mechanisms of 84.2 kilograms U-235. Deduction of this amount resulted in a total of 93.8 kilograms U-235 unaccounted for since plant start-up. The report also stated that the audit of NUMEC's records confirmed the findings of prior surveys that records which purport to control internal movements of material were incomplete and inadequate; therefore, it was not possible to identify, with a high degree of accuracy, the true physical losses which were attributable to any given contract.

NUMEC did not receive a copy of the final survey report. On February 3, 1966, however, the Director, DNMM, and other AEC officials visited NUMEC and discussed the findings and proposed recommendations of the report. By letter dated February 5, 1966, NUMEC advised AEC that it considered the AEC suggestions made at the meeting to be clearly sound and pointed out the actions that had been and were being taken to implement them. On April 6, 1966, AEC submitted to NUMEC a copy of the recommendations as incorporated in the survey report. On April 22, 1966, NUMEC advised AEC of the status of its efforts to accomplish the needed improvements outlined by AEC.

From June 23 through 25, 1966, AEC officials visited NUMEC to review the progress made by it toward implementing the recommendations. The AEC officials also observed the procedures and

practices being applied by NUMEC in connection with a physical inventory that it was conducting on June 25. According to AEC records, the AEC officials concluded that, in general, NUMEC had made satisfactory progress in implementing the survey recommendations and in ensuring the maintenance of adequate control over its enriched uranium. The officials also reported that, while they had not made a complete survey, which would have included an audit of the records and AEC verification of the inventory, the scope of the review had been sufficient to permit a determination as to whether NUMEC's procedures as recently approved by AEC were being followed. AEC records do not indicate whether NUMEC was advised of the results of this review.

In October and November 1966, ORO, assisted by AEC Headquarters personnel, made a survey at NUMEC. A survey report was transmitted to NUMEC on January 24, 1967, which stated that, in the opinion of the survey team, there had been improvements in the area of nuclear material control since the survey was made in November 1965, as evidenced by the fact that 12 of 13 recommendations made in that report had either been accomplished or were being accomplished. The report also stated that, on the basis of the survey and discussion with NUMEC's management, the survey team was of the opinion that the accountability control system that had been established by NUMEC, on the basis of the company's approved procedures manual, was capable of providing adequate internal control of special nuclear material for safeguard purposes if it was followed in all aspects.

On the basis of its survey, however, AEC was unwilling to accept NUMEC's inventory. In this connection the report stated that:

"Despite the actions taken, the survey team is of the opinion that the SN material inventory report presented by NUMEC as of September 30, 1966, does not fairly present their actual holdings as of that date because:

"a. NUMEC has not maintained complete records of known process losses of SN material and, therefore, the quantities of material reported as losses during the period November 1, 1965 through September 30, 1966, are understated. ***.

"b. Label data used to derive the NUMEC inventory was not sufficiently accurate as to quantity of uranium to provide an accurate inventory. ***.

"c. The NUMEC inventory report did not include material contained in approximately 590 items (filters and combustibles) stored in the blue building. ***."

Regarding the first point, AEC noted in its report that accountable effluent losses through stacks and liquid discharges were not being reported as known losses; therefore, it was not possible to obtain a reliable estimate of known losses for the survey period. NUMEC advised AEC that such losses had not been reflected in its reports because of uncertainty with respect to the means of apportioning these losses to specific contracts. AEC noted that NUMEC agreed to report such losses on a proration basis in the future.

With respect to the unrecorded material in the blue building, AEC noted that:

"*** NUMEC management stated that they understood that the AEC planned to measure all filters and combustibles by gamma scan methods and, therefore, they had not performed measurements. Since it never was the intent of the survey team to other than spot check by gamma scan a misunderstanding of what would be done exists."

One of the eight recommendations made to NUMEC stated that an inventory should be made at the earliest practicable time that "*** will reflect truly the actual physical holdings of SN material and that the book inventory be corrected to the physical inventory."

In transmitting the report to NUMEC by letter dated January 24, 1967, AEC's Assistant General Manager for Administration stated:

> "It is recognized that improvements have been made by NUMEC in the area of nuclear materials controls particularly in the establishment of satisfactory procedures. Deficiencies still exist in following the procedures and in the taking of a good physical inventory followed by the adjustment of the records to the physical inventory data. As you know, the NUMEC management and control program for special nuclear material has been of considerable concern to us over an extended period of time. We therefore expect that you will take prompt action to correct the deficiencies noted. In the absence of such corrective action, we will feel constrained to consider actively the measures which may be appropriate either in the administration of the Commission's prime contracts or subcontracts with NUMEC or in the exercise of its regulatory powers."

NUMEC responded to AEC by letter dated January 25, 1967, and expressed regret that AEC was unable to accept NUMEC's inventory as of September 30, 1966. NUMEC stated its disagreement with AEC's opinion on this matter, stating further that:

> "*** the acceptance criteria and the related statistical treatment of the test results were not those which had been used in evaluating past inventories at NUMEC, and, moreover, that the criteria utilized in the October inventory are basically experimental and 'have not been officially adopted'. It is unfortunate that the new criteria utilized in verifying the October inventory were not communicated to the Company prior to the initiation of the inventory. Such information would have

assisted materially in our preparation for the inventory, particularly in the categorization of the materials to be inventoried, and would thereby have assisted in avoiding utilization of too loose or too tight acceptance criteria, as noted in [AEC's] report."

NUMEC stated that it was proposing March 31, for a physical inventory and advised AEC of the actions that had been and were being taken to comply with the recommendations.

By letter dated February 10, 1967, ORO advised NUMEC that it would observe the taking of the March 31, 1967, physical inventory and submitted for NUMEC's consideration a survey plan summary which had been developed by ORO as a means of arriving at a mutual understanding of the survey plans. ORO advised NUMEC that:

"*** you should make every effort prior to the inventory, to reprocess as much scrap to a measurable state as possible, and to consolidate items to reduce the inventory to a more desirable inventory position."

Subsequent to the February 10, 1967, letter, AEC and NUMEC agreed to delay the survey until April 30, 1967, because it was expected that by that time the uranium inventory would have been reduced because of completion in April of a job involving a large quantity of highly enriched uranium. It was expected that, with this reduction in inventory and the clean up of a substantial portion of the plant, a more accurate physical inventory could be taken.

We were subsequently advised by AEC that its planned March 31, 1967, inventory verification had been postponed because of the condition of NUMEC's uranium inventory. NUMEC had advised AEC that approximately half of its uranium inventory was in scrap residues.

NUMEC proceeded with its physical inventory on April 30, 1967, and so advised AEC during a meeting on May 4, 1967. We were informed that it had been agreed during the meeting that NUMEC provide AEC with (1) a detailed description of the steps it used to take the inventory, (2) all sampling, analytical, and other measurement data obtained from the physical inventory and NUMEC's interpretation of such data, and (3) NUMEC's statement of its April 30, 1967, inventory. We were further informed that an AEC survey team had arrived at NUMEC on May 10, 1967, to review the current situation.

SPECIAL NUCLEAR MATERIAL LOSSES
AT NUMEC'S APOLLO FACILITY

In November 1965, AEC made a detailed survey to determine the total cumulative U-235 loss at NUMEC since start-up in 1957 and to attempt to find explanations for the "unexpectedly high U-235 loss" on the WANL contract.

On the basis of AEC's survey findings, the report stated that the total cumulative loss, including known losses, discards, and MUF, at NUMEC during the period from plant start-up in 1957 until October 31, 1965, had been established as 178 kilograms U-235. The report stated that, during this period, NUMEC had recognized and reported cumulative losses of 149 kilograms U-235, or 29 kilograms U-235 less than the amount established by the AEC survey. The report also stated that, because of a large number of heterogeneous uranium-bearing residues on inventory which could not be sampled, some upward or downward revisions of the established loss might be necessary.

The survey team estimated that, of the total of 178 kilograms U-235 lost to October 31, 1965, 84.2 resulted from known loss mechanisms, and the remaining amount of 93.8 kilograms U-235 was categorized as MUF. MUF is defined as the difference between the physical inventory and the book inventory after the latter has been adjusted for losses resulting from known loss mechanisms, such as accidental losses, normal operational losses (discharges into tanks, sewers, stacks, burial grounds, etc.), and other known removals of material. Thus, MUF is usually the result of uncertainties of measurements, unknown losses, and undetected errors in the records. As stated by the team, the amount as developed was based on estimates; however, the loss mechanisms identified appeared appropriate and the largest part of the known losses was traceable

to records or could be developed by analyzing existing data and applying judgments thereto.

On an overall basis, AEC calculated that the estimated loss of 178 kilograms U-235 amounted to about 1.2 percent of total plant receipts since start-up. The report stated that:

> "This cumulative loss, while larger (both on an absolute and relative basis) than those reported by other commercial facilities conducting more or less comparable operations, does not appear to be so much larger as to be unexpected, ***."

During the period of our review, we found that additional losses had been disclosed and NUMEC's records showed that cumulative losses of U-235 through December 31, 1966, totaled about 260 kilograms, or about 1.2 percent of total receipts. These losses, which were reported to AEC through periodic status reports by NUMEC to ORO, included known and identifiable process losses and MUF which was disclosed by physical inventories or by material settlements at the completion of jobs. NUMEC advised us that the increase in losses since the October 1965 inventory was almost entirely attributable to losses incurred in processing large quantities of material during the intervening period.

The AEC report on the November 1965 survey presented the view that, while it could not be stated with certainty that diversion did not take place, the survey team found no evidence to support the possibility of diversion. The report added that the survey team and others observed a number of NUMEC's practices that reduced the possibility of diversion.

With respect to AEC's observation regarding overall losses at NUMEC, we were advised that AEC's view as to the reasonableness of the losses was based on its experience in the nuclear materials

management field. AEC has not established standards on which to base an evaluation of a contractor's loss performance. In regard to MUF, we are unable to state an opinion on its disposition. Because of the condition of NUMEC's records, a determination could not be made as to the approximate period of time or the process area in which the MUF occurred. We found no evidence of diversion. After considering all available information, including NUMEC's explanation of the losses related to the WANL contract (a copy of which is attached as appendix II), we have no reason to question AEC's conclusion regarding the matter of diversion.

Comments on the WANL contract

In September 1962, WANL entered into a fixed-price contract with NUMEC to furnish a product to WANL to be used in the manufacture of nuclear fuel elements. Under the terms of the contract, NUMEC had full financial responsibility for all special nuclear material furnished to it for the production of the product. Any excess enriched uranium and all scrap generated by NUMEC in fabricating the product was to be processed, as part of the contract price, to an acceptable chemical form meeting established AEC specifications and returned to AEC or paid for within 180 days after the final delivery of product to WANL.

Under the terms of the contract, for the first 90 days after final delivery of the fabricated product to WANL, no inventory use charge was to be imposed on NUMEC for the enriched uranium still in its possession; thereafter, however, a use charge of 4-3/4 percent per annum of the value of the material still in the possession of NUMEC was to be assessed. The contract also provided for the right of repossession by AEC of the enriched uranium at the expiration of the 180 days.

During the course of the contract, NUMEC was furnished with about 1,013 kilograms U-235 of which about 713 kilograms U-235 was delivered as acceptable product to WANL; thus, NUMEC was required to return to AEC about 300 kilograms U-235. On August 12, 1964, NUMEC made its final shipment of the fabricated product to WANL. By agreement with WANL, NUMEC continued experimental efforts to upgrade the product to meet new specification requirements. According to WANL, the actual contract completion date was October 30, 1964, because, on that date, WANL made its determination that the experimental material fabricated by NUMEC after August 12, 1964, would not meet the new WANL requirements.

On the basis of this completion date, assessment of inventory use charges was to commence on January 29, 1965, and the final settlement date was established at April 28, 1965. According to AEC records, NUMEC informed Government and WANL personnel that NUMEC would not be able to settle the contract on the specified date. Further, according to AEC records, NUMEC suggested that accountability for the remaining WANL material charged to NUMEC be transferred to NUMEC's supply agreement, previously entered into with ORO. By doing so, the final settlement date for material losses could be postponed until NUMEC could process the scrap remaining under the WANL contract. In the interim, NUMEC would continue paying the inventory use charge.

The proposal was agreed to by AEC providing that (1) the quantity of material to be transferred be established on the basis of a physical inventory and (2) prior to the transfer, NUMEC pay for any losses incurred under the WANL contract.

According to AEC's records, two 1-month extensions of the closeout date were made in order to take the physical inventory.

As of April 30, 1965, the date of the inventory taking, NUMEC had declared losses under the WANL contract of about 33 kilograms U-235; AEC's physical inventory disclosed an apparent loss of about 53 kilograms U-235, indicating a liability on NUMEC's part of about $735,000.

NUMEC refused to accept AEC's loss computation on the basis that AEC's calculations did not give proper effect to all recoverable sources of uranium. Consequently, the transfer of the accountability for the remaining WANL material to the supply agreement was not consummated. AEC estimated that, under the assumption that NUMEC was correct in its calculations, NUMEC's financial responsibility would amount to about $650,000. Negotiations were thereafter conducted with NUMEC to reach a settlement on the WANL contract. Our comments on the material losses ascribed to the WANL contract and to the financial settlement follow.

Comments on special nuclear material loss ascribed to the WANL contract

The AEC survey in November 1965 ascribed a loss of about 61 kilograms U-235, or about one third of NUMEC's cumulative estimated losses of 178 kilograms at that time, to the WANL contract. At that time, AEC reported that NUMEC had recognized and reported losses of 38 kilograms U-235 as being chargeable to the WANL contract; this was about 23 kilograms U-235 less than AEC's calculations. Notwithstanding extensive reviews of NUMEC's operations, neither AEC nor NUMEC have been able to identify with a high degree of certainty the specific causes of WANL material loss.

On November 28, 1966, settlement of the WANL contract was made. An analysis of material transfers under the WANL contract as of that date is presented in the following schedule:

Schedule of Special Nuclear Material
Received from, Returned to, and not Returned to AEC
by NUMEC under the Contract

	Uranium (grams)	Enrichment (percent)	U-235 (grams)
Receipts:			
Total material received by NUMEC for WANL job	1,086,946	93.15	1,012,505
Shipments:			
Finished product shipped to WANL	765,089	93.13	712,515
Balance to be returned	321,857		299,990
Scrap recovered and returned:			
As of December 22, 1965	231,041	89.55[a]	206,894
December 22, 1965, to November 23, 1966	159,591	16.40[a]	26,048
Total scrap returned	390,632		232,942
Balance not returned:			
Loss (gain)	(68,775)		67,048[b]

[a]Average enrichment of the 22 lots returned as of December 22, 1965, and additional 15 lots returned as of November 23, 1966.

[b]A cash settlement of about $929,000 was made by NUMEC for this material.

As shown in the schedule, NUMEC returned a greater quantity of total uranium than it was furnished but the U-235 content returned was about 67 kilograms less than that received. On the basis of NUMEC's explanation of the WANL loss contained in appendix II and the foregoing analysis of material transfers under the WANL contract, it is apparent that non-WANL material has been returned for credit under the WANL contract and/or that WANL material was mingled with other material, with the result that most of the non-product WANL material returned to AEC was significantly degraded.

This significance is shown by the fact that, for the quantity of scrap recovered and returned as of December 22, 1965, the difference between 231 kilograms of 93.15 percent enriched uranium and 231 kilograms of 89.55 percent enriched uranium, represents over 8 kilograms of U-235, or, on the basis on AEC's published schedule of enrichment charges, an economic loss of about $105,000.

During our review at NUMEC, we attempted to trace the internal movements of the WANL material by material balance areas (MBAs). MBAs are described in the AEC manual as control units into which a facility may be subdivided to provide closer control of material flows, to localize losses, and to provide means of simplifying the taking of physical inventories. MBAs may be established around individual processes, separate steps of a process, separate geographical areas, or organizational subdivisions. The NUMEC facility is subdivided into MBAs, and, under the company's procedures, internal transfer documents are to be used to support the movements of the material between MBAs. The internal transfer documents are to be used also for posting to the internal control ledger which summarizes the material balances in each MBA.

We were unable to trace the WANL material movements because the records were incomplete. According to NUMEC officials, internal transfer documents were not always posted to the internal transfer ledger; thus the resulting effect was that the ledger did not accurately show the balances of material at the MBAs. During the period of the WANL contract, NUMEC did not ascertain losses associated with the WANL contract by MBAs. We were advised that, during the period of the WANL contract, physical inventories were taken on a plant-wide basis rather than by MBAs; therefore, the results of the inventories were not recorded in the internal control ledger that indicated material balances by MBAs.

As a result, this ledger could not be reconciled with the general ledger. From our examination of NUMEC's records, we noted that losses reported through April 1965 were generally not identified as resulting from known loss mechanisms. In relation to this, NUMEC's records made available to us showed that burials of scrap residues were made during the period of the WANL contract; these records, however, did not show the quantities of uranium actually buried although records showed that NUMEC subsequently recovered about 7.4 kilograms of U-235 from the burial pits. Also, NUMEC advised us that part of this problem was a result of its uncertainty with respect to the best means of prorating losses due to effluent discharge mechanisms and, as stated previously, that matter has now been resolved.

A NUMEC official advised us that the internal transfer documents were prepared when material was transferred and were used as receipts for the MBA transferring the material. The official stated that the foremen accumulated the documents but eventually they might be lost or discarded and thus not all documents would be posted to the internal transfer ledger.

AEC apparently encountered similar problems in its analysis of NUMEC's records. The AEC Headquarters report on its November 1965 survey stated that the findings of previous surveys were confirmed in that the records which purport to control internal movements of material were incomplete and inadequate; therefore, it was impossible to identify with a high degree of accuracy the true physical losses attributable to any given contract. AEC noted that the plant-wide material records were based largely on book values of inventory and generally were adjusted for losses only at the time of closing a contract. AEC's report also contained the following comment:

> "In an attempt to establish yields and loss mechanisms directly applicable to this purchase order [WANL contract] the survey team requested NUMEC production control and process engineering data on this and other contracts. The data available was of little or no value in this regard. Process lots or batches could not be correlated to points in time nor could a sequence of processing events be established. All efforts in this direction were negated when it was learned that many of the requested records had been inadvertently destroyed by supervisory personnel during a 'clean up' campaign at the time of an employee strike, January 1 to February 25, 1964."

Comments on financial settlement of special nuclear material loss under the WANL contract

Under the terms of the contract, use charges were imposed beginning January 29, 1965, on material not returned by NUMEC to AEC. Final settlement was to have been made April 28, 1965, which was 180 days after contract completion as determined by WANL. Two 1-month extensions of the closeout date were made in order to take the physical inventory and WANL was instructed to take no further action toward settling the contract until receiving further direction.

Such direction was provided to WANL on November 17, 1965, and, effective November 23, 1965, WANL and NUMEC entered into a supplemental agreement under which NUMEC agreed to pay to WANL or AEC, by no later than November 23, 1966, the amount of $1,134,849.34, representing the value of the special nuclear material still chargeable to NUMEC's account. In terms of material quantities, the amount represented the value of about 94 kilograms U-235. Further, under the agreement, NUMEC agreed to pay interest at 6 percent per annum on any amounts unpaid subsequent to December 23, 1965. Since January 28, 1965, NUMEC had been paying a use charge as provided in the contract at the annual rate of 4-3/4 percent on the value of material not returned.

In accordance with the agreement of November 23, 1966, NUMEC, in liquidating its liability, returned material having a value of about $301,000 and made payments totaling about $834,000, which included about $74,000 retained by WANL from contract payments. Also, prior to the assessment of interest, NUMEC had paid use charges totaling about $68,900 and subsequently had paid interest totaling about $25,800. In terms of material quantities, NUMEC's

ultimate shortage on the WANL contract amounted to about 67 kilograms U-235 and the settlement necessitated a cash outlay on NUMEC's part of about $928,700.

We believe that the financial arrangement for settlement of the material losses on the WANL contract provided reasonable protection of the Government's financial interest in the special nuclear materials. A question could be raised as to whether interest rather than use charges should have been assessed from the date that the contract was originally scheduled to terminate, April 28, 1965, until the date that supplemental agreement was effective, November 23, 1965. Had interest been assessed, the maximum additional income that AEC could have realized would have amounted to about $9,400.

Another point relates to a financial benefit that may have accrued to NUMEC. In explaining how the material losses occurred on the WANL contract, NUMEC has stated that WANL material, as a result of NUMEC's scrap recovery operation, had been mixed unknowingly with other material and was returned under other contracts. If it is assumed that this assertion is valid, NUMEC, in effect, realized a deferral of liability for payment of losses under those contracts where WANL material may have been returned. The financial benefit that may have accrued to NUMEC as a consequence of such action does not appear to be susceptible to measurement because of the nature of NUMEC's records.

SUMMARY EVALUATION AND CONCLUSION

Under the Atomic Energy Act of 1954, as amended, AEC is authorized to prescribe such regulations or orders as it may deem necessary to guard against loss of special nuclear material. A basic fundamental to any arrangement for control over special nuclear materials in the hands of industrial firms is the principle of periodic accounting for such materials. To fully implement this principle, a materials control system must be devised requiring the use of records and reports showing the quantity of material that should be on hand and the taking of periodic physical inventories to show how much material is, in fact, on hand. Another aspect of this system is the development of records in such a manner as to permit the timely detection and localization of losses.

As shown by our review, neither AEC nor NUMEC could identify the specific causes for MUF of about 93 kilograms U-235 as of October 31, 1965, a substantial portion of which loss was ascribed to the WANL contract. With respect to the WANL contract, the alternative possibilities that present themselves are that the losses occurred in a number of contracts over a period of years without being detected and the WANL contract became a repository for such losses or that the losses occurred within the WANL contract itself. The condition of NUMEC's records do not permit us to make a conclusive determination as to the time or the manner in which the losses occurred. AEC reviews and other data suggest that the losses occurred over a period of years.

Underlying this inability to detect on a timely basis and determine the reasons for such a significant loss of special nuclear materials are both ultimate and proximate causes. The ultimate or underlying cause, in our opinion, was the system of control that

evolved as a result of AEC's decision in 1955 to rely, in making available special nuclear materials to licensees, on the concept of intrinsic value and severe criminal penalties to adequately protect the Government's interest. The proximate causes are that there was an absence of definite criteria to direct or guide NUMEC in the formulation of an acceptable materials control system and a lack of an effective approach to obtain improvements in the NUMEC system.

AEC surveys over the years have repeatedly identified the need for improvements to NUMEC's materials control system, and, at various intervals, have resulted in concern as to the adequacy of NUMEC's controls over special nuclear materials. For the most part, AEC has attempted to obtain improvements in NUMEC's system through encouragement and suggestions, rather than by more aggressive efforts to ensure the existence of an accurate and reliable materials control system. For example, considering the concern evidenced, we feel that it would have been appropriate to institute a resident inspection system at NUMEC to provide AEC assurance that an accountability system was being developed and maintained, which would afford effective control over the material.

Although AEC records indicate that NUMEC has generally responded to suggestions made as a result of the surveys, it appears that NUMEC did not exert the sustained effort necessary to effect and maintain the accountability system improvements necessary for the localization and timely detection of losses. As late as the November 1965 survey, AEC stated that its audit of NUMEC records confirmed the findings of prior surveys that the records which purport to control internal movement of material were incomplete and

inadequate. Consequently, it appears that relatively significant progress in the development of a sound accountability system has occurred only in the recent past.

A significant factor which we believe may have worked against AEC's ability to achieve the development of an effective materials control system at a much earlier date was that AEC did not define, except in broad terms, for the benefit of NUMEC, criteria or requirements which AEC considered necessary in the formulation of an adequate materials control system. As a result, AEC was conducting reviews and making suggestions or recommendations for improvements on the basis of criteria which was not necessarily apparent to NUMEC.

Another factor which may have hindered the development of an effective system was AEC's apparent inconsistency in its dealings with NUMEC. Generally, AEC reports, as a result of detailed surveys, would identify the need for improvements; these needs, in our opinion, indicated serious weaknesses in NUMEC's system. Later, after brief visits to NUMEC, AEC would compliment NUMEC on the progress being made. Succeeding detailed surveys would thereafter recite problems similar to those disclosed in prior surveys. As an illustration, in October 1960, AEC's first survey report notified NUMEC of the need to establish controls to localize losses; its most recent report, issued to NUMEC in January 1967, had recommended improvements in this area.

Also, it appears to have been incumbent on NUMEC to ensure the effective implementation of system improvements since, on the basis of the record, it should have been evident to NUMEC that its system was not providing a current and accurate accountability for the special nuclear materials for which it was responsible. In our

opinion, had AEC and NUMEC effectively followed through toward the maintenance of a system which would localize and detect losses in a timely manner, it is conceivable that the specific causes of the experienced losses could have been identified.

In May 1966, after reviewing its policy which was based on the intrinsic value concept, AEC concluded that a change should be made in the direction of placing more reliance on positive requirements, with respect to domestic safeguards for licensees. There was, among the actions taken to strengthen the program since that time, approval by AEC on January 25, 1967, of amendments to 10 CFR 70 which will require licensees holding more than specified minimum quantities of nuclear material to:

1. Establish and maintain written procedures for the control and accounting for special nuclear material in their possession.

2. Submit full descriptions to AEC of the procedures for control and accounting for special nuclear material and identify to AEC the fundamental controls considered necessary for adequate safeguarding of the material.

3. Perform inventories not less often than annually.

In addition, provision has been made for expansion of the scope of surveys of special nuclear materials, held under lease and under fixed-price contracts and subcontracts, to include a determination of the quantities of and the probable causes of process losses, accidental losses, wastes, write-offs, and MUF, and an evaluation of the significance of these quantities.

We believe that AEC's revision of its 1955 decision toward controls over special nuclear materials in the hands of licensees is appropriate. The need for this revision became more imperative

with the advent of private ownership of special nuclear materials. This step in the development of the atomic industry will entail a lessening of the traditional contractual controls under which material has been furnished by AEC. Also, the need for more effective safeguards control is indicated in consideration of the anticipated growth of nuclear power, which will require greater participation by private industry in such areas as fuel fabrication and chemical separation and the handling of larger amounts of highly enriched uranium and plutonium.

With respect to the current situation at NUMEC, our review showed that, in the past year, NUMEC has made relatively significant improvements to its materials control system. For example, our review of selected transactions after January 1966 showed that, through a subsidiary ledger, NUMEC was maintaining control over material by individual job and by material balance area and that the subsidiary ledger was being reconciled with the general ledger. In addition, NUMEC's records of recent burials were more complete and meaningful. Also, we noted that AEC's report on its most recent survey showed that 12 of the 13 recommendations for improvements in the accountability system, made as the result of the prior survey, had been accomplished or were in the process of being accomplished by NUMEC.

We noted that improvements are still necessary in the area of localization and timely detection of losses. Also, on the basis of its most recent survey, AEC, while recognizing that improvements have been made by NUMEC in the area of nuclear materials control, has yet to be satisfied as to the adequacy of the implementation of NUMEC's system. By letter dated January 25, 1967, NUMEC advised AEC of the actions that had been and were being taken to comply

with recommendations in AEC's most recent survey report and proposed March 31, 1967, as a date for a physical inventory of special nuclear material at NUMEC.

By letter dated February 10, 1967, ORO advised NUMEC that it would observe the taking of the March 31, 1967, physical inventory and would conduct a survey and submitted for NUMEC's consideration a survey plan summary which had been developed by ORO as a means of arriving at a mutual understanding of the survey plans. We were subsequently advised that, by mutual agreement between AEC and NUMEC, the survey was delayed until April 30, 1967, because it was expected that by that time the uranium inventory would have been reduced, and a more accurate physical inventory could be taken.

After considering the history of this case, we expressed the view to NUMEC and AEC that this survey should be utilized as a basis for developing a mutual understanding and agreement on AEC requirements and for establishing jointly a fully acceptable materials control system on a timely basis.

We were subsequently advised by AEC that its planned April 30, 1967, inventory verification had been postponed because of the condition of NUMEC's uranium inventory. NUMEC had advised AEC that approximately half of its uranium inventory was in scrap residues.

NUMEC proceeded with its physical inventory on April 30, 1967, and so advised AEC during a meeting on May 4, 1967. We were informed that it was agreed during the meeting that NUMEC would provide AEC with (1) a detailed description of the steps it had used to take the inventory, (2) all sampling, analytical, and other measurement data obtained from the physical inventory and NUMEC's interpretation of such data, and (3) NUMEC's statement of its April 30, 1967, inventory. We were further informed that an AEC survey team arrived at NUMEC on May 10, 1967, to review the current situation.

APPENDIXES

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Congress of the United States

JOINT COMMITTEE ON ATOMIC ENERGY

September 7, 1966

Honorable Elmer B. Staats
Comptroller General of the United States
General Accounting Office
Washington, D. C.

Dear Mr. Staats:

This will confirm the discussion on August 29, 1966 between the JCAE and GAO staff in which AEC representatives participated.

With the implementation of the private ownership legislation, the Joint Committee has been concerned as to the adequacy of AEC's regulations and contractual arrangements relating to the accountability and safeguarding of special nuclear material. The Committee is particularly interested in ascertaining what changes, if any, may be necessary in existing regulations, contracts and procedures, particularly with regard to AEC licensees.

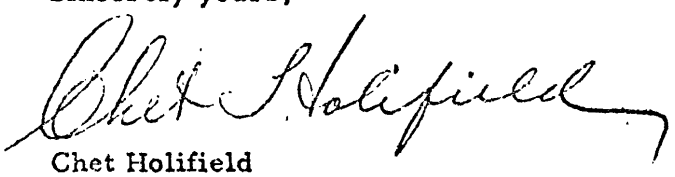
In this connection I would appreciate it if the GAO will review the past procedures employed by Nuclear Materials and Equipment Corporation (NUMEC) for the safeguarding and accountability of AEC-owned special nuclear material. The GAO is requested to review the written reports of AEC's investigation of the recently reported loss of substantial amounts of special nuclear material at NUMEC and to examine into the determination of loss charges and associated AEC use charges. Particular attention is requested to be given to appraising the internal controls and accountability of special nuclear material, including review of the company's financial and inventory control records. Thereafter, it is requested that the GAO make a comparative review of two or three other companies doing comparable work under similar AEC regulations and contractual arrangements in an effort to ascertain to what extent the situation at NUMEC may be unique or if it is characteristic of the industry.

Honorable Elmer B. Staats

I would appreciate it if a written report of your findings and conclusions will be submitted to the Joint Committee at your earliest convenience.

Thank you for your past and present cooperation.

Sincerely yours,



Chet Holifield
Chairman

NUMEC

Nuclear Materials and Equipment Corporation Apollo, Pennsylvania 15613 Telephone GRover 2-8411 Cable NUMEC

December 29, 1965

Mr. Douglas George
Director, Division of Nuclear Materials Management
United States Atomic Energy Commission
Washington, D. C. 20545

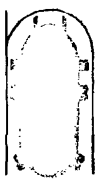
Dear Mr. George:

In the course of the past two months, representatives of The Division of Nuclear Materials Management have conducted an extensive physical inventory at NUMEC and have examined the Company's records in an effort to determine the disposition of approximately 55 kilograms of uranium-235, presently unaccounted for under Westinghouse Astronuclear Purchase Order No. 59-NP-12674. Although the precise dimensions of the materials loss have not as yet been established, we fully appreciate the overriding importance of investigating and resolving any question of safeguards connected therewith at the earliest possible date.

Necessarily, in any task as complex as the Commission's current investigation, your staff will have derived a vast amount of information from the records of the Company and through conversations with NUMEC personnel. Because much of this data has been derived from old and, in some instances, incomplete records or from the recollections of individuals of the events of several years ago, the information you have received may be somewhat fragmentary. Accordingly, I believe it would be helpful if we were to set forth, as completely as possible, our best analysis of the disposition of the material presently unaccounted for under Purchase Order 59-NP-12674 (NUMEC Contract 1231).

Unusual Nature of The 1231 Contract

In order to place this matter in perspective, it is important to understand the nature of the product and the process required under the 1231 Contract. The manufacture of pyrolytic graphite coated uranium dicarbide fuel particles on a production scale had never been done before. In general, the process involved the following steps: (1) conversion of UF_6 to UO_2; (2) blending of UO_2 with graphite and a binder material; (3) pressing of the



blended material into sinter stock; (4) sintering of the pressed material; (5) crushing of the sintered stock to form melt stock; (6) melting of the material by direct arc to form carbide ingots; (7) crushing, grinding and sizing of the ingots to form fine on-size particles; (8) spheroidizing of the particles in a plasma torch; (9) carbon coating of the spherical particles in an induction heated fluid bed reactor in an atmosphere of methane and an inert carrier gas.

Although the foregoing is only a brief description of the process, it may serve to illustrate the complexity of the manufacturing operation which may be characterized fairly as an extremely dirty and dusty process. As described below, more fully, NUMEC's product yield in this process was quite low, necessitating an extensive recycling of material in order to deliver sufficient product to the customer. Extensive recycling of material, as you know, inevitably involves a repetition of losses.

As noted earlier, the manufacture of this material was, for NUMEC, a "first of a kind contract"; it has never been performed again by the Company. Consequently, our direct experience factors are limited in terms of comparing the losses on this job with other contracts. Nevertheless, we believe it is not inconceivable that high losses* -- perhaps up to 30 kilograms of material (or 3%) -- may have been experienced in this unique and complex operation. For instance, on jobs involving the same number of unit operations, but on material inherently less dusty in nature, we have experienced losses of the same magnitude.

Even assuming, however, that such losses were experienced, this will not fully explain the disposition of the total amount of U-235 presently unaccounted for, approximately 6 percent of the total U-235 received by NUMEC for processing under the contract. Such an explanation must be derived from an examination of NUMEC's scrap recovery operations.

Scrap Generated Under 1231 Contract

The basic reference point in an inquiry into the disposition of 1231 material must be the amount of scrap generated under the contract.

*As used in this context, losses are defined as both the accounted for and the unaccounted for losses, i.e., all material not shipped to the customer as product or returned to the Commission as recovered from scrap.

The records of NUMEC's CP-2 facility, in which the initial conversion of UF_6 to UO_2 was performed, show that 1240 kilograms of material entered the facility for conversion under the 1231 contract. It should be noted, however, that only 1087 kilograms of UF_6 containing 93+ percent U-235 were furnished by the customer for conversion under the contract. The difference (153 kilograms) represents the quantity of recycled material required to make the final product accepted by the customer. It is, therefore, apparent that 153 kilograms of recycle material were, at some point, reprocessed in NUMEC's facilities. Illustrative of the process by which such recycle material is generated is the initial conversion (UF_6 to UO_2) in the CP-2 facility. NUMEC's records show that this conversion was performed in [redacted] discrete batches of approximately 163, 272, 252, 150 and 350 kilograms each, spaced three months apart between October 1962 and October, 1963. One would expect to leave behind, in the first pass through the facility, approximately ten kilograms of material from each batch. This non-yield uranium settles in clean-up materials and in the form of other wastes which are subsequently recovered and recycled. Thus, in the initial step of the process, at least 50 of the 153 kilograms of scrap described above, were generated.

It is also clear, in view of the fact that 1087 kilograms were processed to produce 763 kilograms of end product [redacted] that NUMEC had as inventory, after final product shipments, some 324 kilograms of material (process losses aside) which it was required to reprocess.

Finally, it should be noted that 65 kilograms of uranium, in the form of UO_2 prepared by NUMEC from the aforementioned scrap, were rejected by the customer. This material, too, required reprocessing.

In summary, a total of 542 kilograms (153 + 324 + 65) of scrap uranium, generated under the 1231 contract, were at various times injected into NUMEC's scrap recovery stream. It is in the reprocessing of this 542 kilograms of material that there exists the greatest possibility of mixing and consequent allocation of special nuclear material to other contracts.

The Nature of NUMEC's Scrap Recovery Operations

The possibility for the allocation of materials generated in the recovery of scrap to contracts other than 1231 is quite great in view of the manner in which NUMEC's scrap recovery operation was conducted.

A scrap recovery facility, in a company handling a large number of special nuclear materials contracts each year, cannot be reserved for an extended period of time to recover all of the scrap that may be generated

under a contract which may require a year or more to complete and which, from time to time, may generate quantities of scrap material. Of necessity, the scrap from a long-term contract must be scheduled for recovery intermittently with scrap material from other contracts. Such was the case with respect to the 1231 scrap material.

A major clean-up between jobs would be required in order to insure against the downgrading of material in an intermittent operation of this type. Such a clean-up itself, however, will generate additional losses since material is bound to be lost in the huge amounts of solution required to adequately clean the complex equipment in the plant.

Moreover, since the scrap recovery operation involves a solvent extraction process, one must reach near saturation equilibrium in the plant before extracted material is chemically clean. Thus, the first material removed from the process must always be recycled to achieve clean material. Correspondingly, the material last removed from the process is, as a general matter, never pure enough to be used in end product and, therefore, again becomes scrap.

The foregoing suggests the economic infeasibility, if not the practical impossibility of totally segregating each job in a plant with a view toward "finishing" each job before moving to the next. To offset these consequences, it was NUMEC's practice to segregate material by contract only through the point of dissolution, at which point the accountability under a given contract was established. Thereafter, our scrap recovery equipment was operated on a "heel to toe" basis without segregation of material between jobs. Thus, if scrap from ten jobs, for example, was processed in one recovery campaign, certain assumptions had to be made in assigning the recovered material between the originating contracts. This assignment was made on a basis proportionate to each contract's feed contribution. Losses were calculated in the manner described below. We believe that this method of scrap recovery operation is generally consistent with industry practice.

Disposition of 1231 Material (1962-63)

With this information as background, it becomes pertinent to examine the scrap recovery contracts most likely processed at NUMEC during the same time the 1231 contract was active. Table I, attached, lists these contracts. We believe these jobs were run on a "heel to toe" basis in conjunction with the recycle and/or scrap material from Contract 1231. Excluded, however, are those contracts involving the processing of uranium of less than 5% enrichment. Since NUMEC maintained a separate reprocessing facility for material less than 5% enriched, it is unlikely that such material would have been run on a "heel to toe" basis with highly enriched material.

The total quantity of uranium represented by the contracts in Table I is approximately 470 kilograms of U-235. These jobs were closed out with an average overall U-235 loss of approximately 1.5 per cent, or 7 kilograms. The average 1.5 per cent loss figure was selected on the basis of our best estimate, at the time, of the losses experienced in our recovery operation. A definite figure could not be established since, in the "heel to toe" process, described above, there was no complete clean-up between reprocessing campaigns. It is important to note, at this point, that due to the complexity and quantity of the scrap on hand during 1962-1963, there was a large uncertainty with respect to total plant accountability during this period. As a result there was no clear evidence, at the time, to indicate that the 1.5 per cent figure was inaccurate.

It was only within the last year, during which NUMEC performed two large scrap contracts of 108 kilograms [AT(40-1)3302] and 137 kilograms [AT(40-1)3376] that it became evident that the losses were greater than those initially anticipated. In both cases, a closed accountability was maintained; that is, there was no "cross-over" between jobs. In the first case, losses were 4.1 per cent; in the second, 3.0 per cent. (The second contract is approximate because final accountability has not been established.) In both cases the scrap involved was similar in nature to that processed during 1962-1963 and, accordingly, utilized nearly the same process chemistry and equipment. On the basis of our current experience, it would appear that a loss factor of 3.5 per cent may have been more appropriate than one per cent. On this basis, the losses experienced under the scrap recovery contracts itemized in Table I could have been 16.5 kilograms instead of the 7 kilograms declared. This would suggest that approximately 9 kilograms of 1231 contract U-235 could have been inadvertently mixed and returned with material under these scrap recovery contracts.

To further substantiate the possibility of mixing of material from the 1231 contract, we refer you to a letter of July 8, 1963, from A. H. Kasberg, NUMEC, to T. C. Johnson, Westinghouse Astronuclear, a copy of which is attached. This letter indicates that 30 kilograms of out-of-specification UO_2 (26.3 kgs of U) was scheduled for scrap return to Oak Ridge. The only supporting evidence to show that this material was returned is an entry on NME-CCC-95, a copy of which is attached, indicating that only 21.4 kilograms of uranium, slightly downgraded, was returned. This suggests the possibility that 4.6 kilograms of 1231 contract material may have in the course of scrap recovery, been returned under other contracts.

A further example is illustrated in the attached memo of October 5, 1963, from C. Beltram, NUMEC, to F. Forscher, NUMEC, describing a degradation incident involving 2.7 kilograms of 1231 contract material. We find no evidence that this material was returned as 1231 material. It can be reasonably inferred that this material may have been recovered along with other scrap material and subsequently returned, although possibly misidentified.

These are but examples of specific instances in which 1231 contract material might have been mixed with other scrap. The fact of overriding importance, however, is that because of the nature of NUMEC's scrap recovery operations, it is highly probable that scrap from the 1231 contract may have been returned under other purchase orders.

Disposition of 1231 Material as a Function of Overall Company Operations (1960-1963)

The foregoing analysis covers only the period during which 1231 contract material was being processed at NUMEC. It is important to note, however, that the same type of scrap recovery operation was conducted at NUMEC prior to the arrival of the 1231 material creating the same possibility of unavoidable mixing of material. In the period, prior to and during which, 1231 material was being processed at NUMEC, a large number of scrap recovery contracts involving 1020 kilograms U-235 in scrap were processed and closed including contracts shown in Table I, plus additional contracts shown in Table II. Using an estimated average 1.5 per cent loss figure, NUMEC declared losses of approximately 15 kilograms U-235 on these contracts. Had the more recently derived loss figure of 3.5 per cent been used, losses could have amounted to 36 kilograms U-235.

It is possible that the difference, amounting to 21 kilograms U-235 was compensated for through the return of scrap material from other purchase orders closed out before, and during, the 1231 contract. Scrap from the 1231 contract, it can be reasonably surmised, may in turn, have been returned under these purchase orders. Although it is not possible to state that a given amount of 1231 material was returned under another given purchase order, it is nevertheless probable that the net difference - 21 kilograms - (which includes the 9 kilograms discussed above) has, in fact, come to reside in the 1231 contract.

The 1231 contract has become the final repository of these estimated losses through a chain of relatively recent events. It is only within the past year, that through a concerted measurement effort and a reduction in the NUMEC inventory, it became possible to measure with a reasonable certainty, the materials loss experienced at NUMEC. After a close-out of all inactive NUMEC contracts, only the 1231 contract remained as the identifiable point for all other prior misassigned losses.

With respect to NUMEC's over-all facility operation, I believe your analysis will indicate that NUMEC's loss experience is well within the range one might reasonably expect in a facility such as ours. Moreover, our loss experience is probably not significantly higher than that of other facilities of a like nature. Accordingly, the possibility of any diversion of special nuclear material can be discounted with reasonable certainty.

I hope that this information will assist you in your investigation of this matter. Should you desire any further information, please do not hesitate to call on us.

Very truly yours,

S. A. Weber
Accountability Representative

SAW/geo

NUMEC'S COMMENTS AND OUR EVALUATION THEREOF

NUMEC commented on our draft report in a letter dated April 7, 1967, and these comments were further explored with NUMEC representatives in a meeting on April 11, 1967. We were advised that NUMEC's comments, which follow together with our evaluation thereof, were made with the understanding that this report is one of several examining the efficacy of accountability controls at a number of industrial facilities and, therefore, that the conclusions expressed by us are not necessarily unique to NUMEC. The underlined material quoted by NUMEC was included in the GAO draft report submitted to the company for comment.

"(1) '*** NUMEC's past procedures and practices for the accountability of special nuclear material were not sufficiently adequate to identify losses of uranium with specific jobs or process areas or with the period of time in which such losses occurred.'

"This opinion addresses itself to one of two principal facets of a safeguards system; namely, the procedures purporting to control internal movements of material and the mechanisms for reporting thereon. An adequate safeguards system, however, has another significant element - the control of external transactions. (The accountability requirements of 10 CFR 70, as initially published, were basically devoted to control of external transactions. ***.) We believe the record will show that transactions involving the introduction and removal of material from the Apollo plant have, on the whole, been well documented and controlled. Accordingly, we offer for your consideration that the above-referenced statement be amended to read as follows:

'Although the record indicates that external transactions (those involving the introduction or removal of special nuclear material from the Apollo plant) have been reasonably well controlled and documented, in our opinion, NUMEC's internal controls

not consistent with the prudent businessman concept considered by the Commission in formulating its 1955 policy.'

"This statement is unnecessarily vague and susceptible of an interpretation which we do not believe is intended. The report *** notes that the principal underpinning of the Commission's 1955 policy was the expectation that financial responsibility (coupled with the criminal penalties involved) would provide the incentive necessary for individual companies to create and enforce an adequate accountability system. The report then expresses the opinion, noted above, that, at least with respect to internal controls, NUMEC's procedures have, in the past been inadequate. We believe the ultimate conclusion intended *** is:

'Also, it appears that financial responsibility, the essential underpinning of the Commission's 1955 policy decision with respect to materials accountability, failed to provide the expected incentive for the creation and enforcement of an adequate system of internal controls at NUMEC to identify losses of uranium with specific jobs, process areas or time periods.'

"We suggest the foregoing *** as being more accurate and representative of the conclusion intended by the report."

We agree that the use of the term 'prudent businessman concept" in this instance could result in misinterpretation. Accordingly, we have revised this section of the report to more clearly indicate our position.

"(3) '***. AEC records indicate that NUMEC has generally responded to suggestions made as a result of the surveys. However, it appears that NUMEC did not exert the sustained effort necessary to effect and maintain the accountability system improvements necessary for the localization and timely detection of losses.'

"The record, in our view, does not support the conclusion expressed in the second sentence, above. The survey reports

over the past six years repeatedly note 'significant progress,' 'commendable performance' and 'positive cooperation' by NUMEC. Reports to this date, continue to note significant improvements in NUMEC's accountability system. To the extent that deficiencies have been noted from time to time, it must be remembered that an accountability system is not static. As new procedures are employed - and this is particularly true at NUMEC where, as your report notes, 'first of a kind contracts' have been characteristically performed - the accountability system must often be modified. Moreover, certain objectives of a good accountability system, particularly in relation to the localization of losses, pose a never ending challenge. That a recommendation relating to the localization of losses is made repeatedly, is not an indication of a continuing deficiency but rather a call for increased effort to meet a continuously moving target.

"Although many of these points are made elsewhere in your report, we believe they should be included, at least in summary fashion, in the last paragraph on Page 7 [of the draft report] in order to place your statement of opinion in a reasonable context."

As we mentioned in the report, on a number of occasions AEC reports and letters resulting from surveys and visits to NUMEC do comment on NUMEC's progress and attitude in a favorable manner. We agree also that a sound accountability system cannot remain static. In this connection NUMEC should have anticipated the need for and initiated changes to its accountability system to afford proper localization of losses. The record which contains repeated AEC recommendations and suggestions relating to localization of losses seems to indicate that NUMEC did not assume such initiative but, at best, may have at times reacted to the initiative provided by AEC. We believe that the overall record of NUMEC's experience in this area of activity clearly supports the view that NUMEC did not exert the sustained effort necessary to effect and maintain the

accountability system improvements necessary for the localization and timely detection of losses.

"(4) '***. ORO noted in its letter that NUMEC was mixing uranium from several contracts which prohibited commingling, that containers of uranium were not properly labeled, and that NUMEC was not submitting complete and factual material balance reports to AEC.'

"The foregoing summary of the April 1964 survey report is misleading. To the extent it implies a deliberate commingling of material it is in error. The only reference to commingling in the AEC's letter is promptly accompanied by an acknowledgement that such commingling was the result of an inadvertent mis-labeling of a container of material. It should be made clear in your report that NUMEC has not engaged in, and has never been accused of, the unauthorized commingling of material.

"The reference to incomplete or non-factual material balance reports is likewise out of context. The AEC's criticism was aimed at the existence of two internal scrap accounts (one for lease material; the other for station material) of which the AEC was aware but which had not been reflected in the Company's monthly material balance reports. In accordance with AEC's instructions, subsequent material balance reports have reflected these scrap accounts. There was not, however, at any time an attempt to withhold data not already known to AEC. We believe your discussion of the April 1964 survey report should be amended to reflect these facts.

"In the same vein, we would like to request some modest expansion of the paragraph *** outlining the position expressed by NUMEC in its letter of January 18, 1967 concerning, inter alia, the 1964 survey. This paraphrase of our position fails to convey an appreciation of the special problems associated with accountability for materials in scrap recovery operations. We suggest, in the alternative, a direct quote from our letter of January 18, 1967 beginning with the third full paragraph, Page 4 ('A careful review ...) and ending with the paragraph continuing over to Page 5 (... to assure the proper safeguarding of special nuclear material ...')."

We have expanded the report to delineate AEC's findings resulting from its survey of February 1964 and NUMEC's position on the significance of these findings as expressed in a letter dated January 18, 1967. NUMEC concluded that, when considered in the context of current standards and requirements, the findings of the April 1964 survey report would not reflect a determination by AEC that NUMEC's system was inadequate to ensure the proper safeguarding of special nuclear material. It was, however, the opinion of the survey team that NUMEC had expended insufficient thought and effort in the interests of establishing an acceptable and realistic accounting structure for the recording and reporting of special nuclear materials. Moreover, in our opinion, AEC's letter of April 1, 1964, advising NUMEC that:

> "Failure to comply with acceptable scrap processing and special nuclear material accounting procedures may require the AEC to take appropriate action including that which would preclude your receipt and processing of special nuclear materials."

evidenced serious concern over the adequacy of NUMEC's then existing accountability practices as they related to the scrap recovery operations.

> "(5) '*** ORO also advised NUMEC that the percent of material unaccounted for (MUF) disclosed by comparing the adjusted book inventory to the physical inventory was 8.82 percent loss of uranium above 75 percent U-235, 3.19 percent loss of uranium below 75 percent U-235 and 6.01 percent loss of leased nuclear materials. ORO stated that these percentages were in excess of that which was acceptable to AEC.'
>
> "The foregoing, while substantially a direct quote from an AEC letter of October 15, 1964, uses the term 'MUF' erroneously, implying that an 'MUF' is a 'loss.' As your

own report *** correctly notes, MUF is merely a convenient means for expressing the uncertainty on a given inventory. It is not a 'loss' but rather, as you note, 'the result of uncertainties of measurements, unknown losses and undetected errors.' Moreover, in seeking to relate a MUF to the quantity of material handled, it is not meaningful to compare the adjusted book inventory to the physical inventory and then take the difference and express it as a percentage of the adjusted book inventory. The MUF is more properly expressed as a percentage of the total amount of material received or shipped in a given category or under a given contract.

"Based on the foregoing, we suggest that the referenced statement *** be deleted and be replaced by a statement such as:

'ORO also advised NUMEC that the MUFs disclosed by its physical inventory were in excess of that which was normally acceptable to AEC.'"

Because the percentages and terms used in the cited sentence may be subject to misinterpretation, we have revised the sentence in accordance with NUMEC's suggestion. While we do not agree that MUF is merely a convenient means for expressing the uncertainty on a given inventory or that the method used by ORO to arrive at loss percentages is necessarily not meaningful, these matters are no longer pertinent to the section of the report to which NUMEC's comments are addressed.

"(6) '***: The report stated that on the basis of the survey team's findings, the total cumulative loss was established at 178 kilograms U-235 as of October 31, 1965, or 29 kilograms more than had been reported to AEC by NUMEC in periodic reports.'

"This statement, standing alone, carries the inference that NUMEC had understated its losses to the extent of 29 kilograms. It should be noted that the last report made by NUMEC and based on a physical inventory had been

submitted more than six months prior to the date of the above-referenced report. One would naturally expect additional losses in the course of processing additional material over a six-month period. Accordingly, we suggest the deletion of the words 'or 29 kilograms more than had been reported to AEC by NUMEC in periodic reports.'"

We did not intend to imply that NUMEC had deliberately understated its losses but intended only to point out that the AEC survey disclosed significant losses in addition to those previously recognized. To avoid possible misinterpretation we have deleted reference to the additional losses in the report.

"(7) '***: Reference extract of AEC letter of January 24, 1967'

"*** the report extracts three statements of opinion by the AEC regarding the most recent inventory and survey at NUMEC. Briefly, they are:

"a. NUMEC did not maintain complete records of known process losses and losses are, therefore, understated.

"b. Label data were not adequate to provide an accurate inventory.

"c. NUMEC did not include certain filters in its inventory report.

"Your report extracts from a NUMEC letter of January 25, 1967, to AEC a summary of our position with respect to Item 'b' above. It should be noted that our letter also expressed a very clear position with respect to Items 'a' and 'c'. With respect to the understatement of known process losses, we pointed out that extensive data which had already been made available to the AEC on losses through stack and liquid effluent discharges had not been reflected in our reports to the Commission because of our uncertainty with respect to the means of apportioning these losses by contract. We noted, further, that a prorating agreement reached with AEC would eliminate this

problem henceforth. We specifically noted that NUMEC had never failed to report a known process loss which could be associated with a specific contract.

"With respect to Item 'c', it may be well to quote as follows from our letter of January 25, 1967, to AEC in which it is made clear that any failure to report filters on our inventory report was the product of a misunderstanding:

> 'Your opinion notes that there are a number of contaminated air filters stored without a measured content, and that there apparently was a misunderstanding with the AEC concerning the inventory of these items. It was our understanding that the AEC planned, as they had done in November, 1965, to measure all of these filters independently. We regret that a misunderstanding existed regarding the measuring of filters, and we are actively engaged at this time not only in measuring the uranium content of these filters, but in sorting out those which contain recoverable quantities of uranium.'

"We suggest that these facts be included in your discussion of our response to the opinions expressed by AEC as part of its November 1966, survey."

To more fully report on the circumstances resulting in AEC's opinion that NUMEC's stated inventory as of September 30, 1966, did not fairly present actual holdings, we have expanded our discussion of AEC's three stated objections and NUMEC's position thereto.

"(8) '***: During the period of our review, we found that additional losses had been disclosed and NUMEC's records showed that cumulative losses of U-235 through December 31, 1966, have totaled about 260 kilograms, or about 1.2 percent of total receipts.'

"Although we do not believe that the inference is intended, the foregoing statement carries the connotation that earlier loss reports were inaccurate. The difference between the October, 1965, loss estimate of

178 kilograms and the December 31, 1966, estimate of 260 kilograms is almost entirely attributable to losses incurred in processing large amounts of material during the intervening period. This should be made clear in your report."

NUMEC's comment on the additional losses during this period has been incorporated in the report.

"(9) ***." (NUMEC's comments in this section of its letter concern questions of fact as to the sequence of events leading to the settlement of the WANL contract. After reviewing the evidence in our meeting of April 11, 1967, NUMEC representatives agreed that our presentation was in the correct sequence.)

"(10) '***. From our examination of NUMEC's records, we noted that losses reported through April, 1965, were generally not identified as resulting from known loss mechanisms.'

"This is, in large part, a result of our uncertainty with respect to the best means of pro-rating losses through effluent discharge mechanisms. (See discussion under Item (7) above.) The pro-ration agreement recently reached between AEC and NUMEC will eliminate this problem."

The report discusses improvements which NUMEC has made in its practices and those which it has agreed to make. NUMEC's comment in this instance does not appear to require further report amplification.

"(11) '***. Further, under the agreement, NUMEC agreed to pay interest on any amounts unpaid subsequent to December 23, 1965.'

"It may be useful to note that the specified rate of interest was six percent."

In accordance with NUMEC's suggestion we have noted in the report that the interest rate under the supplemental agreement to WANL contract was 6 percent.

"(12) '***. Generally, AEC reports, after detailed surveys, would identify the need for improvements which, in our opinion, indicated serious weaknesses in NUMEC's system. Thereafter, following brief visits, NUMEC would be complimented for the progress being made. Succeeding surveys would thereafter recite problems similar to those disclosed in prior surveys. As an illustration, in October, 1960, AEC's first survey report notified NUMEC of the need to establish controls so as to localize losses; its most recent report, issued to NUMEC in January, 1967, recommended improvements in this area.'

"It is error to cite the record, generally, and specifically, as it relates to the localization of losses, as evidence for the proposition that AEC has been inconsistent in its dealings with NUMEC or that NUMEC has failed to comply with AEC's suggestions for improvements in the accountability system. The objective of localizing losses, as noted above - like so many other aspects of an accountability system - requires continuing effort. That a recommendation of this type is repeated after a lapse of time is neither an indication of inconsistency on the part of AEC nor an indication of fitful or uneven compliance by the Company. Good accountability, whether in the localization of losses or elsewhere, is a never-ending professional challenge. (In this connection, it may be useful to note that our accountability staff is now being increased to 6 full-time professional employees, supported by 7 technicians and clerical personnel.) Suggestions for further improvement, though repetitive on occasion, more often than not reflect changes or refinements in technology and an increasing degree of sophistication in the handling of special nuclear materials. We submit that an acknowledgement of this fact would provide a useful perspective for your report."

NUMEC's comments here are consonant with those contained in point (3) wherein NUMEC stated "That a recommendation relating to the localization of losses is made repeatedly, is not an indication of a continuing deficiency but rather a call for increased effort to meet a continuously moving target."

As mentioned in the report AEC has on a number of occasions complimented and encouraged NUMEC in areas relating to its procedures for accountability. On the other hand, the record shows that AEC has repeatedly cited weaknesses in NUMEC's system, which were continuing in nature and, in our opinion, were serious. For example, as late as April 1966 AEC reported that a recent audit of NUMEC's records confirmed the findings of prior surveys that records which purport to control internal movements of material were incomplete and inadequate; therefore, it was not possible to identify with a high degree of accuracy the true physical losses which were attributable to any given contract.

Consequently, while we agree that a sound accountability system cannot remain static, we believe the overall record of NUMEC's experience clearly supports the view that NUMEC did not exert the sustained effort necessary to effect and maintain the accountability system improvements necessary for the localization and timely detection of losses.

U.S. GAO, Wash., D.C.