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

JUL 27 1972

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Dear Senator Proxmire:

Your letter of April 22, 1971, requested that we look into statements, made by Mr. John McGee, concerning the following criticisms of the Department of Defense (DOD) Equipment Oil Analysis Program.

- The specification for the military spectrometer was tailor made for a specific contractor, Baird-Atomic.
- No other suppliers of spectrometers could meet the requirement of the specification included in the request for technical proposals to supply the new spectrometers.
- ✓ --Contractor-supplied spectrometers could not meet the original specification.
- Commercial spectrometers are much more dependable than those furnished to meet Government specifications.
- Cost of spectrometers built to the military specification increased between 100 and 300 percent.
- The military services continue to operate their own oil analysis program, disregarding the Department of Defense program.

In subsequent discussions Mr. McGee questioned (1) the procurement of electrodes and calibration standards used in the program, (2) the use of a civilian laboratory in Puerto Rico, and (3) the Navy's purchase of spectrometers which did not meet contract specifications.

The information we obtained follows.

BACKGROUND

The purpose of the oil analysis program is to monitor the condition of engines by analyzing samples of lubricating fluid from the engines. The samples are analyzed for metals that wear off moving parts and mix with the fluid. The analysis can identify abnormal wear of components before they

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fail. The program uses laboratories; equipment, including spectrometers; and specialized techniques to analyze oil sample.

Before May 1969 each service operated its own oil analysis laboratories and equipment. Two types of spectrometers were being used, and their analytical outputs were not compatible. Each required separate spare parts support, and interservice use was limited. Then DOD established a joint Army, Navy, and Air Force program, known as the Equipment Oil Analysis Program. The Department of the Navy was directed to manage it. DOD also decided that a specification for a standardized spectrometer--to be used in the program--should be developed.

DEVELOPMENT OF THE SPECIFICATION FOR THE MILITARY SPECTROMETER

Many engineering and technical personnel from the Army, Navy, and Air Force were involved in planning and developing the specification which was designed to meet the special requirements for an oil analysis program for all the services.

Several engineering and technical officials with whom we talked indicated that in establishing the specifications they were within, but approaching, the limits of the state of the art as they were known at the time.

They sent a draft of the specification to officials at various military organizations for comment and to many industrial firms that made spectrometers, including Baird-Atomic. Suggestions which resulted in 48 changes to the draft were received from seven military organizations and six firms. Some of Baird-Atomic's suggestions were later adopted, as were suggestions by other manufacturers. In any event, the suggestions adopted were not considered to result in major changes to the specification--MIL-S-83129. In view of the number of parties involved in developing the specification, it does not appear to us that MIL-S-83129 was tailor made for Baird-Atomic.

CONTRACT AWARD TO SUPPLY NEW SPECTROMETERS

MIL-S-83129 was included in the Navy's Request for Technical Proposals, dated June 30, 1969, which was sent to 40 suppliers and manufacturers. The Navy received 24 responses, but only two suppliers submitted proposals.

We noted that the concept of a standardized military spectrometer had been strongly criticized by some important manufacturers of spectrometers. Both Perkins-Elmer and Jerrell-Ash, two manufacturers considered by the military to be the most likely to compete with Baird-Atomic, believed that MIL-S-83129 was unrealistic. Both companies took exception to the specification because of its stringent requirements and stated it was not feasible to build such spectrometers. They recommended that DOD consider using one of their commercial spectrometers.

DOD disagreed and stated that the requirements of the specification were stringent but that the performance required of the instrument was attainable and within the state of the art. DOD cited data which indicated that oil analysis equipment had already been built to meet rigorous operational and environmental conditions required of the military equipment.

In July 1969 a committee, composed of 14 DOD engineering and technical personnel experienced with spectrometers, was set up to evaluate the technical proposals received from Perkins-Elmer and Baird-Atomic. The committee decided that the Perkins-Elmer proposal was nonresponsive and that the Baird-Atomic proposal met essentially all the requirements of the Request for Technical Proposal.

A letter contract for 40 spectrometers was awarded to Baird-Atomic on May 28, 1970. We have not looked into the Navy's justification for using a letter contract when a military specification was available. On April 1, 1971, a definitive contract was negotiated for 43 spectrometers costing \$42,675 each.

On the basis of (1) participation of industry in developing the military specification and (2) the understanding of responsible DOD officials that the specification was within the limits of the state of the art, we believe that DOD's handling of the specification in this transaction was reasonable. On the basis of the information developed in our review, it would appear that Baird-Atomic was the only firm qualified and willing to attempt construction in accordance with the specification. The two suppliers--Perkins-Elmer and Jerrell-Ash--considered to be the most qualified potential competitors with Baird-Atomic seemed unwilling to attempt to meet the specification. They concentrated instead on trying to

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persuade the military to abandon the military specification and to buy standard commercial-type spectrometers.

EXTENT OF CONTRACTOR'S COMPLIANCE
WITH THE ORIGINAL SPECIFICATION

Under the terms of the Request for Technical Proposals and the letter and definitive contracts, the spectrometers were to be manufactured in accordance with MIL-S-83129 with certain minor modifications. Accuracy and repeatability are important factors in laboratory oil analysis sampling and testing programs. Accuracy is the exactness with which a spectrometer can produce correct sample analyses in relation to a standard or set of standards. Repeatability is the capacity of a spectrometer to repeatedly produce the same accurate analysis of the sample or the exactness with which all spectrometers can produce the same accurate analysis of a sample.

The specification required high standards of accuracy and repeatability for oil tests involving a wide variety of equipment ranging from aeronautical engines to marine engines and heavy ground equipment engines. The standards for marine and ground equipment engines were considered to be more difficult to attain than those for aeronautical engines.

Baird-Atomic found that it could not meet the required repeatability and accuracy tests at the high ranges required for the marine and ground equipment engines and refused to sign the definitized contract until these requirements were relaxed.

On April 5, 1971, 4 days after the contract was definitized, the contract was modified to (1) recognize that it might not be technically possible to meet the repeatability and accuracy requirements of the specification for all elements at all contamination levels and (2) provide new acceptance criteria for the spectrometers. The accuracy and repeatability requirements for analyses at higher contamination levels were relaxed in varying degrees for 15 of the 20 elements that the spectrometer was designed to measure.

Although the instruments built to the modified specification may be adequate for aeronautical equipment, they may not be adequate for other equipment, such as marine engines and heavy ground equipment engines. DOD plans to extend the oil

analysis program to that equipment when test programs demonstrate feasibility. Wear-metal contamination in such equipment can reach much higher levels than in aeronautical engines before any trouble is indicated; therefore more stringent requirements for accuracy and repeatability are needed. Consequently, when the program is expanded to such equipment, spectrometers that can meet only the accuracy and repeatability of the modified specification requirements may be inadequate for meaningful analyses of oil from these engines.

SUITABILITY OF COMMERCIAL SPECTROMETERS
FOR MILITARY USE

We discussed the suitability of commercial oil analyses equipment for military use with an official of the office of DOD Equipment Oil Analysis Program Activity. He stated that the type of spectrometer manufactured by Perkins-Elmer might be more accurate and might have better repeatability than the military-type instruments at the lower contamination levels. This superiority, he agreed, probably could be extended into the higher contamination ranges by further dilution of the oil samples being tested. He also stated that any commercial instrument probably could meet the accuracy and repeatability standards of the military specification for all 20 elements if advance preparation of the oil samples were permitted. The advanced preparation is a manual process, however, and the separate laboratory testing of the 20 elements is both time consuming and costly.

The military specification prohibits any advance preparation of oil samples because this would slow down production testing by the spectrometers to an unacceptable degree. The military specification provides for simultaneous testing of all 20 elements from a single sample and incorporates other requirements for explosion-proofing, ruggedness, and sampling speed, which the commercial models cannot meet.

We also discussed the acceptability of off-the-shelf instruments with officials at the Technical Support Center, Pensacola, Fla., who agreed that the commercial equipment could not meet the military specification. They said that-- although commercial spectrometers were readily available, less costly, and more accurate and reliable--they could not be utilized in the program because they:

--Required hand preparation of samples and were therefore too slow to meet the required response time.

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- Could not analyze more than six of the 20 elements called for in the military specification.
- Did not have computer printout capability.
- Could not be used aboard aircraft carriers because they could cause explosions.

In summary, although the commercial spectrometers have better accuracy and repeatability under certain conditions than those built to military specification, they cannot fully meet certain military requirements.

COST GROWTH OF DOD
EQUIPMENT OIL ANALYSIS PROGRAM

The contractor's original proposal made in March 1970 was for 41 to 50 spectrometers at \$36,853 each. A letter contract for 40 spectrometers was awarded on May 28, 1970. On August 7, 1970, the contractor increased the proposed unit price to \$42,286. On February 2, 1971, the contractor proposed a further increase in the total cost of the contract without identifying the amount applicable to each contract item. The final negotiated prices in the definitive contract were \$42,675 each for 43 units and \$47,375 each for nine units. Using an average unit price of \$43,488 applied to the procurement of 109 units required under this program, we estimate that the cost of the spectrometer will be 18 percent higher than the original bid, if the price of the spectrometers does not change further.

On June 19, 1970, DOD prepared a cost study showing the estimated costs of the total program for fiscal years 1971 and 1973. Costs were categorized as (1) laboratory costs, which include facility preparation, certain costs of processing samples at the installation level, and the amortization and maintenance of equipment, and (2) total program costs, which include costs of administering the program and certain user costs not included in the cost of processing samples. The study shows that the estimated total program cost for fiscal year 1971, based on the number of spectrometers then in use and in inventory, would be \$14,165,509. The study included no estimates for fiscal year 1972, but it estimated the total program costs for fiscal year 1973 at \$13,909,530, on the basis of the use of 109 spectrometers built to the new military specification. The decrease is due primarily to lower labor and overhead costs expected in the operation of the new spectrometers.

We conclude that, although the program has suffered cost increases, they are probably much lower than the 100- to 300-percent increase cited by Mr. McGee. Actual cost data, applicable only to the spectrometers, show a cost increase of about 18 percent. DOD cost estimates for the program as a whole show that, from fiscal year 1971 to fiscal year 1973, a decrease of about 2 percent is expected.

OPERATION OF INDIVIDUAL OIL ANALYSIS
PROGRAMS BY MILITARY SERVICES

DOD Directive 4154.14, dated May 15, 1969, requires military activities to send their oil samples for testing to an assigned laboratory once it has been certified to handle oil analyses for all the services. We were told that a number of military activities had been permitted to continue making oil analyses themselves because laboratories which might give them oil analysis support had not been certified under the program. The laboratories have not yet been certified because of the reduced capabilities of the new spectrometers and because of problems DOD is having in developing certification criteria acceptable to the Army, Navy, and Air Force. Therefore the military activities which continue to perform their own analyses are not operating in violation of the directive as long as the laboratories continue to lack the necessary certification.

PURCHASE OF ELECTRODES AND
CALIBRATION STANDARD FLUIDS

In conversations with us, Mr. McGee questioned the DOD purchases of disc electrodes for the new spectrometers from Baird-Atomic on a proprietary basis. He stated they are identical to electrodes purchased on the open market at a lower cost and used on older model spectrometers.

DOD officials stated that, because of the lack of experience with the new spectrometers, Baird-Atomic had been given a contract to maintain them for 1 year. Because Baird-Atomic claimed that the accuracy of the new spectrometers would be affected by use of the disc electrodes, the Government agreed to allow Baird-Atomic to furnish electrodes for the maintenance period. The additional cost was estimated to be \$37,400 for the year. In view of the importance of using the right kind of electrodes and the small amount of money involved compared with the overall program cost, we concluded that the purchase of a limited quantity of the spectrometer manufacturer's electrodes for the initial period of a maintenance contract was reasonable.

Mr. McGee also questioned the sole-source procurement of calibration standard fluids. DOD officials agreed that calibration standard fluids were purchased on a sole-source basis because they were required to handle 20 metallic and nonmetallic elements to be analyzed by the new spectrometer. Fluids with this capability were obtainable only from the Continent Oil Company; therefore there appears to have been no alternative to sole-source procurement.

USE OF A CIVILIAN OIL ANALYSIS
LABORATORY IN PUERTO RICO

Mr. McGee told us that the selection of the civilian laboratory for the DOD program may have been influenced by the friendship between the laboratory owner and a DOD official.

We were informed by program officials that the civilian oil analysis laboratory in Puerto Rico was used because the small volume of oil samples being generated in that geographic area could be analyzed more economically by that laboratory than they could be by establishing and using a military laboratory. This civilian laboratory is the only one performing spectrometric oil analyses in Puerto Rico and has done satisfactory work for the Navy for a number of years. Currently, the cost of test samples at the civilian laboratory is about \$2.50 each and the total cost is under \$20,000 per year. We were told that this sample cost compared well with the military sample cost of about \$2 and with other Navy commercial laboratory sample costs of \$5 to \$6.

NAVY PURCHASES OF SPECTROMETERS
DID NOT MEET SPECIFICATIONS

Mr. McGee stated that three Baird-Atomic spectrometers purchased by the Navy in June 1968 had not met the contract performance specifications but that they had been accepted and paid for by the Navy.

The prototype spectrometers were purchased in accordance with a Navy purchase specification prior to the development of the DOD specification. There were many complex technical reasons why the spectrometers did not meet the specification Baird-Atomic provided additional services and spare parts as an adjustment, but technical personnel in DOD were of the

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opinion that the Government did not receive an adequate allowance from Baird-Atomic for its failure to meet the specification. We did not develop any information which we could use to determine whether Baird-Atomic's allowance to the Government was adequate.

We trust that the information furnished will be useful; we shall be pleased to meet with you or with members of your staff if additional discussion is desired. Formal comments have not been obtained from DOD on the data we are providing. We will not distribute this report further unless copies are requested and we obtain your agreement or unless you publicly announce its contents.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "James B. Parsons". The signature is fluid and cursive, with a prominent initial "J" and "P".

Comptroller General
of the United States

The Honorable William Proxmire
United States Senate