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Proc I

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

FILE: B-185582 **DATE:** January 12, 1977

MATTER OF: Jarrell-Ash Division of the Fisher Scientific Company

DIGEST:

Requirement for 4A/mm minimum dispersion contained in specifications of first step of two-step formally advertised procurement for spectrometer is defective and overly restrictive, since only one firm's standard instrumentation meets requirement, and since specifying dispersion without resolution is not adequate or meaningful because same performance capability desired through dispersion requirement could well be achieved by spectrometer having less dispersion but superior resolution. Also, requirement for continuous and automatic alignment monitor is of questionable validity. Consequently, spectrometer requirement should be resolicited based on actual Government requirements.

The Jarrell-Ash Division of the Fisher Scientific Company (Jarrell) has protested against certain specifications contained in the first step of invitation for bids (IFB) DAAA22-76-B-0004, a two-step formally advertised procurement, issued by the Department of the Army, Watervliet Arsenal, Watervliet, New York.

The first-step request for technical proposals called for a direct reading vacuum spectrochemical analysis system (spectrometer). The spectrometer is to be used to analyze varied materials utilized in the fabrication, processing and production of weapons to determine the elements present and their concentrations. Basically, the spectrometer analyzes material by atomizing the material sample, dispersing the light emanated through a specially designed grating, and focusing the dispersed light at the focal plane where it appears as monochromatic lines of the spectrum representative of the elements in the sample. The elements present and their concentrations can be identified by the spectral lines. A "direct reading" spectrometer has pre-set exit slits (i.e., small openings in the focal plane located at the particular spectral lines) and corresponding photomultipliers (to measure radiation intensity) to ascertain the presence and concentration of specified elements. The optics of the procured spectrometer are enclosed in a vacuum.

The specifications protested by Jarrell are:

"3.2.2 The spectrometer shall detect and measure in the spectral range between 1750A to 4300A minimum. The spectrum produced at the focal curve shall be continuous and have a linear dispersion of four (4) angstroms per millimeter [4A/mm] or better in the first order. The instrument shall have a capacity of not less than forty (40) exit slits and forty (40) photomultiplier tubes.

"3.2.2.1 The spectrometer shall be equipped with an alignment monitor capable of automatic and continuous spectral alignment, sensitive to one (1) micron of misalignment at the focal plane." (Emphasis supplied.)

Jarrell contends that the requirements for 4A/mm dispersion and an automatic monitor are overly restrictive and can be met only by standard instrumentation manufactured by one domestic manufacturer--Baird-Atomic, Inc. (Baird). Jarrell further states that although a number of firms have the technical ability to meet these requirements, compliance could not then be had with paragraph 3.1.4 of the request for technical proposals which states in pertinent part:

"The equipment shall be new and of the manufacturer's latest approved design. This design is not to be a prototype system and the manufacturer must have working models of similar system in the field. * * *"

Six technical proposals were submitted under the first step from the following firms: Jarrell, Baird, Angstrom, Inc. (Angstrom), Applied Research Laboratories, and the Labtest Equipment Company (two alternate proposals). The Army has not formally determined which proposals are acceptable pending our decision in this matter. It would appear that since only Baird's technical proposal meets both of the protested specifications, it would be found to be the only acceptable proposal under the first step.

The determinations of the needs of the Government and the methods of accommodating such needs are primarily the responsibility of the contracting agencies of the Government. 38 Comp. Gen. 190 (1958); Manufacturing Data Systems Incorporated, B-180608, June 28, 1974, 74-1 CPD 348. We recognize that Government procurement officials, who are familiar with the conditions under which supplies, equipment or services have been used in the past, and how they are to be used in the future, are generally in the best position to know the Government's actual needs, and, therefore, are best able to draft appropriate specifications. Manufacturing Data Systems Incorporated, B-180586, B-180608, January 6, 1975, 75-1 CPD 6; Maremont Corporation, 55 Comp. Gen. 1362 (1976), 76-2 CPD 181. Consequently, we will not question an agency's determination of what its actual minimum needs are unless there is a clear showing that the determination has no reasonable basis. Maremont Corporation, supra. Although the law does not require that the Government's legitimate needs be compromised to obtain competition where these needs can only be satisfied by a single source, we will closely scrutinize minimum needs determinations which effectively limit competition to a single source. See Winslow Associates, 53 Comp. Gen. 478 (1974), 74-1 CPD 14, and B-178740, May 8, 1975, 75-1 CPD 283; Globe Air, Inc., B-180969, June 4, 1974, 74-1 CPD 301.

With the foregoing principles in mind, we have reviewed the protested specifications in consultation with technical experts. For the reasons that follow, we have concluded that the protested specifications are defective.

The basic performance characteristics of the spectrometer are defined in paragraph 3.2.1 of the specifications. This paragraph contains an alloy matrix defining the precision of analyses which the system is required to achieve. This matrix defines the spectrometer's ability to find certain specified elements in specified alloys at specified concentrations within specified deviations.

The 4A/mm dispersion requirement was imposed in addition to these required performance characteristics. Only Baird's proposed spectrometer met this requirement (2.94 A/mm). Other proposed spectrometers varied from 4.63 A/mm to 5.6 A/mm dispersion.

Dispersion in a spectrometer is a function of the grating spacing and the focal length (i.e., the distance between the grating and the focal plane). For constant grating spacing, dispersion increases as the focal length increases; for constant focal length, dispersion increases as the grating spacing decreases. Consequently, dispersion is related to the physical size of the spectrometer (e.g., Jarrell's spectrometer's focal length is .75 meters and Baird's focal length is 2.0 meters). As noted by the Army, "dispersion is a measure of the ability of a spectrometer to resolve differences between closely spaced diffracted spectra." The greater the dispersion, the greater the distance between adjacent spectral lines, and thus the greater the ability to differentiate between these lines.

Based on our review, we do not believe that merely specifying a minimum dispersion is an adequate or meaningful measure of spectrometer performance. Another necessary characteristic to differentiate between the spectral lines to ascertain what elements are present in a tested sample is the <u>resolution</u> of the spectrometer. Resolution is also an optical quality of the spectrometer. It is a function of the spectrometer's grating design, focus and freedom from optical aberration. That is, resolution determines the <u>clarity</u> of the spectral lines. Resolution for a particular spectrometer can be quantified according to wave length and position in the spectrum.

It is indispensable that a spectrometer have both sufficient dispersion and sufficient resolution. Dispersion without resolution serves no useful purpose. If a spectrometer has insufficient resolution, superior dispersion will not allow for differentiating between adjacent spectral lines; if insufficient dispersion exists, superior resolution will not permit meeting the performance requirements. Moreover, a spectrometer with superior resolution and lesser dispersion can have the ability to differentiate between the same close spectral lines as a spectrometer with superior dispersion but lesser resolution.

Consequently, since only the Baird standard instrumentation can meet the 4A/mm dispersion requirement and since the desired performance capability which the Army has stated it wishes to achieve through the 4A/mm dispersion requirement could well be achieved by spectrometers having less than 4A/mm dispersion with greater resolution characteristics, we believe this requirement is overly restrictive and defective. See <u>Globe Air, Inc.</u>, <u>supra</u>. Although the Army states that solicited expert advice showed the 4A/mm dispersion requirement to be a minimum requirement of the Government, there has been no persuasive response by the

Army to the protester's and other interested parties' assertions that spectrometers with superior resolution could perform the specifications' analytical requirements as well as Baird's larger spectrometer.

The Army states that the 4A/mm dispersion requirement is minimal to perform its current analytical requirements. The Army explains that although each bidder's spectrometer may be able to meet the paragraph 3.2.1 analytical requirements considering each element independently, only spectrometers with more than 4A/mm dispersion can analyze the complex alloys involved. The Army states that the 4A/mm dispersion requirement is necessary to insure that the many specified elements can be analyzed, notwithstanding the specified alloys' complexity and the similarity of spectral lines when they are present in the alloys in combination in greatly varying concentrations. As a specific example of elements whose spectral lines are so closely located that 4A/mm dispersion is necessary to separate them, the Army cites sulphur and boron.

The fact that the spectrometer to be procured is to be "direct reading" shows that the bidders were being required to promise that the equipment will simultaneously detect all elements listed in the matrix for the specified alloys. A "direct reading" spectrometer has pre-set exit slits at the focal plane at a particular spectral line for each and every element specified in the matrix. By indicating compliance with paragraph 3.2.1, which states the Government's current performance requirements, a bidder is bound to supply a direct reading spectrometer which has sufficient resolution and dispersion to simultaneously detect the presence and concentrations of all of the specified elements in the specified alloys. Nothing in the record would indicate that any the five bidders cannot meet this requirement.

With regard to the sulphur and boron example, certain spectral lines for these two elements are very close together (e.g., a difference of .15A). However, since each element has more than one spectral line and since the spectral lines used in the spectrometers to be procured to detect these elements are predetermined through the exit slit configuration, a bidder can design the spectrometer selecting whatever spectral lines for the elements it wants so long as the paragraph 3.2.1 performance requirements are satisfied. For example, in commenting on the protest, Jarrell and Baird have proposed varied solutions utilizing different spectral lines to resolve the sulphur-boron problem.

The Army also indicates that the 4A/mm dispersion requirement is necessary to allow for growth potential to meet future needs. However, for the reasons discussed above, specifying a minimum dispersion without considering resolution is not a sufficient method to provide for future needs, since resolution is also an essential and necessary condition. In direct reading spectrometers, determining whether particular new elements or alloys can be analyzed by adding new exit slits and photomultipliers is a very complex engineering design task. Since possible interference with other spectral lines must be considered, it may be impossible to merely add another exit slit at the focal plane for a new element. Requiring a minimum dispersion in a spectrometer without reference to resolution in no way ensures that it will be easier to effectively add exit slits for new elements in the future.

It would appear that the best way for providing for possible future needs is to specify what specific elements and alloys may have to be analyzed in the future in a matrix such as in paragraph 3.2.1. Bidders can then plan how the system can be modified to meet these conditions when they may arise. The Army states that 4Å/mm dispersion is required to analyze the very complex boron, cobalt and uranium alloys, which it implies it may have to analyze in the future. If these capabilities are known and needed, they should be specified as performance characteristics.

The Army states that the 4A/mm dispersion requirement is well within the "state-of-the-art," and bidders could have modified their existing equipment to comply with this requirement if they had so desired. The Army also notes that Jarrell would have met the 4A/mm dispersion requirement if it had proposed its larger "Model 1500" (1.5 meter focal length), which has a dispersion of 3.4 A/mm.

With regard to the "Model 1500" spectrometer, Jarrell has stated that it is not available with a vacuum attachment and could not possibly meet the paragraph 3.2.2.2 temperature stability requirements (quoted below). In addition, the "Model 1500" does not have an automatic monitor in violation of paragraph 3.2.2.1 (discussed below).

We cannot say that the changes necessary to increase the dispersion in a spectrometer, which appear to be within the technical expertise of the five bidders, would necessarily render the instrument a "prototype" --i.e., "an original model on which something is modeled." See Webster's New Collegiate Dictionary (1975 ed.). However, the critical question in this case is not whether the requirement is within the "state-of-the-art." Rather, the critical question is whether the 4A/mm dispersion specification has a reasonable basis, which we have found to be lacking here.

In any event, contrary to the Army's implications, the changes necessary to convert a spectrometer to 4A/mm dispersion would constitute, at best, a difficult engineering design problem. The instrument's basic performance could well be significantly impacted if such changes were attempted. Since dispersion is a function of focal length and grating spacing, either the size of the spectrometer or the grating design would have to be altered to increase dispersion. It seems apparent that changing the physical size (focal length) of the spectrometer would essentially require redesign of the system. Also, changing the grating spacing may require appreciable redesign of the system and may adversely affect wave length coverage.

In view of the foregoing conclusion that the 4A/mm dispersion requirement lacks a reasonable basis, we believe the Army's spectrometer requirement should be resolicited based on the Government's actual requirements.

Also, based on our review, we believe the requirement that the spectrometer have a continuous and automatic monitor is of questionable validity. All spectrometers have an optical alignment monitor to correct misalignment between the exit slits and spectral lines, which would cause errors in analyzing materials. Misalignment is primarily caused by environmental factors, in particular, temperature fluctuations.

Besides Baird, only Angstrom proposed a spectrometer with an automatic monitor, which adjusts for misalignment without the need of human interference. However, in its proposal, Angstrom stated that the automatic monitor "* * * is an added cost item which is not required for continuous operation * * *." Angstrom has subsequently characterized the automatic monitor as "an unnecessary complication" which "can contribute more problems than they are worth." Moreover, since Angstrom's proposed spectrometer did not meet the 4A/mm dispersion requirement, only Baird's proposal appears to be acceptable. The other bidders proposed manual monitors, which can be periodically checked and, if misalignment is detected, adjusted by merely turning a control knob.

The Army has cited the following reasons for needing an automatic alignment monitor:

> "1) With the normal temperature fluctuation in the area where this spectrometer will be housed, which have been aggravated by ongoing energy conservation measures, misalignment is going to be a problem.

"2) The intended skill level of the technician operating the equipment will be at the lowest practical level commensurate with the complexity of the system.

"3) The requirement to frequently check and correct misalignment is an unacceptable and unnecessary complexity.

"4) The potential of overlooking misalignment resulting in erroneous results could have very undesirable impact, particularly in the areas of incoming and in-process material analysis.

"5) Experts and users consulted on the necessity for automatic and continuous alignment state [it is]'an important and necessary feature, well worth investment, particularly, to minimize skill level and probability of error.'"

Paragraph 3.2.2.2 of the specifications provides that "the spectrometers vacuum chamber shall be thermally insulated to withstand room temperature variation of ± 10°F per hour." Since the spectrometer optics are in vacuum, the instrument is required to be able to withstand temperature fluctuations of plus or minus 10°F without adverse effects on performance. Consequently, the Army's first stated reason seems to say that the spectrometer--a valuable piece of precision laboratory equipment--is to be used in an environment where the temperature fluctuations will exceed plus or minus 10°F. Although such usage seems implausible, it would appear that large temperature fluctuations in relatively short periods of time may be better controlled by a continuous and automatic alignment monitor.

The second stated reason also appears doubtful. It seems unlikely that totally unskilled persons would operate such an expensive precision instrument. Reading the manual monitors takes only elementary training. Also, to manually correct misalignment, one need only twist a control knob. This takes about 10 seconds and requires very little skill.

As for the third stated reason, it would appear that adjustments to alignment are not as "frequent" as the Army implies in spectrometers with manual monitors. That is, assuming relatively stable environmental conditions, it is very likely that daily verifications would be sufficient. Moreover, we note that a manual master monitor to check the automatic monitor is provided in the Baird system. We assume this monitor has to be periodically checked and perhaps adjusted just as a manual alignment monitor.

In view of the foregoing discussion, the fourth and fifth stated "reasons" seem of less import.

In addition, although the Army correctly notes that automatic monitors are within the "state-of-the-art" and achievable by the five bidders, adding such monitors to a spectrometer presently having a manual monitor could also cause knotty engineering design problems, which may impact on the system's performance. Also, although the Army claims that analysis costs will be reduced through an automatic monitor—which we do not believe the record necessarily supports—an automatic alignment monitor would certainly add more initial hardware costs.

In view of the foregoing, we believe that the Army should reassess its needs regarding an automatic monitor for the procured spectrometer.

During our review, we also noted that paragraph 4.4.3 of the specifications requires quality assurance acceptance test standards, which appear to be impossible to meet and which are inconsistent with the paragraph 3.2.1 analytical performance requirements. Paragraph 4.4.3 provides that "the system shall analyze one certified standard for each of the alloy systems listed in paragraph 3.2.1 to within 2 percent of the <u>amount</u> present." (Emphasis supplied.) It is our understanding that achieving <u>accuracy</u> in amount (as opposed to precision) at the 2-percent level for the analytical conditions specified is beyond the state-of-the-art.

Accordingly, Jarrell's protest is sustained. We recommend that the Army resolicit this requirement consistent with this decision.

Since our decision contains a recommendation for corrective action, we have furnished a copy to the congressional committees referenced in section 236 of the Legislative Reorganization Act of 1970, 31 U.S.C. § 1176 (1970), which requires the submission of written statements by the agency to the House and Senate Committees on Government Operations and Appropriations concerning the action taken with respect to our recommendation.

R. F. Keller

Deputy Comptroller General
of the United States