

A QUALITY-BASED SELECTION PROCESS FOR ANALYTICAL SUBCONTRACTORS  
FOR ENVIRONMENTAL PROGRAMS AT THE WASTE ISOLATION PILOT PLANT

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ABSTRACT

The Radiological Baseline Program (RBP) at the Waste Isolation Pilot Plant (WIPP) is a three-year program to quantify background levels of radiation and radionuclides in the environment. Samples of airborne particulates, soil, water, and biotic media are collected and provided to a commercial laboratory for radiological analysis. An objective selection process was used in order to ensure that analyses are performed by the most appropriate commercial laboratory.

Five criteria were applied toward the selection of a commercial laboratory to perform analyses for the RBP. These are, in descending order of importance:

1. Potential performance, as assessed by a Prequalifying Program in which soil and water samples were spiked with radionuclides and delivered to each candidate laboratory for analysis.
2. Sensitivity, as declared in each laboratory's cost proposal in the form of a lower limit of detection (LLD) for each radionuclide.
3. Quality, as determined in evaluations of the compatibility of each laboratory's Quality Assurance/Quality Control (QA/QC) Program relative to the QA/QC program established for the WIPP.
4. Responsiveness, as indicated by each laboratory's stated ability to meet the scheduling constraints described in the Request for Proposal.
5. Price, as declared in each laboratory's cost proposal.

The selection process for the WIPP RBP involved seven commercial laboratories which had expressed an interest in analyzing samples. Two candidates were disqualified for failing to complete the Prequalifying Program (criterion 1) and one was disqualified due to unsatisfactory performance on the prequalifying program. The remaining four laboratories were ranked according to their combined scores for all five criteria.

INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) is a research and development facility to demonstrate the safe disposal of radioactive wastes generated by the defense activities of the United States Government. Transuranic (TRU) wastes<sup>b</sup> will be placed in underground passages mined in bedded salt 655 m below the surface at a remote location in south-

eastern New Mexico. The facility is operated by Westinghouse Electric Corporation for the U.S. Department of Energy (DOE). The mission and desire of the WIPP project is fully described in the Safe Analysis Report (2).

The first delivery of radioactive waste is scheduled for October 1988. It is important that radiological conditions in the environment be

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<sup>b</sup> Transuranic wastes are defined as materials which are contaminated with alpha-emitting radionuclides with atomic numbers greater than 92 and half-lives greater than 20 years, and which have a total activity exceeding 100 nCi/g. Small quantities of fission and activation products may also be present. See DOE Order 5480.2<sup>1</sup> for more discussion.

thoroughly characterized before that date. The Radiological Baseline Program (RBP) was initiated in June 1985 in order to assemble at least three years of preoperational radiological data. The RBP includes the following subprograms of sampling and analysis, which are detailed in the RBP implementation plan (3).

- Collection of airborne particulates using filters on continuous low volume aerosol samplers and intermittent high volume samplers.
- Collection of soil samples, both on the surface and at depth.
- Collection of water samples from surface water bodies, wells, and influent and effluent streams.
- Collection of bottom sediments from nearby rivers and lakes.
- Collection of floral and faunal media, including native vegetation, quail, rabbits, fish, and locally raised beef.
- Measurement of ambient radiation with an aerial survey, an area radiation monitor, and a network of thermoluminescent dosimeters.

All but the last of these items require that samples be analyzed for the activities of a number of radionuclides, including isotopes of elements which are naturally present (e.g., radium, thorium, and uranium), and isotopes of elements which will be present in the wastes received at WIPP (e.g., plutonium, americium, curium, cesium, strontium, and cobalt). These analyses are being conducted by a commercial laboratory that performs under contract to the Management and Operating Contractor for the project.

Radiological analyses are not conducted on site because the number of samples during the preoperational phase is not large enough to warrant the expense, maintenance, and staffing of a fully equipped analytical laboratory at the WIPP site.

The fact that the WIPP will be the Department of Energy's first repository for transuranic waste means that the project is closely observed by the scientific community, regional governmental agencies, and the public at large. The project's high visibility requires that the quality and capability of analytical subcontractors be quantitatively tested and documented. It is for this reason that a comprehensive evaluation was conducted during 1985 to rank the suitability of seven commercial laboratories which had expressed an interest in analyzing environmental samples to be collected in the RBP.

Five general criteria were used to evaluate potential analytical contractors. These criteria were specified in the Request for Proposal and the relative importance (point value) of each criterion was established prior to opening of the bids. The five criteria are listed below, along with points to indicate relative value.

<u>CRITERION</u>	<u>POINTS</u>
Performance in the Prequalifying Program . . .	10
Lower Detection Limits . . . . .	6
Quality Control and Quality Assurance Measures	4
Delivery Schedule . . . . .	3
Price . . . . .	<u>2</u>
TOTAL SCORE	25

This paper describes the methods used for evaluating each criterion as well as the general results (although the laboratories are not identified). The Summary includes a discussion of how the results were compiled into a ranking of overall suitability. The most important objective of this paper is to illustrate an effective method for selecting analytical contractors according to their ability to meet specific quality standards and requirements for the WIPP RBP.

### SELECTION CRITERIA

#### The Prequalifying Program

The most important element in the selection process was the Prequalifying Program, in which spiked samples of soil and water were sent to each candidate laboratory for analysis. The spiked samples were prepared by the Monsanto Mound Laboratories according to general specifications provided by the WIPP Radiological and Environmental Programs Section. A detailed discussion of the Prequalifying Program, including the radiochemical methods for preparing the spiked samples is being prepared as a manuscript for the open literature (4). This section includes a general discussion of the Prequalifying Program and its results.

Soils were collected from the vicinity of the WIPP. The natural radioactivity levels of these soils were enhanced by additions of Pu-238, Pu-239, Pu-240, Am-241, Cs-137, Co-60, Sr-90, and natural Uranium. Water was used from the Monsanto water supply and spiked with the same radionuclides plus tritium. Both soil and water were spiked at three different levels of activity, ranging from values close to the laboratory's anticipated detection limits. One of the three water treatments was made into a 1 molar saltwater solution to simulate the high molarity of water from saline lakes and groundwater around the site.

After spiking the samples, Mound checked the results by performing five replicate analyses on each treatment. Soil and water from each treatment was also sent to DOE's Environmental Measurements Laboratory in New York where the materials were analyzed for several of the radionuclides mentioned above. This served as a check on Mound's preparation and subsequent analyses of the samples. The mean deviation of checks from spikes was 5.5% in soil and 3.7% in water. The spike values were used (as opposed to check values) as the standard for evaluating the results reported by each laboratory.

On 15 April 1985, three soil samples and three water samples were sent to each of seven laboratories for their analysis. Five of the seven laboratories reported a full set of results. The accuracy of each analysis was scored using the following equation:

RE =  $|L-S|/S$  where: RE is the relative error,  
 L is the lab's result, and  
 S is the spike, as reported by  
 Mound.

Inaccuracies were penalized and graded as follows:

		LETTER GRADE
RE < 0.15	no penalty points	A
0.15 < RE < 0.30	1 penalty point	B
0.30 < RE < .045	2 penalty points	C
0.45 < RE < 0.60	4 penalty points	D
0.60 < RE	8 penalty points	F

Points were scaled to apply especially severe penalties to gross inaccuracies in individual analyses. Penalty points and grades were assigned to each laboratory's results to disqualify unacceptable candidates and to rank the remaining candidates according to their performance capabilities.

Figure 1 displays the individual and composite results in terms of their deviation from the spike values. Table I lists the "report cards" assigned to each laboratory, grading their performance in different categories. Transuranic (TRU) nuclides were segregated out due to their importance in the wastes to be received at WIPP, hence in the WIPP radiological baseline.

TABLE I

Lab	"Report Cards" for Each Laboratory				Overall Grade
	Soil		Water		
	TRU	Others <sup>a</sup>	TRU	Others <sup>a</sup>	
1	B	C	A	B	B
2	D	C	D	B	C
3	B	C	B	C	B-/C+
4	C	C	C	A	C+
5	A	A	A	A	A

<sup>a</sup> Refers to radionuclides other than transuranics, including tritium (in water), fission products, and activation products.

It is important to clarify the relationship between the Prequalifying Program described here and the ongoing evaluation program maintained by the Environmental Measurements Laboratory (EML) of the U.S. Department of Energy. In the EML program, which is described by Sanderson and Feiner (5), samples of soils, water, and aerosol filters are sent approximately semiannually to all subcontractor and commercial laboratories who perform radiological analyses for a DOE facility. The radionuclides which are analyzed by each laboratory depend upon that laboratory's particular set of responsibilities for the government of its prime contractors.

The WIPP Prequalifying Program differed from the EML program in that the samples and the analytical assignments are representative of the specific conditions associated with the RBP. This includes both the properties of the media and the list of the radionuclides to be analyzed. Thus the results of the Prequalifying Program are more germane to the needs of the WIPP project than the results of

the EML program, which are intended to be more general in applicability.

Once an analytical contractor has been selected, day-to-day performance may be assessed by including random, unidentified check samples in the shipments of material for analysis. Relative errors can be determined for these occasional spiked samples to provide a measure of confidence in the analytical results.

#### Lower Limits of Detection (LLD)

The second most important criterion was each laboratory's estimated sensitivity, expressed as an LLD for each radionuclide. Equipment, counting time, background radiation, and sample size all contribute to the calculation of LLDs. Laboratories were requested to declare their anticipated LLDs in response to the Request for Proposal issued to all successful participants in the Prequalifying Program (laboratories which had earned an overall grade of C or better).

At the same time, suggested, LLDs were provided by Monsanto Mound for the radionuclides analyzed in the Prequalifying Program. These were used as standards, against which each laboratory's projected values were scored.

LLDs were scored by calculating simple ratios between each laboratory's stated sensitivity and the standards, and thereby determining order of magnitude variations. Points were assigned for these sensitivity ratios (SV) as follows:

SV < 0.1	+1
0.1 < SV < 10.0	0
10.0 < SV < 100.0	-1
100.0 < SV < 1000.0	-2
1000.0 < SV < 10000.0	-3
Not reported	-3

Scores for LLDs in water and soil samples were used to rank the laboratories according to their sensitivities. The rankings for transuranic radionuclides and the uranium isotopes were judged to be more important than the rankings for other radionuclides, and were therefore weighted to represent a greater portion of the total points awarded.

#### Quality Assurance and Quality Control Measures

Each laboratory's QA/QC program was carefully evaluated by the Westinghouse WIPP Quality Assurance Department for compatibility with the QA/QC standards established for the WIPP. The following components were reviewed and scored to arrive at an overall QA/QC score:

Organization	0.3
Quality Assurance Program	0.4
Instructions, Procedures, and Drawings	0.3
Document Control	0.3
Control of Purchased Items and Services	0.3
Control of Processes	0.5
Control of Equipment for Measuring and Testing	0.5
Handling, Storage, and Shipping of Samples	0.3
Control of Nonconforming Items	0.3

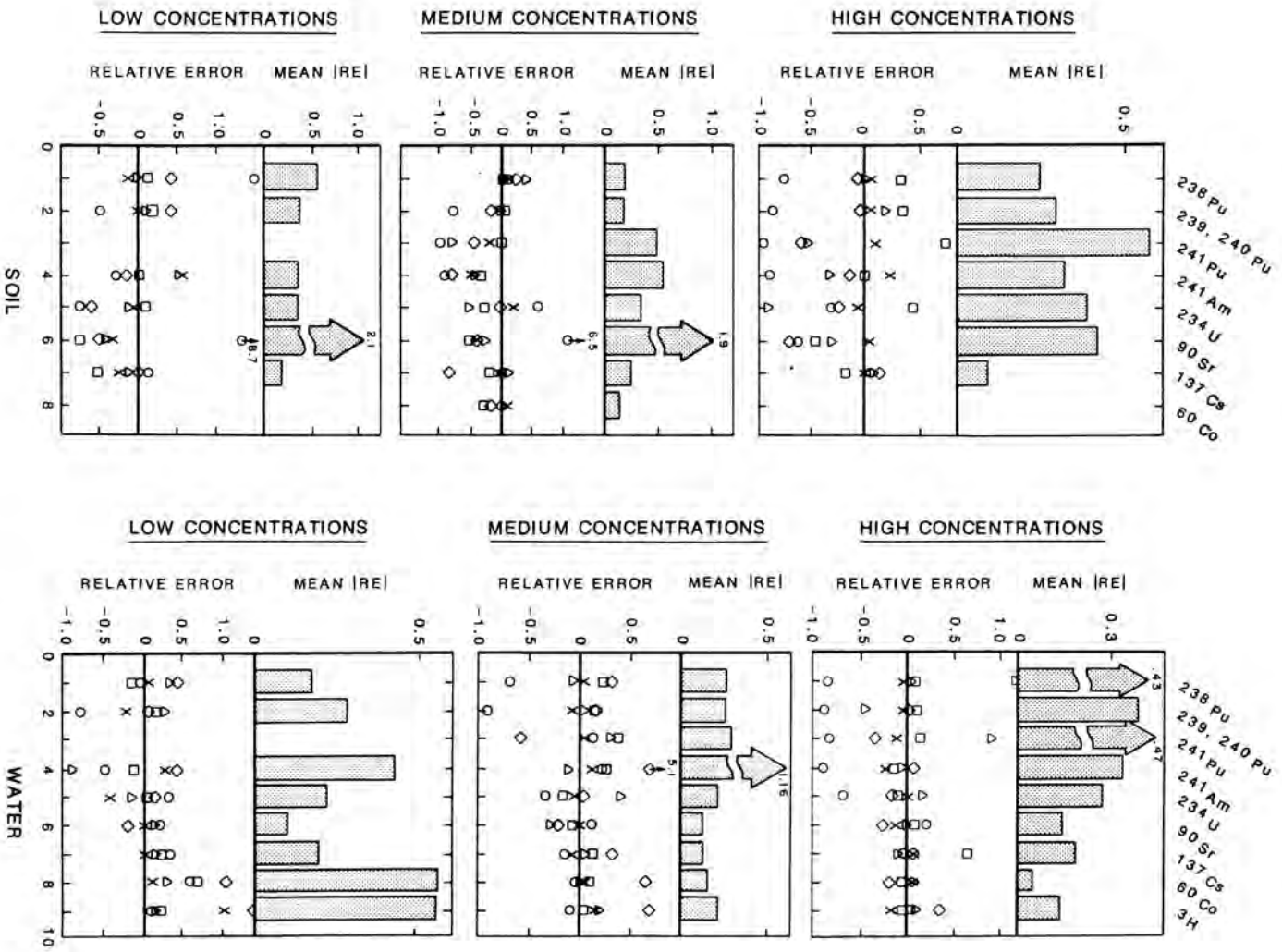


Fig. 1. Relative errors for radiological analysis, including combined (histograms) and individual performance.

Quality Assurance Records . . . . .	0.5
Internal QA Records . . . . .	0.3

Regardless of the QA/QC score and the total selection score, any laboratory performing work for the Radiological and Environmental Programs Section must comply with strict standards which are inherent within the WIPP organization.

Delivery

Each laboratory was asked to state their ability to achieve the turnaround times specified in the Statement of Work. The lab was awarded 3 points or a fraction thereof based on this statement.

Price

The final scoring criterion was price, which was solicited on a "per analysis" basis in the statement of work. The lowest financial bid earned a full two points. Other bids earned some fraction thereof, depending upon the amount in excess of the lowest bid.

SUMMARY

The selection process involved seven laboratories which had expressed an interest in providing contract services. No other labs expressed an interest, although the number of participants is limited by the cost and mechanics of spiking samples.

Two of the seven laboratories who received spiked soil and water samples did not perform full analyses and were therefore removed from further consideration.

The remaining five laboratories responded fully to the Prequalifying Program and were assigned grades. Four labs were successful in the Prequalifying Program (no grades below a C) and were issued Requests for Proposals soliciting LLDs, QA/QC information, delivery commitments, and price quotations.

Table II summarizes results and provides an overall ranking of suitability. It should be mentioned that Table II lists positive points, awarded based on performance in each category (not to be confused with the penalty points assigned in the Prequalifying Program).

TABLE II

Evaluation Points and Overall Ranking

	Maximum Possible	Lab 1	Lab 3	Lab 4	Lab 5
PREQUAL TRU	6	5.0	4.0	2.0	6.0
PREQUAL MISC	4	1.8	1.2	2.4	4.0
LLDs	6	5.5	2.0	2.5	5.0
QA/QC	4	3.0	2.7	3.4	3.6
DELIVERY	3	1.3	3.0	3.0	3.0
PRICE	2	1.5	1.8	2.0	1.5
GRAND TOTAL	25	18.1	14.7	15.3	23.1

In conclusion, the evaluation program provided an effective basis for selecting laboratories to analyze samples for the WIPP RBP. The evaluation not only increased the likelihood of reliable performance by analytical subcontractors, but also provided evidence of the WIPP projects' commitment to quality in the monitoring and documentation of potential environmental impacts.

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