LESSONS LEARNED: PROBLEMS ENCOUNTERED WITH SUBCONTRACTED ANALYTICAL SERVICES FOR THE CHARACTERIZATION OF DRUMMED LOW-LEVEL RADIOACTIVE, RCRA HAZARDOUS, AND MIXED WASTE

Tracy B. Plessinger
U. S. DOE

Kenneth E. Karp and Daniel J. Haley
Chem-Nuclear Geotech

ABSTRACT

The U. S. Department of Energy, Grand Junction Projects Office (DOE-GJPO) assisted DOE's Idaho National Engineering Laboratory (INEL) by characterizing 229 drums containing unknown concentrations of potentially low-level radioactive waste, Resource Conservation and Recovery Act (RCRA) hazardous waste, and mixed waste. Sampling and analyses were performed on the waste so that specific recommendations for appropriate disposal and/or treatment options could be formulated. Ten percent of the drums required resampling because of analytical difficulties such as invalid data due to excessive hold times, use of "unapproved" analytical methods, and sample shipment delays. Improvements in the communication with and the auditing/management of the subcontracted analytical services would have eliminated these difficulties.

INTRODUCTION

The Special Manufacturing Capability (SMC) Project at the INEL manufactures hardened metal for national defense purposes. It is currently operated by Babcock & Wilcox-Idaho (B&W) for the DOE-Idaho Field Office. The manufacturing process and support functions, such as analyses of process materials, waste management activities, maintenance activities, and laboratory testing, have produced a wide variety of potentially radioactive, hazardous, or mixed waste streams.

The SMC Project requested the assistance of the DOE-GJPO and its operating contractor, Chem-Nuclear Geotech, Inc. (Geotech), to characterize the drummed waste and to develop recommendations for the disposition of those wastes. Historically, the SMC Project stored much of its waste under its RCRA interim status permit or transferred it to EG&G Idaho, Inc. (a separate INEL contractor) for treatment and disposal either at the INEL site or offsite at a permitted treatment and disposal facility. Drum characterization was conducted in December 1991 and January 1992.

During the sampling activities conducted, 142 different containers and waste streams were sampled. The samples were sent to two subcontracted analytical laboratories for detailed analysis that corresponded to the waste stream. Field-collected and laboratory analytical data were then used to categorize the waste with respect to the RCRA hazardous waste identification regulations (US EPA, 1), and the DOE's criteria for identification of low-level radioactive waste (US DOE, 2). The data were also used to assess the wastes' acceptability to the Waste Experimental Reduction Facility (WERF) and the Radioactive Waste Management Complex (RWMC) at the INEL and to other offsite treatment, storage, and disposal facilities.

Because of limited treatment and disposal options, the waste acceptance criteria for WERF (EG&G Idaho, 3) and RWMC (EG&G Idaho, 4) were used as the primary data quality objectives. Although other treatment options were researched in the initial phases of the project, their applicability to this waste was limited by virtue of the DOE Waste Shipment Moratorium (US DOE, 5). As a result, characterization of the waste for other treatment and disposal options was not emphasized.

A historical characterization of the SMC drummed waste was conducted by Geotech during the summer of 1991. The purpose of the task was to assess the volume and type of waste so that the proper sampling and analysis methodologies could be identified and incorporated into the sampling and analysis plan. As part of the historical characterization, the waste was categorized into 36 different waste groups; each waste group was assigned an arbitrary waste group code. The categorization was based upon the process that produced the waste, Material Safety Data Sheet (MSDS) information, and the wastes' likely chemical components.

The drummed wastes were variable in nature and predominantly consisted of industrial solvents, hydraulic oils, and lubricating oils; all waste was suspected of being contaminated with depleted uranium (U-238). Targeted constituents and properties were selected based upon the disposal/treatment facility's waste acceptance criteria; the analysis included RCRA hazardous waste characterization for ignitability, corrosivity, reactivity, and toxicity, as well as a screening for the waste's listing status. Gross-alpha particle counting was used to determine the presence of uranium as a means for radioactive waste classification.

Difficulties, primarily related to quality of data, required resampling of 23 drums. The additional sampling was required for the remaining drums because of invalid data due to excessive laboratory hold times, uncertainty of data, matrix and analyte interferences causing the use of "unapproved" analytical methods, and field logistical problems including shipping delays. This paper presents the root causes of these problems, identifies the lessons learned, and provides specific recommendations for other projects considering large sampling/analysis campaigns.

DISCUSSION: PROBLEMS ENCOUNTERED AND LESSONS LEARNED

Problem: Delayed field shipment of samples caused exceedance of TCLP volatile and semivolatile sample-to-extraction "hold times" for many samples. The TCLP methodology requires that the samples be extracted within a specified time following collection. This "hold time" is called the sample-to-extraction hold time. For TCLP volatiles, and semivolatiles, the sample-to-extraction hold time is 14 days.

Several factors contributed to the exceedance of sample-to-extraction hold times. Conditions in the field necessitated that in many cases, the laboratory did not receive the samples until seven to nine days following sampling; this left only five to seven days to complete the initial extraction. Sample shipment was performed by another INEL contractor, and was coordinated by the SMC Project. The laboratory statement of work stated that Geotech would strive to have the samples delivered to the laboratories within 24 hours after collection; however, samples were delivered late primarily because SMC Project management imposed additional packaging and inspection requirements on the sample shipments, consuming three to five days not originally anticipated. Although the additional packaging requirements were necessary for SMC Project management to ensure that the samples were shipped properly and safely, the requirements had not been discussed prior to mobilization of Geotech's field sampling teams. Sample shipment inspections performed by the SMC Project organization were understaffed, and additional resources could have alleviated the problem.

Recommendations:

- Ensure that all steps affecting sample shipment, such as shipment inspection, are discussed with field personnel prior to sample collection and are planned accordingly.
- Ensure that sufficient resources are devoted to the critical-path tasks so that sample inspection, for example, does not cause unnecessary delays in sample shipment.
- If possible, minimize intermediate organizations or do not rely solely on a particular organization to ship samples. If possible, work directly with the actual shipper.
- Provide the laboratory an accurate assessment of the delivery times for the samples.
- Prior to complete field team mobilization, it may be prudent to collect, package, and send some samples to the laboratory using the same procedures, equipment, personnel, and other organizations that would be used for the full-scale sampling campaign. This practice run could reveal which procedures, organizations, or equipment need adjustment so that delays are minimized.

Problem: Laboratory overloading caused exceedance of "extractant-to-analysis" hold times for many TCLP volatile, semivolatile, and mercury hold times. This second "hold time" exists between the extraction and the analysis or, in the case of TCLP semivolatiles, the preparatory extraction. For TCLP volatiles, the extraction-to-analysis hold time is 14 days; for semivolatiles, the hold time is 7 days for the preparatory extraction, and the extractant must be analyzed within 40 days. The laboratories were expecting to receive the samples at a smooth rate of 20 to 30 samples per day. The delivery of the samples was originally scheduled for mid-November, 1991. Due to aforementioned delays in sample shipment, the samples were sent as a bulk shipment; the laboratories received approximately 100 samples within two days.

Additionally, due to delays in training and planning documentation, field activities were delayed from mid-November to mid-December. Most of the samples were received by the laboratory on December 23 and 24, 1992, which is just before the Christmas holidays. One laboratory also received massive numbers of samples from a Superfund client during the same time period.

Recommendations:

- Prompt and accurate communication between Geotech and the laboratories could have better alerted the laboratories that sample shipment was delayed and expected just before the holidays. If the laboratories understood the problem better, one option would have been to obtain more temporary resources to accomplish the job. Prior to field team mobilization, the laboratories were informed that samples would arrive during the third week of December; however, the laboratory did not indicate that overloading due to the holidays or the Superfund client would be a problem.
- Have an overflow laboratory on contract in case the primary laboratory is overloaded or cannot otherwise perform as contracted. Alternatively, the sampling could have been delayed until a more favorable time if the laboratories had indicated the magnitude of overloading.
- Consider the laboratory capacity when planning fieldwork. For example, do not send two sampling teams to the field if the laboratory capacity can only handle the samples generated from one team without being overloaded.
- Consider splitting the analyses between several laboratories. For example, the physical analyses could be conducted by laboratory "A" and the chemical analysis by laboratory "B", while laboratory "C" performs the radionuclide analyses. Overloading of one laboratory could be mitigated by splitting the analyses among several laboratories.

Problem: Lack of adequate data quality objectives negated the use of potentially useful data because of hold time exceedance. The data quality objectives did not specify the usefulness of the data from samples that might have exceeded either or both hold times. The actual effect of excessive hold times on these samples is debatable. Some experts believe that the data are valid even though hold times were exceeded because the samples were removed from drums and placed into clean glass containers; those persons believe that the removal and storage of the sample in a clean glass container would not affect the sample's integrity.

Other experts believe that removal of a sample from a drum disturbs its equilibrium state, which could alter the sample, especially the volatile component. Therefore, those persons believe that meeting the hold times is critical to sample validity. The EPA regulations state that hold times must be met for a sample to be considered valid. Although it is felt by some experts that the hold times specified by EPA may have limited scientific basis; from a regulatory standpoint, samples with excessive hold times must be considered invalid.

Recommendation:

- During the project planning stages, establish the usefulness and validity of samples which exceed hold times; a data quality objectives document is an appropriate place for such discussions. If the data users had agreed to the usefulness and validity of data from samples with excessive hold times before the samples were analyzed, then more of the data would have been useful.

Problem: Laboratory pre-award Quality Assurance/Quality Control audits evaluated laboratory procedures, manuals, and adequacy of proposals as compared to the statement of work; however, analytical logistics were not evaluated. Although the pre-award audits conducted on each laboratory used for this project were quite thorough, they were not designed to uncover the type of problems encountered.

Recommendations:

- Prior to contract award, an audit should be conducted not only to determine if the laboratory is technically and procedurally capable of performing the analyses, but also whether the laboratory capacity will be overloaded with the project's samples or the samples from any other client of the laboratory.
- The project should consider sending a technical representative to the laboratory when the initial samples are shipped. The technical representative might be able to identify overloading problems or technical problems in time to avert serious data deficiencies.

Problem: Lack of adequate communications with the laboratory compounded issues encountered in the field. Clear communications with the laboratory are essential to a successful sampling and analysis campaign. This project had two technical persons who communicated with the laboratory: one person in the field coordinated logistical matters with the samples, and another physically located at the GJPO coordinated technical and contractual matters. Although this system worked, three-way conference calls could have improved communications and averted some of the aforementioned problems.

Recommendation:

- Have the point contact in the field discuss logistical matters with the laboratory on a daily basis. The point contact in the GJPO office also needs to contact the laboratory on a frequent basis to ensure that no technical or contractual matters interfere with the performance of the analyses.

Problem: The delivery dates identified in the subcontract for delivery of analytical data to Geotech were unrealistic and inflexible. The subcontract specified that data reports were to be delivered within 45 days after sample receipt. The laboratories did not deliver the data within the contracted time. The late delivery of the data caused a subsequent delay in completion of the data report. All data from one laboratory were received within 36 to 59 days after sample receipt, whereas the data for the primary laboratory were received between 62 to 91 days after sample receipt. (The Christmas and New Year's holidays were not included in this estimate.) After 50 days had elapsed, three Geotech representatives traveled to the primary laboratory to discuss data delivery and technical performance. During the meeting, the laboratory indicated that all data were complete, except for a few relatively unimportant analytes. The laboratory did not transmit partial data reports because the project personnel had not requested such reports. Project personnel errantly believed that partial reports would only be 50 percent complete and would not have the necessary laboratory quality assurance checks completed.

Recommendations:

- Project management should establish the criteria for partial data delivery with the laboratory; the criteria should be specified in the subcontract. Had the criteria been established for this project, then partial reports could have been used to commence data evaluation and reduction; very little additional schedule slippage would have resulted.
- Determine which data are critical to decision-making and which data are needed for general information. The critical data may be requested in the partial data report, but delivery of the noncritical information could be delayed until a more reasonable time.
- Specify incentive and penalty clauses for data delivery in the contract, if allowed under the regulations governing contract award. This recommendation may not be feasible for every project, but it is worth contemplating. Penalty clauses tend to drive up the base costs because the laboratories need to protect themselves from financial losses. Incentives for better-than-expected delivery of data tend to be more acceptable to everyone involved.
- Penalty and incentive clauses were not included for the SMC Drum Characterization Project because so few laboratories were able to perform the requested analyses. Inclusion of such clauses was likely to frighten away the few available laboratories.
- The data delivery times should be realistic. Realistic delivery dates could be developed during the planning stages if a subcontract laboratory representative is closely working with the project manager.
- The project should add some discretionary float time to the laboratory reporting task.

Problem: The laboratory miscalculated the uranium concentrations on numerous samples. For certain analyses, the procedures specified in the subcontract were not used. The miscalculation of uranium concentration caused a two-week delay in completion of the data report because all uranium data were in question. The use of unapproved methodologies caused problems because the waste receivers needed to approve procedure variations. Unapproved methods were used because the approved methods were ineffective for the particular sample due to interferences. The laboratory's technical judgement was correct, and approval was obtained after the data were reviewed.

Recommendations:

- Have a technical representative at the laboratory during much of the analysis. When procedural problems arise, the technical representative would be available to resolve them quickly. Alternatively, close telephone communication with the laboratory could resolve such problems if the laboratory contacts the project when problems arise instead of acting independently.

Other Miscellaneous Recommendations:

- Send similar waste groups to the laboratory as a single batch. This practice was attempted for the SMC Project, but due to the sample inspection requirements, the batches became jumbled. As a result, an analytical batch, as reported by the laboratory, would include results from several waste groups. Conversely, results for a particular waste group were reported in several analytical batches. If the waste groups matched the analytical batches, then data validation and evaluation would have been much simpler.

- Devote a substantial amount of validation and review time to the first data batches received from the laboratory. This action would alert the project to potential problems that could be corrected on subsequent batches. This technique was used successfully on the SMC Project.
- Obtain additional qualified data evaluation and validation personnel. The known integrity of the data is only as good as the personnel reviewing them. If the data reviewers are overworked to the point of not doing a thorough job, then overall data quality may be misinterpreted.
- Provide detailed training to the field crew. The training program conducted prior to field mobilization significantly contributed to the overall success of the SMC Project. A substantial amount of time was saved in the field by taking the time to review and practice the sampling procedures.

CONCLUSION

Although numerous problems were encountered during the SMC Drum Characterization Project, those problems could have been mitigated by accurate and complete communications among project personnel, the field crew, the client organization, the client's support organizations, and the subcontracted analytical laboratory. Such communication is essential for a characterization project of this complexity.

REFERENCES

1. Code of Federal Regulations, 40 CFR 261, Subpart B, "Criteria for Identifying the Characteristics of Hazardous Waste and for Listing Hazardous Waste," U. S. Environmental Protection Agency (1990)
2. Order 5820.2A, "Radioactive Waste Management, Attachment II - Definitions," U. S. Department of Energy (1988)
3. "Mixed Waste Acceptance Criteria for the Waste Experimental Reduction Facility (WERF) Incinerator," EG&G Idaho, Inc. (April 30, 1991a)
4. "Low-Level Radioactive Waste Acceptance Criteria, DOE-ID-10112, Rev. 4," INEL, (October 1991b)
5. J. E. Lytle memorandum "Shipment of Waste Originating in Radiation Control Areas," (May 1991a)