PARSONS ENGINEERING SCIENCE, INC.
A UNIT OF PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP INC
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RL 33
AFCEE
Vol 1-1
April 15, 1998 Directi

April 21, 1998

Via U.S. Mail
Ms. Jo Jean Mullen
Quality Assurance Evaluator
AFCEE/ERD
3207 North Road
Brooks AFB, TX 78235-5363

Subject: Minutes for April 15, 1998 Meeting regarding
Environmental Encyclopedia Format
Camp Stanley Storage Activity, Texas
Contract F11623-94-D0024, Delivery Order RL33
Parsons ES job 730396.05

Dear Jo Jean:

Enclosed please find a copy of minutes from our informal meeting last week regarding the format of Camp Stanley Storage Activity's (CSSA's) Environmental Encyclopedia. A copy has also been sent to Mr. Brian Murphy at CSSA. Also attached is the encyclopedia table of contents, which has been revised to reflect the issues discussed during that meeting, and a copy of information that Brice Environmental sent regarding the Encapco recycling technology.

Brice has recently completed the particulate metal washing portion of their treatability study. They are currently preparing a letter addressing your concerns regarding evidence that the second step of acid washing is not a viable alternative for CSSA soils. I presume we'll have more discussions about the soil washing treatability study once we have both received the letter and have had a chance to review it. Until that time, Brice is holding the soil samples, awaiting further direction from us on how to proceed.

Please call me at (512)719-6062 if you have any questions or comments.

Sincerely,

Julie Burdey

Julie Burdey, P.G.
Project Manager

encl.

xc: Brian Murphy, CSSA
Beth Garland, AFCEE/ERC
Susan Roberts, Parsons ES - Austin
Ken Rice, Parsons ES
Rachey Peten, Parsons ES
John Stewart, Parsons ES

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MEETING MINUTES

Reference: Contract F11623-94-D0024, Delivery Order RL33
Camp Stanley Storage Activity (CSSA) SWMU B-20 Investigation
Informal Meeting Minutes

Meeting: April 15, 1998
Parsons Engineering Science (Parsons ES) Austin office

Subject: Environmental Encyclopedia format

The meeting was held at the Austin office of Parsons ES, beginning at approximately 0900 hours on April 15, 1998. This meeting was attended by representatives of CSSA, Air Force Center for Environmental Excellence (AFCEE), and Parsons ES. The following were in attendance:

Name	Organization
Brian Murphy	CSSA Environmental Officer
Jo Jean Mullen	AFCEE/ERD Restoration Team Chief
Beth Garland	AFCEE/ERC Chemist
Ken Rice (waste analysis plan discussion only)	Parsons ES, Austin, Task Manager
Julie Burdey	Parsons ES, Austin, Project Manager

The purpose of the meeting was to discuss the format of CSSA's environmental encyclopedia. The format had been discussed during several previous meetings and a mock copy of Volume 1 was delivered to CSSA and AFCEE in December 1997. Comments on the mock copy were incorporated in the March 25 submittal. However, CSSA's recent receipt of the draft EPA 3008(h) order resulted in some desired changes to the encyclopedia format to meet some of EPA's documentation requirements.

Meeting participants reviewed and discussed the table of contents for the encyclopedia in detail, and several changes were requested. It was understood by all parties at the meeting that funds set aside for volume 1 of the encyclopedia were expended during preparation of the version that was submitted on March 25, 1998. New revisions to volume 1 discussed during the April 15 meeting will require additional funding. Furthermore, some of the additions to the other volumes of the encyclopedia were not budgeted in the recent modification to RL33. It is possible that potential savings on RL53 from the aerial survey may be applied to the encyclopedia revisions.

Julie indicated during the meeting that a revised table of contents would be submitted to CSSA and AFCEE *(Note: resulting revised table of contents is attached.)*. Once the revised table of contents have been approved, Parsons ES will prepare an estimate for completing the encyclopedia, taking into account funds already budgeted in RL33.

Additional points discussed during the meeting include the following:

1. The table of contents for the correspondence will include the date of the document, name of the document, and where it is located. Some correspondence will be cross-referenced in other volumes. Correspondence should be listed chronologically under separate sections for "EPA," "TNRCC," etc.

2. A figure showing site location at CSSA should be included for each site in both Volumes 1 and 3. The aerial photo showing SWMUs can be used. All SWMUs can be shown in yellow, but SWMU of concern for that section should be in red.

3. A site map and site photograph should be included for each site in Volumes 1 and 3. It was noted that site maps and photographs were not available for a few sites where no work has been done (B-2, B-3, B-4, etc.). CSSA will consider adding these sites in the future.

4. Brian would like to add reminder flags to geographic information system (GIS) for monthly bacteriological (BACT) sampling.

5. A justification for the rationale for choosing analytes that were analyzed for at each site must be added for each site. Booz-Allen & Hamilton is currently working on this. They are going through the list of practical quantitation limits (PQLs), identifying what was found, what was tested for, and comparing that to what Environmental Assessment (EA) identified as potential contaminants of concern.

6. There was a brief discussion regarding the AFCEE QAPP. Brian asked if version 3.0 of the QAPP should be used for future analysis at CSSA. Beth indicated that there will likely be fewer problems finding a laboratory if version 3 is used. Brian added that Greg Lyssy (EPA) had suggested using CLP instead. Jo advised Brian that CLP has its own shortcomings, and Beth added that it would be better to use version 3.0 of the QAPP.

7. Jo said that all Informal Technical Information Reports (ITIRs) should be sequentially numbered (i.e., ITIR1, ITIR2, etc.), and that the contract number and order number should be on the cover. The encyclopedia can then reference ITIR by number. Brian asked if ITIRs could be put onto CDs, then he would only need one hard copy, plus the CD.

8. Brian indicated that he would like to get the GIS on a CD also, along with ArcView, so he can send a copy to Greg Lyssy (EPA) and the TNRCC. Julie answered that she didn't think a copy of ArcView could be sent. Beth suggested a run-time version of ArcView may be available. She also added that it may be possible to make the GIS available through the Internet. Jo asked Beth to discuss the viability of the Internet avenue with the appropriate people at AFCEE.

9. Brian and Jo suggested that an introduction be added to the encyclopedia which describes how it meets regulatory requirements established for all applicable documents. In other words, the introduction should describe how it meets requirements for waste analysis plan, current conditions report (?), etc. In addition, Brian said that, in

the future, Parsons may be scoped to give a presentation to the regulators on the encyclopedia, and how it meets the requirements.

10. Brian asked if it would be appropriate to add SOWs to the encyclopedia. Jo suggested that contractual information, such as SOWs, should not be included. She noted that the H order requests that information, but suggested that Brian ask that specific information be deleted.

11. Volume 1 will be divided into Volumes 1-1 through 1-6 (as shown in the attached revised table of contents). Appendices to the Work Plan Overview will be redistributed into these volumes.

12. Julie asked if there were any comments on the page, figure, or table numbering system. Brian and Jo said the system that was used is fine.

13. The waste analysis plan will be retitled "An Addendum to the FSP and QAPP." All information that is provided elsewhere in the document will be referenced. However, the format, which meets EPA requirements for waste analysis plans, will stay the same. For example, paragraphs describing CSSA will be removed and the following will be added: "Please see Volume 1-1, Background Information Report for a description of CSSA."

14. Jo indicated that the justification for using 14% Portland Cement for stabilization should be added to the plan. Ken will add that information.

15. There was a discussion regarding including the results of the bench-scale treatability study in the waste analysis plan (Addendum to FSP and QAPP). It was decided that the results should not be included in the plan. However, Ken added that if Malcom Ferris (TNRCC Region 13) requests the results, they could be provided.

16. Julie said that Brice Environmental, the subcontractor performing the soil washing treatability study, has indicated that acid leaching will not be cost effective for the CSSA soils due to their alkalinity. Brice has asked if they can instead do a treatability study to test Encapco (information regarding Encapco is attached). Encapco is a stabilization technique which produces a concrete material which can be used for roads, barricades, etc. Jo said that Parsons has been contracted to do a soil washing treatability study, so Brice must provide evidence that soil washing is not appropriate. Results of physical characteristics testing, costs to do acid leaching, etc., must be provided. What is their evidence? How did they come to that conclusion? If Brice did a treatability study for Lackland AFB, their results might provide appropriate evidence. Jo added that, if Brice does not have evidence, we will still have to do acid leaching test to prove to EPA that it doesn't work, since soil washing is a recommended technology for metals-contaminated soils. Julie suggested that they may be able to do both soil washing and Encapco, because two samples (one of B-20 mounds, one of B-20 shot disposal soils) were sent to Brice. Jo added that Parsons should check into other types of soil washing (e.g. floatation).

17. Brian indicated that dates the work plan was submitted to regulators should be added to the waste analysis plan (retitled Addendum). Julie indicated that she didn't think the

plan had been sent to the agencies because it has never been finalized. Jo and Brian recalled that it had been sent, but Brian said it would have been sent from Parsons. Julie will look through files to determine if it was sent to regulators.

18. Sites to be addressed in the waste analysis plan (B-20/21, B-31, B-32, B-33) will be listed in a table on a separate page, so adding sites in the future will require that only that page be revised.
19. Since it will be a few months before encyclopedia will be submitted to the regulators, Brian and Jo suggested that the waste analysis plan (retitled addendum) be submitted to the regulators by itself, with copies of the appropriate referenced pages attached.
20. Jo requested that AFCEE delivery order 23 tasks be added to the schedule in the Work Plan Overview.
21. Julie asked if Brian or Jo had any comments on the SWMU status matrix that she e-mailed to them a couple of weeks ago. Brian and Jo said they will review it. Jo asked that a copy be resent to her via e-mail.
22. Julie inquired how many copies of the encyclopedia would be required in the future. The recent modification for RL33 included 8 copies, which apparently will not be enough. Brian said he will need 5 copies (includes 1 for library-public record), Jo Jean said she needs 3 (2 for her, 1 for Rene Hefner), TNRCC needs 3, and EPA should get 2. With 2 copies for Parsons, total is 15 copies. Brian inquired if it would be possible to get CD copies in the future.
23. Cover should be revised as follows: Put volume number under title of volume. The volume number should be larger so that it is easier to find on the bookshelf. Move "Camp Stanley Storage Activity" above the Army symbol, and make it a larger font.

CLARIFICATIONS

Upon the revision of the encyclopedia table of contents after the meeting, the following questions arose:

1. Regarding contractual correspondence: should all contractual correspondence be included? There is a lot of it, including document transmittal letters, requests for contract modifications and schedule changes, notifications of site visits, etc.
2. It was agreed during the meeting that the work plan for AFCEE delivery order 23 would be moved to Volume 5. Should SAP and HSP addenda for DO23 also be put in Volume 5?
3. Should previous plans produced under the Armstrong Laboratory be included in Volume 1-6?
4. Will existing groundwater monitoring reports and/or investigation reports be included in Volume 5?

ACTIONS

CSSA

- Review and comment on or approve revised table of contents.
- Review and comment on or approve SWMU status matrix format.

AFCEE

- Send copy of written comments on encyclopedia which Jo Jean has at her office to Parsons.
- Review and comment on or approve revised table of contents.
- Review and comment on or approve SWMU status matrix format.
- Review Parsons ES' proposal for additional funding to revise encyclopedia.
- Provide results of Booz-Allen & Hamilton's research into CSSA data regarding PQLs, detects, etc. to Parsons for inclusion in the encyclopedia. *(Note: Jo Jean provided diskette at meeting.)*
- Look into putting CSSA GIS on the Internet.
- Address clarifications noted above.

Parsons ES

- Prepare revised table of contents for CSSA and AFCEE approval. *(Note: Revised table of contents is attached.)*
- E-mail SWMU status matrix to Jo Jean. *(Note: SWMU status matrix was e-mailed to Jo Jean on April 16, 1998.)*
- After revised table of contents has been approved, prepare estimate for completing encyclopedia, taking into account funds already set aside for encyclopedia under RL33 and the increased number of copies (item 21).
- Instruct GIS team to put BACT reminder flags into GIS.
- Look into providing CSSA GIS and ArcView on CD to EPA.
- Prepare justification for selection of analytes at each site.
- Revise waste analysis plan (retitled Addendum) to incorporate comments. Attach appropriate referenced pages.
- Provide information on Encapco from Brice Environmental *(Note: Copy of information received from Brice is attached.)*. Also, discuss other types of soil washing with Brice, and determine if they have evidence to support the fact that acid washing is not appropriate. *(Note: Brice is preparing letter regarding inapplicability of soil washing, which will include experience at sites with similar soils.)*
- Provide justification in "Addendum to FSP and QAPP" for use of 14% Portland cement.
- Add AFCEE delivery order 23 tasks to the Work Plan Overview schedule.

- Revise cover of encyclopedia.

xc: Brian Murphy, CSSA
Jo Jean Mullen, AFCEE/ERD
Beth Garland, AFCEE/ERD
Susan Roberts, Parsons ES
Ken Rice, Parsons ES
Rachey Peten, Parsons ES
John Stewart, Parsons ES

ATTACHMENT
Revised Table of Contents for
Environmental Encylopedia

VOLUME 1- SCOPING DOCUMENTS

VOLUME 1 - 1 WORK PLAN

VOLUME 1 - 2 SOLID WASTE MANAGEMENT

SWMU O-1

VOLUME 1-3 AREAS OF CONCERN

VOLUME 1 - 4 SAMPLING AND ANALYSIS PLAN

Field Sampling Plan

Quality Assurance Project Plan

RL33 Addenda

RL53 Addenda

VOLUME 1 - 5 HEALTH AND SAFETY PLAN

Health and Safety Plan

RL33 Addenda

RL53 Addenda

VOLUME 1 - 6 OTHER PLANS AND APPROACHES

Soil Sifting Technical Approach

VOLUME 2 - BACKGROUND METALS LEVELS

VOLUME 3 - INVESTIGATION REPORTS

VOLUME 4 - TREATMENT TECHNOLOGIES AND TREATABILITY STUDIES

VOLUME 5 - GROUNDWATER

VOLUME 6 - PERMITS

OTHER DOCUMENTS

Integrated Spill Prevention Control and Countermeasures Plan

Integrated Cultural and Natural Resources Plan

ATTACHMENT
Information from Brice Environmental
regarding Encapco Recycling Technology

BRICE ENVIRONMENTAL SERVICES CORPORATION **BESCORP**

Home Office
3200 Shell Street
P.O. Box 73520
Fairbanks, Alaska 99707
Tel (907) 456- 1955
Fax (907) 452-5018

554 Route 31
P.O. Box 78
Ringoes, NJ 08551
Tel (908) 806-3655
Fax (908) 806-3293

FACSIMILE TRANSMITTAL COVER SHEET

To: Julie Burdy Fax No: 512/719-6099

From: Carl Bauer Date: 4/15/98

This form plus 10 pages(s) have been transmitted to you. If not properly received, please call (907) 456-1955.

Notes:

Julie, here is the information on ENCAPCO and their process.

Please let us know where to send the density treated soil samples (Composites and Previous) for Total, TCLP, and ~~MEP~~ SPLP Lead analysis. ~~The Person at~~ These QA Samples are ready for Shipment

Samples are +4 mesh, 4x10 mesh, 10x40 mesh, 40x200 mesh, -200 mesh, and Composite soil. 6 QA samples. per proposal.

ENCAPCO RECYCLING TECHNOLOGY FOR CONTAMINATED SOILS

Introduction

Encapco is a California company with a historical base in the road-building segment of the construction industry. Encapco management has developed a strong interest in resolving environmental problems gained through its participation in several major highway construction projects involving contaminated rights-of-way. This combination of expertise and focus has led to the development of a recycling technology capable of converting a contaminated soil into a useful and valuable product, such as a roadbase or engineered fill. Furthermore, this technology uses only high throughput equipment and does not require addition of heat or specialized techniques.

In the highly regulated field of hazardous waste, the recycling of a waste into a useful product is governed by rules and standards concerning the engineering properties of the product as well as those concerning its environmental properties. The relevant engineering properties are determined, of course, by the proposed use of the product and the accepted standards for that use. The American Association of State Highway and Transportation Officials (AASHTO), the American Society for Testing and Materials (ASTM), and other agencies such as the California Department of Transportation (Caltrans) have developed tests and standards for the road-building industry which are applicable to the use of this technology to produce roadbase materials.

Because Encapco's product is typically a roadbase or a fill placed on or in the land, the relevant environmental rules and regulations for this type of recycling are found under the category "use in a manner constituting disposal". The U.S. Environmental Protection Agency (U.S. EPA) has a long-standing policy that exempts recycled waste from Resource Conservation and Recovery Act (RCRA) regulations if all the following conditions pertain:

(1) the resulting product is produced for the general public's use

(2) it contains recyclable materials that have undergone a chemical reaction so as to become inseparable by physical means

(3) the product meets the Land Disposal Restriction (LDR) standards

Most states administer the RCRA program in their jurisdictions without any modifications. However, several states and the Federal EPA are in the process of reviewing their hazardous waste laws in their entirety. Present indications are that these agencies intend to adopt risk assessment as the basis for their revised programs. Federal EPA has been using this approach in setting Preliminary Remediation Goals and in their proposed rule for contaminated media. The highly publicized Brownfields program also uses risk-based standards which are dependent on the future use of a site.

The Encapco technology is compatible with both new and existing regulatory philosophy because it is based on the concept of rendering a hazardous waste non-hazardous. Of course, it goes one step farther by also imparting useful engineering properties on the product. This has the advantage of converting an economic liability into an economic asset.

The Technology

The technology can be classified as stabilization or fixation, but it is fundamentally different than the most commonly used cement or pozzolonic-based processes. Pozzolonic materials are characterized as high-pH inorganics, the simplest of which is lime. Even at low dosages, such as 2–3 percent by weight, these materials can raise the pH of a soil to 12 or more. A soil with a pH that high is so corrosive as to be unsuitable for many uses. In addition, a recent study (Ref. 1) funded by the Department of Energy shows that long-term stability of the pozzolonic fixation reaction is not well understood.

Encapco uses organic materials, such as asphalt (cold mix) as an emulsion, rather than the high-pH inorganics used by others. This is not a new technology for the stabilization of soils in the construction industry. Guidelines have been developed and published for the use of emulsions to create roadbase materials. The Asphalt Institute manual series (Ref. 2) sets forth specifications and methods for emulsion treated base (ETB). The Highway Research Board of the National Academy of Sciences - National Academy of Engineering published "Soil Stabilization" in 1973 as Number 442 of the Highway Research Record. An article of particular interest in that volume (C.S. Dunn and M.N. Salem, "Temperature and Time Effects on the Shear Strength of Sand Stabilized with Cationic Bitumen Emulsions"), discusses strength build-up as a function of curing, temperature, and emulsion content. Additional information can be found in Reference 3.

Encapco's innovation is to adapt this technology to solve environmental contamination problems while simultaneously creating a useful product. Using specialty emulsions, Encapco has successfully applied this technology to soils contaminated with petroleum hydrocarbons (TPH); heavy metals, especially lead; and polynuclear aromatic hydrocarbons (PAHs). Because of the organic chemistry used in the technology, the assimilation of TPH and PAHs into the cured product is an expected result, based on the principle of "like dissolves like." Extending that part of the chemical theory behind this technology, we intend to also test the emulsions on polychlorinated biphenyls (PCBs) and some of the more persistent pesticides, such as DDT.

Full-Scale Example

While the cement-based technologies do not commonly produce a useful product when applied to a contaminated soil, except for the most expansive, high plasticity clays and muds the Encapco emulsion-based technology can yield a true roadbase material with exceptional strength characteristics without the addition of a commercial aggregate. A recent project for the California Department of Transportation (Caltrans) in the San Francisco Bay Area demonstrated this on a full-scale basis. The work was conducted in 1995 as a cooperative effort of Encapco, Caltrans, DeSilva Gates Construction, and C.C.

Myers Construction. It involved the removal of 11,000 tons of soil from the site of a former steel mill and transport of the soil to a new freeway interchange and "Park and Ride" lot.

The contaminant of concern on the soil was lead, with total concentrations up to 2,300 mg/kg. Analytical test work showed the soil to be a "California-only" hazardous waste. That is, Waste Extraction Test (WET) results were in excess of the California limit of 5 mg/l with leachable concentrations reaching as high as 17 mg/l. The Toxicity Characteristic Leaching Procedure (TCLP) results were below the federal limit of 5 mg/l, and therefore it was not a RCRA characteristic waste. Bench-scale evaluation and testing led to an emulsion design capable of physically encapsulating the lead contamination while creating a high quality roadbase. That mix design was applied to the stockpiled soil at the Park and Ride site using a conventional pug-mill. Caltrans was able to use this recycled hazardous waste as a substitute for AB roadbase in the freeway ramp and parking areas.

The attached report by Testing Engineers, Inc. gives the results of Dynaflect testing of the Encapco product at the freeway interchange site. They calculated a Gravel Factor of 1.5 for the ETB which is significantly higher than a Gravel Factor of 1.1 associated with Class II AB. This result reflects the superior strength of the ETB made with soil, leading to a very economical resolution of an environmental problem for Caltrans, which would have otherwise been faced with soil disposal and roadbase costs. Total costs for conversion of contaminated soils into roadbase, placement, and compaction were on the order of $40/ton.

It should be emphasized that any future job will require the same type of bench-scale testing used to create a mix design for the Caltrans project. Although Encapco has a data base of laboratory, bench-scale, and field results for both encapsulation and engineering properties, the variabilities and heterogeneities in soil types combined with the typical uncertainties about the exact chemistry of environmental contaminants will always make it necessary to conduct site-specific emulsion design testing.

Laboratory-Scale Test Results

In addition to the asphalt-based emulsions, such as the one used on the Caltrans project, Encapco has been developing other organic emulsions for use in recycling of metal-bearing RCRA-contaminated soils. These new emulsions are compatible with the asphalt emulsions. The new emulsion formulas are of interest to Encapco because they are capable of chemically encapsulating heavy metals. A patent application is being prepared which will reveal this chemistry.

In order to guide the development of these new emulsions, Encapco has been conducting an ongoing laboratory testing program using a northern California soil spiked with lead sulfate. This soil has been classified as a "yellowish-brown clayey sand with gravel/sandstone." Its optimum moisture content was 11.4 percent and it contained about 30 percent silt or clay. Lead sulfate was added to the soil as a dry powder, most commonly at a concentration of 2,000 mg lead per kilogram (Pb/kg). This would typically give a result of about 55 mg/l when the spiked soil was tested by the toxicity characteristic

leaching procedure (TCLP). A result of 5 mg/l or greater classifies a waste as hazardous under EPA regulations.

At this time, two emulsion formulas have been successful in chemically fixing lead on the spiked soil in laboratory tests. A typical emulsion formula is about 50 percent organic base material, emulsifier, and additives. The remaining 50 percent is water. At a dosage of 12 percent by weight, we have produced a construction material from soil while reducing the soluble lead from about 55 mg/l to below 5 mg/l when tested by the Federal TCLP. These emulsions are readily produced using conventional equipment and techniques, and they have shown good stability and handling properties. When the application calls for it, they can be diluted in the field with no difficulties.

Conclusion

Encapco is one of the few companies working in the environmental arena that focuses on recycling rather than just treatment. This can lead to two major advantages for users of their technology. Those advantages are as follows:

(1) From an economic point of view, the Encapco recycle technology converts a liability into an asset. While the typical treatment approach involves excavation and transport to a permitted facility plus the purchase of clean fill to restore the site, the Encapco process converts the soil into a useful material. A savings of $100/ton or more can be expected for pesticide- or metals-affected soils, with lesser savings for petroleum-affected soils.

(2) Because the recycled material is non-regulated, there is no long-term liability such as with a manifested disposal and there is no long-term monitoring such as with many containment options.

Encapco's technology can be classified as stabilization; but, unlike the commonly used high-pH inorganic pozzolonics, they have developed specialty emulsions capable of chemically fixing hazardous contaminants while imparting engineering properties on the product comparable to hot-mix asphalt. Pozzolonics, such as cement, rely on the aggregate in the mix to achieve structural strength. The Encapco ETBs can exhibit roadbase quality with many soil types and no added aggregate. This organic chemistry has been successfully demonstrated on TPH, PNAs, and lead. Further testing is expected to achieve positive results for chlorinated pesticides, PCBs, and other refractory organics. Furthermore, this chemical fixing of contaminants is compatible with the regulatory definition of "use constituting disposal."

Encapco's Laboratory Program

1. Soil - The soil used in the laboratory studies was selected, with the help of a geotechnical engineer, from a quarry in the San Francisco Bay Area. It is a typical alluvial soil with a very low organic content. The soil was characterized by Woodward-Clyde Consultants' (WCC's) geotechnical laboratory in Pleasant Hill, California (see the attached report from WCC).

2. Spiking - For the work on the encapsulation of lead, we used the same spiking procedure as that used by EPA's Risk Reduction Engineering Laboratory (RREL) in their treatability work on synthetic soil mixtures. A laboratory-grade lead sulfate (powder) was mixed with a screened and weighed sample of the quarry soil. We typically screened the soil to -3/8 inch and added 2.927 gm of lead sulfate to 1 kg of soil. That spiking dosage will yield a soil with 2,000 mg Pb/kg. We found that TCLP results for such a soil are about 55 mg/l.

3. Procedure - Once the spiked soil was prepared, as described above, the moisture content of the soil was adjusted so that the planned addition of the emulsion would result in a treated soil close to the soil's optimum. That is, if we planned to test an emulsion at a dosage of 12 percent, we figured the added moisture from the emulsion would be 6 percent. Therefore, we would adjust the soil to (optimum - 6) percent. Since this soil had an optimum moisture of 11.4 percent, in this example we would adjust the soil to 5.4 percent.

The emulsion was mixed with the spiked and moisture-adjusted soil in a stainless steel mixing bowl using a metal spoon. The typical batch size for an experiment was about 350 gm of screened soil. The mixing of emulsion and soil took approximately 30 seconds.

The treated soil was then allowed to cure at room temperature in the laboratory. The curing time before submittal to a California-certified laboratory for analysis by TCLP was the final variable in the study. Unless specified otherwise, a curing time of 3 days was used. A control sample was analyzed for total lead for every treated soil sample analyzed by TCLP.

4. Results - The chemistry behind the success of the new Encapco emulsions will be revealed in a patent application. We now have results on two formulas demonstrating this success. Starting with a spiked soil which has a TCLP result of about 55 mg Pb/l, we can create a product soil using an emulsion dosage of 12 percent that has a TCLP result of 3–4 mg Pb/l. The pH of the product soil is near neutral and it exhibits good structural characteristics.

EXECUTIVE SUMMARY

Remediation of abandoned Small Arms Firing Ranges (SAFRs) presents unique challenges in that contaminants exist as discrete metal particles and as ionic lead coatings, and base conversion schedules must be met. The cleanup is further complicated by the fact that SAFR soils typically fail Toxicity Characteristic Leaching Procedure (TCLP) tests, requiring them to be dealt with as hazardous waste. To combat the high cost of disposing of this hazardous waste while meeting rigorous project schedules, we have developed a no net waste approach to SAFR remediation.

Historic stabilization techniques have included the use of pozzolonic stabilization, which increases the volume of soil and raises soil pH, diluting and buffering against leaching, and phosphate-based stabilization which changes the chemical makeup of treated soil. While both can be used to "blind" TCLP tests, they are not permanent solutions since they do not physically remove the lead and have difficulty passing the multiple extraction procedure (MEP) test. Phosphates are also water soluble and could negatively impact adjacent waterways if the phosphate-treated soil is left on site. In addition, phosphates have been known to destroy the ion exchange capacity of soils, eliminating a safety factor in long term stability.

The approach proposed by Brice Environmental couples soil washing for gross particulate lead removal with emulsion stabilization of ionic coated residuals. Although soil washing and emulsion stabilization have both seen highly successful commercial use for the last 60 years or more, their combined use for remediating SAFRs provides an exciting, innovative approach and a permanent solution to an old problem. This combined approach is truly a "no net waste" approach where all range materials are recycled or reused on site without restriction.

The Brice soil washing process is a water-based process that uses mineral processing techniques and procedures to recover particulate lead and copper fragments as a refined "product." The operation is dust free, and the recovered product is "scrap metal" per 40 CFR 261.1(c)(6). Under this citation, scrap metal is classified as a "recyclable material" that is not regulated or manifested. Through our ongoing recycling program with secondary smelters, we can provide a ready market for recovered metals, with the salvage value of the material passed on to the Air Force to offset remediation costs.

Soil washing is effective in reducing total lead levels associated with particulate metal contamination, but it is not totally effective in dealing with the bio-available lead associated with ionic coatings. Because risk-based closures typically have total lead and leachable lead cleanup requirements, an additional step is required. In the past, acid leaching has proven effective in dealing with these

ionic coatings. However, our work has shown that certain soil types that have a high pH or carbonate mineralogy are not conducive to acid leaching.

In these cases, we can use the proprietary ENCAPCO emulsion process to both chemically fix residuals with ionic coatings and recycle the soil, to create a road base or engineered fill product with a commercial value. Under 40 CFR 266.2(b) this product is exempt from RCRA regulation as it meets current Land Disposal Restriction (LDR) standards.

Historically, skeet range and pistol range soils can meet reuse criteria after gross lead removal, while rifle range soils typically require additional treatment. Treatment needs vary from site to site based on soil and environmental conditions, so adaptability is a critical concern. Unit operations are modular, so the process can be tailored to the risk-based closure requirements on a site-by-site basis. Since the plant components are all proven commercial mineral processing units, plant set up is simplified and processing rates can be scaled to meet project schedule requirements.

Our approach is consistent with the Air Force's current risk-based approach to SAFR closure and can be implemented under existing contract vehicles or procured as a turnkey, stand-alone program. A treatability study will be performed on representative soils from each selected site to ensure that only the required modules are deployed and only the soil fractions failing TCLP tests are

EMULSION STABILIZATION

ENCAPCO uses resinous, plant-based and/or asphalt emulsions rather than the high-pH materials or phosphate fertilizer-based products employed by others. ENCAPCO's innovation is to adapt this technology to environmental contamination problems, while simultaneously creating a useful product. Using specialty emulsions, ENCAPCO has successfully applied this technology to soils impacted with petroleum hydrocarbons, heavy metals, and polynuclear aromatic hydrocarbons. While cement and fertilizer-based technologies do not produce a useful product, the ENCAPCO process yields a true product designed in accordance with well established and accepted engineering practices.

The SAFR soils failing reuse criteria after soil washing will be stabilized using the ENCAPCO process. The emulsion blend will be developed as part of treatability testing prior to mobilization. A pugmill will be used to mix the soil and emulsion additives per the treatability data. After mixing, the recycled material will be stockpiled and/or placed in service as an aggregate/road-base or engineered fill..

SOIL RECYCLING

Under current regulations, waste that is recycled and "used in a manner constituting disposal" is exempt from RCRA regulation if the resulting product is produced for the general public's use, it contains recyclable materials that have undergone a chemical reaction so as to become inseparable by physical means, and the product meets LDR treatment standards. (See 40 CFR 266.20 (b)).

ENCAPCO's recycling process for RCRA waste satisfies the criteria set forth in 40 CFR 266.20 (b).

- The resulting product meets engineering and regulatory standards for commercial roadway construction materials. The process has been recently used in this manner on a California State Highway project involving "Cal-Only" waste material. Thus, it is produced for public use as a construction product.
- The resulting product uses the contaminant soil as a necessary and integral part of the finished structural material. The process produces chemical fixation or stabilization of the waste material. Further, waste-derived cement and asphalt products were deemed to have satisfied the "chemical reaction" requirement when the final rule was issued in 1985. (See Federal Register, Vol. 50, No 3 at 646.)
- To be permitted under 40 CFR 266.20(b), the resulting product must satisfy the LDR treatment standards pursuant to the appropriate test procedure. ENCAPCO's resultant product has been proven to pass these tests.

Brice Environmental has evaluated several different stabilization technologies and has found that combining gross lead removal with the ENCAPCO emulsion stabilization is the only approach that satisfies the above criteria for unrestricted reuse of SAFR soils. Stabilization of gross particulate lead contamination within the soil matrix, as is commonly done by others, does not create a product because the metals are not inseparable from the soils by physical means