WHITE PAPER ADDRESSING COMPACTED CLAY LINERS

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Department of Energy
Fernald Environmental Management Project
P. O. Box 398705
Cincinnati, Ohio 45239-8705
(513) 648-3155

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Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - SRF-5J
77 W. Jackson Blvd.
Chicago, IL 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, OH 45402-2911

Dear Mr. Saric and Mr. Schneider:

WHITE PAPER ADDRESSING COMPACTED CLAY LINERS

The Ohio Administrative Code (OAC) prescriptive specifications for compacted clay liners were discussed in an August 31, 1995, alignment meeting between representatives of the Ohio Environmental Protection Agency (OEPA) and the Department of Energy, Fernald Area Office (DOE-FN), the Fernald Environmental Restoration Management Corporation (FERMCO) and its subcontractor GeoSyntec Consultants. At the meeting, OEPA suggested that a "white paper" be prepared to address the prescriptive specification set forth in OAC 3745-27-08(C)(1)(c)(iv) that cannot be met by the on-site clays, and to outline the steps that will be taken, and the information that will be generated, to support the alternative demonstration allowed by OAC 3745-27-08(C). This white paper is enclosed for your review.

If you have any questions, please contact Rod Warner at (513) 648-3156.

Sincerely,

Johnny Reising

FN:Jalovec

Johnny Reising
Fernald Remedial Action
Project Manager

Enclosure: As Stated

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cc w/enc:

K. H. Chaney, EM-423, GTN
B. Skokan, EM-423, GTN
G. Jablonowski, USEPA-V, AT-18J
Manager, TSPP/DERR, OEPA-Columbus
F. Bell, ATSDR
D. S. Ward, GeoTrans
R. Vandergrift, ODOH
S. McClellan, PRC
AR Coordinator, FERMCO

cc w/o enc:

M. McCune, EM-423, GTN
L. Parsons, DOE-OH
S. Pearce, BA&H
T. Hagen, FERMCO, 65-2
N. Weatherup, FERMCO, 52-2
M. Yates, FERMCO, 9

ALTERNATIVE TO OAC PRESCRIPTIVE SPECIFICATIONS FOR COMPACTED SOIL LINERS

BACKGROUND

The on-site disposal facility (OSDF) at the Fernald Environmental Management Project (FEMP) will include compacted brown and gray clays in the liner and cap system. The source of the clays will be the OSDF excavation area and the East Field borrow area (DOE 1995a, Figure 1-2 [attached]). Preliminary laboratory testing conducted on the soil from these two areas indicates that all of the prescriptive material specifications for compacted clay layers set forth in Ohio Administrative Code (OAC) 3745-27-08(C)(1), except one, will be met by the brown and gray clays. The one exception is the criterion cited in OAC 3745-27-08(C)(1)(c)(iv), which requires that the soil contain *"not less than 25% of the particles, by weight, having a maximum dimension not greater than 0.002 mm"* (i.e., 2 microns). Based on the available laboratory test results (DOE 1995b, Figures 4-1 through 4-3 [attached]), the brown and gray clays do not consistently have more than 25 percent of its particles, by weight, smaller than 0.002 mm.

OAC 3745-27-08(C) states that alternatives to the prescriptive requirements for soil liner materials may be used: *"...if it is demonstrated to the satisfaction of the Director (OEPA) that the materials and techniques will result in each lift having a maximum permeability of 1 x 10^{-7} cm/s."* The available test data demonstrate that the remolded brown clay is capable of achieving a hydraulic conductivity less than 1 x 10^{-7} cm/s. Remolded hydraulic conductivities of the gray clays are being performed as part of the ongoing geotechnical investigation for the on-site clay borrow area (DOE 1995a). Additional permeability testing is also being performed on the brown clays in the borrow area as part of this investigation.

SUPPORT FOR MEETING ALTERNATIVES TO PRESCRIPTIVE REQUIREMENTS

The primary considerations in addressing the OAC prescriptive specification for the minimum acceptable percentage, by weight, of particles finer than 0.002 mm are given below:

- The primary performance criterion for compacted soil liners in OAC 3745-27-08(C)(1)(a) requires that each lift of the liner have a maximum hydraulic conductivity of 1 x 10^{-7} cm/s. The hydraulic conductivity of a clayey soil is, in

part, a function of the percentage of clay-size particles. However, other factors such as soil plasticity, compaction moisture content, and dry density also strongly influence hydraulic conductivity. Benson et al. (1994) performed detailed analyses of how each of these parameters correlates with hydraulic conductivity. The results of their study, which were based on data from 67 landfills, indicate that an average (rather than a minimum) fraction of clay-sized particles exceeding 15 percent is an acceptable criterion for compacted soil liners. In addition, Benson et al (1994) provided data on a large number of compacted soil liners which do not meet the clay-size particle criterion set forth in OAC 3745-27-08(C)(1)(c)(iv), yet, when constructed using appropriate procedures, have measured hydraulic conductivities less than 1×10^{-7} cm/s. It is also noted that widely-accepted guidelines for clay liner materials (Daniel 1993) do not contain criteria for the minimum acceptable percentage of clay-size particles.

- As part of the OSDF design, a test pad program will be conducted using soil obtained from the OSDF excavation area and East Field borrow area. Test pads will be constructed using equipment and techniques that will subsequently be used to construct the OSDF clay liner. Laboratory and field permeability testing will be performed during the test pad program to define the compaction conditions that will yield a soil liner with a hydraulic conductivity not greater than 1×10^{-7} cm/s. The test pad program will meet the requirements for test pads set forth in OAC 3745-27-08(C)(1)(m).

- The results of the test pad program, including all laboratory and field hydraulic conductivity test results from the program, will be presented in a report that DOE will provide to OEPA and USEPA. This report will specify construction equipment types and construction procedures that result in a compacted clay liner satisfying the hydraulic conductivity performance criterion of OAC 3745-27-08(C)(1).

- During construction of the OSDF liner system, a detailed construction quality assurance (CQA) program will be implemented. The CQA activities will include moisture/density testing of soil liner materials at the frequency required by OAC 3745-27-08(C)(1)(o) to verify that the compaction conditions are consistent with those established during the test pad program. In so doing, a high level

of assurance will be provided that the hydraulic conductivity of the soil liner material is not greater than 1 x 10^{-7} cm/s. The CQA program will also include confirmatory hydraulic conductivity testing.

CONCLUSION

The information that will be generated from the activities described above provides a sound basis for obtaining a compacted brown and gray clay liner that satisfies the performance criterion of OAC 3745-27-08(C)(1). DOE proposes to use this information as a basis for discussion with OEPA as to whether the proposed activities (including presentation of test pad test results and construction procedure requirements in the soil liner test pad report) form an acceptable basis for making the demonstration to the OEPA as allowed by OAC 3745-27-08(C). Also note that the OAC prescriptive specification for the minimum acceptable percentage of clay size particles applies to the compacted clay component of the final cover system. Thus, the scope of the test pad demonstration described above will be made broad enough to address the suitability of using the brown and gray clays in the final cover for clay cap construction.

REFERENCES

Benson, C.H., Zhai, H., and Wang, X, "Establishing Hydraulic Conductivity of Compacted Clay Liners," *ASCE Journal of Geotechnical Engineering*, Vol. 120, No. 2, Feb 1994, p. 366 to 387.

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U.S. Department of Energy, July 1995b, "Disposal Facility Predesign Geotechnical Investigation," prepared by Parsons (PO 132), DOE Fernald Area Office.