Bechtel Associates Professional Corporation

Inter-office Memorandum J. O. Kane

To R. L. Castleberry

Subject Plant Area Fill
Midland Units 1 & 2
Job 7220-001

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From S. S. Afifi

Of Geotechnical Services

At Ann Arbor - E

1/ This memo is intended to assist in preparing your formal response to Item 3 of BCBE-370 regarding compaction requirements for the plant area. Herein, we address recommendations given in the soils reports prepared by Dames & Moore for the Midland project and compare them with our earthwork specifications. The material in this memo confirms our previous discussions with your group.

2 The evaluation here pertains to plant area fill supporting and surrounding structures, any Category I slopes in the plant area, and the berm fill.

In-Situ Clays

3 Tables 1 & 2 attached (taken from Dames & Moore's soils report of June 28, 1968, Page 15 and its supplement of March 15, 1969, Page 16) present compaction recommendations for fill and backfill. In the June 28, 1968 report, the minimum clay compaction is recommended to be 95% for support of critical structures, 90% for support of non-critical structures, and 90% adjacent to structures, respectively; all percent compaction values are according to ASTM D 1557 Method D (about 56,000 ft-lb compaction energy). In the March 15, 1969 report, the minimum clay compaction is recommended to be 100% for support of structures, 95% adjacent to structures, and 90% for area fill (not supporting or adjacent to structures); all percent compaction values are according to Bechtel Modified Compaction (BMC: 20,000 ft-lb compaction energy).

4/ Specification 7220-C-210 (Section 13.7) requires 95% of ASTM D 1557 Method D for in-situ clay in the plant area and berm.

5 In comparing the reports with the specification for in-situ clay supporting structures, it is seen that the specification and the 1968 Dames & Moore report are identical. Also, the specification and the 1969 report are consistent since 95% of ASTM D 1557 Method D is approximately equivalent to 100% BMC in some soils. However,

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the requirement of 95% of ASTM D 1557 Method D given in the specification is the applicable criteria for compacting clay to support structures. Further assurance by conducting shear strength tests is required (see Section 12.4.8, Specification 7220-C-210). Compressibility tests may also be required.

6 The berm fill must be compacted to 95% of ASTM D 1557 Method D to insure adequate seepage protection and stability.

7 Category I fill placed within the failure zone of a slip circle may require a degree of compaction higher than 95% of BMC, because of design for the full SSE. However, it is conceivable that in-place fill compacted to 95% of the BMC will be adequate if strength and permeability properties are shown to be adequate.

8 Similarly, in-place fill supporting light structures may be adequate at 95% of BMC provided its strength and compressiblity are shown to be adequate.

9 Fill in the plant area which will not support structures or pipes or be placed within the failure zone of Category I slopes may be compacted to a lesser degree than 95% of ASTM D 1557 Method D (e.g. 95% of BMC). This agrees with Dames & Moore's 1969 report and is consistent with their 1968 report which requires only 90% of ASTM D 1557 Method D.

In-Situ Sands

10 The Dames & Moore June 1968 report presents recommendations for compacting sand in terms of maximum density while their March 1969 report presents recommendations in terms of relative density. The later report is considered more applicable for sands since relative density is one of the basic parameters required to control liquefaction. Therefore, in-situ sands supporting structures must be compacted to a relative density of 85% (ASTM D-2049). For well-graded sands around structures, the 80% relative density specified in 7220-C-211 is adequate.

11 Accordingly, any in-situ clay which will be supporting structures or be involved in Category I slopes and the berm must be compacted to 95% of ASTM D 1557 Method D.

12 If the fill is already in place according to BMC, it may be adequate for some structures, pipes, or slopes, provided it is shown by sufficient testing that its strength, compressibility and seepage

characteristics are adequate. This requires sampling and laboratory shear strength and consolidation testing. Section 12.4.8 of the earthwork specification addresses this issue for any in-place fill. Compaction curves using both ASTM D 1557 Method D and Bechtel Modified Method must also be developed and correlated with shear strength and consolidation test results on the compacted soil to evaluate the compressibility and shear strength achieved from both methods of compaction for the in-place fill.

This information will allow a complete evaluation of any in-place fill for its proposed function, in addition to providing information which will be needed for the FSAR. It should also clear up any questions as to how fill should be placed in the future.

We will be happy to discuss this matter further with you at your convenience.

S. S. Afifi

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Attachments

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TABLE 1

Minimum Compaction Criteria from Dames & Moore

June 1968 Report**

Purpose of Fill	Recommended Minimum Compaction Criteria Percent of Maximum Density* On-Site Cohesive Soils	On-Site Granular Soils
Support of Critical Structures	95	100
Support of Non-Critical Structures	90	95
Adjacent to Structures	90	95

* Maximum density and optimum moisture content should be determined by the ASTM Test Designation D 1557 Method D.

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** Report, Foundation Investigation and Preliminary Explorations for Borrow Materials Proposed Nuclear Power Plant, Midland, Michigan, June 28, 1968.

TABLE 2

Minimum Compaction Criteria from Dames & Moore

March 15, 1969 Report***

Purpose of Fill	Recommended Minimum Compaction Criteria On-Site Sand Soils Percent Relative Density*	On-Site Clay Soils Percent of Maximum Density**
Support of Structures	85	100
Adjacent to Structures	75	95
Area Fill (not supporting or adjacent to structures)	70	90

* Maximum and minimum density of sand soils should be determined in accordance with ASTM Test Designation D-2049.

** Maximum dry density and optimum moisture content should be determined in accordance with ASTM Test Designation D-698, modified to require 20,000 foot-pounds of compactive energy per cubic foot of soil.

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*** Supplement to Report, Foundation Investigation and Preliminary Explorations for Borrow Materials, Proposed Nuclear Plant, Midland, Michigan, March 15, 1969.