Consumers Power Company

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July 27, 1981

Mr Harold R Denton, Director
Office of Nuclear Reactor Regulation
US Nuclear Regulatory Commission
Washington, DC 20555

MIDLAND PROJECT
DOCKET NOS 50-329, 50-330
FINAL RESULTS OF SOIL BORING AND TESTING
PROGRAM FOR PERIMETER AND BAFFLE DIKE AREAS
FILE: 0485.16 SERIAL: 13340
ENCLOSURES: 1) TABLE 1 - COMPARISON OF SOIL PROPERTIES USED IN THE FSAR WITH DATA RECEIVED FROM WOODWARD-CLYDE CONSULTANTS, DATED JULY 1, 1981
2) TABLE 2 - COMPARISON OF SOIL PROPERTIES USED IN THE RESPONSE 50.54(f) (NEWMARK ANALYSIS) WITH DATA RECEIVED FROM WOODWARD-CLYDE CONSULTANTS, JULY 1, 1981
3) TEST RESULTS, PERIMETER AND BAFFLE DIKE AREAS, SOIL BORING AND TESTING PROGRAM, MIDLAND PLANT - UNITS 1 AND 2, VOLUME I AND VOLUME II
4) WOODWARD CLYDE CONSULTANTS (WCC) LETTER 81C217-4 DATED JULY 22, 1981: DOCUMENTATION OF THE UNIFORMITY OF FOUNDATION TILL DEPOSIT IN BORINGS DRILLED IN THE PERIMETER DIKE AREA

We are providing forty (40) copies of the enclosed Woodward-Clyde Consultants' final report dated July 1, 1981 which documents the soil boring and laboratory testing data for the fill and natural foundation materials in the perimeter and baffle dike areas. This report supercedes our earlier report of the preliminary results of soil boring and testing program for perimeter and baffle dike areas which was forwarded by our correspondence Serial 12244 of June 19, 1981. This finalized version contains the few additional index property and undrained triaxial compression test results which were not included in the preliminary version of the report transmitted on June 19, 1981. The enclosed report is presented in two volumes. Volume I includes the main report and the primary appendices containing the boring and laboratory test results. Detailed supporting data for the triaxial tests are included in Volume II.

The soil boring and testing program was performed by Woodward-Clyde Consultants who have been retained by Consumers Power Company as an independent contractor. Corps of Engineers (COE) personnel have observed the drilling and sampling operation in the field. COE personnel have also visited Woodward-Clyde Consultants' soil laboratory at Clifton, New Jersey, and have

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observed laboratory operations, including extrusion of tubes, preparation of triaxial and consolidation test specimens, and performance of index and engineering property testing.

The soil properties obtained from the laboratory tests (Boring Nos: COE-1 through COE-7 and COE-7A) and the property values used in the design of dikes are provided in Tables 1 and 2. Table 1 indicates that the shear strength values of the fill and natural foundation materials of the perimeter dikes are higher than the conservative values used in the design of the dikes. The slope stability analysis of the perimeter dike with the new shear strength properties will result in a higher factor of safety than the factor of safety values reported in the FSAR Table 2.5-20.

Table 2 indicates that the shear strength values of fill materials and foundation clay for the baffle dike above elevation 598.0 feet are higher than the values used in the 50.54(f) response (Response to Question 45, Part 1f, Table 45-2), while the shear strength of foundation clay below elevation 598.0 feet is slightly lower than the values used in the 50.54(f) response. The analysis performed for the 50.54(f) response resulted in a large margin of safety using a seismic acceleration of 1.0g, and the acceleration value assumed for the Midland site is at least a factor of 5 lower than the ground acceleration of 1.0g used for the 50.54(f) analysis. Therefore, the slightly lower shear strength values do not in any way alter our conclusions presented in the 50.54(f) response.

Enclosure 4 is a copy of a Woodward-Clyde Consultants letter of July 22, 1981 which documents a telephone discussion on the same day between Mr D Hendron (WCC) and Messrs J Kane (NRC) and H Singh (COE). This WCC correspondence documents Mr D Hendron's response to certain NRC and COE questions relating to the cooling pond dike borings. Mr J Kane requested that these verbal responses, which are represented in Enclosure 4, be documented for the record. It is our understanding that Messrs J Kane and H Singh found the responses provided by D Hendron acceptable.

A stability analysis of portions of the dike adjacent to the Category I piping is being provided as a portion of the testimony of Dr A J Hendron which is being transmitted by separate correspondence. This analysis used shear strength data at least as conservative as those contained in the enclosed final report.

Our conclusion is that the new soil properties and slope stability analysis clearly indicate that portions of the perimeter and the baffle dikes adjacent to the Category I piping will maintain their integrity and stability under very conservative postulated conditions.

G S Keeley for J W Cook

JWC/NR/RLT/cr

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22 July 1981
81C217-4

Dr. T.R Thiruvengadam
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Subject: Documentation of the Uniformity of Foundation Till Deposit in Borings Drilled in the Perimeter Dike Area

Dear Dr. Thiruvengadam:

In response to the request of Mr J. Kane of USNRC and Mr H. Singh of the Detroit District Corps of Engineers, on this date, the writer orally presented documentation of the uniformity of the foundation till deposit in the borings made in the perimeter dike area during the recent Soil Boring and Testing Program. This letter summarizes the substance of the writer's oral presentation.

Four borings (COE-2, COE-3, COE-4, and COE-5) were drilled along the perimeter dike at the Midland plant. Each boring penetrated the foundation till deposit beneath the dike fill materials.

Field tests including visual classification and pocket penetrometer and laboratory tests including index property and density determination were performed on samples taken from the borings. Results of the field and laboratory tests are given in Volume I of our report dated 1 July 1981 entitled "Test Results, Perimeter and Baffle Dike Areas, Soil Boring and Testing Program, Midland Plant - Units 1 and 2, Midland, Michigan". Results of field tests are given in the boring logs in Appendix A; results of laboratory index property and density tests are given in Appendices B and C of the referenced report.

The results of these field and laboratory tests showed the foundation till to be a uniform deposit. Visual classification of samples from the borings indicated the till deposit to be a hard, sandy, slightly plastic silty clay soil with visual evidence of a granular component ranging in size from fine sand to course gravel. Results of pocket penetrometer determinations all indicated greater than 4.5 tsf. Results of index and density tests are summarized in Table 3 of the referenced report. These results show very small ranges in the index parameters tested (liquid limit, plasticity index, water content, density, and gradation).

High recovery core barrel samples were taken in borings COE-4 and COE-5. Laboratory test specimens for triaxial testing were to be trimmed to 2.9 in. dia. Core taken in COE-4 was 4-in. dia; core taken in COE-5 was 3¼-in. dia.

The visual classification of core from both borings was similar in all respects. It was decided that test specimens should be trimmed from core taken in COE-5 because less trimming would be required to fit the laboratory equipment. Core from COE-4 was to be reserved for testing in the event that trimming of core from COE-5 resulted in disturbance of test specimen or if additional testing was judged necessary. Test specimens were successfully prepared from core samples from boring COE-5 and no additional tests were judged necessary.

It is our judgement that results of tests on these specimens represent the samples of the foundation till deposit taken in the borings made along the perimeter dike.

Very truly yours,

David M. Hendron
Project Director

DMH:js

Enclosure

cc: Mr. N. Ramanujam (2 copies)
Mr. T.C. Cooke/D.S. Sibbald
Dr. R.B. Peck
Dr. A.J. Hendron, Jr.
Mr. A.J. Boos, Bechtel
Dr. S.S. Afifi, Bechtel
Dr. H.M. Horn, WCC
Dr. R.S. Ladd, WCC
Mr. L.M. Campbell, WCC

TABLE 2
COMPARISON OF SOIL PROPERTIES USED IN THE
RESPONSE 50.54(f) (NEWMARK ANALYSIS) WITH DATA
RECEIVED FROM WOODWARD-CLYDE CONSULTANTS, JULY 1981

Baffle Dike (Section Y-Y')

		Total Stresses					
		Response 50.54(f)			Woodward-Clyde		
Zone	Description	γ (pcf)	ϕ (deg)	c (psf)	γ (pcf)	ϕ (deg)	c (psf)
2	Random fill	130	0	1,000-2,000	130	0	1,200-4,200
	" "	130	25(1)	0		-(1)	
7	Foundation clay EL 598' to EL 604'	132	0	3,500	140	0	3,200-5,600(2)
8A	Foundation clay EL 590' to EL 598'	132	0	6,000	140	0	5,300-6,300(2)
8B	Foundation clay Below EL 590'	140	0	7,000	140	0	6,500(2)

(1) The random fill materials were assumed to have effective angle of internal friction of 29°, but for the total stress analysis an angle of 25° was used. The tests from Woodward-Clyde showed an effective angle of internal friction of ϕ'=35.1° and c'=0 for random fill-granular and an effective angle of internal friction of ϕ'=28.6° and c'=190 psf for random fill-cohesive.

(2) For the Perimeter Dike (Section T-T'), glacial till with shear strength ranging from 11,000 to 25,000 psf was encountered in borings COE-2, 3, 4, 5 and 6.

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TABLE 1
COMPARISON OF SOIL PROPERTIES USED IN THE FSAR WITH
DATA RECEIVED FROM WOODWARD-CLYDE CONSULTANTS, JULY 1981

Perimeter Dike

		Effective Stresses						Total Stresses					
		FSAR			Woodward-Clyde			FSAR			Woodward-Clyde		
Zone	Description	γ (pcf)	φ' (deg)	c' (psf)	γ (pcf)	φ' (deg)	c' (psf)	γ (pcf)	φ (deg)	c (psf)	γ (pcf)	φ (deg)	c (psf)
1	Impervious fill	135(1)	29	0	135	30.9	140		-		135	0	1,400-6,300
2	Random fill	135(1)	29	0		-(2)			-			-	
7	Foundation sand, silt and firm clay	110(1)	32	0		-(3)			-			-	
8	Foundation glacial till	140(1)	35(4)	0	140	32.4	1,810		-		140	0	11,000-25,000
9	Foundation glacial till		-			-		125	0	7,000(5)	140	0	11,000-25,000

(1) See FSAR Table 2.5-22 for ranges of dry density for various zones. Values shown above were used in stability analysis.

(2) Samples taken from the Baffle Dike random fill-cohesive gave c'=190 psf and φ'=28.6° and random fill-granular gave c'=0 and φ'=35.1°.

(3) Samples taken from the Baffle Dike foundation clay gave an effective angle of internal friction of φ'=25.3° and c'=780 psf, however, borings COE-2, 3, 4, 5 and 6 drilled in the Perimeter Dike showed only foundation glacial till.

(4) FSAR Table 2.5-22 shows 37° while actual value used was 35°.

(5) c used only in earthquake analysis of emergency cooling water reservoir slope (Section Z-Z').

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