U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

Report No. 50-409/79-12

Docket No. 50-409 License No. DPR-45

Licensee: Dairyland Power Cooperative
2615 East Avenue - South
La Crosee, WI 54601

Facility Name: La Crosse Boiling Water Reactor

Inspection At: La Crosse Site, Genoa, Wisconsin

Inspection Conducted: May 22-24, and July 9, 1979

Inspector: E. J. Gallagher E J Gallagher 7-12-79

Approved By: D. W. Hayes, Chief RC Knop for 7-12-79
Engineering Support Section 1

Inspection Summary

Inspection on May 22-24, July 9, 1979 (Report No. 50-409/79-12)
Areas Inspected: Special, announced inspection to (1) observe soil test borings and recovery of undisturbed soil samples, (2) review procedures and specifications for test borings, (3) review quality records of boring logs and drilling certification, (4) observe laboratory preparation and cyclic triaxial testing of undisturbed soil samples. The inspection involved a total of 20 inspector-hours by one NRC inspector.
Results: No items of noncompliance were identified in the area inspected.

DETAILS

Persons Contacted

Principal Licensee Personnel (Dairyland Power Cooperative)

*R. E. Shimshak, Plant Superintendent
*J. D. Parkyn, Assistant Plant Superintendent
R. R. Wery, Quality Assurance Specialist

Dames and Moore

M. S. Mataraja, Project Manager, Washington Office
B. Cook, Field Engineer, Washington Office
E. Rosik, Field Engineer, Chicago Office
M. Silver, Consultant, University of Illinois, Chicago

Raymond International

N. Eger, Driller, Chicago Office
W. Phillip, Driller, Chicago Office

*Denotes those in attendance at the exit meeting.

Functional or Program Areas Inspected

1. Background and Purpose of the LACBWR Subsurface Study

As part of the Systematic Evaluation Program (SEP), the NRC staff indicated that the seismic evaluation of the La Crosse Boiling Water Reactor performed by Dairyland Power Cooperative did not include sufficient data concerning seismic design input and structural capability for safety related structures, systems and equipment to withstand earthquake effects. (ref: NRC letter to DPC dated January 15, 1979)

An analysis was performed by the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi. The results of their analysis are contained in a report entitled, "Liquefaction Analysis for La Crosse Nuclear Power Station", dated December 1978. On January 9, 1979, a meeting was held to discuss the liquefaction potential at the LACBWR site and the results of the WES analysis (ref: NRC memo dated January 20, 1979). At this meeting it was agreed that it would be appropiate to initiate a soils properties investigation program. This program was to include obtaining undisturbed soil samples at the site and conduct laboratory cyclic triaxial tests to better define the soils properties.

A subsequent meeting was held on February 9, 1979, to discuss the current available information on liquefaction potential at LACBWR and the soils properties investigation program for resolving this issue under the NRC Systematic Evaluation Program. The proposed soil properites investigation program described by Dames and Moore included taking at least four borings at strategic locations on the LACBWR site as well as laboratory testing of the samples from various depths of interest. (ref: NRC memo dated February 15, 1979.)

Dames and Moore then submitted a report entitled, "Review of Liquefaction Potential LACBWR" for DPC of which Section 7.0 describes the recommendations for further site investigation work. This report was reviewed by the WES and comment submitted to the NRC. (ref: WES letter to NRC dated April 4, 1979.) One of the comments made was the tests may be critical to the evaluation of liquefaction at La Crosse and should be closely monitored by the NRC staff.

As a result of this recommendation, RIII office was requested to have an inspector observe site sampling of the subsurface materials and laboratory tests. The following sections describe the observations and records review by the RIII inspector.

2. Review of Procedures for Site Soils Investigation

Dames and Moore and Raymond International used the following quality assurance procedures for the site test borings and associated work:

a. QA Procedure No. 5[illegible], dated May 18, 1979. (Attachment 2)

b. Specification for Test Borings. (Attachment 3)

These procedures are attached for the information of NRC Geosciences Branch (NRR).

The program required four test borings identified as DM-7, DM-8, DM-9 and DM-10. Two borings (DM-8 and 10) were to provide continious blow count values using standard penetration test for the collection of "N" values continuously at various depths. Two other borings (DM-7 and 9) were to provide "undisturbed" samples for insitu density tests and cyclic triaxial laboratory tests. The "undisturbed" samples were to be recovered according to report entilted "State-of-the-Art of Undisturbed Sampling of Cohesionless Soils" by W. Marcuson and A. Franklin to be presented at the International Symposism on Soil Sampling in July 1979.

In addition, test borings were to be performed in accordance with ASTM D-1586, "Penetration Test and Split-Barrel Sampling of Soils" and ASTM D-1587, "Thin-Walled Tube Sampling of Soils."

The detailed sampling procedure for recovering and handling "undisturbed" samples is contained in Dames and Moore procedure No. 53, Section 2.1.1 (sampling procedure).

3. Observation of Test Borings at LACBWR Site

A number of photographs were taken of the site soils investigation and are included in Attachment 1 of this report.

The following specific observations were made during the standard penetration test borings and undisturbed Osterberg sampling performed by Dames and Moore:

a. Standard Penetration Test Boring (DM-8)

The following equipment was used for the test boring:

(1) Mobile B-61 drill rig
(2) Type "A" drill rod; 10 ft lengths
(3) Two raps of rope around cat head; rope lubricated periodically
(4) Tri-cone diffused discharge type drill bit (4 1/8" diameter)
(5) 140 lb. hammer; 30-inch drop
(6) 7.56 lb. anvil
(7) Standard split spoon sampler

The test boing was performed in accordance with ASTM D-1586. Penetration (blow/ft) and soil classification were recorded on boring logs. Split spoon samples were recovered and job samples retained for lab classification. Boring holes were filled with cement material by dropping material into borehole and rodding.

The following preliminary field results were recorded:

Boring DM-7

Date Sampled	Sample Type	Depth of Sample (Ft)	Penetration (Blows/Ft)	Soil Classification
5/21/79	Splitspoon (SS)	1	9	SP
"	SS	5'-6"	5	SP
"	SS	10'-6"	7	SP
"	SS	15'-6"	6	SP
"	SS	20'-6"	5	SM-ML
"	Osterberg	25	Push	SM
"	SS	30'-6"	10	SP
"	SS	35'-6"	13	SP
"	SS	40'-6"	14	SP

"	SS	45'-6"	16	SP
"	SS	50'-6"	26	SP
"	SS	55'-6"	25	SP
"	SS	60'-6"	41	SP
"	SS	65'-6"	26	SP
"	SS	70'-6"	41	SP
5/22/79	SS	75'-6"	18*	SP
"	Osterberg	80'-0"	Push	SP
"	SS	85'-6"	29	SP
"	SS	90'	64	SP
"	SS	95'-6"	100/6"	SP
"	SS	100	150/6"	GP
"	SS	105	115/6"	GP
"	SS	110'-6"	59	SP
"	SS	115'-6"	100/4"	SP
"	SS	120'-6"	120/6"	SP
"	SS	125	36	SP
"	--	131'-6"	--	Rock

*Restart of boring on 5/22/79.

b. Undisturbed Sampling (Boring DM-7)

It was understood that one of the objects of the site testing was to recover relatively "undisturbed" soil samples at various depths which were to be used for laboratory cyclic triaxial tests in order to determine soil properites and the effect of a seismic event on soil liquefaction. The sampling method which was to be employed is contained in report entitled "State-of-the-Art of Undisturbed Sampling of Cohesionless Soils" by W. Marcuson and A. Franklin.

Undisturbed sampling (Boring DM-7) was performed by Raymond International Drillers under the technical supervison of Dames and Moore field engineers and Dr. M. Silver of the University of Illinois, Chicago Circle Campus.

The following specific observations were made during the test Boring DM-7:

(1) When drilling was below the water table drilling mud (Quik-Gel Bentonite) was used to support the wall of the hole.

(2) A modified fish tail bit with baffles installed to deflect drilling fluid upward was not used as recommended. Instead a 4 1/8" diameter tri-cone difused discharge bit was used.

(3) The "push" on the Osterberg piston was uninterupted; the thin-walled tube sampler was 3 inches in diameter.

(4) The hydraulic fluid pressure for the drive mechanism was not determined since a gauge was not available on the drill rig.

(5) The withdrawal of the sampler tube was in a manner to minimize sample disturbance.

(6) The thin-walled tube was cut from the Osterberg piston using a pipe cutter to relieve the vacuum after withdrawal from the borehole.

(7) Samples in the thin-walled tube were plugged on both ends with an expandable "O" ring which included a means of allowing drainage of the sample. Drainage was required for a minimum of 24 hours prior to freezing.

(8) The samples were planned to be frozen onsite using dry ice and the transporting the samples to a local freezer plant. The samples are then planned to be transported to the University of Illinois laboratory in Chicago, by Dr. M. Silver, for preparation and testing. The inspector observed the samples being handled carefully to minimize disturbance.

The following preliminary field results were recorded:

Test Boring DM-7

Date Sampled	Sample Type	Depth of Sample (Ft)	Penetration (Blows/Ft)	Classification
5/23/79	SS	1'-6"	8	SP
"	Osterberg	5'	Push	SP
"	SS	10'-6"	10	SP
"	Osterberg	15'	Push	--
"	SS	20'-6"	11	SP
"	Osterberg	25'	Push	ML
"	SS	30'-6"	13	SP
"	Osterberg	35'	Push	--
"	SS	40'-6"	13	--
"	Osterberg	45'-6"	Push	--
"	SS	50'-6"	20	--
"	Osterberg	55'	Push	--
"	SS	60'-6"	36	SP
5/24/79	Osterberg	65'-6"	Push*	--
"	SS	70'-6"	31	SP
"	Osterberg	75'	Push	SP
"	SS	80'-6"	33	SP

*Thin walled tube sheared in borehole - sample lost.

4. Observation of Laboratory Testing

On July 9, 1979, members of the NRC staff and Waterways Experiment Station observed cyclic triaxial tests of soil samples recovered during site soil borings. The soils laboratory testing was performed at the University of Chicago, Circle Campus, under the direction of Dr. Marshall Silver and Dames & Moore personnel.

Exit Interview

The inspector met with site staff representatives at the conclusion of the inspection on May 24, 1979. The inspector summarized the scope and findings of the inspection. The licensee acknowledged the findings.

Attachments: Attachments 1-3

ATTACHMENT 1

Description of Photos

Slide No. 1 - La Crosse Boiling Water Reactor, La Crosse, Wisconsin

Slide No. 2 - Standard penetration test using 140# hammer at 30" drop.

Slide No. 3 - Standard penetration test - 2 raps of rope around cathead.

Slide No. 4 - Tri-cone diffused discharge type drill bit (4 1/8" diameter).

Slide No. 5 - Tri-cone diffused discharge the drill bit.

Slide No. 6 - Anvil used to transmit energy to drill rod.

Slide No. 7 - Osterberg piston soil sampler.

Slide No. 8 - Osterberg piston soil sampler.

Slide No. 9 - Osterberg piston soil sampler.

Slide No. 10 - Piston mechanism of Osterberg soil sampler.

Slide No. 11 - Piston mechanism of Osterberg soil sampler.

Slide No. 12 - Piston mechanism of Osterberg soil sampler.

Slide No. 13 - Recovery of undisturbed soil sample using Osterberg piston soil sampler.

Slide No. 14 - Preparing bottom of sample after removal from boring hole.

Slide No. 15 - Installing expandable "O" ring on bottom of soil sampler. Note small holes in bottom for drainage.

Slide No. 16 - Using pipe cutter to relieve vacuum in soil sampler.

Slide No. 17 - Drilling hole in thin wall tube to relieve vacuum on sampler.

Slide No. 18 - Preparing top surface of undisturbed soil sample.

Slide No. 19 - Preparing top surface of undisturbed soil sample.

Slide No. 20 - Preparing top surface of undisturbed soil sample.

Slide No. 21 - Installed expandable "O" ring on top of undisturbed soil sample.

Slide No. 22 - Expandable "O" ring used on top and bottom of soil sample. Note holes for drainage of soil sample prior to freezing.

Slide No. 23 - Recovery of soil sample.

Slide No. 24 - Recovery of soil sample.

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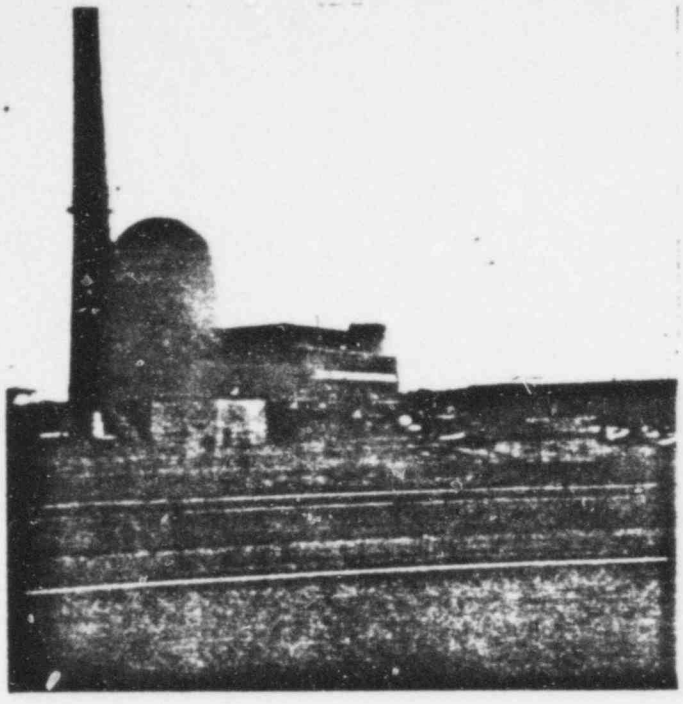

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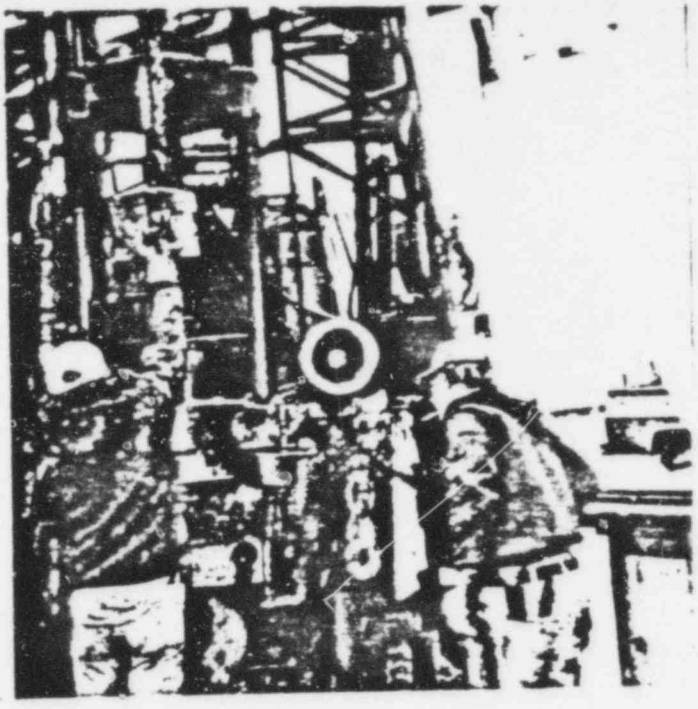

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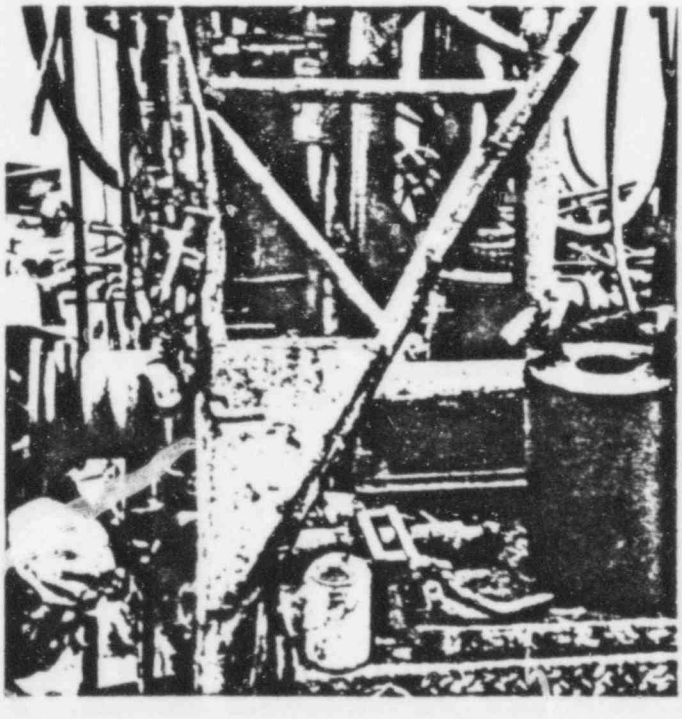

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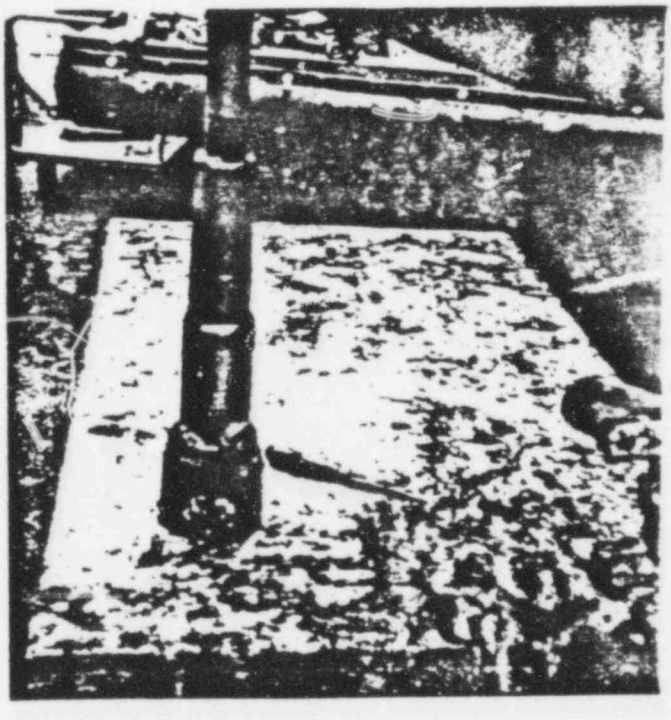

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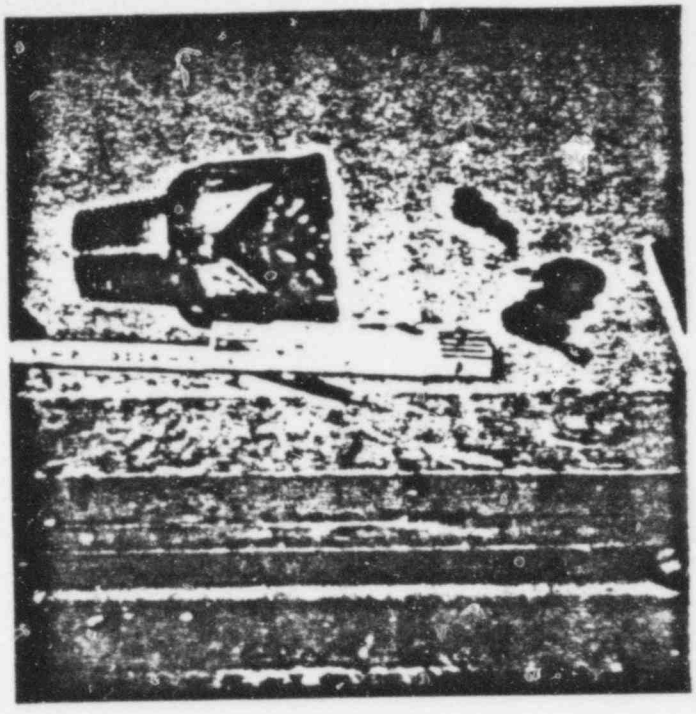

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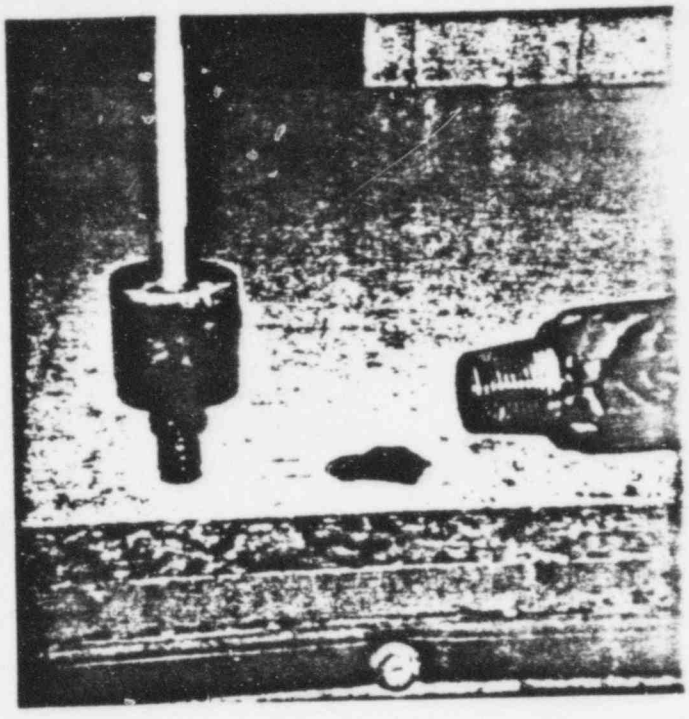

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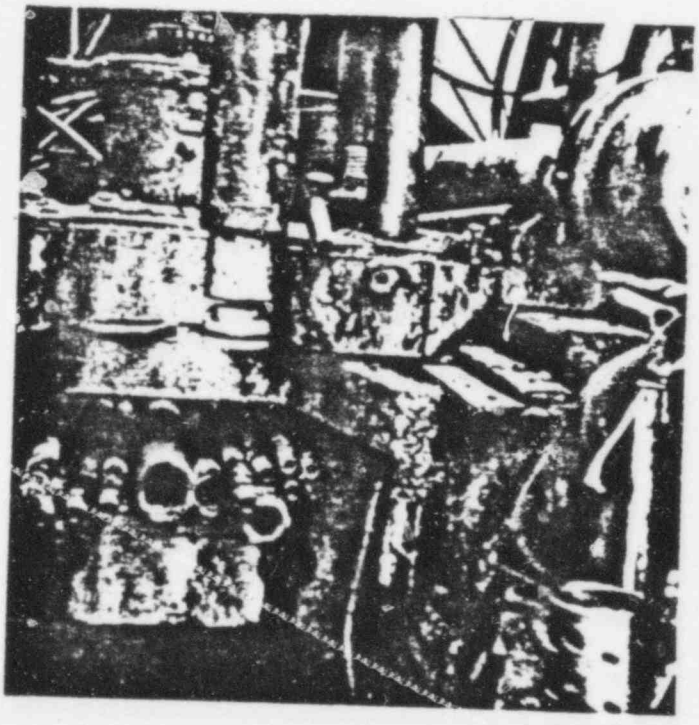

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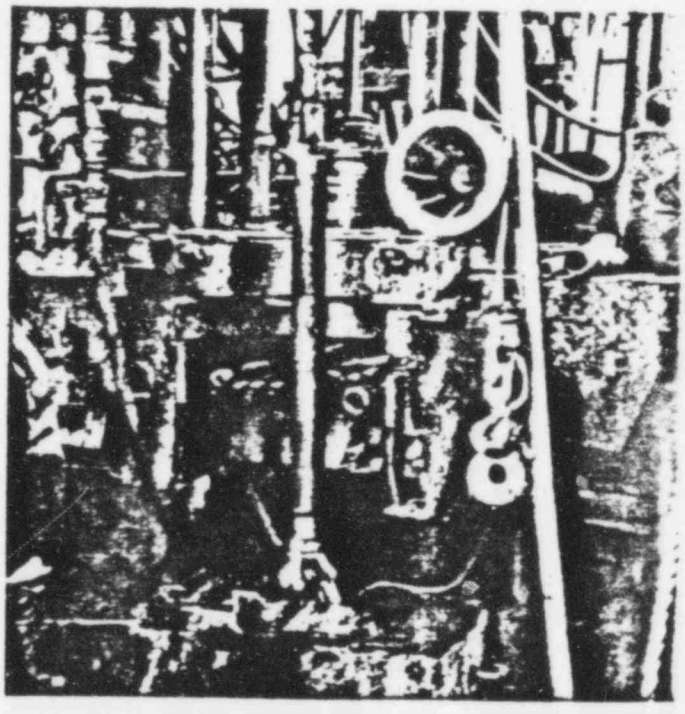

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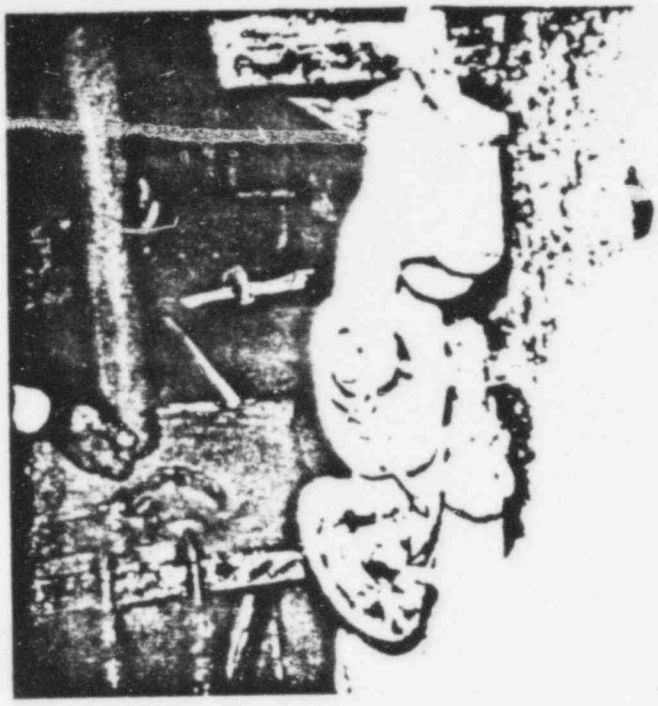

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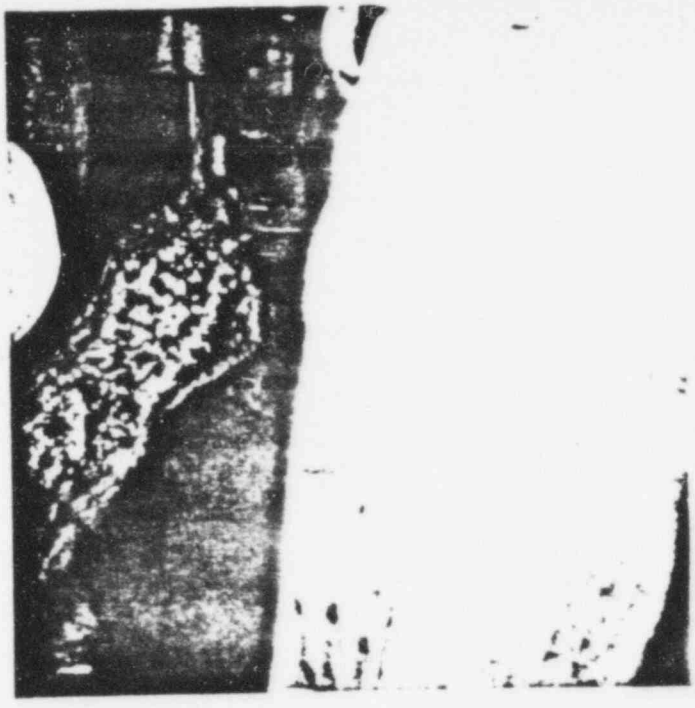

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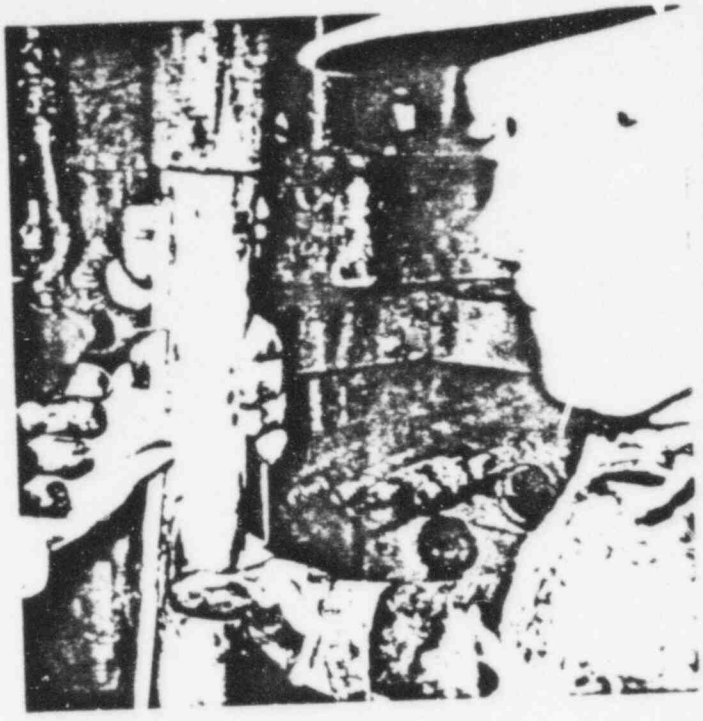

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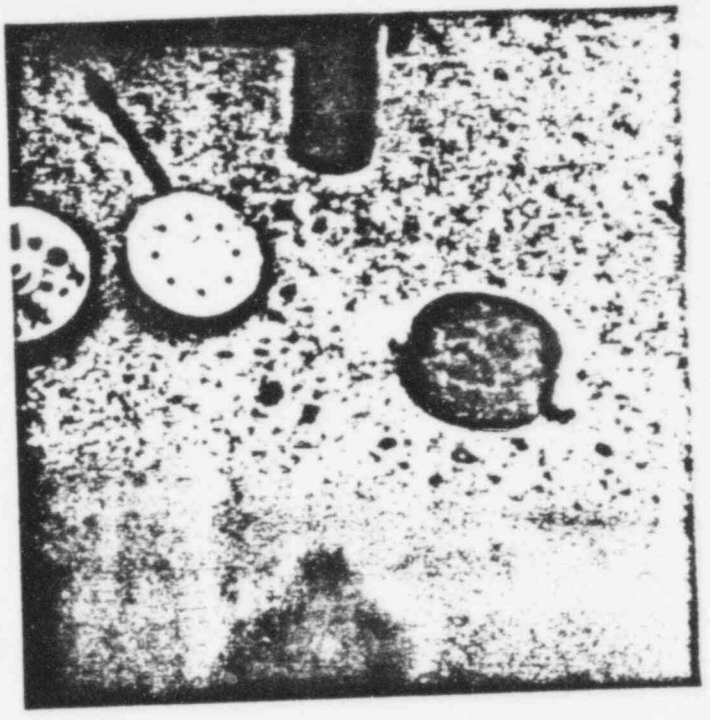

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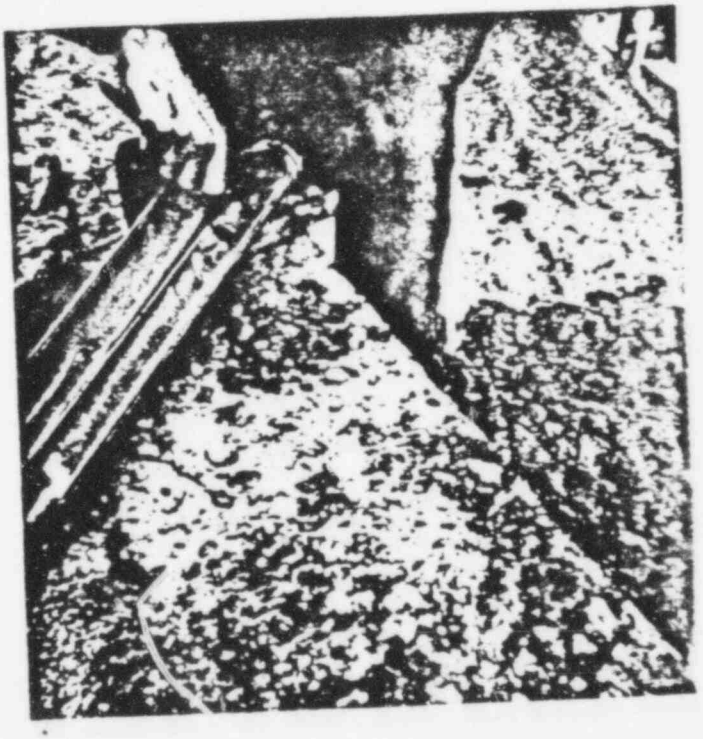

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DAMES & MOORE QUALITY ASSURANCE PROCEDURE

NO. 5.3

EXHIBIT C
COVER SHEET FOR
PROJECT PLAN AND MEMORANDUM

LIQUEFACTION STUDIES LACBWR PLANT
(PROJECT TITLE) (DISCIPLINE)

OWNER DAIRYLAND POWER COOPERATIVE

JOB NO. 11166-003 Q.A. JOB NO. 11166-002

SITE NEAR GENOA, LA CROSSE WI

PREPARED BY (PI or Originator) [signature] (Signature) DATE May 15/79

APPROVED (PIC or PM) [signature] (Signature) DATE May 17/79

APPROVED (Tech. Reviewer) [signature] (Signature) DATE May 18/79

APPROVED (RQAC) [signature] (Signature) DATE May 18/79

DAMES & MOORE

7101 WISCONSIN AVE, WASHINGTON D.C 20014
OFFICE ADDRESS

1.0 INTRODUCTION

1.1 General

In 1973, Dames & Moore (D&M) performed a Geotechnical Investigation of Geology, Seismology, and Liquefaction Potential at the La Crosse Boiling Water Reactor (LACBWR) site. The contents of the 1973 Dames & Moore report were submitted to the U.S. Nuclear Regulatory Commission (NRC) in 1974, as a part of the application for an operating license for the LACBWR plant. In its 1973 study, Dames & Moore concluded that the LACBWR plant had adequate factors of safety against potential for liquefaction under the design Safe Shutdown Earthquake (SSE).

In 1978, NRC initiated a review process under its Systematic Evaluation Program (SEP). As a part of SEP, the U.S. Army Engineer Waterways Experiment Station (WES) was requested by NRC to review the 1973 Dames & Moore soils investigation. WES, after reviewing the data and analysis presented by Dames & Moore, performed its own analyses based on rather conservative interpretations of the same data. The WES report, submitted to NRC, and made public in 1978, concluded that the factors of safety against liquefaction were considerably lower than those calculated by Dames & Moore in 1973.

Upon request by Dairyland Power Cooperative (DPC), Dames & Moore re-evaluated its 1973 analyses and reviewed the 1978 WES analyses. Based on this effort, Dames & Moore presented to NRC a position which was essentially consistent with its 1973 study.

However, there are certain questions that have been raised by NRC regarding the lack of test data on undisturbed samples and lack of continuous standard penetration test results. Since the existing data do not satisfy these new concerns, Dairyland Power Cooperative has decided to perform modest field and laboratory investigations and limited analyses to verify the earlier findings on liquefaction potential.

2.0 THE PROGRAM

The new program planned for the LACBWR site consists of: (a) a test boring program consisting of a minimum of 4 borings, (b) a limited laboratory program, and (c) a limited amount of analyses.

2.1 Test Boring Program

Twelve test borings were drilled during previous investigations before 1973. Six additional test borings were drilled in 1973 under Dames & Moore supervision. The purpose of drilling the proposed four additional borings is to verify the findings from the 1973 investigation. The approximate locations of the four proposed borings, DM-7, DM-8, DM-9, and DM-10, are shown on Figure 1 along with the borings drilled previously. It is proposed that these holes be drilled to a minimum depth of 100 feet. The exact final location of borings will be determined at the site after the DPC representatives approve of the recommended locations. (DPC will check to make sure that no underground pipelines, cables, etc., will be encountered at the boring locations).

Borings DM-7 and DM-8 will be drilled as close as possible to DM-1, and DM-9 and DM-10 will be drilled close to DM-3. DM-7 and DM-9 will be used for continuous sampling while DM-8 and DM-10 will be drilled for performing continuous standard penetration tests (ASTM-D1586-70). The purposes of the above arrangement are that:

(a) DM-8 and DM-10 will provide continuous blow count values using standard split spoon. (The previous use of other samplers, such as Osterberg and Dames & Moore Type U, had precluded the collection of "N" values continuously at all depths drilled).

(b) DM-7 and DM-9 will provide the best possible ("relatively undisturbed") samples for in situ density determinations and cyclic triaxial tests.

(c) There will be a basis for estimating in situ densities and relative densities by correlation with blow counts and for comparing the new data and the data already collected. (The proximity of the new test boring locations to the previously drilled test borings should facilitate such a comparison).

General outlines of procedures developed recently (Ref-1) will be followed for "undisturbed" sampling of sand under the water table. Three-inch diameter thin wall tube samplers will be used if the tube can be pushed into the soil (ASTM-D-1587-67). If the above procedure fails, other samplers such as Pitcher and Osterberg piston samplers will be used to obtain samples. Drilling mud will be used while drilling to keep the hole from caving in and also to help retain the sample in the sampling tube. The drilling operation will be performed by a qualified drilling contractor under the supervision of a Dames & Moore field engineer. It is proposed that some moisture and density tests be performed at the site on a few samples immediately after extracting them, to minimize the possible effects of sample disturbance during transportation.

The "undisturbed" samples obtained from the test borings DM-7 and DM-9 will be transported carefully (in specially prepared boxes packed with cushions) to the laboratory for testing. The split spoon samples from borings DM-8 and DM-10 will be used for visual classification and logging in the field and further laboratory classifications.

2.1.1 Sampling Procedure

1. Sampling shall be performed in a mud filled hole with a diameter only slightly larger than the diameter of the sampler to be used.

2. A fish tailed bit modified with baffles that directs the drilling fluid upward away from the bottom of the bore hole shall be used to advance the hole.

3. Casing in the top of the boring and a mud level above the ground water table shall be used to prevent caving of the hole.

4. While the sampler is being withdrawn from the bore hole, fresh drilling mud shall be introduced into the bore hole to prevent caving.

5. When the sampling tube just clears the bore hole, a small amount of soil shall be removed from the core tube and an expandable O-ring packer shall be introduced into the tube and locked to prevent the loss of sand. The packer shall have holes to facilitate drainage.

6. A small drill shall be used to make a small hole in the top of the tube to break any vacuum developed in top of the specimen.

7. The dimensions and weight of the sample shall be obtained.

8. Samples shall be drained for 24 hours in a vertical position.

9. Samples shall be quickly frozen in dry ice or in liquid nitrogen.

10. Samples shall be stored in a freezer or commercial freezing plant if they are not to be immediately transported to the testing laboratory.

11. Samples shall be transported in the frozen state using either dry ice or other refrigeration technique

2.2 Laboratory Program

A minimum of six stress-controlled cyclic triaxial tests on "undisturbed" samples and/or on reconstituted samples shall be performed. Samples shall be selected from critical depths and shall be consolidated under pressures corresponding to the in situ effective confining pressure. The stress ratios at failure will be selected to obtain a good definition of stress ratios versus number of cycles required to cause liquefaction.

Several moisture and density tests, several grain size distribution tests, and a few specific gravity tests are also proposed. If the in situ densities measured under the proposed program show significant differences when compared to those measured under the previous investigation, a limited number of strain controlled cyclic triaxial tests will also be performed on "undisturbed" and/or remolded samples to define the variation of shear moduli and damping ratios with strain levels.

Standard procedures recommended by ASTM will be followed for all static tests mentioned above. The Dames & Moore Manual of Technical Practices procedures will be followed for any nonstandard tests.

2.3 Analyses

The following analyses shall be performed to estimate the factors of safety against liquefaction for the LACBWR site.

(a) Seed & Idriss simplified analysis (Ref. 2)

(b) empirical analysis using data on past performance of various sites under different earthquakes (Ref. 3)

(c) modified Japanese analysis (Ref. 4)

(d) one-dimensional wave propagation analysis using the computer program SHAKE (Ref. 5)

After analyzing the results of the above analyses, a final conclusion regarding the factor of safety against liquefaction will be made.

All the phases of the above program will be performed under the Dames & Moore quality assurance program.

3.0 FILING SYSTEM

1.0 GENERAL ADMINISTRATION

- 1.1 Proposal
- 1.2 Contract
- 1.3 Staffing
- 1.4 Project Plan
- 1.5 Procedures
  - 1.5.1 Field Procedures (Sampling)
  - 1.5.2 Field Laboratory Procedures
  - 1.5.3 Laboratory Testing Procedures
  - 1.5.4 Analytical Procedures
- 1.6 Meetings
- 1.7 Memoranda
- 1.8 Telephone Conversations
- 1.9 Correspondence
  - 1.9.1 Incoming Letters
  - 1.9.2 Outgoing Letters

2.0 FINANCIAL INFORMATION

- 2.1 Job Set-up
- 2.2 JRS
- 2.3 Purchase Orders (Vendors)
- 2.4 Consultants
- 2.5 Billing Records

3.0 FIELD DATA

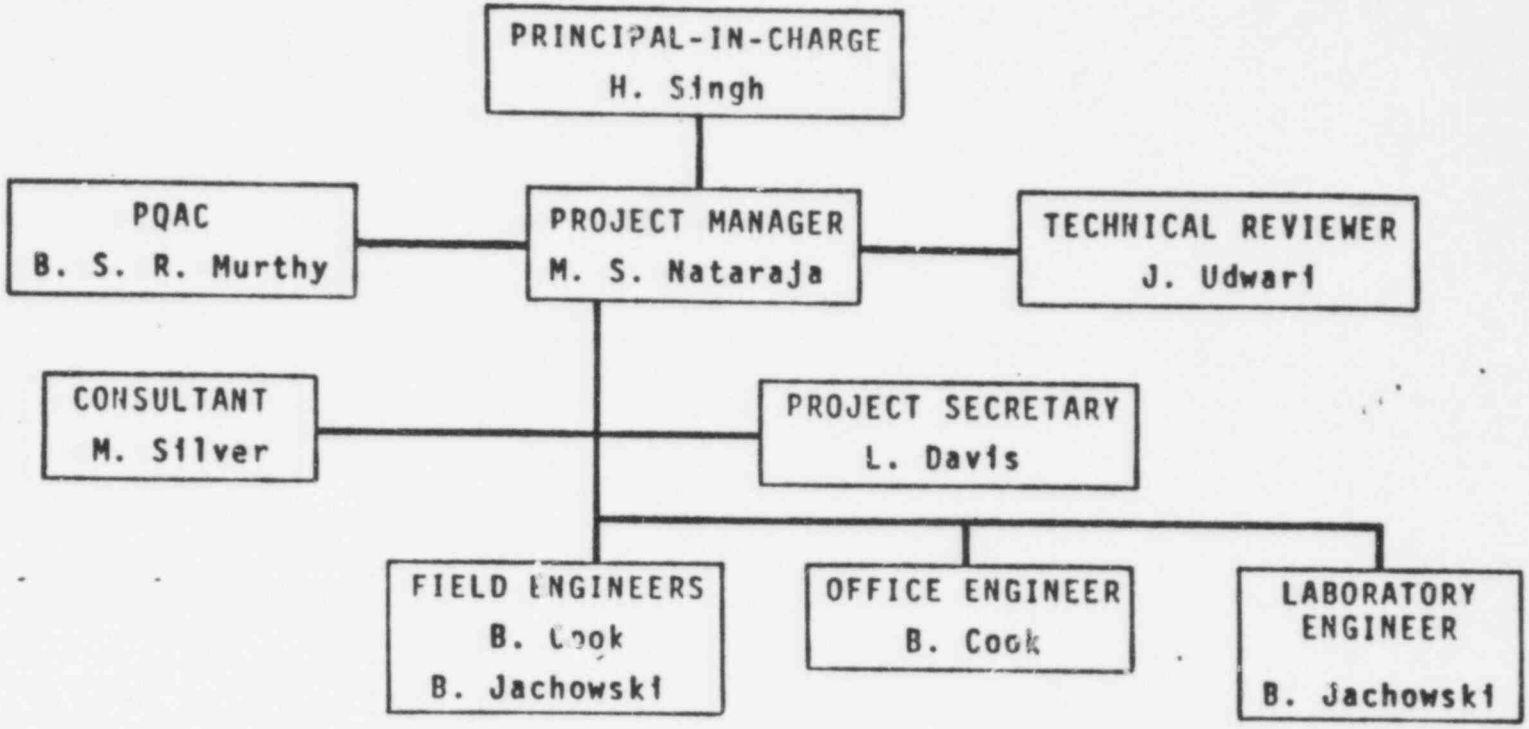
- 3.1 Original Boring Logs
- 3.2 Daily Reports
- 3.3 Edited Logs
- 3.4 Field Test Data
- 3.5 Miscellaneous

4.0 LABORATORY DATA

- 4.1 Laboratory Test Programs
- 4.2 Laboratory Test Results
- 4.3 Miscellaneous

5.0 ANALYSES

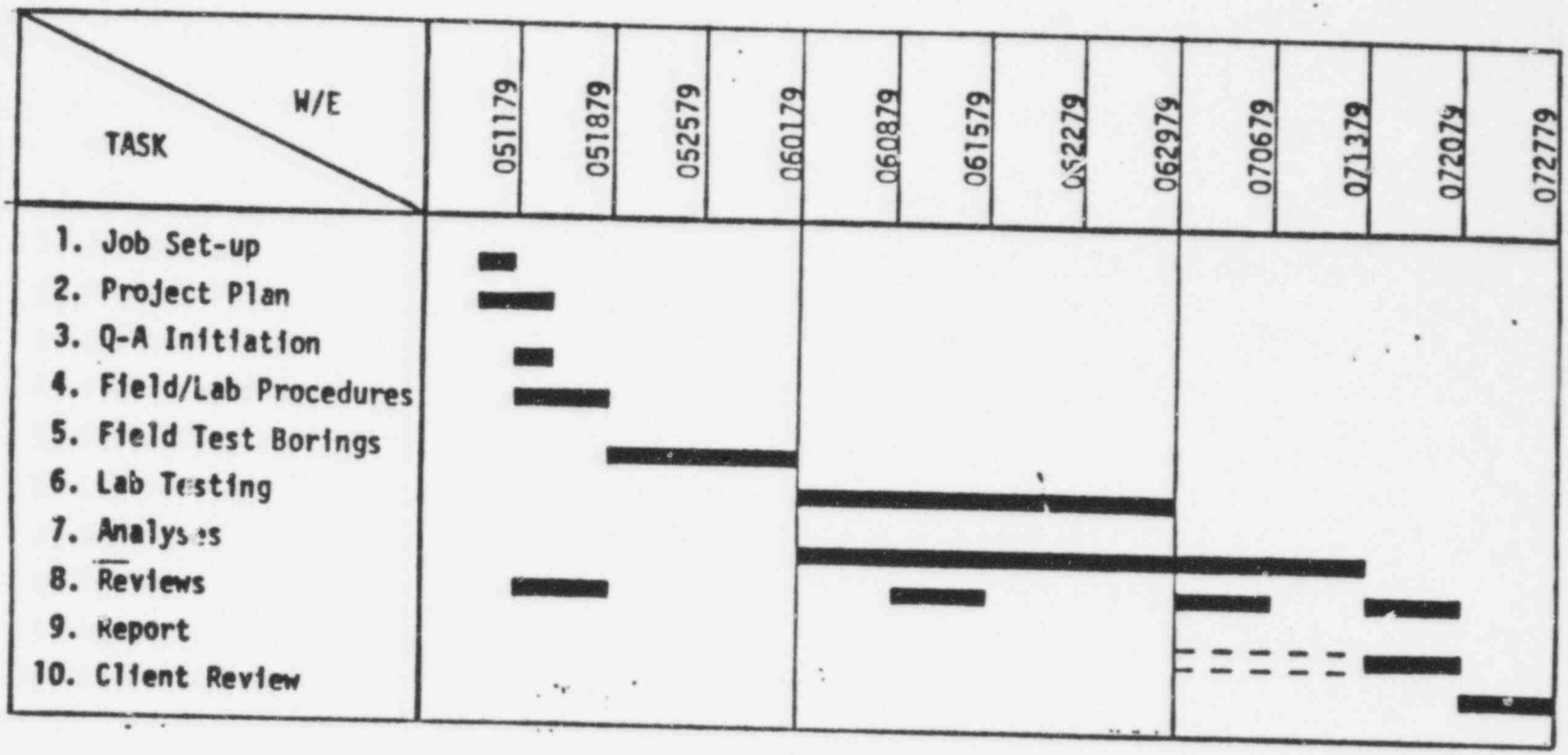
- 5.1 Calculations
- 5.2 Drawings
- 5.3 Drafts
- 5.4 Reviews
- 5.5 Computer Outputs/Logs



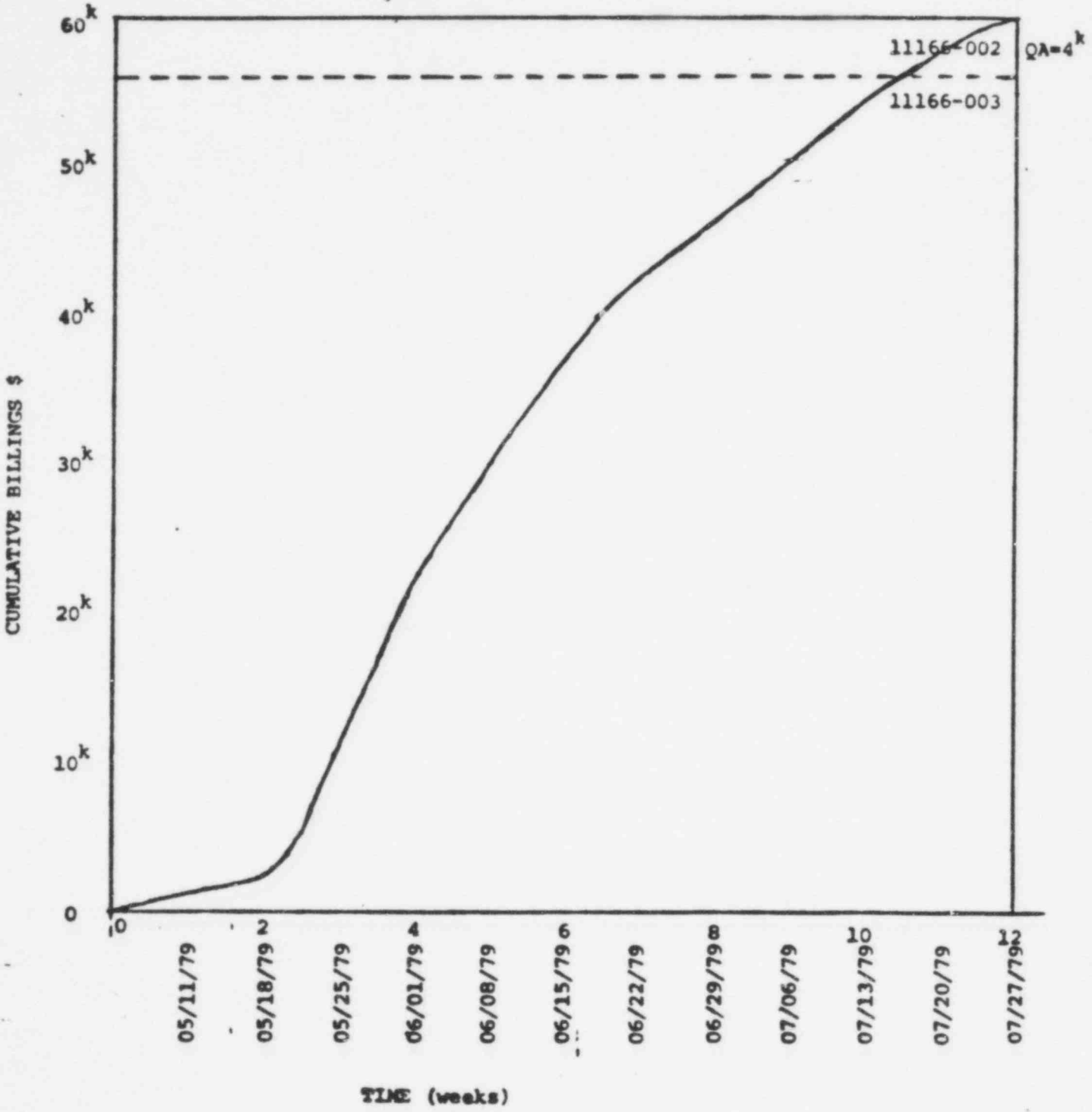
4.0

ORGANIZATION CHART
LACBWR LIQUEFACTION STUDIES

5.0 SCHEDULE



6.1 CUMULATIVE COST CURVE



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6.0 MANHOUR AND COST ESTIMATES

I. Field Operation

Item	Manhours	Amount
Drilling Contractor	-	$ 8,000
Field Supervision and Engineering	240	8,000
Travel, Subsistance, Rentals, Sample Shipment, and Miscellaneous	-	3,000
II. Laboratory Testing	-	6,000
III. Analyses (includes computer charges)	480	19,000
IV. Project Management	100	3,900
V. Meetings, Partner Participation, etc.	40	3,000
* VI. Quality Assurance Program	80	4,000
VII. Support Services (Technical Illustration, Secretarial, clerical, accounting, and computer job cost control)	200	5,000
TOTAL	1140	$59,900

*QA program will be treated as a separate job and will bear the job number 11166-002-27 on all our statements. The rest of the program will be under job number 11166-003-27.

7.0 MILESTONES

Following milestones are established for the LACBWR project:

1. Field Test Boring Program
2. Laboratory Program
3. Analytical Studies
4. Reports-Reviews-Presentations

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8.0 QUALIFICATIONS

Project Manager: The professional assigned as project manager shall be experienced in management of nuclear projects. The PM should have at least a Master's Degree in the area of his specialization and at least 5 years of total experience.

Field Engineer: The professional assigned to Field Engineering shall be experienced in various aspects of drilling, sampling, logging, classification, etc. The field engineer shall have a Bachelor's Degree in civil engineering and at least 2 years of experience.

Office Engineer: The office engineer shall have a Master's Degree in Soil Mechanics and 2 years of experience.

Laboratory Engineer: The laboratory engineer shall have a thorough knowledge of all aspects of Testing and at least 2 years of testing experience.

The personnel chosen for LACBWR project are shown on the organization chart (Section 4.0). The resumes of the key personnel are attached.

10.0 REFERENCES

1. Marcuson, W. F., and Franklin, A. G., "State-of-the-Art of Undisturbed Sampling of Cohesion by Soils," to be presented at the International Symposium on Soil Sampling, Singapore, July 1979.

2. Seed, H. B., and Idriss, I. M., "Simplified Procedure for Evaluating Soil Liquefaction Potential," Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 97, No. SM9, Proceedings Paper 8371, September 1971, pp. 1249-1273.

3. Seed, H. B., "Evaluation of Liquefaction Effects on Level Ground During Earthquakes," Preprint 2752, Liquefaction Problems in Geotechnical Engineering, ASCE National Convention and Exposition, Philadelphia, Penn. 27 September - 1 October 1976, pp. 1-104.

4. Ohashi, M., Iwasaki, T., Tatsuoka, F., and Tokida, K., "A Practical Procedure for Assessing Earthquake-Induced Liquefaction of Sandy Deposits," Publics Works Research Institute Ministry of Construction, Tenth Joint Meeting U.S. - Japan Panel on Wind and Seismic Effects. UJNR, Washington, DC, 1978.

5. Schnabel, B., Lysnur, J., and Seed, H. B., "SHAKE, A Computer Program for Earthquake Response Analysis of Horizontal Layered Sites," Report No. EERC 72-12, Earthquake Center, College of Engineering, University of California, Berkeley, Calif. 1972.

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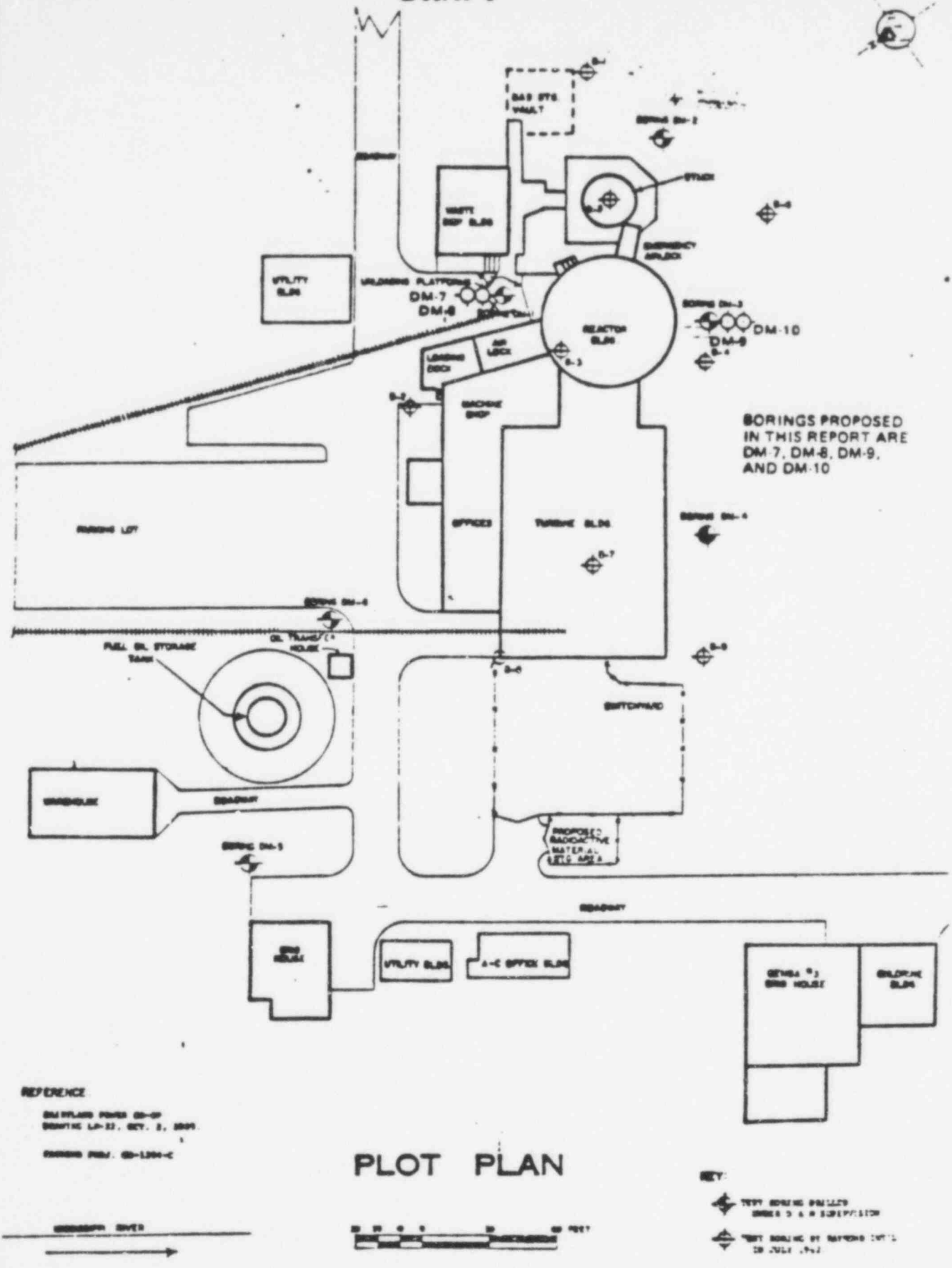

FIGURE-1

DAMES & MOOR

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SPECIFICATIONS FOR TEST BORINGS

I. GENERAL PROVISIONS

1.0 Introduction

Raymond International, Chicago, hereafter referred to as the Contractor, shall furnish all labor, materials, tools, equipment, support facilities, and supplies necessary for drilling test borings and for taking soil samples at the LaCrosse Boiling Water Reactor, Nuclear Plant, Genoa, Wisconsin. The primary purpose of this program is to investigate the subsurface soil and groundwater conditions and verify earlier investigations done at the site. This investigation will primarily involve the securing of disturbed and "undisturbed" soil samples.

At the present time, a total of 4 borings is planned. All borings will terminate above the soil/bedrock interface, at a depth determined by the Dames & Moore field engineer. A maximum total depth of hole of 120 ft should be anticipated. All work will be accomplished under the technical supervision of Dames & Moore, hereinafter referred to as the Engineer. The Engineer reserves the right to change the number and/or depth of the test borings as required by project consideration.

2.0 Scope of Work

The scope of work covered by these specifications is as follows:

1) Mobilization and Demobilization - A single payment for the mobilization and demobilization will be made. This will include transport to the site of all materials, tools, and other equipment and personnel necessary to perform the test borings and associated work, and removal of the same from the site at the completion of the work.

2) Test Borings - Furnish all materials (including drilling water), equipment, and services to drill test borings and to take samples of soil as directed by the Engineer. The borings will be drilled utilizing a truck-mounted drill rig equipped with rotary wash capability for soil sampling. The drill rig shall be capable of drilling borings to the estimated maximum depth of 120 ft below the existing ground surface.

Soil sampling will be performed utilizing the following types of samplers:

a) Standard split spoon

b) Osterberg Sampler

c) Pitcher Sampler

d) Dennison Sampler

e) Large size split spoon sampler

3) Cleanup - Cleanup on a day-to-day basis of work areas as work progresses including removal from the site and adjoining premises, all waste materials and rubbish. When the work is finished, remove from the site all tools, machinery, rubbish and all waste materials for which, in the opinion of the Engineer, the Contractor or his subcontractors are responsible; and leave the work area free and clear from all obstructions and hindrances. In addition, each site shall be repaired to the original condition as best possible and/or as directed by the Engineer.

3.0 Work Not Included

The survey work required to locate borings and to measure surface elevations is not included in these specifications and will be performed by others prior to, or in conjunction with, this Contractor's operation.

4.0 Estimated Quantities

All of the quantities which are either stated or implied in these specifications are not firm or guaranteed. The Engineer shall verify the actual quantities of work performed as the work progresses. Variations in actual and estimated quantities shall not be the basis for extra payment, unit price adjustment, or any other revisions to these specifications. The final contract payment shall be determined by actual quantities.

5.0 Schedule

The Contractor shall be fully prepared to begin drilling operations at the site on May 21, 1979. The Contractor shall be responsible for providing adequate equipment and personnel to complete the required work at a rate compatible with good work practices. In addition, the contractor shall provide the necessary equipment and personnel to complete the estimated quantity of work by no later than June 1, 1979, barring circumstances beyond the control

of the Contractor. If equipment and personnel in excess of any minimum requirements stated in these specifications are required to complete the work, it shall be the Contractor's responsibility to provide the required additional equipment and personnel at the agreed upon unit prices for this equipment.

1.0 Mobilization and Demobilization

Mobilization and demobilization shall consist of initial transporting to each site all personnel, materials, tools, and supplies required for completion of the drilling and testing program, including but not limited to the following specified items.

1.1 Drill Rigs

The Contractor shall mobilize and utilize one drill rig of a design and condition acceptable to the Engineer, completely equipped, manned and maintained, from the start of the work until completion of all boring work.

1.2 Sampling Equipment

The Contractor shall have all the types of soil samplers mentioned in Section 7, continuously available at the site.

1.3 Water Handling Equipment

It will be the responsibility of the Contractor to maintain an adequate supply of water at the site to support the drilling operations; lost time as a result of a lack of drilling water, through no negligence of the Engineer, shall be the responsibility of the Contractor and shall not be considered a quantity for payment.

2.0 Test Borings

2.1 Location of Borings

Locations of the borings will be indicated in the field by the Engineer; the location will be indicated by a ground stake. Directions with regard to an acceptable location of the bore hole with respect to the stake will be provided by the Engineer at the time of set-up on each boring location.

2.2 Access to Boring Locations

The Contractor will be working on the premises of an existing plant. Therefore, he is required to follow all the restrictions and regulations of the plant and shall follow the routes as instructed by the plant superintendent or his designee.

2.3 Setup

All borings shall be drilled in the vertical direction. It shall be the Contractor's responsbility to level the drill rig such that the hole is plumb with the vertical. Leveling of the drill rig shall be completed to the satisfaction of the Engineer prior to the start of drilling.

2.4 Drilling

Rotary wash drilling techniques shall be used to advance the drill holes through soil unless other methods are approved by the Engineer. It is the intent that water from polluted sources be excluded from use as drilling fluid. If, in the opinion of the Engineer, casing is essential for the recovery of undisturbed samples, he is authorized to request that flush joint casing be used. Heavy drilling mud shall be used for maintaining an open borehole unless casing is used. Additives to the drilling mud may be necessary to avoid flocculation. The level of drilling mud in the boring shall be maintained at near the ground surface level at all times to minimize soil disturbance at the bottom of the boring. Prior to all sampling, the boring shall be thoroughly cleaned of all loosened soil and drill cuttings to the satisfaction of the Engineer. To minimize disturbance of loose granular soil and soft clays at the bottom of the boring, rapid withdrawal of drilling rods or surging of the drilling liquid shall not be permitted.

Rock coring shall be accomplished using Nx size double tube core barrels, if the Engineer decides to sample the bedrock.

All casing utilized shall be straight to the satisfaction of the Engineer, with threads in good condition to preclude binding of the sampling equipment in passing through the casing, or breaking off of sections of the casing in the ground. The casing used will be subject to the approval of the Engineer. The weight and drop of the hammer utilized to drive the casing shall be approved by the Engineer.

All equipment, materials, and procedures used for performing the borings shall be subject to the approval of the Engineer. No payments shall be made for any borings performed using equipment, materials or procedures which have been disapproved by the Engineer.

2.5 Sampling

Undisturbed samples shall be obtained in all borings at locations designated by the Engineer in the field. Most sampling will be at spacings of

five feet center-to-center will be required in some portions of some of the borings; these additional samples will be considered for payment per the purchase order.

Soil samples shall be obtained using the standard split spoon sampler, or any other previously mentioned sampler; the choice of sampler being made by the Engineer in the field. The Contractor shall maintain an adequate supply of thinwall tubes and split spoon sample jars at the site to preclude lost time or alteration of sampler type. After obtaining any sample, the hole shall not be advanced further unless directed to do so by the Engineer in the field.

The sampling device connected to the drill rods shall be lowered gently to the bottom of the hole without dropping. When the sampler tube is to be forced into the soil, the Engineer decides the minimum length of push.

The number of blows required to advance the sampler every six inches over a total advance of eighteen inches shall be recorded. The weight and height of drop of hammer shall be approved by the Engineer. When the standard penetration test is performed, the number of blows required to advance the sampler every six inches shall be recorded. The sampler is driven by a 140-pound hammer freely falling a distance of 30 inches onto a collar on the drill rods, in accordance with ASTM standard procedure D-1586. In the event that the soil is so dense as to preclude a total penetration of twelve inches, the Contractor may terminate the sampling upon attaining 100 blows for any six-inch increment.

After penetration, all samplers shall be allowed to "rest" (at the option of the Engineer) for a period of several minutes before withdrawal. The sampler, with the contained soil sample, shall then be carefully withdrawn from the boring. The extraction of the sampler shall be performed in a smooth continuous motion avoiding any sudden acceleration, shock or vibration. The sampler containing the sample shall be carefully detached and delivered to the Engineer. In the event that the sample is disturbed as a result of carelessness of the drilling crew, the Contractor shall clean the hole to the depth penetrated by the sampler and obtain another sample at no additional cost. The Engineer will be the sole judge of the acceptability of the samples. The handling of the samples after removal from the sampler will be the responsibility

of the Engineer. The Contractor shall coordinate the drilling work with the Engineer in the field to permit sufficient time for the Engineer to evaluate the subsurface conditions encountered and select the appropriate depth for subsequent samples or for terminating each boring.

If a sample is not recovered from a boring at a particular depth, or when, in the opinion of the Engineer, the sample recovered is disturbed or not representative of the subsurface materials at the same depth, the Contractor shall, if requested by the Engineer, thoroughly clean the boring to the bottom of the previous sample to the satisfaction of the Engineer and extract a representative sample at the required depth.

The sampling techniques shall be subject to the approval of the Engineer. Where loss of samples is judged by the Engineer to be the result of the techniques and/or equipment employed by the Contractor, the Contractor may be required to change his equipment and/or techniques in order to obtain "undisturbed", representative samples. In the event that the Contractor fails to improve upon his technique or his equipment, the Engineer is authorized to suspend the work until the requested modifications are employed to the satisfaction of the Engineer. No payments shall be made for work performed after the Engineer has requested that the work be suspended, and no payments for stand-by time will be made for the period in which the drilling activities would be suspended. The person authorized to request suspension of the work will be the Dames & Moore Project Manager.

Should the casing or apparatus be removed from a boring without the permission of the Engineer, or should a boring be started and for any reason not extended to a depth required by the Engineer, or should the Contractor fail to extract representative samples consistent with the specifications, thereby rendering the data of questionable validity and value because of lack of continuity, then the Contractor shall perform an additional boring at a location selected by the Engineer; no payment shall be made for the abandoned boring; however, payment for satisfactory samples obtained therein may be made at the discretion of the Engineer.

2.6 Backfilling Borings

Upon completion of all work in each boring, the Engineer will direct the Contractor either to backfill or to seal the holes by suitable grouting operation. Natural materials extracted from the borehole during drilling shall

be utilized for this purpose. The material shall be dropped into the borehole and rodded as appropriate to prevent bridging. The area surrounding the borehole shall subsequently be regraded, and the borehold indicating stake replaced. Prior to the removal of all equipment from the site, backfilled boreholes will be checked for settlement and regraded as necessary.

III. MEASUREMENT AND PAYMENT

1.0 Mobilization and Demobilization

A lump sum will be paid for mobilization and demobilization. The contract lump sum shall be full compensation for transporting to the site all personnel, materials, tools, equipment, and supplies necessary for performance of the specified work and removal of the same from the site at the completion of the work. No separate payment will be made for mobilization and demobilization of equipment used for extra work not specified in these specifications.

2.0 Access to Borings

It is anticipated that the sites will be accessible to truck-mounted drilling equipment. In the event that local conditions on the site make truck access impossible in the opinion of the Engineer, the additional cost for such equipment as a dozer, winch vehicle, etc., shall be considered an extra cost above the lump sum for mobilization and demobilization. The Contractor may bill this additional cost to the Engineer based on the agreed upon unit price.

Further, it is anticipated that the time required to move from one boring to another will be one-half hour or less. In the event that more than one-half hour is required, the additional time for moving shall be considered as excess moving time and payable at the agreed upon unit price.

3.0 Drilling and Sampling

The unit of measurement for borings will be the lineal foot. The quantity to be paid for will be the number of lineal feet drilled below the existing ground surface as measured along the borehole axis. Payment for all samples will be made on a unit price basis or an hourly basis as agreed for each sample type.

It shall be the Contractor's responsibility to supply jar containers for all split spoon (SPT) samples at no additional cost to the Engineer, provide all equipment and materials for sealing all tube samples, and core boxes for storing rock cores.

No separate payment will be made for supplying and pumping drilling fluid, for drilling tool or bit loss and wear, for casing left in the borings not at the direction of the Engineers, or for any reaming or redrilling necessary to reach the required depths.

4.0 Backfilling of Borings

All borings will be backfilled. No additional payment for backfilling shall be made above the charges for borehole drilling on a lineal foot basis.

5.0 Other Hourly Charges

5.1 Standby Time

Standby time shall be defined as that time during which the Contractor is prevented from working due to the actions of the Engineer. No standby time will be paid for inclement weather. Payment for standby time shall be according to the agreed upon hourly rate. The quantity paid will be the number of hours agreed to by the Engineer and the drill rig operator.

No payment will be made for standby time or other times when drilling rig units are out of production due to equipment failures or lack of materials or tools required to fulfill the requirements of this specification.

5.2 Moving Time

Moving time shall be defined as that time in excess of one-half hour necessary for the movement of drilling equipment from one drilling location to another. Payment for moving time shall be in accordance with the agreed upon hourly rate. The quantity paid will be the number of hours agreed to by the Engineer's representative and the Contractor's drill rig operator.

No payment will be made for time for packing or unpacking tools and/or materials.

5.3 Support Services

The cost of support services such as a dozer or winch vehicle will be paid by the Engineer at the agreed upon daily rate. Only those services approved by the Engineer in the field before their enlistment will be subject to payment by the Engineer.

No payment will be made for casing and accessories which are left in place by the Contractor at locations other than those specifically directed by the Engineer.

IV. RESPONSIBILITY AND INDEMNIFICATION

1.0 General

The Contractor shall be responsible for, and forthwith repair, replace, or make good, any and all loss or damage caused by its activities, and those of its services hereunder. The Contractor hereby assumes all responsibility for, and shall indemnify and hold harmless Dames & Moore and Dairyland Power Cooperative, all claims, suits, actions, damages, liability and costs of every kind, including the expense of investigation and defense thereof, arising out of or resulting from the performance of such services by the Contractor, its employees, agents or subcontractors, and such indemnity and agreement to hold harmless shall not be limited by reason of any enumeration herein of required insurance coverage. The obligations of the Contractor under this Section of the Specifications shall survive any expiration or termination of the agreement between the Engineer and the Contractor.

2.0 Insurance

Throughout the course of work, the Contractor shall, at no cost to Dames & Moore, maintain or cause to be maintained, insurance of the types and in the amounts acceptable to Dames & Moore. All such insurance shall be evidenced by insurance policies, each of which (other than Workmen's Compensation policies) shall:

1. name or be endorsed to cover Dames & Moore and the Contractor as insureds as their respective interests may appear; and

2. provide that such policy may not be cancelled or modified until at least 30 days after receipt by Dames & Moore of written notice thereof.

The types and amounts of insurance required to be maintained under this provision are as follows:

1. Workmen's Compensation Insurance of all employees of the Contractor and any subcontractors engaged in performing the services described herein, as required by the laws of the Commonwealth of Wisconsin;

2. Employer's liability or similar insurance for damages arising from bodily injury, by accident or disease, including death at any time resulting therefrom, sustained by employees of the Contractor, or any subcontractors while engaged in performing these services; and

3. Comprehensive general liability insurance for bodily injury liability, including death, and property damage liability, incurred in connection with the performance of these services.