



DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
P. O. BOX 631
VICKSBURG, MISSISSIPPI 39180

IN REPLY REFER TO: WESGH

19 OCT '79

SUBJECT: Review of Liquefaction Potential at La Crosse Nuclear Power
Plant, La Crosse, Wisconsin

Mr. J. P. Knight
Division of Site Safety and
Environmental Analysis
U. S. Nuclear Regulatory Commission
Washington, DC 20555

POOR ORIGINAL

Dear Mr. Knight:

As requested by Mr. John Greeves of your office, we have reviewed the report entitled "Liquefaction Potential at La Crosse Boiling Water Reactor (LACBWR) Site Near Genoa, Vernon County, Wisconsin," dated 10 August 1979, prepared by Dames & Moore for Dairyland Power Cooperative.

Dames & Moore used results of undrained cyclic triaxial tests and dynamic stresses computed using the computer code SHAKE to assess the liquefaction potential at the site. WES believes that the laboratory strength curves used in this analysis are unconservative. Our experience is that loose cohesionless material densifies when sampled, and this densification may be as great as 2 to 3 lb/cu ft. Table 2 of Dames & Moore's report indicates that the specimens further densified an additional 2 to 3 lb/cu ft from the frozen condition to the thawed and consolidated condition in the laboratory. This indicates a total increase in density that could be as great as 4 to 6 lb/cu ft from the in situ condition, and we estimate that the probable total increase in density is 3 to 4 lb/cu ft. This is a substantial change in density when one considers that the minimum density reported by Dames & Moore was approximately 97 lb/cu ft and the maximum density approximately 114 lb/cu ft. This increase in density has not been taken into account in the results presented by Dames & Moore. It is our opinion that correction for this increase in density will substantially reduce the factors of safety presented by Dames & Moore. Consequently, we cannot conclude that the site is safe against liquefaction using this approach.

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If the Standard Penetration Test (SPT) N values presented by Dames & Moore are corrected to an overburden pressure of 1 ton/sq ft and then compared to the empirical correlations between N values and liquefaction occurrence at Niigata, Japan, factors of safety less than 1 are obtained for foundation soils below the water table down to a depth of about 35 ft. Factors of safety are marginal from 35 ft down to a depth of about 40 ft.

In summary, based on the judgment concerning the density and strength data, on the analysis presented by Dames & Moore, and on comparisons of the SPT data presented by Dames & Moore with liquefaction and SPT correlations at Niigata, Japan, WES concludes that the foundation material below the water table down to a depth of approximately 40 ft is not safe against liquefaction if the safe shutdown earthquake with a peak acceleration of 0.12 g occurs.

If you have any questions regarding this review, please contact Dr. W. F. Marcuson, III, at FTS 542-2202.

Sincerely,



F. R. BROWN
Engineer
Technical Director

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DAMES & MOORE

CONSULTANTS IN THE ENVIRONMENTAL AND APPLIED EARTH SCIENCES

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September 26, 1979

LaCrosse Boiling Water Reactor
 Dairyland Power Cooperative
 Post Office Box 135
 Genoa, Wisconsin 54632

Attention: Mr. R.E. Shimsnak
 Plant Superintendent

Gentlemen:

We submit herewith six copies of our report, "Liquefaction Potential at La Crosse Boiling Water Reactor (LACBWR) Site, Near Genoa, Vernon County, Wisconsin" for your use. This report includes:

- a) Brief summaries of all previous liquefaction analyses performed at LACBWR Site and related background studies;
- b) Details of field, laboratory and analytical investigations that were performed to verify the earlier findings regarding liquefaction potential at LACBWR Site; and
- c) Our conclusions based on analyses and testing performed on undisturbed samples obtained by utilizing state-of-the-art techniques.

We have concluded in our study that a threshold liquefaction resistance level for the LACBWR site corresponds to an SSE producing an acceleration between 0.18 g and 0.20 g at the ground surface.

The scope of services for this report was prepared by us after discussions with Mr. Richard Shimsnak of Dairyland Power Cooperative. Three draft copies of this report were submitted to you on August 1, 1979.

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DAMES & MOORE

Dairyland Power Cooperative
September 26, 1979
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It has been a pleasure to work on this very interesting and challenging project. We look forward to a continued association with Dairyland Power Cooperative in any of their ventures involving geotechnical and environmental studies.

Very truly yours,

DAMES & MOORE

(for) *Harsharan Singh*
Harsharan Singh, Ph.D.
Partner

Mysore Nataraja
Mysore Nataraja, Ph.D., P.E.
Project Engineer

HS/MN:amc

Enclosures

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