

August 27, 1982

Docket No. 50-409  
LS05-82-08-067

Mr. Frank Linder  
General Manager  
Dairyland Power Cooperative  
2615 East Avenue South  
LaCrosse, Wisconsin 54601

Dear Mr. Linder:

SUBJECT: SEP SAFETY TOPIC II-4.D, SLOPE STABILITY  
LACROSSE BOILING WATER REACTOR

We have completed our review of the subject topic for LaCrosse Boiling Water Reactor. Enclosed is a copy of our evaluation report for this topic.

You are requested to examine the facts upon which the staff has based its evaluation and respond either by confirming that the facts are correct, or by identifying errors and supplying the corrected information. We encourage you to supply any other material that might affect the staff's evaluation of this topic or be significant in the Integrated Assessment of your facility.

Your response is requested within 30 days of receipt of this letter. If no response is received within that time, we will assume that you have no comments or corrections.

Sincerely,

Original signed by

Dennis M. Crutchfield, Chief  
Operating Reactors Branch No. 5  
Division of Licensing

5004

DSU USE(38)

G. Staley

Enclosure:  
As stated

cc w/enclosure:  
See next page

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Mr. Frank Linder

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Systematic Evaluation Program Topic Assessment  
Topic: II-4.D - Slope Stability  
Plant Name: LaCrosse Boiling Water Reactor Plant (LACBWR)  
Docket Number: 50-409  
TAC Number: 41280

Prepared by: Dr. Jerome R. Pearring, HGEB, DE

## I. INTRODUCTION

This topic pertains to the Geotechnical Engineering Review of the stability of all earth and rock slopes, both natural and man-made (cuts, fills, embankments, dams, etc.), whose failure, under any of the conditions to which they could be exposed during the life of the plant, could adversely affect the safety of the plant. The scope of the review embraces the following subjects which are evaluated using data developed by the applicant and information available from all sources: (1) slope characteristics; (2) design criteria and analyses; (3) results of field and laboratory tests; (4) excavation, backfill, and earthwork in slopes; (5) liquefaction potential affecting slopes; and (6) proposed instrumentation and performance monitoring.

## II. REVIEW CRITERIA

The current criteria for review of this topic are contained in NUREG-0800, Standard Review Plan Section 2.5.5, "Stability of Slopes."

### III. RELATED SAFETY TOPICS AND INTERFACES

Geotechnical engineering aspects of Settlement of Structure and Buried Equipment are reviewed under Topic II-4.F. Other interface topics include:

- II.3.B, "Flooding Potential and Protective Requirements";
- II.3.C, "Safety-Related Water Supply (Ultimate Heat Sink)";
- II-4.E, "Dam Integrity";
- III.A, "Effects of High Water Level on Structures";
- III.C, "In-Service Inspection of Water Control Structures";
- III-6, "Seismic Design Considerations";
- IX-3, "Station Service and Cooling Water Systems"; and
- XVI, "Technical Specifications".

### IV. REVIEW GUIDELINES

In general, the review process was conducted in accordance with the procedures described in Standard Review Plan (NUREG-0800) Section 2.5.5. The geotechnical engineering aspects of the design and as-constructed conditions of slopes were reviewed and compared to current criteria, and the safety significance of any differences was evaluated.

V. TOPIC EVALUATION

The LaCrosse Boiling Water Reactor (LACBWR) site is located approximately 19 mi south of the City of LaCrosse, Wisconsin and approximately 1 mi south of the Village of Genoa, Wisconsin on the east bank of the Mississippi River. The Mississippi River Valley which is bordered by nearly vertical bluffs of flat lying sedimentary sandstone strata is approximately 2.6 mi wide at this location.

The main plant facilities include a reactor containment building, turbine building, 350 ft high stack, gas vault structure, diesel generator building, waste disposal building, crib house and a circulating water system. All of the facilities except the crib house and the circulating water system are supported on piles. Figure 1 presents a site location plan for the LACBWR plant facilities.

The approximate average plant grade is +639 ft msl. The LACBWR plant facilities are situated on 14 ft to 20 ft of fill sand and gravel materials which were hydraulically placed over 100-130 ft of glacio-fluvial deposits overlying bedrock. Borings indicate that the bedrock surface is sloping with an elevation of approximately +509 ft mean sea level (msl) in the area beneath the reactor building to an elevation of approximately +501 ft msl near the river. Recorded measurements indicate the groundwater level to be at about elevation +626 ft msl (Ref. 1).

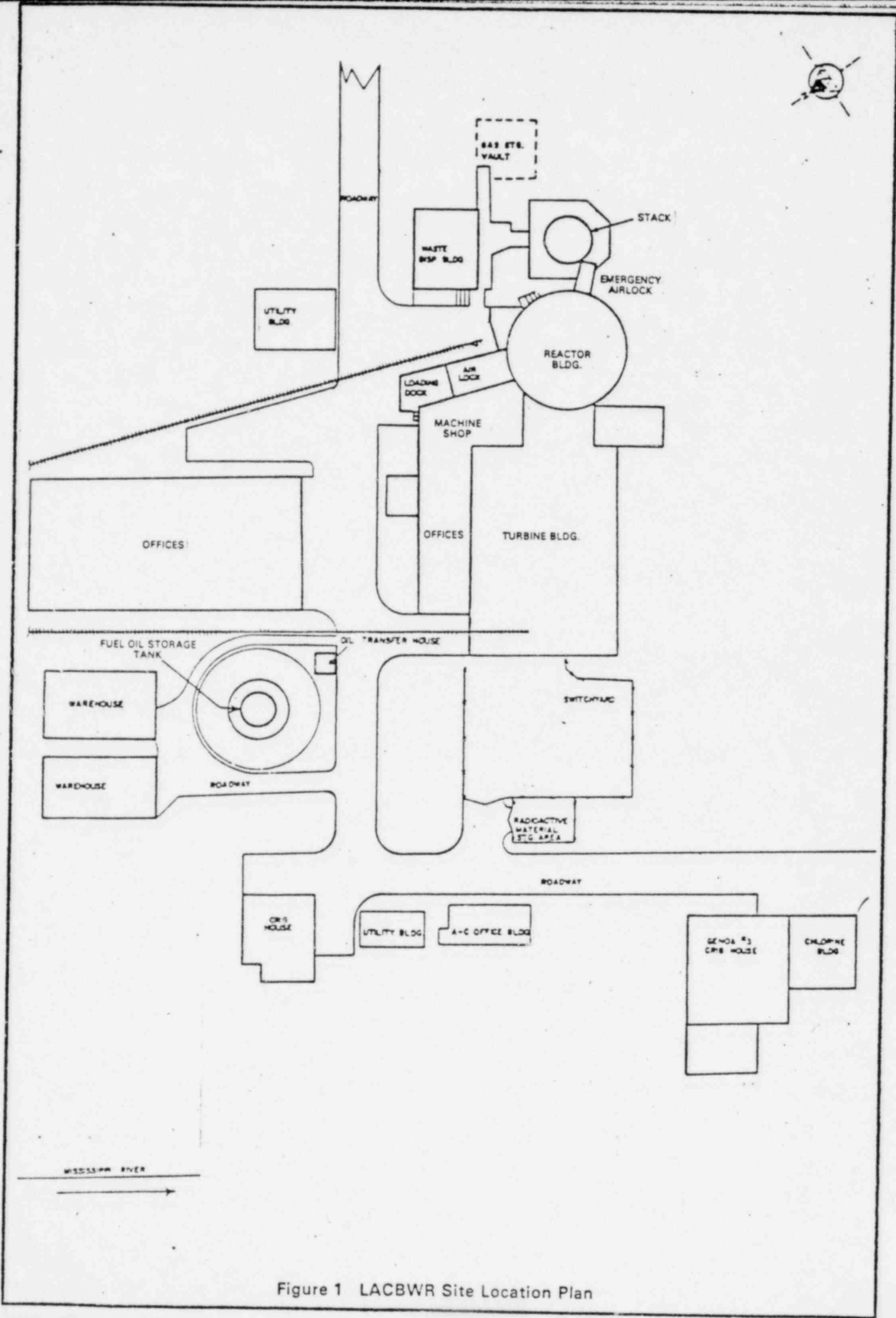


Figure 1 LACBWR Site Location Plan

### Properties of Subsurface Materials

The initial soil investigations at the LaCrosse site were conducted in 1962. Between 1962 and 1980 soil test borings were made at 36 locations in the site vicinity. Of this number, five were associated with subsurface investigations in the power station area, four were associated with the switchyard area, and one was drilled to locate an offsite borrow area for construction fill materials. The remaining 23 were associated with subsurface investigations in the main plant facility area (see Fig. 2). The licensee has presented boring logs depicting the soil conditions encountered in these investigations (Ref. 1, 2, 3, & 4). Field investigation effort included standard penetration tests (SPT) and split-barrel sampling in accordance with ASTM D-1586-67 procedures. Relatively undisturbed samples were also obtained at several locations in thin walled tubes using an Osterberg piston sampler. Laboratory testing of soil samples was accomplished to determine index properties and to establish soil strength parameters. Testing included specific gravity determinations in accordance with ASTM D-854-58, particle size analysis testing in accordance with ASTM D-422-63, relative density determinations in accordance with ASTM D-2049-69 and cyclic triaxial testing in accordance with the procedures of NUREG-0031 (Ref. 5).

### Plant Facilities

The reactor containment structure, turbine building, diesel generator building, stack, waste disposal building and the gas vault are supported on cast-in-place concrete piles consisting of closed end 8-in diameter

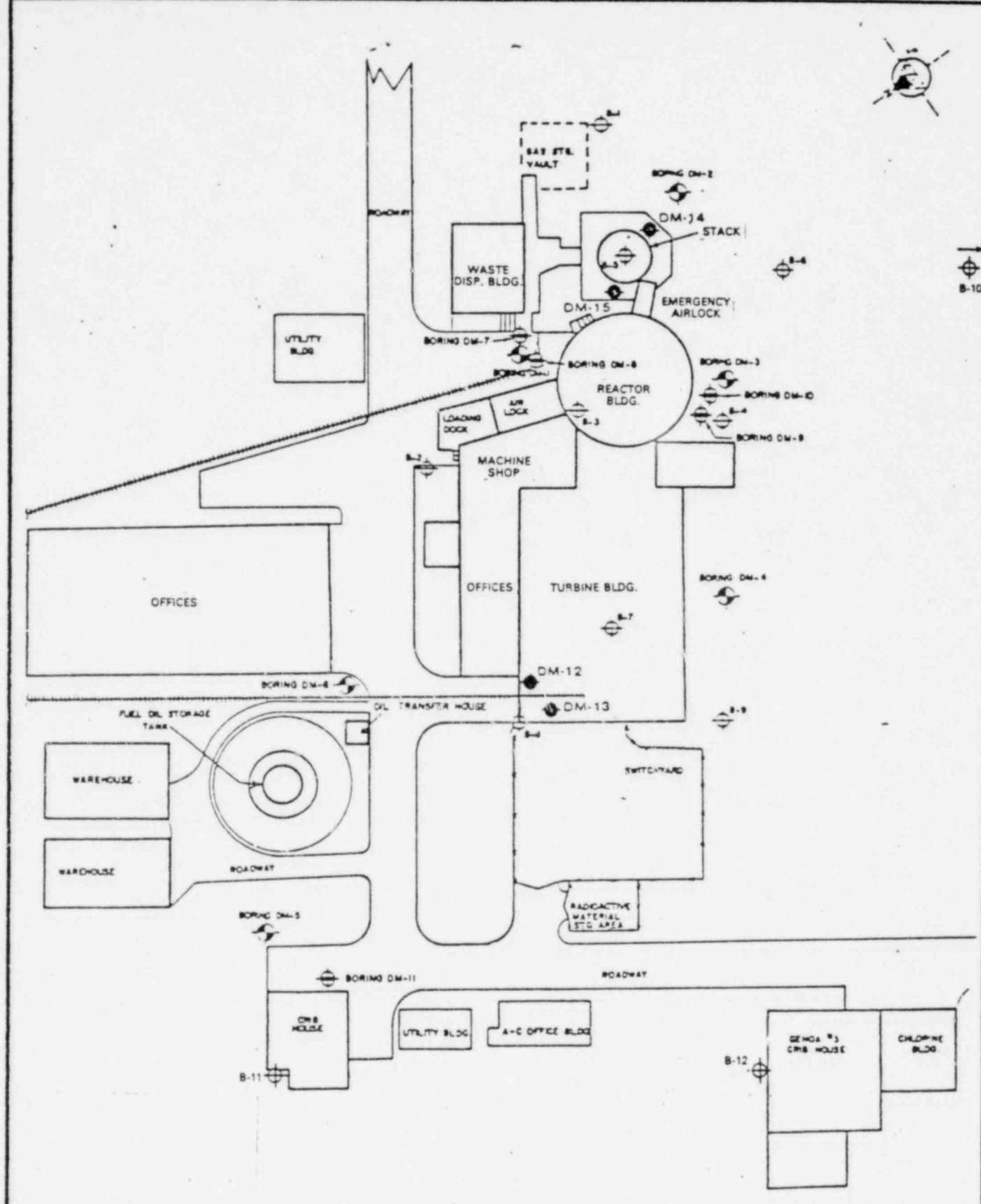


bottom steel shells driven to develop a 50-ton capacity and filled with concrete specified to have a minimum 28-day compressive strength of 3500 psi (Refs. 6, 7, 8).

The crib house and associated water intake and discharge piping are not designated as seismic Category I structures. In February 1981, an emergency service water system was installed which utilizes portable pumps and hoses. The availability and design adequacy of the emergency service water supply system for seismic events has been reviewed by the staff which resulted in the issuance of a license amendment governing availability and surveillance (Ref. 9). The safety evaluation of "Safety-Related Water Supply" is addressed in SEP Topic II.3.C.

There are no seismic Category I or safety-related electrical ducts, manholes, fuel lines or other structures or equipment supported on or buried in soil or rock at this plant other than the seismic Category I pile supported structures identified above (Ref. 10).





- KEY:**
- ◆ TEST BORING FOR D&M INVESTIGATION IN 1973
  - ⊕ TEST BORING BY RAYMOND INT'L IN JULY 1962
  - ⊕ TEST BORING FOR D&M INVESTIGATION IN 1979
  - ◆ TEST BORING FOR D&M INVESTIGATION IN 1980

Figure 2 Soil Test Borings

### Slope Stability

Review of available on and off site topographic data indicates there are no on-site slopes whose failure could cause radiological consequences adversely affecting the public health and safety (Reference 11). One offsite slope, the east bank of the Mississippi River adjacent to the plant cribhouse site was identified from topographic data and evaluated for safety in conjunction with this topic. A generalized typical section for this slope was developed from subsurface data and design features contained in References 2, 11 and 12 and is presented in Figure 3.

The staff has performed a stability analysis of this slope using conservative soil strength parameters developed from the results of the site subsurface investigation reported by the licensee in Reference 2 and using the procedures presented in References 13, 14 and 15. In the analysis an angle of internal friction  $\phi$  of  $27^\circ$  was assigned each soil layer and the slope stabilizing influence of the slope protection riprap material was conservatively ignored. Results of the analysis indicates the factor of safety against failure under static loading conditions is greater than 1.5. Based upon the criteria contained in Reference 16 the staff concludes that an adequate margin of safety exists under static loading conditions.

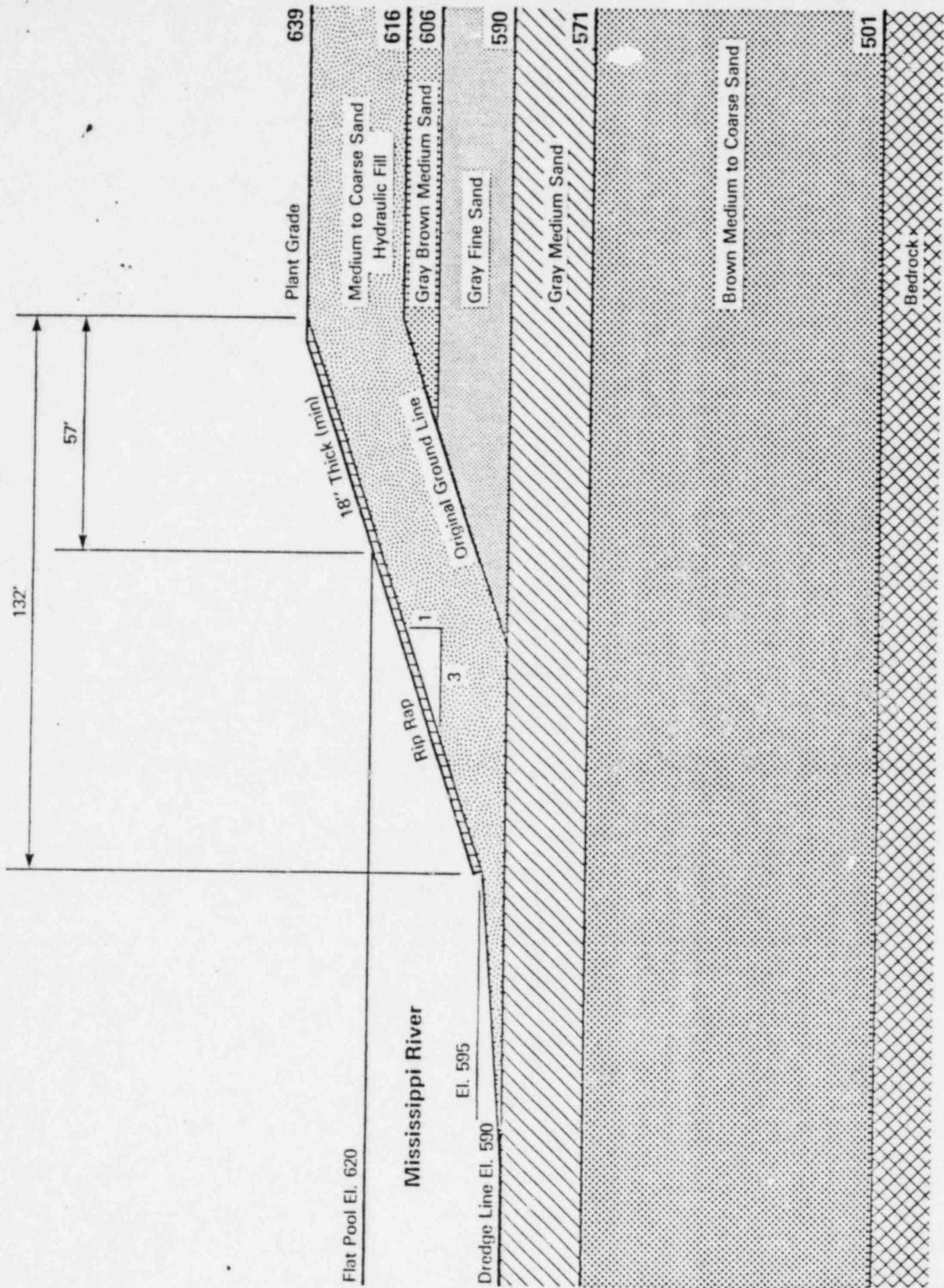


Figure 3 East Bank River Slope.

Due to the fact that the cribhouse and the associated water intake and discharge piping are the only plant structures in the vicinity which will potentially be affected by a postulated failure of the east river bank slope, and these structures are not designated as seismic Category I structures, a dynamic (pseudostatic) slope stability analysis is not appropriate and was not performed.

#### VI. CONCLUSIONS

Based on the review of available site data and on information obtained during a staff visit to the site we conclude that the stability of slopes associated with the LaCrosse Boiling Water Reactor site does not pose a safety concern for this plant.

VII. REFERENCES

1. Dairyland Power Cooperative - "Seismic Evaluation of the LaCrosse Boiling Water Reactor", January 11, 1974.
2. Dairyland Power Cooperative - "Soil Test Borings - Drawing No. L-475-28", June 22, 1962.
3. Dairyland Power Cooperative - "Liquefaction Potential at LaCrosse Boiling Water Reactor (LACBWR) Site Near Genoa, Vernon County, Wisconsin", September 28, 1979.
4. Dairyland Power Cooperative - "Final Assessment of Liquefaction Potential at LACBWR Site" July 25, 1980.
5. NUREG-0031, "Laboratory Triaxial Testing Procedures to Determine the Cyclic Strength of Soils: Final Report", Silver, M L. June 1977.
6. Sargent and Lundy Report SL-2003 "Containment Vessel Pile Driving Operations for 50 Mwe Boiling Water Reactor at Genoa, Wisconsin," February 25, 1963.
7. Allis-Chalmers Report - "Generator Plant of LACBWR, Report of Pile Driving Operations, 60 MW Steam Turbo-Generator, Genoa, Wisconsin," August 21, 1963.
8. Allis-Chalmers Specifications 41-551 Revision 1 October 1, 1963 - "Specifications for Excavation, Piles, Erection Foundation and Backfill LACBWR Project - Reactor Plant."
9. License Amendment 24 to Provisional Operating License DPR-45, NRC Letter, Crutchfield to Linder, February 25, 1981.
10. Telephonic Conference Call - NRC staff and Dairyland Power Cooperative Representative Mr. David Rybarik, June 10, 1982.
11. Dairyland Power Cooperative - "Topog. Map - Drawing No. L-475-1E", May 20, 1960. (Revised Nov. 24, 1972 to show shore line improvements).
12. Dairyland Power Cooperative - "Construction Site - Drawing No. L-475-2D" June 22, 1962.

13. Marcuson, W. F. III and Bieganousky W. A., "SPT and Relative Density in Coarse Sands," Journal of the Geotechnical Engineering Division ASCE Vol. 103 No. GT 11, Proceedings Paper 13350, November 1977, pp. 1295-1309.
14. Bowles J. E., - "Physical and Geotechnical Properties of Soils." 1979, Chapter 16.
15. Bowles, J. E. - "Foundation Analysis and Design," 1977, pg 85.
16. U.S. Army Corps of Engineers Manual - "Engineering and Design Stability of Earth and Rock Fill Dams" - EM 1110-2-1902 April 1, 1970.