Appendix A

Contents

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GENERAL OFFICES
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TELEPHONE: AREA 704
374-4011

November 30, 1976

COPY TO NEIL GILBERT

Mr. C. E. Sams
Law Engineering Testing Co.
P. O. Box 11297
Charlotte, N. C. 28209

RE: Cherokee 1-3
Geologic Mapping
File No: CK-1108.00

Dear Mr. Sams:

Attached is a copy of the procedure we propose to use for geologic mapping at Cherokee for your review. Please plan to meet with us at the Electric Center on ~~Monday~~ Wed, December ~~13~~ 15, 1976, at 2:00 p.m. to discuss our overall mapping program at Cherokee and Law Engineering's role in that program. We can discuss any comments you might have on the procedure at that time.

Yours very truly,

L. C. Dail, Chief Engineer
Civil/Environmental Division

By: I. W. Pearce, Principal Engineer

IWP/gc

Attachment

cc: C. Q. Reeves
D. R. Privett
M. F. Schaeffer

Geologic Mapping Procedure
Outline

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DUKE POWER COMPANY
PROJECT 81
CHEROKEE NUCLEAR STATION
GEOLOGIC MAPPING PROCEDURE

Section I - General Description

A. PURPOSE

The purpose of the geologic mapping program for Cherokee Station is to provide a permanent record of the foundation conditions encountered in areas of safety-related structures as outlined in PSAR Section 2.5.1.2(9). This Section of the procedure outlines the relationship of responsibilities and activities between Design Engineering and Construction Departments, and the Consultants in the following areas:

Scope of Mapping and Sequence
Definition of Parties
Assignment of Responsibilities
Requirements for Mapping

B. SCOPE OF MAPPING AND SEQUENCE

The geologic mapping required by this procedure shall be performed for certain designated areas including the following major plant structures:

(1) Power Block Area - (Reactor Building, Auxiliary Building and Turbine Building Complex)
(2) Nuclear Service Water Pond Dam foundation
(3) NSW Pond Spillway Control Section foundation
(4) NSW Pump Structure foundations

The complete program of geologic mapping shall be sequenced in two basic phases depending on the extent of excavation progress.

Phase I - Scale 1"=20' - Mapping of the top of rock before blasting is started in power block area only. Detailed mapping at 1"=5' where necessary.

Phase II - Scale 1"=10' - Mapping of final excavated surfaces. Detailed mapping at 1"=5' where necessary.

When the final foundation grade is above top of rock, no Phase I mapping will be necessary. Scale for final mapping in saprolite shall not be less than 1"=20'.

C. DEFINITION OF RESPONSIBLE PARTIES

(1) Responsible Engineer - The Principal Engineer in charge of the responsible Civil Projects Section in the Civil/Environmental Division of Design Engineering Department or his designated representative. I. W. PEARCE Alternate C. O. Reeves

(2) Geologist - The individual designated by Chief Engineer of Civil/Environmental Division to act as his field representative in any matters pertaining to geologic mapping. MALCOLM

(3) Field Engineer - The specific individual designated by the Construction Department Project Manager to be responsible for the coordination of all construction support or activities required for carrying out the geologic mapping program.

(4) Consultant - The person or persons assigned by Law Engineering and Testing Co. (LETCo) with sufficient training and experience to assist with field mapping work and review of drawings and reports when requested by the Geologist or Responsible Engineer.

(5) Independent Geologic Consultant - A third-party consultant (or consultants) with recognized expertise in the geology of the area engaged specifically for this work. This consultant will provide independent review of fault features and supporting data and conclusions where NRC notification is required for non-similar features as defined in Section III. Bob Hatcher

D. ASSIGNMENT OF RESPONSIBILITIES

All parties involved in the geologic mapping program will have general overall responsibilities to jointly support the requirement of the mapping program, to pursue their respective assignments in a timely and professional manner, and to assure that the resulting maps, data, reports, and documents are sufficient in content and accuracy to accomplish the purpose intended. The specific scope of responsibility for each of the parties for field mapping work is outlined below:

(1) Geologist -

a. Supervises and coordinates all field geologic activity involved in mapping.

b. Schedules mapping of prepared areas designated by the Field Engineer and coordinates required construction support with Field Engineer. Provides Field Engineer with estimate of time required for mapping in specific areas.

c. Determines the need for and extent of support necessary from Consultant (LETCO) and schedules personnel required for mapping.

d. Schedules and supervises as necessary all office drafting associated with preparation of geologic maps.

e. Coordinates review of field and office work, including preparation and review of reports, with Consultant (LETCO).

f. Schedules and coordinates site visits of Independent Geologic Consultant when visits are required.

g. Releases investigated areas to Field Engineer after completion of geologic mapping.

h. When designated, represents Design Engineering during NRC site visits and inspections regarding geologic matters.

(2) Field Engineer -

a. Schedules availability of areas to be mapped and assures that specific areas are cleaned and maintained until mapping is complete.

b. Coordinates earthwork operations in areas requiring mapping with Geologist and advises when areas are ready for mapping.

c. Schedules and coordinates labor, equipment, survey support, and other construction resources as necessary to assure that mapping can be completed as soon as possible.

(3) Consultant (LETCO) -

a. Provides geologist personnel support for assistance in mapping when requested by the Geologist and/or the Responsible Engineer.

b. Reviews all maps, drawings, data and reports relating to geology and foundation conditions and offers comments and suggestions as requested by the Geologist and/or the Responsible Engineer.

c. Provides other specialized assistance in personnel or services if requested by the Geologist and/or the Responsible Engineer.

(4) Independent Geologic Consultant -

a. Shall provide inspection, review and opinions pertaining to data developed for special features in consultation with Duke and Consultant (LETCO) when requested by the Geologist and/or the Responsible Engineer.

b. May provide other services as may be necessary if requested by the Responsible Engineer.

E. REQUIREMENTS FOR MAPPING

Phase I - Initial Mapping (Top of Rock)

During early construction on the site, the Geologist will monitor the overall earthmoving activities and will record in a Geologic Field Log and by use of photographs any significant observable geologic features in the areas to be mapped. At an appropriate time before rock excavation begins, the Field Engineer will notify the Geologist when an area will be ready for inspection and mapping. The Field Engineer will coordinate the necessary construction resources to prepare tha area for mapping.

Excavated areas will be mapped at elevations where earth and rock materials can no longer be removed with earthmoving equipment and blasting is required for further excavation. Preparation of an area for mapping will normally consist of a general clean-up of loose surface materials and gentle sloping of surfaces, where practicable. Limited portions of the area may have to be cleaned more thoroughly by air or water hoses, etc., to permit more detailed mapping, if features requiring detail study are found.

For areas scheduled to be mapped, the Geologist will schedule appropriate Duke Personnel and LETCO personnel, if required, to carry out the mapping in that area. In areas of exposed rock the Field Engineer will coordinate with survey crews to establish a 20 ft. grid reference system. The grid shall be plainly visible and shall be capable of being easily photographed. Iridescent type paint may be used for marking the grid and elevations shall be determined on certain grid points as requested by the Geologist to assist in map work. A 5 ft. grid may be required in some areas if determined necessary by the Geologist.

If the area to be mapped contains sloped surfaces, at greater than 30° angle from horizontal, or nearly vertical walls, the Geologist may request the Field Engineer to have the slope marked off in grids on the slope area. The Field Engineer shall also schedule and provide appropriate construction equipment or safety-ropes, etc., to allow taking of structural readings on steep slopes ás requested by the Geologist. When all mapping of an

area has been completed, the Geologist will release the area to the Field Engineer for subsequent excavation.

Phase II - Final Excavation Mapping

As the excavation of an area to be mapped nears final grade, the Field Engineer will advise the Geologist of the expected date when excavation and cleanup of the area will be complete and available for mapping. The Geologist will then determine the expected mapping completion date based on his estimate of required work for the area.

The area shall be mapped as soon as practicable after it is cleaned. Various special equipment and methods may have to be employed by the Field Engineer to maintain a mappable surface. Normally, visible 10 ft. grid reference points will be provided by the Field Engineer for Phase II mapping. The Geologist shall coordinate the mapping with the Field Engineer so that priority can be placed on any critical portions of an area.

When final mapping has been completed in the area, the Geologist will release that area to the Field Engineer for construction.

Section II - Technical Mapping Aspects

Geologic features shall be mapped at the top of rock, or Phase I mapping stage, at a scale of 1"=20' on base maps. Any detail mapping of features shall be at a scale of 1"=5'. Photographs reproduced to an appropriate scale may be used as permanent record and for checking field mapping as determined necessary by the Geologist.

In the final Phase II foundation mapping stage, structural data will be taken concurrently with the mapping effort whenever deemed necessary by the field Geologist. Density of structural readings in the powerhouse excavation should be about 2 readings per 10 ft. grid square or as many as deemed necessary by the Geologist to get a representative sample of the geologic features. The data should include measurements of the following types of geologic occurrences, where applicable:

foliation - type, strike, dip, weathering

joints - spacing, continuity, separation, roughness fill material, strike, dip

shear planes and faults - brecciation, offsets, strike, dip

contacts - rock types, weathering

As determined by the field Geologist, sufficient samples should be selected for study in thin section. The thin section data obtained should be keyed into the mapping and compared with thin section data obtained during previous studies in the area. For fault features, additional thin sections and other data may be required.

An appropriate index system shall be established to reference samples, features, and data to physical locations in the mapped areas. The system shall be suitable for cross-referencing and grouping of similar and non-similar features.

In addition, any potential problem features that may have engineering significance and will affect structure design or construction due to joints, shear zones or weathered condition of rock should be reported to the Responsible Engineer.

Section III - Investigating and Documenting Geologic Fault Features

A. INTRODUCTION

Extensive studies of fault features characteristic of the region and of the project site area have been made at the Catawba Nuclear Station (Docket Nos. 50-413 and -414) during geologic mapping and at the Cherokee project site in support of the Preliminary Safety Analysis Report for project licensing. These studies[1] establish that numerous fault features occur and can be anticipated in any large excavation in the region.

B. PURPOSE

The purpose of this section is to establish a procedure for investigating and documenting geological fault features. The fault investigation will utilize data from previous studies where applicable.

C. SCOPE

This investigation relates directly to those geologic fault features occurring in excavations required for safety related structure foundations.

D. PROCEDURE

1. Geologic mapping will be conducted as stated in Cherokee PSAR Section 2.5.1.2(9) and Section IE and Section II of this Procedure.
2. In the event a feature as described below is discovered the (field) Geologist will promptly notify the Responsible Engineer. Features which are reportable to Responsible Engineer may include brecciated zones containing offsets and any other offsets or displaced feature of tectonic origin.
3. The Responsible Engineer will hold any structure construction in an area containing a feature as described in 2 above until a determination

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[1] Reference: Catawba Nuclear Station - PSAR, Chapter 2, Section 2.5, Appendices 2C and 2E
- "Final Geological Report on Brecciated Zones"
Cherokee Nuclear Station - PSAR, Chapter 2, Section 2.5, Appendices 2C and 2E

can be made 1) that the feature is similar to features previously studied by observation and that its relevant characteristics can be determined by correlation to previously studied features or(2) that the feature is not similar to any previously studied feature and requires new investigation.

4. For similar features (described in item 3(1)), the Geologist will so notify the Responsible Engineer who will release work in the area as soon as the Geologist has indexed the feature, documented it by detailed mapping and photographs, and established the feature's similarity to a previously established feature. This similarity will be documented by comparing relevant characteristics to features observed and studied at Catawba Nuclear Station during mapping or in any of the numerous test pits opened at the Cherokee site during subsurface investigative studies. Where this similarity can be established and documented, mapping and project work will continue routinely. A tabular summary will be prepared which indexes each occurrence of a feature and makes specific comparison to a previously studied feature. Documentation will be subject to audit during field inspections by NRC.

5. For features where similarity cannot be established by comparison to features previously studied at the Cherokee or Catawba sites, the Responsible Engineer will continue to hold work in the area and notify the NRC Project Manager of the discovery. The geologic feature will then be left exposed for ten (10) days for NRC inspection.

5a. Duke with the assistance of Law Engineering Testing Company and/or other consultant will map the feature, develop data, and determine if the feature falls in the sequence of geologic events established and reported in the Cherokee PSAR.

5b. A third party, independent geologic consultant, will be engaged and will visit the site to examine the feature and examine the data developed by Duke and LETCo and/or other consultant. The Geologist will notify the Responsible Engineer (when geologic mapping, photography and field data gathering have been completed) that investigations have been completed and documented. The independent consultant will report his findings to the Responsible Engineer.

5c. If the independent geologic consultant concurs with Duke's conclusions, the Responsible Engineer will then release the area for project construction activity upon completion of item 5b.

5d. For non-similar features a report will be prepared which shall consist of the following:

(1) Description of the feature including the investigation and description of data obtained
(2) Geologic history
(3) Summary and conclusions
(4) Geologic maps and photographs
(5) Report of findings by Geologic Consultant
(6) This report and other data will be available for NRC review whenever requested.

4-27

Mr. C. E. Sams
Assistant Vice-President
Law Engineering Testing Company
P. O. Box 11297
Charlotte, NC 28209

and

Mr. I. W. Pearce
Principal Engineer
Civil-Environmental Division
Duke Power Company
P. O. Box 2178
Charlotte, NC 28242

Dear Sirs:

A meeting was held April 13, 1977, at Cherokee Nuclear Station for the purpose of examining bedrock features in the cleaned area in the Number 1 Turbine Building. Present at the meeting were Malcomb N. Schaeffer, Duke Power Company, Neil J. Gilbert, Law Engineering Company and myself.

The meeting began with a preliminary briefing by Malcomb Schaeffer over lunch. We arrived at the site at about 1:00 PM and joined N. J. Gilbert on the cleaned area in Number 1 Turbine Building. We examined bedrock lithologies and structures and studied the 1" = 20' geologic maps prepared of the cleaned area.

After the examination of bedrock features on the site we returned to the construction site office to discuss the nature of the geologic mapping and more specifically the problems related to 1" = 5' scale mapping and what should be mapped.

The following recommendations were formulated as a result of these discussions:

1. Mapping of features at 1" = 5' scale.

   (a) There should be a minimum of 2 feet offset on a fault. This is the threshold of visibility of offset at the 1" = 20' scale.

and/or

   (b) There should be 50 feet traceable length on a fault. This is again related to a significant threshold of prominence of a structural feature on a 1" = 20' scale map.

and/or

   (c) Cataclastic zones of significant thickness. A minimum thickness of 1 foot is arbitrarily chosen.

Corollary to the above:

Combinations of greater offset with less traceable length and/or thicker cataclastic zones may in the Geologist's judgment warrant 1" = 5' scale mapping. Also, greater traceable length and lesser offset may likewise require 1" = 5' scale mapping.

2. Repetitious sampling of features otherwise established as similar during the initial phases of the top of rock mapping program should not be undertaken. However, samples should be taken at the discretion of the Geologist.

We returned to the site at 5:25 P.M. after the above recommendations were formulated and examined a fault previously not seen by the Independent Geologic Consultant. The above recommendations were applied to this fault and appeared to work well.

The meeting was adjourned at 6:00 P.M.

Sincerely,

Robert D. Hatcher, Jr.

Robert D. Hatcher, Jr.
Professor of Geology
Clemson University
Clemson, SC 29631

RDH:sr

cc: Dr. Donald T. Secor, Jr.