REPORT OF INSPECTION AND TESTING OF COMPACTED FILL PROPOSED EVAPORATION POND EMBANKMENT MORTON RANCH PROJECT NEAR CASPER, WYOMING FOR UNC MINING AND MILLING SERVICES, INC.

DAMES & MOORE JOB NO. 2675-020-06
SALT LAKE CITY, UTAH
September 30, 1980

DAMES & MOORE

September 30, 1980

UNC Mining and Milling Services, Inc.
Post Office Box 2996
Casper, Wyoming 82602

Attention: Mr. C.E. Wolff

Gentlemen:

Report of Inspection and Testing
of Compacted Fill
Proposed Evaporation Pond
Embankment
Morton Ranch Project
Near Casper, Wyoming
For UNC Mining and Milling
Services, Inc.

INTRODUCTION

This report presents the results of our inspection and testing services performed during the 1980 construction season for the proposed evaporation pond embankment at the Morton Ranch project near Casper, Wyoming. The inspection and testing were performed during the period of April 14, 1980 through July 2, 1980 when construction operations were terminated for the season. At that time, approximately 20 percent of the total required embankment fill had been placed.

The purpose and scope of our services were discussed in our proposal dated April 25, 1980.

SUMMARY OF DESIGN

The location of the proposed embankment system is shown with respect to the proposed mill site and the surrounding topography on Plate 1, Plot Plan. The embankment system is shown in profile on Plate 2, Typical Embankment Sections. As designed the embankment will be constructed with a maximum crest elevation at 5,282 feet, a total length of approximately 4,000 feet and a maximum height of 85 feet. The embankment crest will have a minimum width of 30 feet. The embankment sideslopes will be 2.5 horizontal to 1.0 vertical between elevation 5,282 feet and 5,240 feet. Below elevation 5,240 feet, downstream sideslopes will be 6.0 horizontal to 1.0 vertical, while on the upstream side the sideslopes will be 5.0 horizontal to 1.0 vertical.

The embankment will be a zoned structure consisting of a central clay core (Zone 1), a transition zone (Zone 2), a chimney and blanket drain (Zone 3), downstream and upstream shells (Zones 4 and 5, respectively) and riprap and filter zones (Zones 6 and 6a, respectively). The configuration of the individual zones is shown on the typical embankment sections presented on Plate 2. The required materials will generally consist of overburden materials excavated from adjacent open pit mining operations. Specifications pertaining to material gradations and placement criteria are presented on Plate 3, Material Specification and Placement Criteria.

As shown on Plate 2, the embankment design calls for the excavation of a cutoff trench to a minimum depth of 5.0 feet below the natural ground line. When excavated, the cutoff trench

was to have a minimum 15-foot base and 1.5 horizontal to 1.0 vertical side slopes. The cutoff trench was to be situated along the embankment centerline and form a continuation of the core (Zone 1 material).

During the initial field exploration program, zones of loose alluvial soils were encountered within the embankment foundation area. The limits of these loose foundation soils were delineated by a subsequent field study and are shown in plan view on Plate 1. The material was apparently situated within the central portion of the foundation area and ranged in depth up to 30 feet below the existing grade. It was recommended that these loose materials be excavated and removed from the embankment foundation area prior to commencement of major construction operations.

SPECIFICATIONS AND DRAWINGS

The specifications and drawings for the proposed evaporation pond embankment were prepared by our firm and are presented in the following reports.

"Report of Investigation and Design, Tailings Disposal Area, Morton Ranch Mine and Mill, Converse County, Wyoming, For United Nuclear Corporation." Job No. 02675-005-06 dated October 31, 1977.

"Contract Specifications and Drawings For Evaporation Pond and Embankment, Near Casper, Wyoming, For United Nuclear Corporation, Morton Ranch Uranium Mine, Prepared by Dames & Moore" dated December, 1978.

CONSTRUCTION OPERATIONS

GENERAL

Construction of the proposed evaporation pond embankment commenced in mid-April and extended to early July of 1980. During this period all construction operations were performed by UNC personnel during an eight hour shift, five days per week. The work performed included the required site preparation and the placement of approximately 20 percent of the required embankment fill. Discussions pertaining to the total scope of work performed during this phase of construction are presented in the following subsections.

EQUIPMENT

Fill hauling equipment generally consisted of four to six Terex TS-24B push-pull scrapers and three to four Caterpillar self-loading scrapers. The self-loading scrapers were principally utilized to break up and haul the core material (Zone 1). Spreading and compaction was provided by two self-propelled, sheepsfoot rollers. Two graders were also available for fill spreading as required. Moisture was added as needed to the fill by two 10,000 gallon Terex water trucks.

SITE PREPARATION

GENERAL

The site preparation consisted of:

1) The stripping of all topsoil from the embankment foundation and reservoir area.
2) The excavation and removal of the loose foundation materials as dictated by the contract specifications.

3) The excavation and removal of the old waste pile from the downstream toe of the proposed embankment system as shown on Plates 1 and 2.

4) The excavation of the key trench beneath the embankment centerline.

FOUNDATION STRIPPING

Stripping operations consisted primarily of the removal of all topsoil and organic material from the embankment and reservoir area. All excavated materials were stockpiled in designated areas for later use during reclamation. Prior to the placement of embankment fill, all foundation soils loosened during stripping operations were moisture conditioned and recompacted.

FOUNDATION EXCAVATION

The limits of the required foundation excavation were established by UNC survey personnel. The delineated area was then excavated to the required depths as dictated by the project specifications (see Plate 1). Subsequent to the excavation operations, the exposed natural soils were inspected by the Dames & Moore project engineer. The results of this inspection indicated that the excavation had resulted in the removal of the loose foundation soils defined by the previous field exploration programs and, thus, approval was given for the commencement of construction operations.

A discussion of the observations made during this inspection was documented in a letter dated December 20, 1979 which is presented in Appendix A of this report. The final configuration of the excavation was surveyed by UNC personnel and is presented on Plate 4, Foundation Excavation.

EXCAVATION OF MINE WASTE PILE

The mine waste pile located within portions of the embankment foundation area (as shown on Plate 2) was excavated and reused as embankment fill. In general, the material encountered conformed to the gradational limits recommended in the project specifications for Zone 2 (transition) and was placed as bedding for the proposed downstream blanket drain. Upon completion of this initial phase of construction all mine waste material within the limits of the foundation area had been excavated and either used as fill or wasted.

CUTOFF TRENCH

The cutoff trench was excavated in accordance with the recommendations set forth in the project specifications. The location and limits of the cutoff trench were established by a survey performed by UNC personnel. The natural soils exposed in the trench were inspected to ensure that the trench was established within relatively dense, undisturbed material as required in the specifications.

Of particular concern in the excavation of the trench were the potential construction problems anticipated within the base of the aforementioned foundation excavation. In this area, relatively high ground water levels required that the excavation and fill placement operations be performed concurrently. As requested by the NRC representative, the Dames & Moore project engineer was on site to supervise and inspect the general construction procedure and to ensure that the construction of the

cutoff trench conformed to the recommendations set forth in the specifications. A discussion of the obervations made during this inspection was documented in a letter dated May 6, 1980 which is presented in Appendix B of this report.

FILL PLACEMENT

GENERAL

The construction of the embankment generally conformed to the lines and grades presented on Plates 1 and 2. It is estimated that approximately 20 percent of the required embankment fill had been placed during this initial construction period. The fill placement was generally limited to backfilling the foundation excavation and to placing portions of the downstream blanket drain. Subsequent to the termination of construction operations UNC personnel surveyed the general site area. The resulting topographic map showing the approximate limits of the individual zones is presented on Plate 5, Post Construction Site Topography.

ZONE 1 (Clay Core)

The placement of Zone 1 material was limited primarily to the construction of the core within the foundation excavation. The material generally consisted of a grey silty clay (mudstone) excavated from an adjacent open pit area (Pit 1802). The material was placed in six- to eight-inch loose lifts. Each lift was moistened and mixed until the material was near its optimum moisture content, and compacted. The compaction effort consisted of continuous routing of the self-propelled, sheepsfoot rollers and systematic wheel rolling by loaded scrapers. During excavation operations, the self-loading scrapers were utilized in an

effort to break down the oversized mudstone pieces prior to placement. All oversized pieces encountered on the fill were removed prior to compaction.

ZONE 2 (Transition)

The transition zone material was primarily placed within the downstream portion of the embankment beneath the proposed drainage blanket. The purpose of the material was to appropriately contour the existing ground surface in such a manner that the drainage blanket could be constructed with a constant gradient in the direction of the proposed drainage line. The material consisted of a silty sand excavated primarily from the waste pile adjacent to the downstream toe of the embankment.

ZONE 3 (Drain)

The limits of the drainage zone material placed during this phase of construction are presented on Plate 5. The material consisted primarily of a fine to medium sand with a trace of silt excavated from an adjacent open pit area (Pit 1802). The project specifications originally required that the material have no more than 8 percent by weight passing the No. 200 sieve size. However, the material excavated from the borrow area was slightly finer grained and generally averaged approximately 10 to 11 percent by weight passing the No. 200 sieve.

A laboratory testing program was initiated to determine the permeability characteristics of this finer grained material and to evaluate its suitability for use as a drainage material. The results of this study indicate that the permeability of this material compared favorably with the values assumed in the initial design report and thus, its use would not affect the

overall performance of the drainage zone. Therefore, the gradational specifications for this zone were amended to accept materials with up to 12 percent by weight passing the No. 200 sieve. The results of this study were documented in a letter dated July 9, 1980 which is presented in Appendix C of this report.

ZONES 4 and 5 (Downstream and Upstream Shells)

The Zone 4 and 5 materials generally consisted of the silty sand excavated from adjacent open pit operation (Pit 2114). Due to the similarity of the material specifications, the material excavated from this area was considered suitable for use as either Zone 4 or 5 material. In general, the placement of the shell materials was confined to the limits of the foundation excavation as shown on Plate 5.

ZONES 6 and 6a (Riprap and Filter)

During this initial construction season there was no riprap or filter material placed. During the excavation of the borrow areas the oversized pieces encountered were stockpiled for possible later use as riprap.

EARTHWORK OBSERVATIONS AND FIELD CONTROL TESTING

GENERAL

Earthwork operations were performed under the direct supervision of a full time earthwork technician, Mr. Kurt Grabow of Northern Testing Laboratories, Inc. of Casper, Wyoming. Northern Testing was under subcontract to Dames & Moore and the conduct of the inspection services was directly supervised by Dames &

Moore personnel. Mr. Larry T. Murdock was Dames & Moore's project manager and was responsible for the general construction operations and the performance of the inspection services. Mr. Murdock was assisted by Mr. James F. Zitnik, a Dames & Moore project engineer. Both Mr. Murdock and Mr. Zitnik made individual visits to the site during critical periods of embankemnt construction.

REPORTING

Mr. Grabow's main purpose was to observe the construction activities and perform the necessary field control tests to assure conformance with the project plans and specifications. Daily written reports summarizing the field control test results and the project status were prepared by Mr. Grabow. These reports were reviewed by Mr. Zitnik who prepared weekly summary reports which were submitted to the Wyoming State Engineer.

Mr. Murdock visited the site to inspect the overall foundation excavation and the key trench excavation. The purpose of the visits was to assure conformance with the recommended specifications. Reports summarizing these inspections are included in the appendices of this report.

INSPECTION BY OTHERS

A representative of the U.S. Nuclear Regulatory Commission inspected the site area perodically during construction as required by the United Nuclear Corporation Source Material License. The representative, Dr. Steven R. Abt, observed the excavation and fill operations and reviewed the test data for the project.

FIELD CONTROL TESTING

GENERAL

Field control testing was performed to confirm compliance with the material and compaction specifications given in the project plans. The field control testing basically consisted of three types of tests. The three tests were:

1. Gradation Tests
2. Compaction Tests
3. Field Density Tests

A discussion of these tests and a tabulation of the results are presented in the following sections.

GRADATION TESTS

During construction, gradation tests were performed on representative samples of materials obtained from both the borrow and fill areas. The results of the gradation tests were used to evaluate the gradational characteristics of the materials and to insure compliance with recommended specifications. The tests were performed in accordance with the ASTM* Test Designation D-422 (Particle-Size Analysis of Soils, Washed Sieve Method). A summary of the tests results is presented in Appendix D of this report.

The test results indicate that the gradation of the fill materials was relatively consistent and generally conformed to the limits presented in the aforementioned specifications. As discussed previously, the drainage zone material encountered in

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*American Society for Testing and Materials

the borrow areas was found to be slightly finer grained than originally specified. A subsequent laboratory investigation (Appendix C) indicated the acceptability of this material and the recommended gradational specifications were amended accordingly.

COMPACTION TESTS

Compaction tests were performed on representative samples of the individual fill zones to evaluate the maximum dry densities and optimum moisture contents. A number of tests were taken on materials from each zone during the course of construction operations to account for slight variations in the material characteristics. The compaction tests were performed in accordance with the AASHTO T-180 Method of Compaction. The results of the tests are presented in Appendix E.

FIELD DENSITY TESTS

Field density tests were performed as the fill operations progressed. The field density tests were performed in accordance with the ASTM Designation D-1556-64 (sand-cone method) and D-2922 (nuclear method). As presented on Plate 3, the compaction criteria for all embankment zones was based upon 90 percent of the maximum dry density as determined by the AASHTO* T-180 Method of Compaction. When the results indicated that an area had not been compacted to the specified degree of compaction, the fill material was carefully inspected to determine the limits of the poorly compacted material and the cause of the failure. Generally, the lower density resulted from one or a combination of the following:

1. Excess lift thickness
2. Insufficient or excessive moisture
3. Insufficient compactive effort

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*American Association of State Highway and Transportation Officials

After the limits of the lower density material had been established, the material was either removed or reworked and compacted until the specified degree of compaction had been achieved. The locations, elevations and results of the field density tests are presented in Appendix F of this report. The stationing system which was used to locate the tests is shown on the attached plot plan, Plate 1.

Based upon the results of the field testing and construction inspection, it is our opinion the embankment construction has been performed in accordance with the project specifications. The following plates and appendices are attached and complete this report.

oOo

We appreciate having been a part of this project. If you have any questions regarding this report, please contact us.

Yours very truly,

DAMES & MOORE

Larry T. Mudock
Project Manager
Professional Engineer No. 2852
State of Wyoming

James F. Zitnik
Project Engineer

LTM:JFZ:ll

Attachments: Plate 1 - Plot Plan
Plate 2 - Typical Embankment Sections
Plate 3 - Material Specifications and Placement Criteria
Plate 4 - Foundation Excavation
Plate 5 - Post Construction Site Topography

Appendices A - F

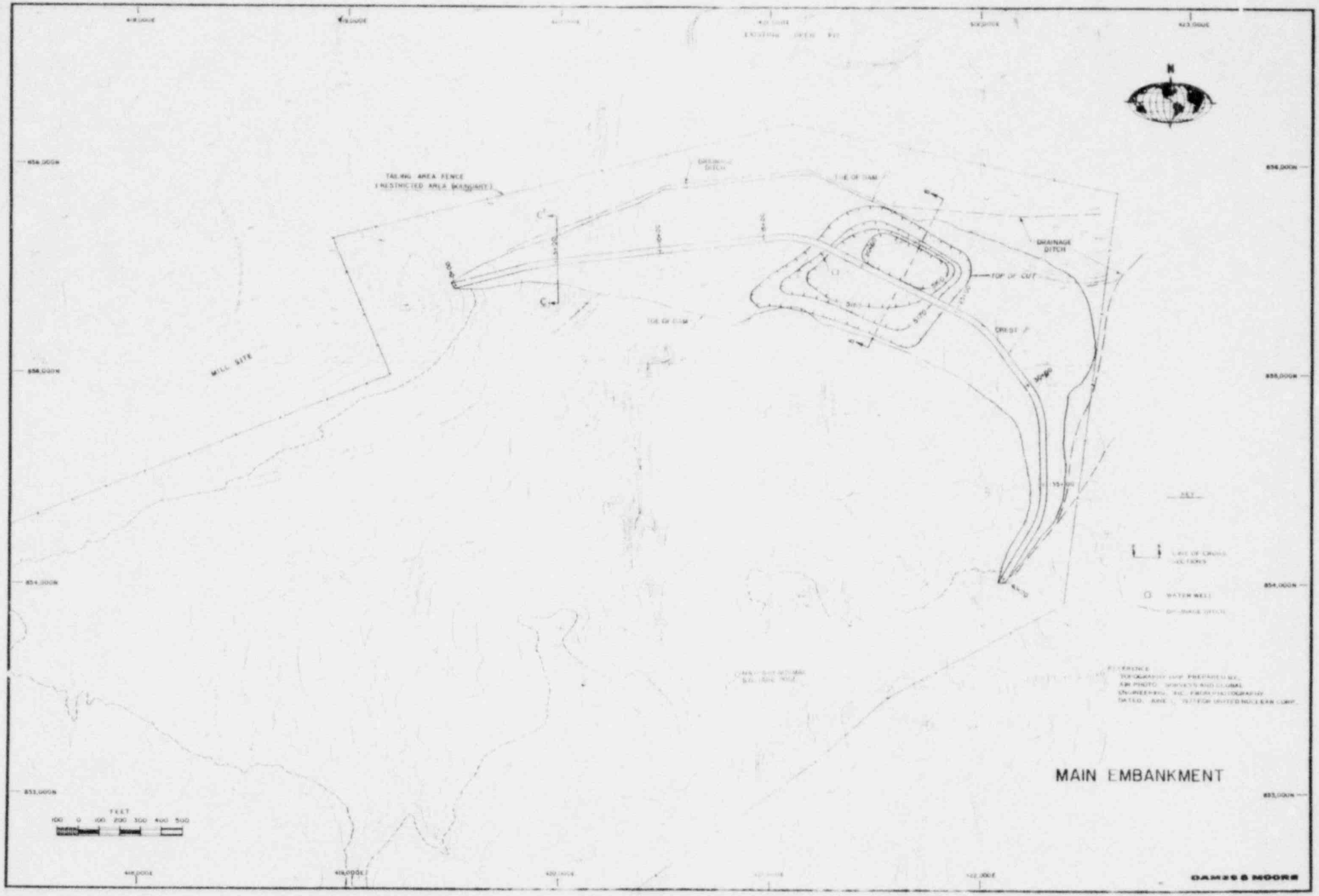
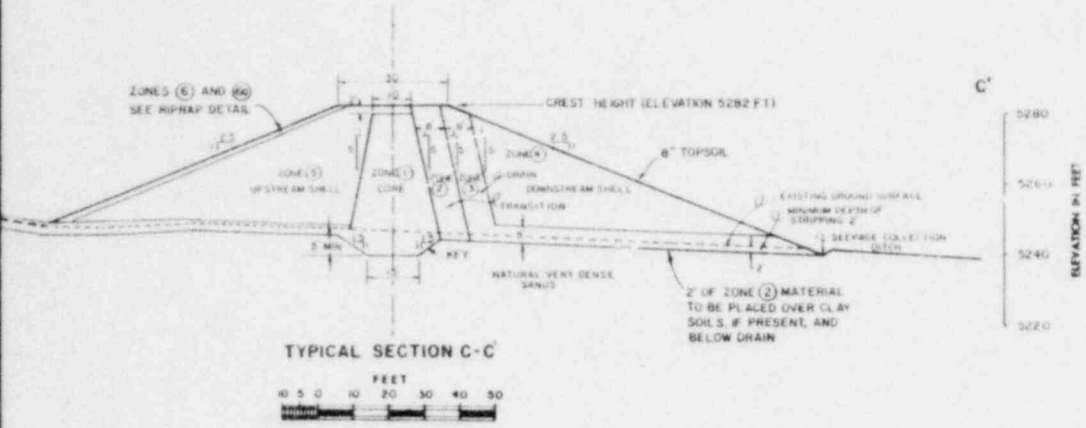
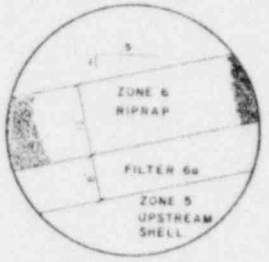


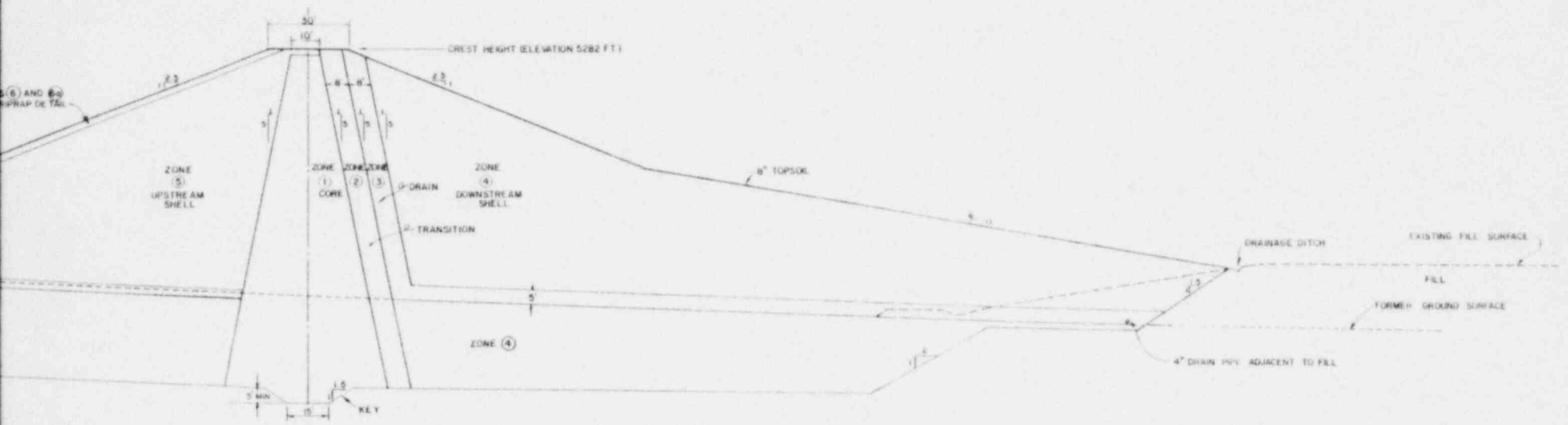
PLATE 1



TYPICAL SECTION C-C'



RIPRAP DETAIL

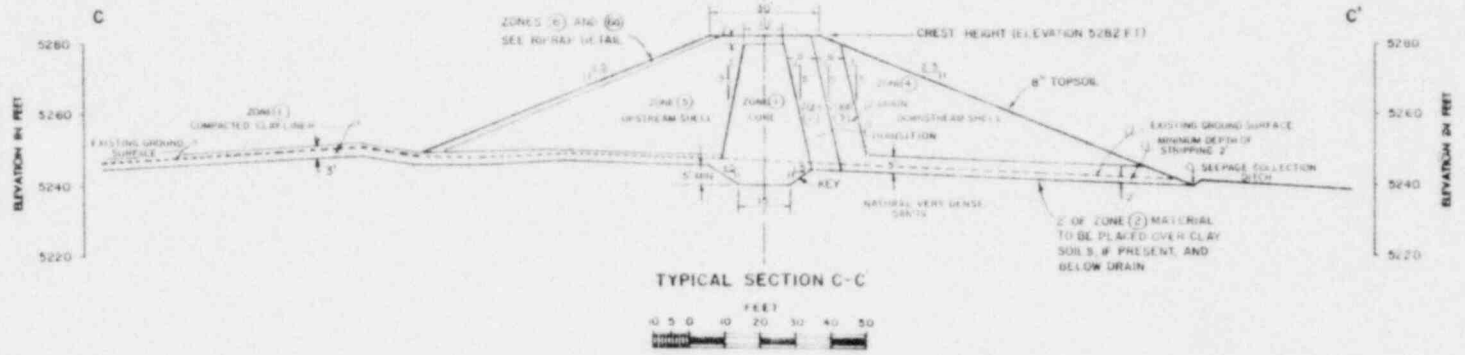


TYPICAL SECTION B-B'

TYPICAL SECTIONS

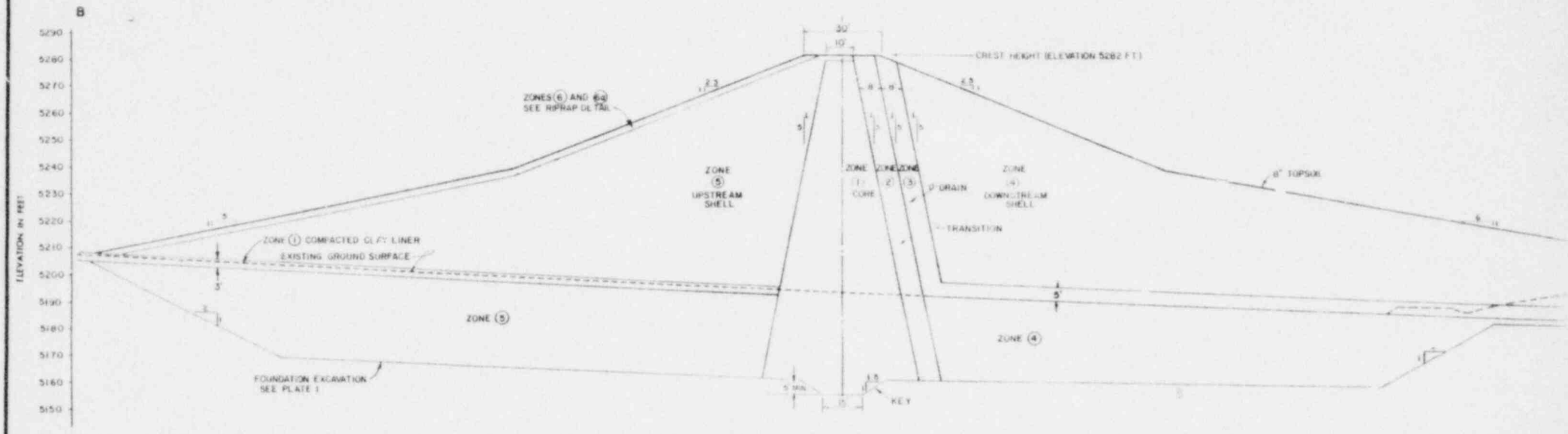
DAMES & MOORE

PLATE 2



TYPICAL SECTION C-C

FEET
10 5 0 10 20 30 40 50



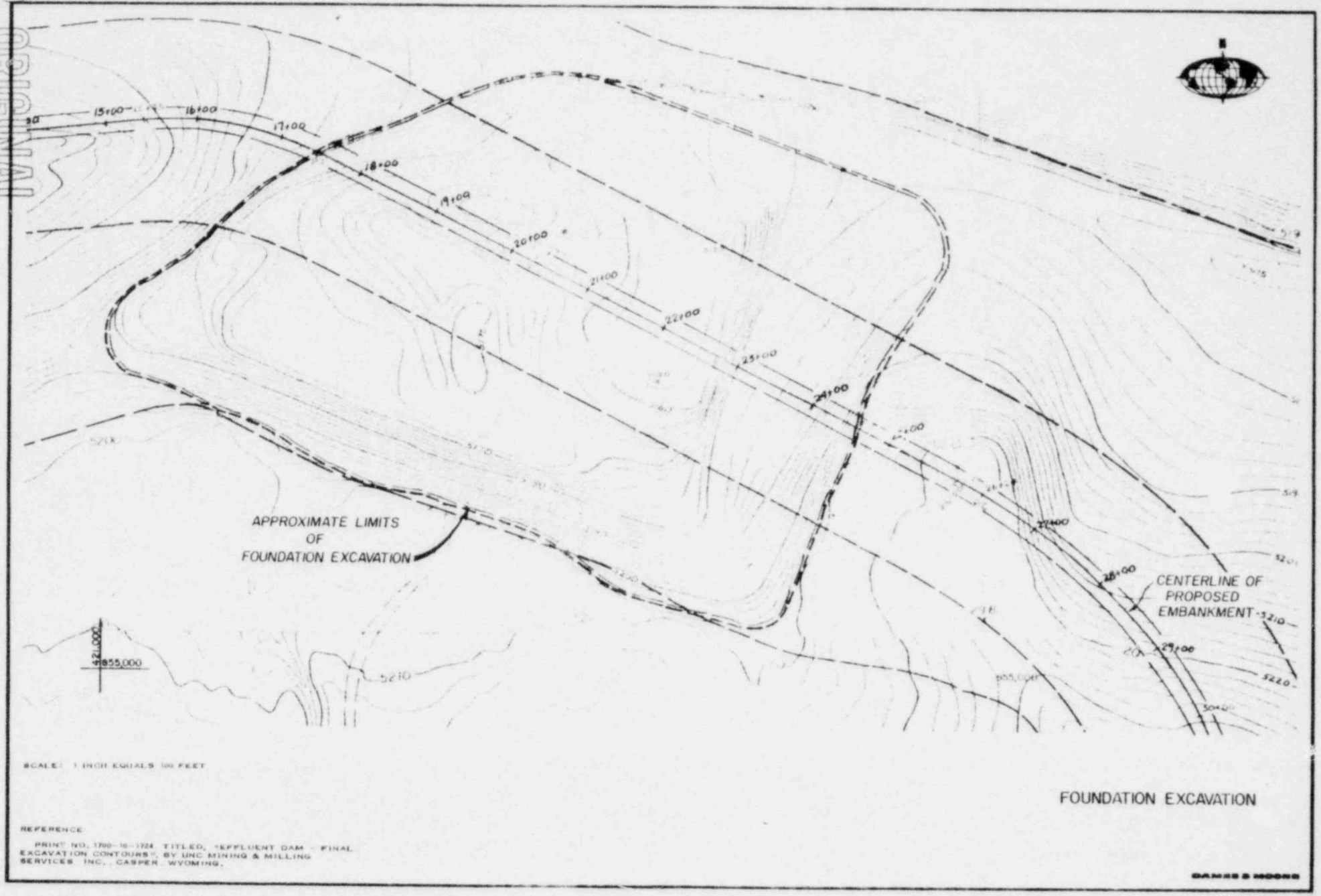
TYPICAL SECTION B-B'

FEET
10 5 0 10 20 30 40 50

CHECKED BY _____ FILE 02675.020 UNC _____ BY _____ DATE _____

Zone	Material Specification	Placement Criteria
1 Core and Liner	Core and liner shall consist of silty clay or sandy clay, meeting the following gradation: Sieve Size — Percent Finer by Weight #8 — 100 #30 — 80-100 #200 — 50-100	Core shall be placed in lifts not exceeding eight inches in loose thickness, disced and harrowed, moisture conditioned, and compacted to a minimum dry density as determined by the ASTM D-1557 Method of Compaction. Moisture content shall be maintained between optimum and three percent greater than optimum during compaction.
2 Transition	Transition shall consist of silty sand, meeting the following gradation: Sieve Size — Percent Finer by Weight 3 in — 100 #20 — 50-100 #50 — 30- 85 #200 — 15- 50	Transition shall be placed in lifts not exceeding eight inches in loose thickness and compacted to a minimum of 90 percent of the maximum dry density as determined by the ASTM D-1557 Method of Compaction.
3 Drain	Drain shall consist of sand, meeting the following gradation: Sieve Size — Percent Finer by Weight 3 in — 100 #4 — 50-100 #16 — 15-100 #30 — 0- 85 #50 — 0- 60 #200 — 0- 8	Same as for Zone 2.
4 Downstream Shell	Downstream shell shall consist of sand, meeting the following gradation: Sieve Size — Percent Finer by Weight 3 in — 85-100 #4 — 30-100 #16 — 15-100 #50 — 0- 85 #200 — 0- 50	Same as for Zone 2.
5 Upstream Shell	Upstream shell shall consist of sand, meeting the following gradation: Sieve Size — Percent Finer by Weight 3 in — 85-100 #4 — 50-100 #200 — 15- 50	Same as for Zone 2.
6 Rip-Rap	Rip-rap material on the upstream face of the embankment shall consist of rock fragments, meeting the following gradation: Sieve Size — Percent Finer by Weight 12 in — 100 9 in — 50-85 5 in — 0-15 Note: The rock fragments shall be dense, sound and resistant to abrasion.	Rip-rap shall be dumped and spread in 12-inch layer in such a manner as to prevent segregation of grain size.
6A Rip-Rap Filter	Rip-rap filter material shall consist of well graded sandy gravel, meeting the following gradation: Sieve Size — Percent Finer by Weight 3 in — 100 3/4 in — 65-85 #20 — 0-20 #200 — 0-10	Rip-rap filter shall be placed on surface of upstream shell prior to placement of rip-rap and spread in such a manner as to prevent segregation of grain size.

MATERIAL SPECIFICATION AND PLACEMENT CRITERIA



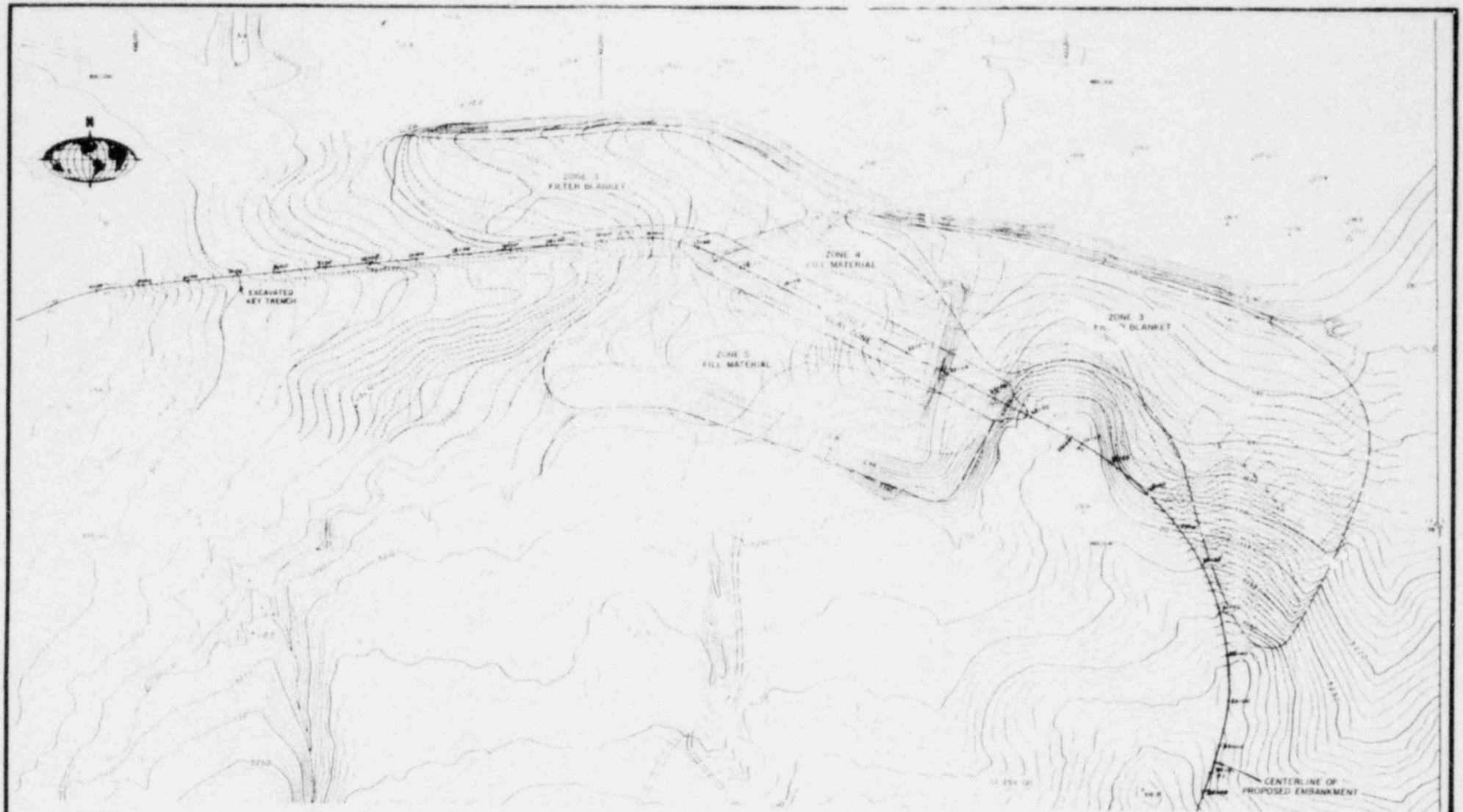
FOUNDATION EXCAVATION

REFERENCE:

PRINT NO. 1709-16-1224, TITLED, "EFFLUENT DAM - FINAL EXCAVATION CONTOURS", BY UNC MINING & MILLING SERVICES, INC., CASPER, WYOMING.

DAMES & MOORE

PLATE 4



POST CONSTRUCTION
SITE TOPOGRAPHY

REFERENCE

PRINT NO. 1790-10-1123, TITLED, "EFFLUENT DAM STAGE CONSTRUCTION CONTOURS CONVERSE COUNTY, WYOMING", BY UNC MINING & MILLING SERVICES, INC., CASPER, WYOMING.

KEY

———— POST CONSTRUCTION CONTOUR LINES

———— PRE CONSTRUCTION CONTOUR LINES SHOWING FOUNDATION AND KEY TRENCH EXCAVATIONS

PLATE 5

APPENDIX A

December 20, 1979

United Nuclear Corporation
Mining and Milling Division
Wyoming Operations
Post Office Box 2996
Casper, WY 82602

Attention: Mr. C. E. Wolff

Gentlemen:

Inspection of Alluvium Excavation
Evaporation Pond Dam Embankment
Morton Ranch Project

INTRODUCTION

This letter presents the results of our recent site inspection of the excavation of alluvial soils beneath the proposed dam embankment. The purpose of the excavation is to remove loose sandy alluvial soils which are potentially susceptible to liquefaction during an earthquake. Approximate limits of the loose soils, as shown in the plans and specifications, were based on information obtained from approximately 17 borings drilled in the area and on testing of samples from the borings.

The purpose of Dames & Moore's site inspection was to examine the soils exposed in the excavation as a basis for providing recommendations for completing the excavation.

SITE CONDITIONS

The excavation was inspected on December 14, 1979 by the writer, in company with Messrs. Wolff, Hiscox, Rout.., and Sorensen of UNC. Roughly 293,000 cubic yards have been removed; the bottom of the pit ranged as low as elevation 5160 in several small areas. A small amount of ground water has seeped into the excavation but has not created any serious problems in excavation.

The distinction between the alluvial soils and the underlying indurated sands and clays is fairly easy to distinquish visually as well as by its stability under the action of the construction equipment. The loose clean sands, which are potentially liquefiable, are generally reddish brown in color.

As would be expected, the bottom of the alluvium appears to be quite irregular, with small pockets and channels which extend up to five feet below the general bottom. The limits of the soft deposits vary somewhat from that shown on the plans and specifications but total quantities appear to be fairly close to the original estimate.

DISCUSSIONS AND RECOMMENDATIONS

It is our opinion that the excavation is proceeding satisfactorily and that the soft soils are being accurately identified and removed. We do not feel it is necessary to excavate firm underlying soils in order to make the limits of the excavation conform to the configuration represented by the contours in the plans and specifications. It was recognized that those limits would be adjusted based on actual conditions found in the field at the time of construction.

We recommend that the work be continued as at present. When all loose deposits are removed, care should be taken to keep water from ponding; this could soften the surface of the underlying firm soils. We suggest that we be present when the NRC inspects the excavation, prior to the start of filling. We would be able to answer any questions regarding the soil conditions, design or construction procedures at that time.

Yours very truly,

DAMES & MOORE

Larry T. Murdock
Associate

LTM/pc

APPENDIX B

ANCHORAGE LOS ANGELES
ATLANTA NEW YORK
CALGARY PHOENIX
BOSTON PORTLAND
CHICAGO SALT LAKE CITY
CINCINNATI SAN FRANCISCO
CRANFORD SANTA BARBARA
DENVER SEATTLE
HONOLULU SYRACUSE
HOUSTON WASHINGTON, D.C.
LEXINGTON, KY WHITE PLAINS

DAMES & MOORE

CONSULTANTS IN THE ENVIRONMENTAL AND APPLIED EARTH SCIENCES

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SUITE 200, 250 EAST BROADWAY · SALT LAKE CITY, UTAH 84111 · (801) 521-9255
CABLE: DAMEMORE TWX: 910-925-5692

May 6, 1980

UNC Mining and Milling Services, Inc.
Post Office Box 2996
Casper, Wyoming 82602

Attention: Mr. Tom Hiscox

Gentlemen:

REPORT OF CUTOFF TRENCH INSPECTION
PROPOSED EVAPORATION POND EMBANKMENT
MORTON RANCH PROJECT
NEAR CASPER, WYOMING
FOR UNC MINING AND MILLING SERVICES, INC.

INTRODUCTION

This letter presents a summary of the field observations made during the construction of the cutoff trench for the above-referenced evaporation pond embankment. The inspection services were recommended during a recent site visit, by Dr. Steven R. Abt, representing the Nuclear Regulatory Commission.

The field observations made during the construction operations were discussed with Dr. Abt during a previous telephone conversation.

CUTOFF TRENCH INSPECTION

On the morning of April 24, 1980, the site was inspected by Mr. Larry T. Murdock, the Dames & Moore Project Manager. At

that time the cutoff trench excavation had been completed between Stations 17+00 and 24+00. This included the lower portions of the foundation excavation where seepage and soft soil conditions were a primary concern of Dr. Abt. The configuration of the trench generally conformed to the recommendations as presented in the plans and specifications*.

During the construction operations, water was periodically pumped from the excavation and at the time of the inspection the trench was relatively dry with standing water limited to minor puddles within the lower areas. Seepage into the trench area was minor and generally confined to the bottom of the trench. At the request of Mr. Murdock, the trench was cleared of loose soils and a subsequent inspection indicated the trench was established within firm undisturbed material. The initial lift of clay was placed immediately upon completion of excavation operations. In-place density tests performed on this initial lift indicated conformance with the recommended compaction specifications.

CONCLUSIONS

It is our opinion that the construction of the cutoff trench conformed to the requirements as stated in the plans and specifications. The trench was established within firm and undisturbed materials and was maintained in a relatively dry state during placement of the core material.

* * *

*Contract Specifications and Drawings For Evaporation Pond and Embankment, Near Casper, Wyoming, For United Nuclear Corporation, Morton Ranch Uranium Mine, Prepared by Dames & Moore, December 1978.

If you have questions pertaining to the information presented herein or require additional information, please contact us.

Very truly yours,

DAMES & MOORE

Larry T. Murdock
Project Manager
Professional Engineer #2852
State of Wyoming

James F. Zitnik
Project Engineer

LTM/JFZ:si

cc: Dr. Steve Abt
Jerry M. Dogget
N. C. Sorensen

APPENDIX C