9. FOIA 84-463

J. Kane
5/14/84

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAY 1 1 1984

Docket Nos.: 50-424 and 50-425

MEMORANDUM FOR: Elinor G. Adensam, Chief
Licensing Branch No. 4
Division of Licensing

FROM: George Lear, Chief
Structural and Geotechnical Engineering Branch
Division of Engineering

SUBJECT: MARCH 1984 SITE VISIT - GEOTECHNICAL ENGINEERING REVIEW

Plant Name: Vogtle Electric Generating Plant, Units 1 and 2
Licensing State: OL
Docket Numbers: 50-424/425
Responsible Branch: LB-4; M. Miller, LPM

We are providing Enclosure 1 in order to document the discussions at the March 6 and 7, 1984, site visit and the agreements reached on our request for additional information. Enclosure 2 provides a list of the attendees at the March site visit.

During the site visit, the geotechnical engineering staff reviewer identified a problem in the Applicant's field procedures for demonstrating fulfillment of a FSAR commitment to control the placement moisture content of Category 1 backfill within specified limits. This problem is discussed in greater detail in paragraph 3.d of Enclosure 1.

Until the compaction control test records are provided by the Applicant in response to Q241.4, the extent of the problem caused by using the rapid drying test to establish moisture content of Category 1 backfill material before compaction is not known.

It is our understanding that this information is to be provided to the staff by May 9, 1984.

In the interim, we have recommended that the moisture content of the remaining Category I backfill be controlled as indicated in the following paragraphs.

8405210620 XA

1. For Clean Sand Backfill (Soils with less than 5 percent fines of low plasticity and/or soils with permeability higher than 10^{-3} cm/sec after compaction)

    a. Thoroughly wet (approaching saturation) the clean sand fill after it has been spread to the proper lift thickness and immediately follow (within 50 feet) the wetting operation with the compactor. The wetting and compaction operations are to be conducted in such a manner that ponding of free water on the surface of the compacted fill will not be permitted. This restriction can be met by requiring drainage through proper grading of fill surfaces or the planned placement of fill in recognition of their permeability characteristics. Clean sands that have been thoroughly wetted and compacted in this manner will not be required to meet a specified moisture content range. In situ density and laboratory compaction tests are still required in order to demonstrate the required level of compaction has been achieved.

2. For Backfill Other Than Clean Sands (Soils with permeability less than 10^{-3} cm/sec after compaction)

    a. After the backfill has been properly placed and spread in a lift, the moisture will be uniformly brought to a condition throughout the entire lift thickness within the required limits of ± 2 percent of optimum moisture content as determined in ASTM D 1557. As a construction expediency, the rapid drying test (Frying of soil sample on gas burner) would be acceptable as an initial indicator of the moisture condition before compaction, but the final decision on meeting the FSAR moisture content range will be made on fill material tested after compaction in accordance with the accepted published procedures of ASTM D 2216 (See Reg. Guide 1.138) and ASTM D 1557.

    b. Any request for deviations by the Applicant from the above specified moisture content controls will require written justification and supporting test data and be subject to the approval of the NRR staff.

The staff's recommendations are prompted by our concern for unanticipated settlements of the fill that could potentially occur if proper moisture controls were not enforced and the fill soils become saturated. We consider the above recommendations to reflect current, good engineering practice in the compaction control of fills and referred the Applicant to the Corps of Engineers Guide Specification for Embankments, CE-1306, for additional information and to understand the basis of our recommendations.

The staff's recommendations on moisture control were discussed in telephone conference calls between the Applicant and J. Kane, SGEB and M. Miller, LB-4 on May 2, 1984, and on May 7, 1984. The Applicant indicated in these calls that the compaction control test records being forwarded to the NRC will demonstrate their current control procedures are acceptable in obtaining the required degree of compaction. A tentative date of May 16, 1984, was proposed for a meeting in Bethesda, MD. to permit discussions and clarification of any questions that may develop in the staff's review of the submitted data and prior to the staff taking a final position on the moisture content control procedures to be required.

George Lear

George Lear, Chief
Structural and Geotechnical
Engineering Branch
Division of Engineering

Attachments:
As stated

cc: w/attachments
R. Vollmer
J. Knight
T. Novak
G. Lear
L. Heller
M. Miller
S. Chan
J. Hopkins
J. Kane

Enclosure 1

Vogtle Electric Generating Plant, Units 1 and 2

Docket Nos. 50-424/425

Subject: Summary of Discussions During March 6 and 7, 1984 Site Visit

Prepared by J. Kane, DE, SGEB, GES

1. The list of attendees who participated in the March 6-7, 1984 visit at the Vogtle site are provided in Enclosure 2.

2. The site visit afforded the opportunity to the NRC Staff's geotechnical engineering reviewer to view plant construction progress and also permitted the Applicant to discuss the staff's FSAR review questions and request for information which had been forwarded to Georgia Power Company in E. Adensam's letter of February 21, 1984 to D. Foster.

3. Each of the 24 questions in the geotechnical engineering area (identified as 241.1 through 241.24) were discussed during the site visit with general understandings and agreements being reached on the information and data that was required to be submitted to the NRC. In discussing the review questions, certain clarifying information was obtained for several of the questions. The questions affected by these discussions are addressed in the following paragraphs.

   a. Q241.1 and Q241.20. Because the Radwaste Solidification Building was stated not to be a seismic Category 1 structure, staff questions directed at the drilled caisson foundation design for this structure were withdrawn.

   b. Q241.2. Clearly marked half-sized drawings that highlight the requested foundation information on seismic Category 1 structures, conduits and piping will be provided by the Applicant in response to this question.

   c. Q241.3. Recoveries of cores from drilling of the clay marl foundation materials in the vicinity of important seismic Category 1 structures were not available for visual inspection as had been requested in the February 21, 1984 letter. The staff's concern for the foundation competency of this lightly cemented rock persists. The Applicant did agree to search out and and provide the actual field logs of the CS series borings, where poor recovery in 9 out of 36 borings was indicated, in the hope of being able to provide an explanation for the poor recovery (e.g. drilling record indicating time consuming grinding of the rock rather than soft or open zones). The Applicant was also requested to provide a list of borings in the immediate vicinity of important seismic Category 1 structures that demonstrate the foundation competency of the clay marl layer with depth. Field logs will also be reviewed by the Applicant to establish the extent of slickensides on rock jointing. Available photos reflecting the condition and competency of the clay marl material are also to be provided. The explanation provided at the site visit as to how important soil and foundation parameters were selected in design is to be documented.

d. Q241.4. A few of the voluminous records that summarize the results of compaction control testing of Category 1 backfill were reviewed by the staff during the site visit. An agreement was reached that in response to Q241.4, only the compaction testing records for the first six months of 1983 would be required to be submitted. This information will include the control test summary tables and also the supporting data that includes gradation and laboratory compaction curves. A copy of Bechtel's earthwork specification (C2.2, Rev.11, dated February 17, 1984) was provided in response to the staff's questions on testing frequency and actions required for test results not meeting specified limits, etc. This specification needs to be reviewed by the staff when evaluating the compaction control records to be provided by the Applicant.

A problem was identified by the staff's brief review of the compaction control testing records relative to the Applicant fulfilling a commitment (FSAR, Section 2.5.4.5.2.7) in controlling the placement moisture content of Category 1 backfill within ± 2 percent of optimum moisture content. Certain test results in the summary tables provided by the Applicant indicated moisture contents well outside the required ± 2 percent range (e.g. test no. 8909 for the testing period from 4/1/83 to 4/14/83). When questioned on this matter on March 6, 1984, the Applicant's consultant was unable to provide an explanation on the basis of information available in the summary table. Subsequently on March 7, 1984 an explanation was given that a rapid drying moisture content test was run in the field when the fill was being placed prior to compaction by rollers and it was the rapid moisture test which was used to decide whether the placement moisture content was proper and met specified limits. The staff reviewer indicated that neither the rapid drying moisture test nor the Applicant's practice of using it to decide on the final correct moisture content range were acceptable for the following reasons:

(1) The rapid drying test is acknowledged to give results that are variable and often questionable and are admittedly only rough approximations.

(2) The moisture content test to be used to decide on moisture acceptability should be performed in the lab using ASTM D2216. Normal and good engineering practice would require the moisture test to be performed on the same material removed in the in situ density test because it is the molding moisture condition which exists during actual compaction that has the most significant influence on resulting soil parameters (e.g. shear strength and compressibility).

(3) Theoretically, if the moisture content test result from the rapid drying method was correct, there should be little

difference in the test results between the rapid test and the moisture obtained in the in situ density test because specifications on moisture control require the moisture content to be uniformly mixed throughout the entire fill layer within the specified limits. If differences are shown to exist between the two types of moisture tests, it would be more reasonable to place greater emphasis on the standardized lab test. The statements made by the Applicant's consultants with respect to not relying on the moisture content results from the in situ density tests because of potential large changes in in situ moisture due to rising groundwater levels or to the effects of surface precipitation or surface evaporation are not considered realistic in recognition of the procedures, timing and speed in which the field and laboratory tests are normally performed. These factors would be unique site conditions that would have effects at highly infrequent intervals and should actually be documented, if in fact they were affecting the test results.

The extent of the problem caused by the practice of using the rapid drying test to check for proper placement moisture contents is not known at this time but can be assessed in the future following the submittal of the requested compaction control test records. During the site visit discussions, the Applicant would not agree to the staff's recommendation to control future fill moisture placement using the lab determined moisture content from the in situ density test. The discussions ended with the staff indicating this issue would, therefore, have to be pursued with higher NRC management.

e. Q241.5. The Applicant's consultant acknowledged that Table 2.5.4-12 is in error and corrections will be made.

f. Q241.17. Up-to-date plots of settlement versus time were not available. Several plots with settlement readings up to the fall of 1983 were reviewed and it was indicated that a portion of the Auxiliary Building had experienced a settlement of approximately 3 inches. This amount of settlement is the maximum predicted settlement for the Auxiliary Building which would include the years of plant operation. In response to Q241.17, the Applicant has agreed to provide tables which summarize the up-to-date measured settlements for all seismic Category 1 structures but only graphical settlement time-history plots for the containment buildings, auxiliary building and nuclear service cooling water towers are required to be submitted. Significant construction activities affecting settlements are to be identified and provided with the submittal of the settlement data.

g. Q241.22. In response to this question a copy of "Final Report on Dewatering and Repair of Erosion in Category 1 Backfill in Power Block Area, August 15, 1980" was provided for Staff review.

Enclosure 2

List of Attendees
March 6 and 7, 1984 Site Visit at Vogtle Electric Generating Plant

Name	Affiliation
James Bailey	SCS-NSLD
Ken Kopecky	SCS-NLLD
Mehdi Sheibani	Georgia Power Co.
Roy Kiser	Bechtel
Mike Perovich	Bechtel
Z. Yazdani	Bechtel
A. Wehrenberg	Bechtel
John Hopkins	NRC, NRR, DL
Joseph Kane	NRC, NRR, DE

Enclosure 2

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A. Wehrenberg	Bechtel
John Hopkins	NRC, NRR, DL
Joseph Kane	NRC, NRR, DE

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Subject : Review Comments on Vogtle Submittal of May 8, 1984

1. MOISTURE CONTROL.

Based on information provided the following appears to be the current procedure

a. Based on an average moisture content of tests on soils taken in the stockpile / borrow areas, a PREDETERMINED optimum moisture is established. This average ranges between 11.5% to 13%.

b. Soils placed as Cat. 1 backfill are tested for moisture content just before compaction, after the fill has been spread in lifts. This before compaction moisture is then compared to the PREDETERMINED optimum moisture content and needs to be within the -3% to +2% of that predetermined value. If within this range, compaction takes place.

REVIEW COMMENTS

The problems with this procedure are:

a. Establishing an AVERAGE optimum moisture content. Not good practice

b. Deciding that the fill moisture is satisfactory Before compaction rather than "as compacted".

c. In essence there is no moisture control in effect. The practice of comparing an averaged PREDETERMINED optimum moisture content with a field moisture result, without regards to the optimum moisture content that is eventually determined for the compacted fill and without regards to the moisture established on the compacted fill in the field density test - this practice is not an acceptable compaction control procedure.

Examples of current practice by GPC :

Test No.	PREDETERMINED opt. m.c.	Moisture in field density test	Opt. Moisture in lab compaction	Actual moisture variance	
~~1/7/83 8554~~	~~12.7%~~	~~8.1%~~	~~8.2%~~	~~-0.1% but 4.5% by GPC~~	
1/6/83 8547	11.7%	7.6%	13.0%	-5.4%	
1/13/83 8596	11.2%	7.6%	13.3%	-5.7	35
1/7/83 8553	12.7%	10.8%	8.2%	+2.6%	

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2. MAX. DRY DENSITY.

I: • Many of the lab compaction tests (ASTM 1557 Modified) appear to be establishing max. dry densities in the range of 103 pcf to 107 pcf which intuitively appear to be 5 pcf to 10 pcf too low. The effect of this occurrence is that the reported percentages of compaction are over 100% which is unlikely and not correct.

(Expected range in max. dry density for the type of m-f sands w/silt being placed in Vogtle's backfill would be for $C_u \approx 2$ expect $\gamma_{d_{max}} = 112$ pcf

if $C_u \approx 4$ expect $\gamma_{d_{max}} = 125$ pcf
if $C_u \approx 5$ expect $\gamma_{d_{max}} = 130$ pcf)

Possible reasons for not attaining max. dry density:

a. Incomplete mixing of water and soil for uniform moisture condition (particularly @ max. density)
b. Insufficient number of water contents to define compaction curve accurately (See attached compaction curves
c. Testing errors (e.g. incorrect volume of mold, non-uniform distribution of rammer blows, etc.)
d. More appropriate to test for max. dry density in relative density test rather than Modified Proctor.

Fortunately the majority of the field density tests reflect $\gamma_{dry} \geqq 108$ pcf and perhaps 10% to 15% of the fill tested for field densities are below 108 pcf (and possibly below 95% of Modified max. dry density)

Recommendations:

GPC should be required to verify their lab compaction testing procedures. Preferable to have independent testing (of present Q/A program) in order to compare with already completed results. Independent firm could also be asked to provide recommendations on how h + to proceed with remaining work (both max. dry density and moisture control). The qualifications of testing firm should be approved by NRR and this firm should be required to provide its proposed testing program for verification before beginning work [Modified vs. Rel. Density; range of materials to be tested; tests to be run (compaction, gradation, A.L where applicable etc.); details for comparing w/ results of current Q/A group.]

Moisture Density Test Data

DATE	SAMPLE NO.
1-6-83	8541

SOIL DESCRIPTION RED BROWN MED. FINE GR. SILTY SAND

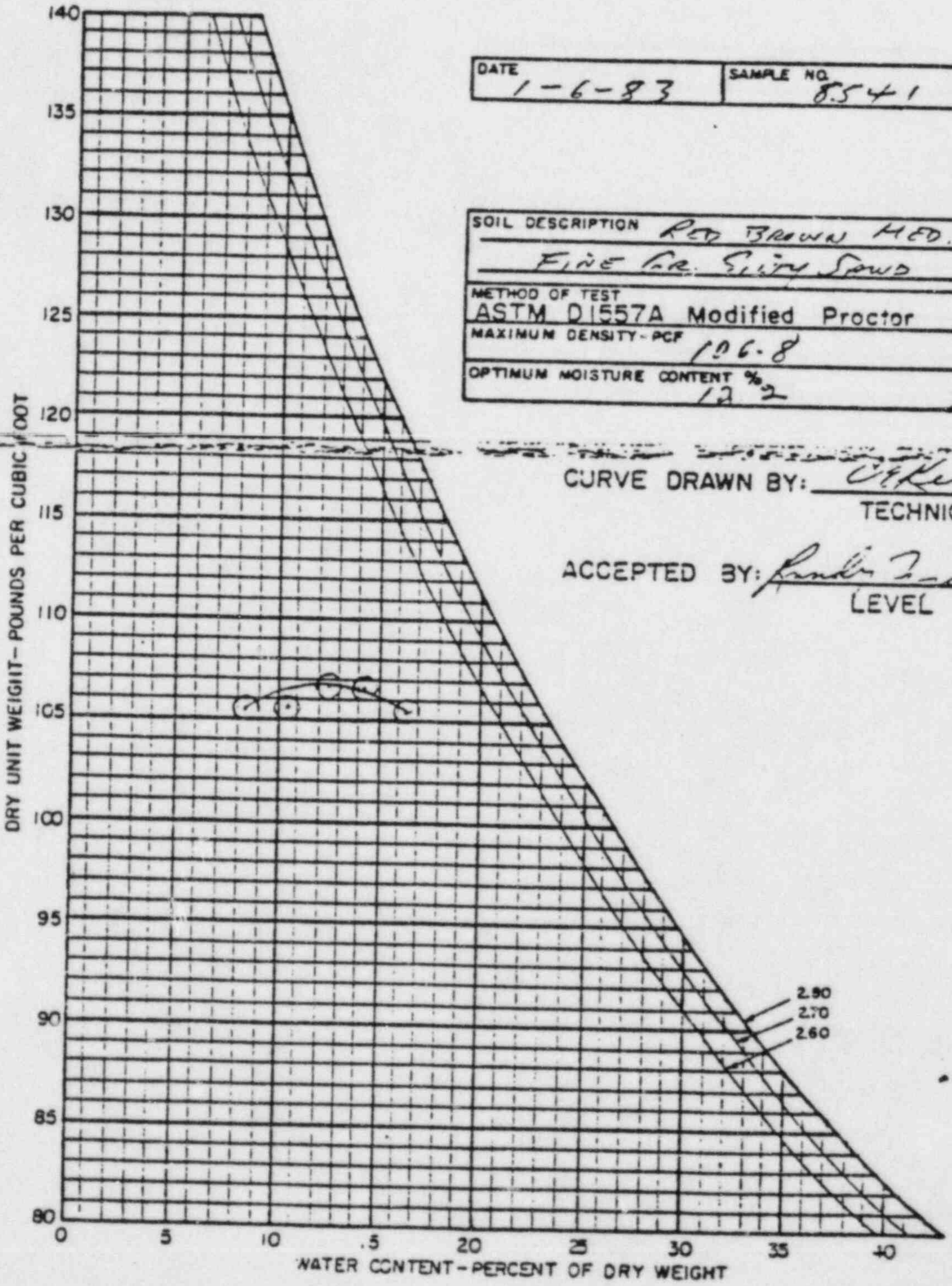
METHOD OF TEST
ASTM D1557A Modified Proctor

MAXIMUM DENSITY-PCF 106.8

OPTIMUM MOISTURE CONTENT % 12.2

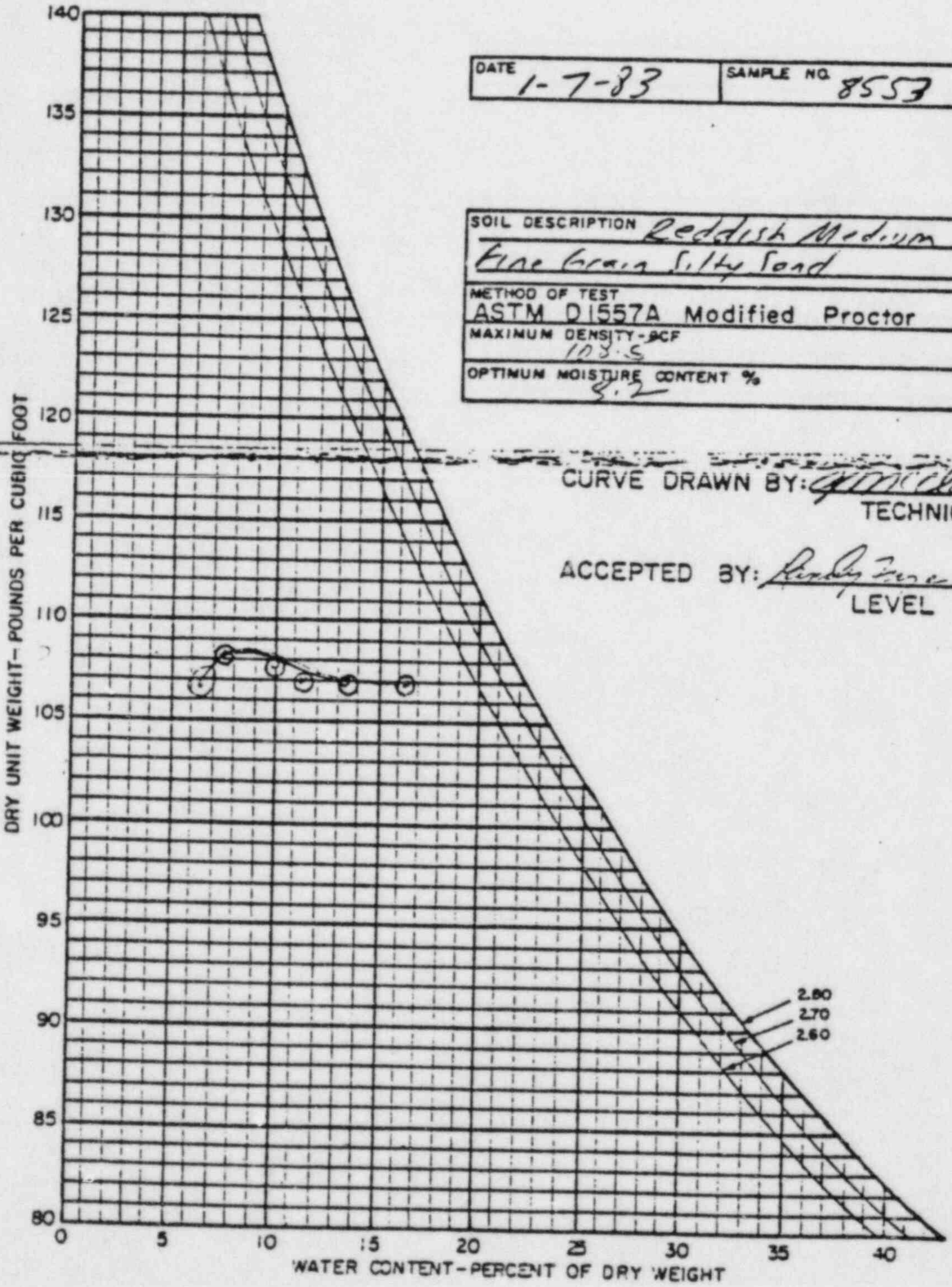
CURVE DRAWN BY: C.F. Kerr
TECHNICIAN

ACCEPTED BY: 1-7-83
LEVEL II



701193

Moisture Density Test Data



DATE 1-7-83

SAMPLE NO. 8553

SOIL DESCRIPTION Reddish Medium Fine Grain Silty Sand

METHOD OF TEST
ASTM D1557A Modified Proctor

MAXIMUM DENSITY-PCF
108.5

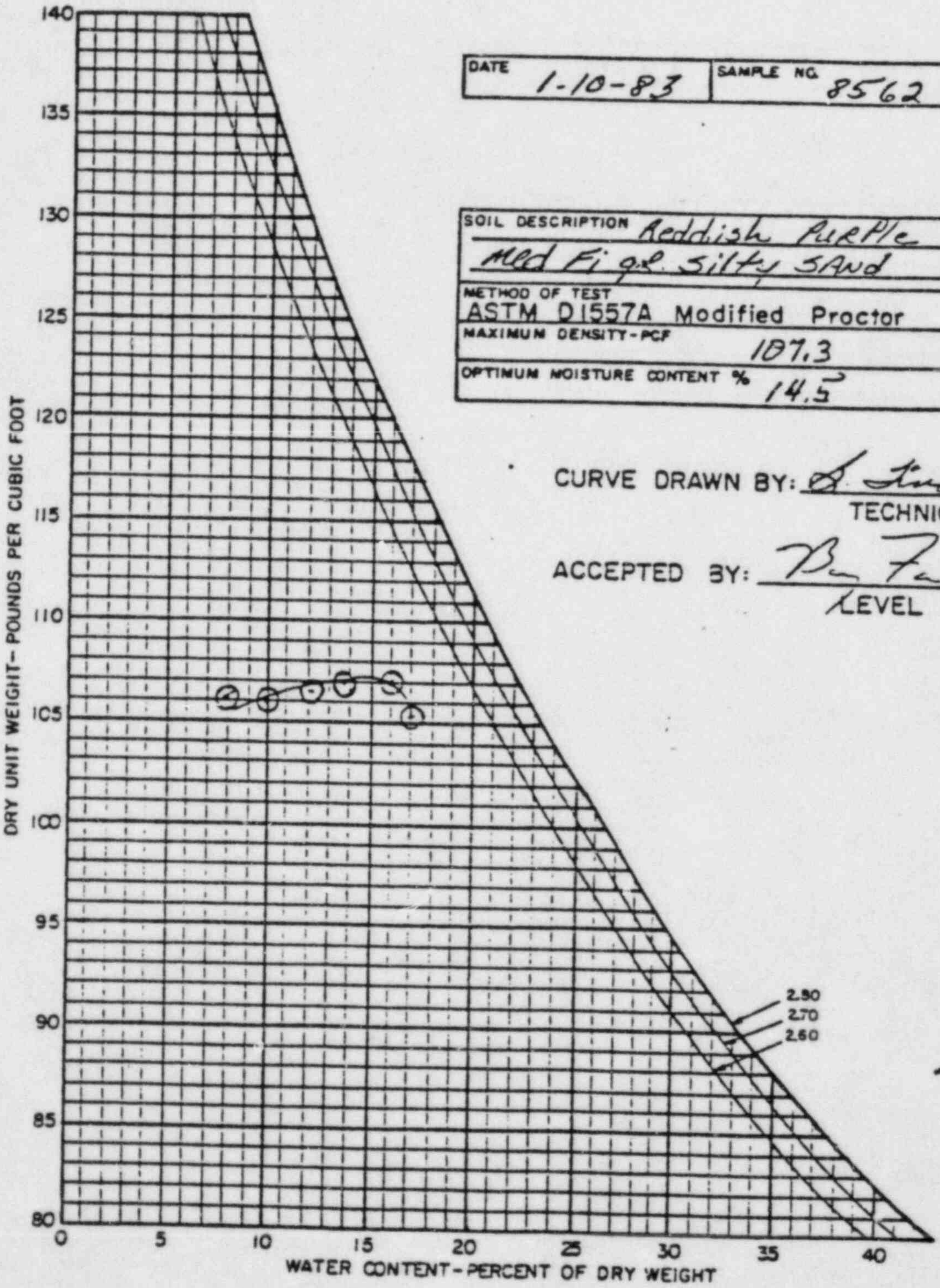
OPTIMUM MOISTURE CONTENT %
8.2

CURVE DRAWN BY:
TECHNICIAN

ACCEPTED BY: 1-8-82
LEVEL II

Moisture Density Test [illegible]

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION PURPOSES



DATE 1-10-83	SAMPLE NO. 8562

SOIL DESCRIPTION Reddish PurPle
Med Fi gr. Silty SAnd

METHOD OF TEST
ASTM D1557A Modified Proctor

MAXIMUM DENSITY-PCF 107.3

OPTIMUM MOISTURE CONTENT % 14.5

CURVE DRAWN BY: S. Tindall
TECHNICIAN

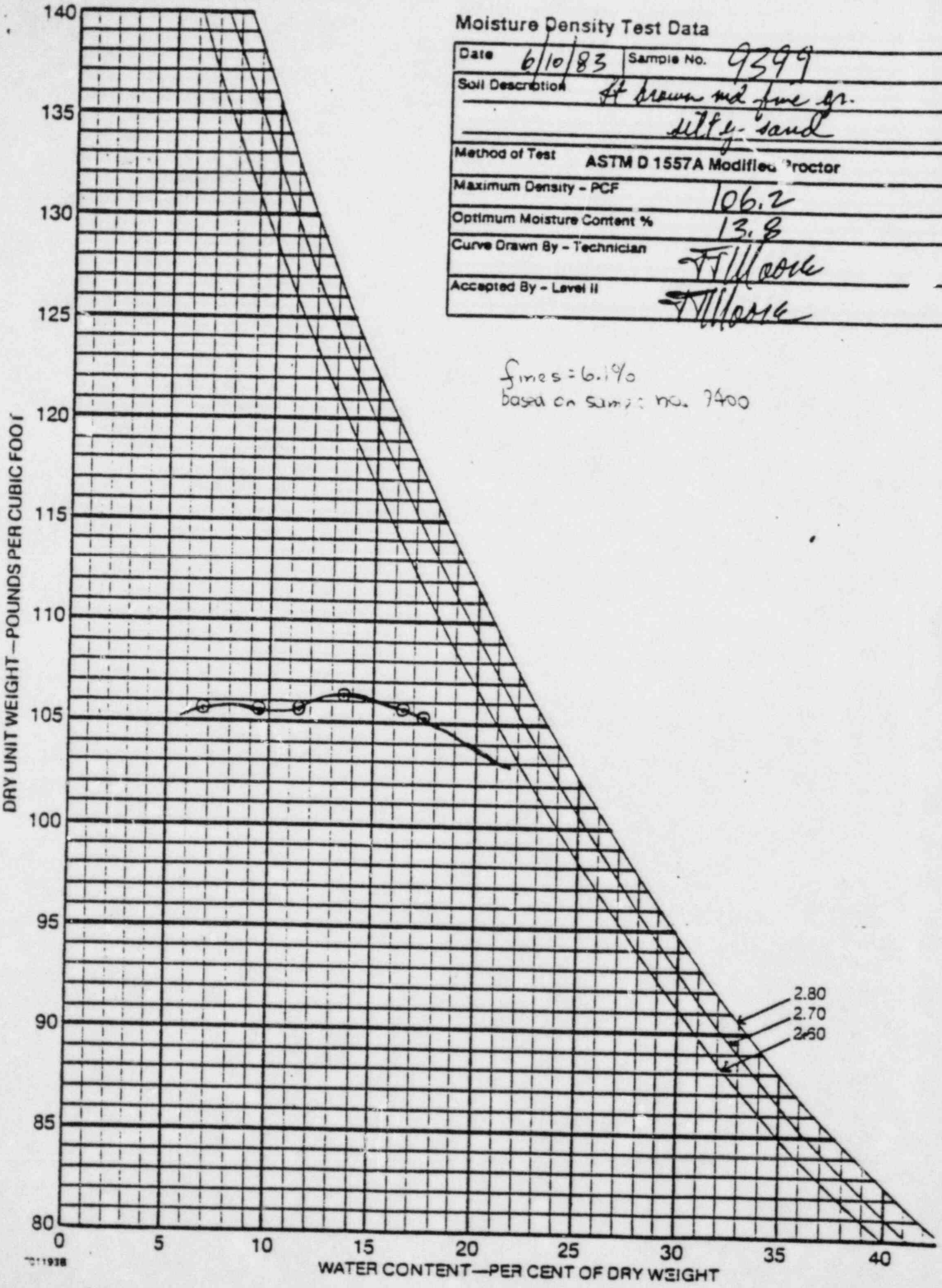
ACCEPTED BY: B. F[illegible]
LEVEL II

⑨

Moisture Density Test Data

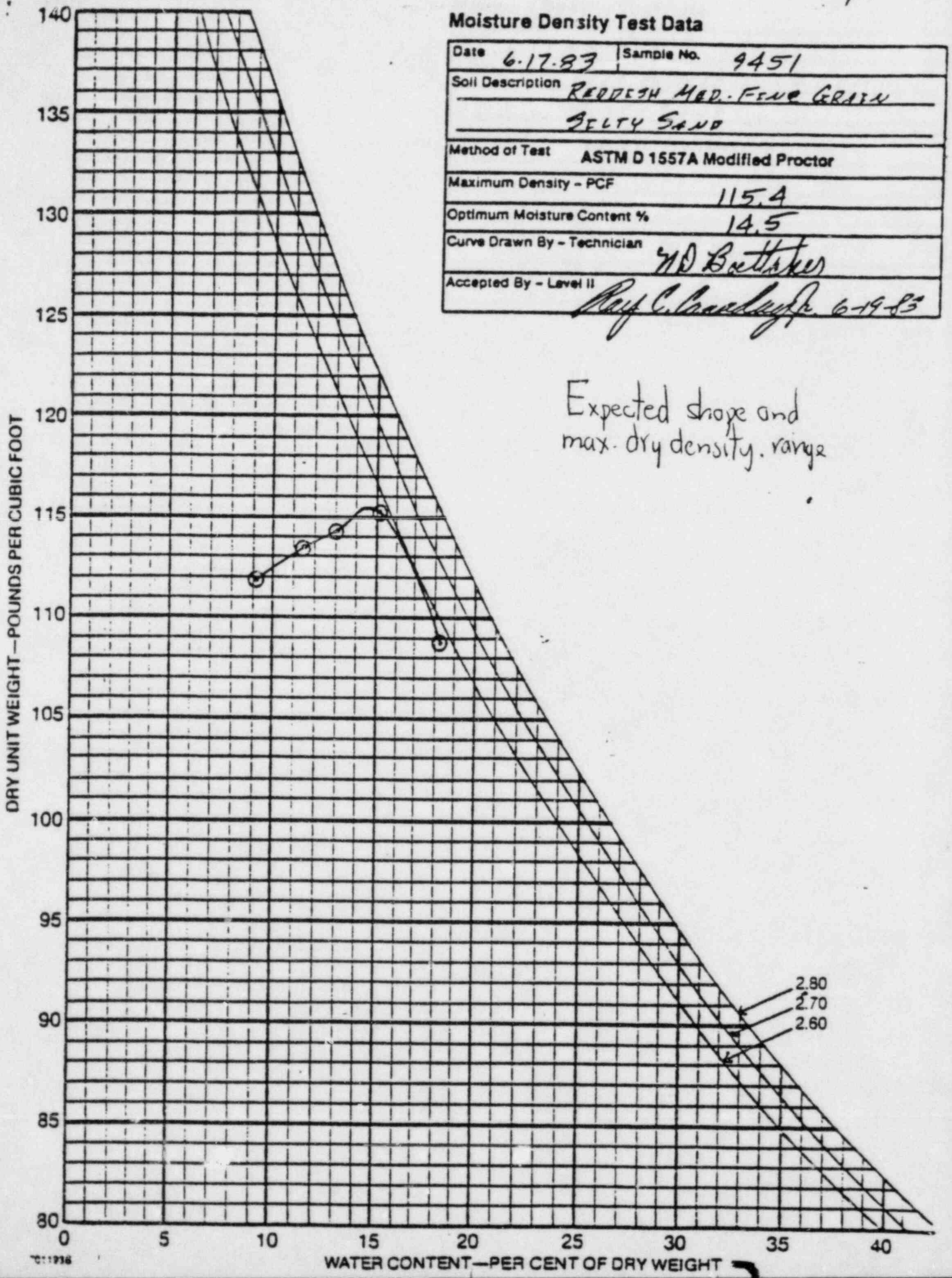
Date	6/10/83	Sample No.	9399
Soil Description	lt brown md fine gr. silty sand		
Method of Test	ASTM D 1557A Modified Proctor		
Maximum Density - PCF	106.2		
Optimum Moisture Content %	13.8		
Curve Drawn By - Technician	Moore		
Accepted By - Level II	Moore		

fines = 6.1%
based on sample no. 9400



Moisture Density Test Data

Date 6.17.83	Sample No. 9451
Soil Description REDDISH MED.-FINE GRAIN SILTY SAND	
Method of Test ASTM D 1557A Modified Proctor	
Maximum Density - PCF 115.4	
Optimum Moisture Content % 14.5	
Curve Drawn By - Technician MD Battaker	
Accepted By - Level II Ray C. Crawley Jr. 6-19-83	



Expected shape and max. dry density. range

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Discuss w/ Melanie Miller (2-4259)

Based on our review of the May 8, 1984 submittal from GPC:

1. We continue to support our recommendations provided in our May 11 '84 letter (transmittal of site visit report) on needed moisture control.

2. Our review of submitted compaction test data has raised a concern as to whether GPC lab testing is actually indicating the max. dry density in the lab compaction test (ASTM D 1557). See discussions w/ L. Heller for resolution.

3. What could happen if independent testing were performed?

Possibility # I. GPC results (as summarized on "Summary of Compacted Fill Tests") would be confirmed. Their current field procedures are allowing them to attain degrees of compaction greater than their FSAR commitments. NRR concern for moisture control would no longer be an issue.

Possibility # II. GPC results are somewhat lower (lab determined max. dry densities are lower) than values by independent group, but when corrected, the degree of compaction is still acceptable ($\geqq 97\%$). Moisture control may or may not be an issue.

Possibility # III. GPC results are significantly lower and the degree of compaction is less than FSAR commitments. In this case future compaction efforts could be corrected. The significance of difference for fill already placed would need to be evaluated. Under future loading conditions (static & earthquake) how would the fill (as placed) perform? (Concern would be for future settlement, liquefaction etc)

Discuss w/ field personnel - what is normally required when fill is brought in from stockpile/borrow area? Is water required to be added (in what quantity? __gallons/__ft^2) Must raise 6 to 8%
How closely does compaction follow the addition of water

5/14/84

water hoses grade to 6"
water truck - grade to 6"
harrow - grade to 6"

General Discussions - Vogtle Project

- What action is taken when testing indicates "FILL FAILURE" (see test no. 9277 (5/25/83) #117 % clay = 8%

Amend May 9 '84

- When will we be receiving GPC response to GES request for information (Feb. 21, 1984)? It is suggested that GPC review the May 11 '84 summary of the March 6-7, 1984, site visit BEFORE mailing responses to check that all agreed upon information is being forwarded.

Still not resolved within GPC

What is the significance of GPC April 23, 1984 letter w/ respect to safety-related piping and potential impact due to liquefaction. Is the details of this "potential deficiency" to be covered in GPC response to one of GES questions (Feb. 21, 1984 ltr. to GPC)? If yes, the response to which question (e.g. Q 241.14 or 241.2?)

Verify that GPC will be providing information in addition to their recent submittal of 5/8/84 in response to Q 241.17. This would include:

See response in May 9 '84 submittal from GPC

1. Identification on settlement plots and summary tables - the dates of significant construct activities (loading, dewatering activities, etc)
2. Tables summarizing settlement history of remaining Cat. 1
3. Missing plots on Towers, ~~[illegible]~~

In Q 241.18 GPC has been requested to compare measured vs. estimated and discuss the significance of recorded settlements

* Indicate that J. Kane will await until all information is submitted in response to NRC Feb. 21 '84 transmittal (24 questions) before responding to GPC. (Avoid piecemeal response)

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Discussions w/Lymon Heller

Indicate w/GPC the need for a confirmatory program to verify adequacy of compaction control program. Needed in order to write SER. Concern is not only with proper moisture control @ placement & compaction but with the apparently low max. dry densities which are being indicated.

Discuss w/GPC their willingness to have an <u>independent</u> firm do confirmatory testing and <u>provide recommendations</u> for controlling the remaining fill. GPC may wish to think about it and get back w/names of several firms who they feel would be acceptable to the NRC. Recommendations by independent group submitted for NRR approval. Could propose modifications to FSAR commitments on both moisture control and max. dry density.

* NRR would want to reach agreement on program by indep. group BEFORE testing was performed.

If GPC is not willing - indicate liklihood that NRC will retain the COE, or outside consultant to perform the confirmatory testing. In this case GPC is requested to forward the "summary of compacted fill tests forms" for testing completed between March 1984 and present date. NRC will select types of materials to be tested based on these results and will ask GPC to obtain and retain large bag samples (in plastic lined) for COE, or consultant testing. These summary forms are needed by May 23, 1984 for NRC to decide what bag samples are needed for testing

Testing by independent group would include:

1. Both Modified Proctor and Relative Density to establish max. dry density for the various types of materials being placed and optimum moisture contents
2. Supporting gradation test
3. Atterburg Limit (as necessory)

Details to be discussed w/independent testing firm:

a. Their procedures for determining what range of soils need to be tested.
b. Their plans for comparing their test results w/lab results of Q/A organization @Vogtle which is responsible for information on form "Summary of Compacted fill tests"
c. Possible recommendations for changes in current field and lab testing procedures in controlling placem

12. FOIA 84-463

Discussed w/Jim Bailey and W. Ferris on 5/24/84. Agreements reached on NRC recommendations for additions. GPC will make arrangements w/Law Engr. and send letter documenting entire program as discussed in teletype and calls at May 23 and 24, 1984.

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NRC Review Comments on GPC Proposed Independent Testing Program

Samples to be shipped to Independent Testing Lab

Soil Type	Material Type	Proposed by GPC No. of Bags	NRC Recommendations
I.	Sand w/less than 5% passing 200	4 bags, approx 100# each thoroughly mixed (S-1, S-2, S-3, S-4)	addt'l. 2 bags approx 100# each UNMIXED (S-9, S-10)
II.	Silty Sand w/5% to 9% fines	2 bags, approx 100# each thoroughly mixed (S-5, S-6)	2 addt'l. bags, approx 100# each UNMIXED (S-11, S-12)
III.	Silty Sand w/9% to 12% fines	2 bags, approx 100# each thoroughly mixed (S-7, S-8)	2 addt'l. bags, approx 100# each UNMIXED (S-13, S-14)

On each bag for each type of material run a series of tests that will include D422 (Particle Size), Modified Proctor D1557 and Relative Density (D2049).

GPC shall be given the same number of bag samples (14 total) and will run D422 and D1557 tests on each bag (no relative density).

GPC is asked to double the amount of record samples that they originally proposed (would retain 28 bags rather than 14). NRC may elect to request testing by COE at some future date. Bags kept for record purposes should be clearly marked and cross-referenced with material tested by Independent testing firm and stored in protected location that is readily accessible.

When obtaining samples in borrow/stockpile areas, the samples should be recovered in a manner that approximates normal field operation procedures (not excavated over a large depth but rather over a wider area such as with a scraper)

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Alternately – take from fill area after placement but before compaction

(W. Ferris – There may be a problem in obtaining samples for all three types of fill after spreading as plant fill. Bechtel will consider taking @ fill location where possible when obtaining to select all three types of soils.

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NRC Review Comments

In recognition of the large volume of soil samples and transportation costs, NRC would recommend acceptance of Law Engineering as the independent testing firm as proposed by GPC.

NRC requests the opportunity to discuss the objectives of the confirmatory testing program with Law Engineering before testing is actually started but after Law Engineering is familiar with the scope of the required lab testing program. NRC may elect to send a representative to the testing lab while testing is being performed and therefore would require sufficient advance notice on dates of actual testing.

Clarify that an independent party will receive the lab testing results from the two testing facilities (Law & GPC) BEFORE they have seen each other's results or BEFORE they have had discussions with each other on the results order to preserve the independence of the testing program

NRC requests that curves of log k (coef. of permeability) versus density be developed by Law Engineering for soil types II and III. (Additional testing request)

Phone Conference - May 16, 1984 - 2:00 p.m., M. Miller's Office

Bechtel	GPC	NRC	Vogtle
M. Perovich	J. Bailley	M. Miller	H. Gregory
Z. Yazdani	R. Thomas	J. Kane	Robt. McManus
Gramroos			Davis
Chakitis			Brooks
John Wisnan			Harvin
Dave Houton			
W. Ferris			

- Gave NRR recommendations for testing by independent group.
- GPC asked to provide the names of 3 testing firms for NRR approval of May 23 '84. NRR would want to meet w/Ind. Group after program is devised but BEFORE start of tests.
- J. Kane estimated actual testing by Independent Group would take about 2 weeks. (For all types of soils placed as Cat. I backfill - run, lab compaction tests (both relative density and Modified Proctor, gradation tests and Atterburg Limits, as necessary)
- J. Kane discussed the possible situations that could develop depending on findings of Independent Group
- W. Ferris referred NRC to results of test fill program - recently submitted
- J. Kane referred W. Ferris to GEI study performed for SCS

Rec'd 5/23/84

VOGTLE - CONFIRMATORY TESTING
by Independent Testing Firm

Southern Company Services
the southern electric system

28747

SOUTHERN COMPANY SERVICES
INVERNESS CENTER PARKWAY
BUILDING 10
BIRMINGHAM ALABAMA
35244

T.C. # ______

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Step # 3 ______

Step # 4 ______

pg. 1's

VOGTLE ELECTRICAL GENERATING PLANT
UNITS 1 & 2

CONFIRMATORY LABORATORY TESTING PROGRAM FOR CATEGORY 1 BACKFILL

INTRODUCTION

As part of their evaluation of the backfill compaction data, the Nuclear Regulatory Commission (NRC) has requested that some confirmatory laboratory tests be performed on representative samples of Category 1 backfill material using recognized standard testing procedures. The purpose of the testing is to verify maximum dry density values used by Georgia Power Company (GPC) to determine the degree of compaction achieved in the field. A total of eight samples, representative of the Category 1 backfill material, will be tested. The testing will be performed by an independent testing laboratory acceptable to the NRC, GPC and Bechtel. A brief description of the testing program and names and addresses of three testing laboratories acceptable to Bechtel and GPC are given below. The testing will commence as soon as NRC, GPC and Bechtel agree on the choice of the testing laboratory.

(1) WOODWARD CLYDE CONSULTANTS
201 Willowbrook Blvd.
Wayne, N. J. 07470
Telephone: (201) 785-0700

(2) LAW ENGINEERING TESTING COMPANY
396 Plasters Ave. N.E.
P. O. Box 13260
Atlanta, GA 30324
Telephone: (404) 873-4761

(3) DAMES AND MOORE
14 Commerce Drive
Cranford, N.J. 07016
Telephone: (201) 272-8300

The testing laboratory selected shall perform the required testing and submit copies of the test data to Georgia Power Company. Copies of parallel test data developed by GPC along with data received from the testing laboratory shall be forwarded by GPC to Southern Company Services (SCS). The complete set of test data received by SCS will then be transmitted to the NRC and Bechtel so that a comparison of the data received from the two sources can be made. The entire testing program from the time of receipt of the samples by the testing laboratory is not expected to exceed 2 weeks.

SCOPE OF LABORATORY TESTING

The following laboratory tests shall be performed on representative samples of the backfill material.

No.	Type of Test	ASTM Designation
1	Particle Size Analysis of Soils	D 422
2	Moisture - Density Relations of Soils and Soil-Aggregate Mixtures using 10 lb (4.54 KG) Rammer and 18-in (457-mm) Drop	D 1557 (Method A)
3	Relative Density of Cohensionless Soils	D 2049

The above laboratory tests shall be performed on the following three types of Category 1 backfill.

1. Sand with less than 5% passing the US No. 200 sieve size.
2. Silty sand with 5 to 9% passing the US No. 200 sieve size.
3. Silty sand with 9 to 12% passing the US No. 200 sieve size.

A total of 4 series of tests (ASTM D 422, D 1557 Method A, D 2049) shall be performed on material with 5 percent or less fines, by the testing laboratory. A total of 2 series of tests each shall be performed on soil types 2 and 3 described above by the testing laboratory. Georgia Power Company shall perform the ASTM D 422 and 1557 tests on split samples of all three soil types.

Indepnt- 4+2+2 = 8 bags
GPC / 4+2+2
Record

SAMPLING

Sampling of the backfill material shall be done by GPC. For each series of tests a minimum of 100 lbs of sample will be required. In order to obtain 100 lbs of sample for the testing laboratory, GPC shall sample approximately 300 lbs of material of each soil type from the borrow or stockpile area. The large sample shall be thoroughly mixed in the field laboratory and then subdivided into 3-100 lb test samples. One sample shall be shipped to the selected testing laboratory and the other two shall be retained by GPC. Of the two retained samples, one shall be used for testing by GPC and the other shall be stored for record purposes.

Prior to shipping, testing and storing samples, GPC shall perform a minimum of one gradation test in accordance with ASTM D 1140 on material obtained by quartering from each 100-lb sample. The purpose of the ASTM D 1140 test is to determine percent passing the US No. 200 sieve size. This will help GPC establish whether the samples selected for testing will meet the criteria with respect to soil types defined earlier in the program. The above procedure of obtaining and selecting samples shall be followed for all eight test samples.

All samples for shipping shall be placed in double plastic-lined bags to decrease the probability of bag breakage. These bags shall then be placed in strong wooden boxes and shipped to the testing laboratory. The sample bags shall be identified as Samples Nos. S-1 through S-8. The same identification numbers shall be used for the corresponding storage samples and corresponding samples to be tested by GPC. Storage samples shall also be placed in plastic-lined bags. Samples that are shipped and stored shall have duplicate identification tags, one on the outside of the plastic-lined bags and the other with the soil inside the bag.

13. FOIA 84-463

Conference Call @ 1:10 p.m. 6/6/84

GPC	NRC	Bechtel	Law
J. Bailey	M. Miller	W. Ferris	Allan Lancaster
~~A. Lancaster~~	J. Kane	Yanzani	
		M. Perovich	

Questions:

Where will testing be performed? (Address)

When will Modif. Proctor & Rel. Density Tests be run? (Dates)

Have the materials for testing been provided to Law?
Were the samples taken from stockpile or after placement as fill?

What steps are being taken to assure that the testing will be independently performed and reported to the NRC.?
When could these results be expected?

Following submittal of data (Independent & Vogtle Field Labs) to NRC, we would anticipate a letter report that would:

1. Compare the test results from the two labs & provide evaluation
2. Comment on the adequacy & accuracy of testing already completed & listed in "Summary of Compacted Fill Tests on fill already
3. Provide recommendations for changes/modifications to FSAR commitments, if confirmatory testing indicates it is needed for control of remaining fill to be placed

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1 of 2
J. Kane

Preparation for Vogtle Conference Call

Check w/ Melanie Miller (2-4259)

Has GPC documented the confirmatory testing program as discussed 5/24/84?

Is call still scheduled @ 1:00pm

Major Objectives of Confirmatory Testing Program: (From NRC point of view)

1. To determine lab max. dry density for Vogtle types of plant fill (<5%; 5 to 9% & 9 to 12% fines) using ASTM D2049 (Relative Density) and ASTM D1557 (Modified Proctor.
2. To help decide whether Vogtle's plant fill has been well compacted.
3. To reexamine Vogtle's FSAR commitments on compaction control (specifically attaining 97% max. dry density (Modf. Proctor) and ± 2% of opt. moisture) and determine if there is a need for either modifying the FSAR commitments or the field and lab compaction testing procedures that are currently required (e.g. moisture content).

Other Objectives:

1. Confirm the adequacy and accuracy of current field testing procedures or make necessary changes, where warranted.

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J. Kane

Scope of Confirmatory Testing Program:

Questions of Law Engr.

1. Lab testing will include:

a. Relative Density ASTM D 2049-69

Look @ COE manual what is indicated w/ respect to variations in frequency

set @ max amplitude

Need to run both wet & dry methed to establish m density

Will amplitude of vibrations be changed
(ASTM requires vibration control @ max amplitude
(3600 vibrations per minute

b. Modified Proctor ASTM D1557

what is Law's anticipated shape of compaction curve for these granular mat'ls

Importance of finding max. dry density and effect of "near" saturation.? 2 pts wet of

Discourage "reuse" of sample mat'l. in compaction test — will not reuse

How is high moisture content maintained in test compaction specimens? (From compact. specimen)

Ask for lab procedure in obtaining m.c. of test specimen (NRC asked also that sample be taken when place in mold (before compaction)

c. Particle Size ASTM D422
(Hydrometer for Type III mat'l 9 to 12% fines)
Sieve to 200 sieve

2431

d. Permeability ~~ASTM D~~ COE Procedure App VII 1110-2-1906
(for k versus density curve for types II & III materials)
Bechtel - asking for back pressure OK if density measured, after backpressure
-select one in 5 to 9%
9 to 12%

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For Soils w/ fines <u>between 9 and 12%</u>

	Test No.	% Fines	Lab γmin pcf	opt m.c (%)
1/29	8635	9.2	* 109.2	12.5%
2/5	8650	10.5	* 116.5 Highest 8650	11.0%
2/25	8735	11.0	* 113.4	12.4%
4/26	9040	11.0	105.3 Lowest 9043	
4/26	9045	12.3	114.9	
4/28	9065	11.6	115.3	
6/7	9385	9.7	* 110.3	14.8
6/26	9515	10.9	113.1	

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For Soils <u>w/ less than 5% fines</u>

	Test No.	% Fines	Lab $\gamma_{max\,dry}$ (pcf)	Opt m.c. (%)
5/8	9130	3.3	* 105.5	13.8
5/9	9140	2.7	* 103.8	15.3
5/9	9145	4.5	* 104.6	13.2
5/11	9155	4.6	100.7	
5/12	9160	4.4	104.1	
5/13	9165	3.3	107.2	
5/13	9170	1.6	107.2	
5/14	9175	3.0	* 102.4	13.0
5/15	9180	4.9	104.2	
5/17	9190	1.8	101.8	15.2
5/17	9195	2.1	101.8	
5/17	9200	2.3	102.7 Lowest	
5/17	9205	1.8	* 99.7 9205	12.1
5/18	9210	3.0	* 102.9	14.3
5/19	9220	2.8	100.0	
5/19	9225	4.2	106.7	
5/20	9230	3.7	102.7	
5/20	9235	3.6	99.6 9223	
5/21	9240	3.6	* 103.8	11.0 lowest
5/22	9245	3.6	106.9	
5/22	9250	4.0	106.9	
5/24	9260	4.3	108.7	
5/25	9275	4.4	107.3	
5/25	9280	3.9	104.6	
5/26	9290	4.2	105.7	
5/30	9330	4.6	106.5	
6/2	9360	4.9	* 105.8	15.4
6/3	9370	4.7	107.1	
6/18	9460	4.3	* 105.7	15.3
6/19	9470	4.0	104.3	

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For Soils w/ Less than 5% Fines

	Test No.	% Fines	Lab $\gamma_{dry\ max}$ (pcf)	Opt. m.c. (%)
6/21	9485	3.8	106.2	
6/25	9500	4.2	101.0	
6/26	9510	3.3	103.9	

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For Soils w/fines between 5 to 9%

	Test No.	% Fines	Lab γ_{max} (pcf)	opt. m.c (%)
1/5	8540	8.0	* 111.3	10.5%
1/6	8545	6.4	104.9	~~[illegible]~~
1/7	8550	9.0	* 112.2	11.2%
1/8	8560	9.0	* 110.1	11.4%
1/10	8565	8.7	112.5 ✓	
1/10	8570	8.9	112.3	
1/11	8575	8.5	* 110.8	12.3%
1/12	8580	7.3	* 107.8	12.6%
1/12	8585	6.2	107.8	
1/13	8590	5.5	105.4	
1/13	8595	5.8	105.4	
1/15	8600	7.3	107.5	
1/16	8605	8.8	104.8	
1/18	8610	7.6	* 107.3	13.5%
1/22	8615	8.6	* 108.8	13.3%
1/23	8620	7.7	* 107.6	11.0%
1/24	8625	7.9	* 107.7	12.5%
1/25	8630	6.0	* 102.4	13.5%
1/30	8640	5.7	* 105.2	13.0%
2/1	8645	8.4	* 110.8	4.0%
2/6	8655	5.0	* 105.0	13.5%
2/9	8660	8.8	* 111.8	13.3%
2/11	8665	9.0	* 106.2	11.5%
2/18	8695	6.3	* 101.2 ✓	12.5%
2/19	8700	8.3	* 108.8	10.8%
2/20	8705	7.2	* 108.3	13.2%

*Actual lab compaction test run on test sample (not inferred)

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For Soils w/fines between 5 to 9%

	Test No.	% Fines	Lab γmax (pcf)	opt m.c. (%)
~~2/24~~	~~8710~~			
2/24	8725	8.0	* 109.3	10.0
2/26	8740	5.2	* 104.9	14.4
2/28	8745	5.1	104.7	
2/28	8750	7.6	104.7	?
3/3	8755	7.0	* 110.8	13.2%
3/4	8760	8.6	106.0	
3/4	8765	5.8	106.0	
3/5	8770	7.2	107.9	
3/8	8775	7.0	101.8 ✓	
3/9	8780	7.6	* 110.6	13.7%
3/12	8795	7.5	* 110.8 ✓	7.8% Lowest
3/14	8810	7.0	* 108.3	14.5%
3/15	8815	5.9	* 108.4	15.0%
3/16	8820	5.5	* 107.7	13.4%
3/18	8825	6.5	* 103.8	13.3%
3/20	8835	7.0	104.8	
3/22	8850	8.3	107.5	
3/22	8855	6.0	104.8	
3/28	8880	5.2	* 107.2	13.8%
3/28	8885	6.4	* 108.6	12.8%
3/30	8895	5.1	* 108.0	14.5%
3/30	8900	5.7	* 110.1	14.0%
4/1	8905	8.9	* 106.4	11.9%
4/2	8910	6.7	101.8 ✓	
4/3	8915	8.4	* 108.9	13.0%
4/3	8920	8.1	105.8	
4/4	8930	8.0	* 110.0	12.1%
4/5	8935	6.7	109.7	
4/6	8940	6.5	* 107.1	12.3%

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For Soils w/fines between 5 to 9%

	Test No.	% Fines	Lab $\gamma_{max\,dry}$ (pcf	opt m.c.(%)
4/7	8945	6.4%	105.8	
4/12	8950	6.0%	* 107.8	15.0%
4/12	8955	8.0%	108.6	
4/13	8960	6.3%	108.5	
4/13	8965	6.9	114.7 ✓	
4/14	8970	7.0	* 105.9	12.8%
4/16	8975	6.1	105.3	
4/17	8985	7.9	* 111.5	12.5%
4/18	8995	5.3	* 107.2	11.7%
4/20	9002	6.0	106.2	
4/20	9010	8.9	102.5	
4/21	9015	6.8	* 108.4	9.0
4/22	9020	5.9	109.7	
4/25	9030	7.7	* 111.1	12.8
4/25	9035	7.3	* 109.6	11.7
4/27	9055	5.9	105.1	
4/28	9070	5.2	102.2	
4/29	9075	5.1	103.8	
4/30	9085	6.4	114.6	
5/2	9090	7.4	* 108.9	14.0
5/3	9095	9.0	105.2	
5/4	9100	7.4	101.8 ✓	
5/6	9115	5.9	* 105.8	13.7
5/8	9135	6.5	105.5	
5/11	9150	6.8	100.7	[illegible]
5/16	9185	6.4	* 108.2	13.3
5/19	9215	6.1	* 106.7	15.5
5/23	9255	7.0	* 108.7	8.0
6/24	9265	5.4	108.7	
5/25	9285	5.2	104.6	
5/27	9295	5.4	107.7	

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For Soils w/Fines Between 5 to 9%

	Test No.	% Fines	Lab $\gamma_{d\,max}$	Opt m.c.(%)
5/27	9300	5.9	107.7	
5/28	9305	6.0	109.7	
5/28	9310	5.0	109.7	
5/28	9315	5.0	109.9	
5/29	9320	6.2	110.5	
5/29	9325	7.3	110.5	
6/1	9340	6.7	109.8	
6/1	9345	6.3	109.8	
6/1	9350	6.8	103.9	
6/2	9355	5.7	106.1	
6/3	9365	6.0	107.1	
6/4	9375	5.9	108.8	
6/4	9380	6.4	115.2	
6/9	9390	7.3	* 108.7	15.0
6/10	9395	6.7	* 109.0	14.2
6/10	9400	6.1	106.2	
6/11	9405	7.4	* 111.7	13.8
6/12	9410	6.0	* 107.6	14.5
6/13	9415	5.2	110.0	
6/13	9420	7.3	* 105.5	14.6
6/14	9425	8.7	111.8	
6/15	9430	8.6	* 112.5	13.2
6/16	9435	6.1	104.7	
6/16	9440	6.5	108.4	
6/17	9445	7.4	115.4 9451 Highest	
6/17	9450	6.5	115.4 9451	
6/18	9455	8.0	103.8 ✓	
6/18	9465	5.8	109.3	
6/19	9475	8.1	104.3	

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For Soils w/ Fines between 5 to 9%

	Test No.	%Fines	Lab $\gamma_{dry\,max}$ (pcf)	Qt mc(%)
0	9480	8.9	105.4	
1	9490	8.3	106.2	
4	9495	8.4	* 108.3	13.5
5	9505	5.8	101.0 9503 Lowest	
8	9520	7.8	107.6	
29	9525	8.3	* 111.4	15.2 Highest
30	9530	6.0	* 106.4	14.0

FOIA 84-403

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Vogtle Compaction Control Test Results for Jan-Jun, 1983 Period

Note - Only soils w/gradation test results have been listed

For Soils <u>w/ less than 5% fines</u>

*Actual lab compaction test run on sample (Not Inferre

	Test No.	% Fines (Passing #200 sieve)	Lab γ_{max} (pcf)	opt. m.c. (%)
2/11	8670	4.1	* 103.2	13.2%
2/12	8675	4.2	* 102.7	
2/15	8680	3.0	* 104.0	14.5%
2/16	8685	3.4	* 102.3	14.2%
2/18	8690	3.3	101.2	
2/21	8710	2.3	* 102.6	17.6% Highest
2/22	8715	3.2	* 103.3	15.3%
2/25	8730	3.0	* 101.8	15.2%
3/10	8785	3.8	* 108.3	14.0%
3/11	8790	2.3	* 101.1	11.8%
3/13	8800	4.4	106.4	
3/13	8805	3.3	109.7 Highest 8197	
3/19	8830	3.9	104.2	
3/20	8840	4.3	102.4	
3/22	8845	1.9	* 104.8	15.8%
3/23	8860	4.8	106.4	
3/26	8870	4.7	104.1	
3/26	8875	4.9	* 104.1	12.5%
4/4	8925	3.0	108.7	
4/16	8980	3.5	* 103.0	15.1%
4/17	8990	4.6	106.3	
4/27	9050	2.6	* 103.1	13.8
4/28	9060	4.7	* 105.1	12.8
4/29	9080	3.1	103.8	
5/5	9105	2.9	* 102.5	16.8
5/5	9110	2.9	106.6	
5/7	9120	4.8	* 106.0	15.1
5/7	9125	4.8	107.4	13.0

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For Soils w/ fines between 9 and 12%

	Test No.	% Fines	Lab γ_{max} pcf	opt m.c (%)
1/29	8635	9.2	* 109.2	12.5%
2/5	8650	10.5	* 116.5 Highest 8650	11.0%
2/25	8735	11.0	* 113.4	12.4%
4/26	9040	11.0	105.3 Lowest 9043	
4/26	9045	12.3	114.9	
4/28	9065	11.6	115.3	
6/7	9385	9.7	* 110.3	14.8
6/26	9515	10.9	113.1	[redacted]

15. FOIA 84-463

6/12/84
1 of 1
J. Kane

Subvect: Summary of Vogtle's Compaction Control Test Results for Period of Jan – June 1983 (For soils with gradation test results only)

Type 1 **Soils w/ less than 5% fines**

Range of $\gamma_{dry\,max}$ – From 99.6 pcf to 109.7 pcf (See attached lab data sheet
Range of optimum moisture content – From 11% to 17.6%

Type 2 **Soils w/ Fines between 5% to 9%** (Major type of fill placed)

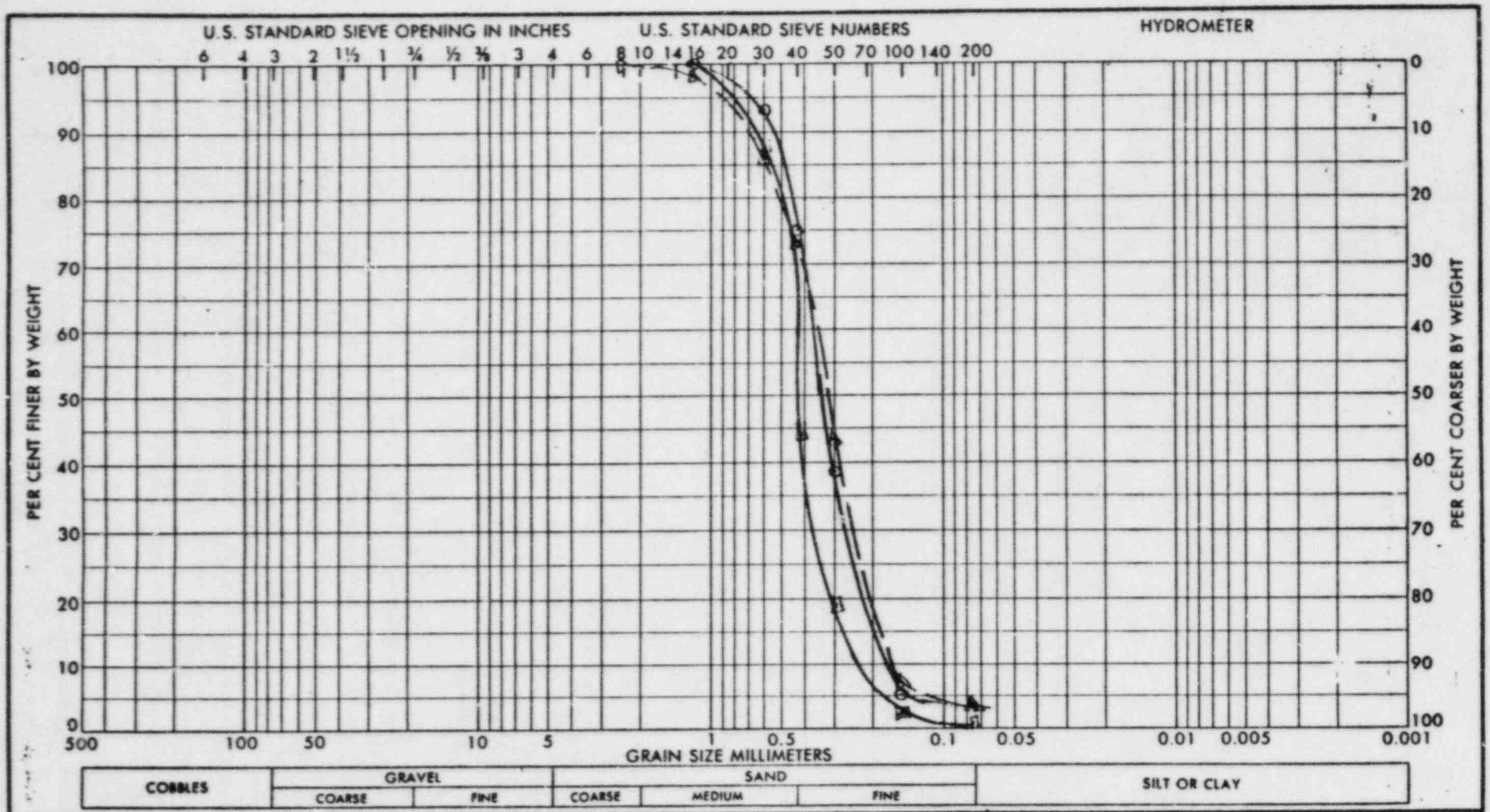
Range of $\gamma_{dry\,max}$ – From 101 pcf to 115.4 pcf (See attached lab data sheets
Range of optimum moisture content – From 7.8% to 15.2%

Type 3 **Soils w/ Fines between 9% to 12%** (Smallest volume of fill type p

Range of $\gamma_{dry\,max}$ – From 105.3 pcf to 116.5 pcf (See attached lab data sheets
Range of optimum moisture content – From 11% to 14.8%

Comments: The gradations for the three types of fill are very similar and it is highly unlikely that they would be distinguishable by eye
The reasons for the wide differences in max. dry densities (e.g. for type 2, range betw 101 pcf to 115 pcf) for these seemingly similar materials are not understood. Are the low values of max. dry densities a result of lab testing procedures which require special care and precautions in order to assure that the effects of bulking (or other factors are eliminated? If there are factors in the lab which make these materials sensitive to dense compaction, then these same sensitive factors would have to be addressed and handled in field compaction (e.g. producing near saturatio in order to obtain max. dry densities)

(over)



SAMPLE NO.	ELEV OR DEPTH		CLASSIFICATION	NAT W%	LL	Test No.	γ_{dry} pcf
8805	3/13/83	⊙	Fine uniform SAND $C_u = 2.1$			8797	109.7
9235	5/21/83	△	m-f SAND $C_u = 2.1$			9228	99.6
9205	5/17/83	⊡	$C_u = 1.7$			9205	99.7

PROJECT Vogtle Project

Fill Soils w/less than 5% Fines

AREA

BORING NO.

DATE Jun 12, 1984

GRADATION CURVES

ENG FORM 2087
1 MAY 63

REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE.

(TRANSLUCENT)

U S GOVERNMENT PRINTING OFFICE 1963 OF—709-129

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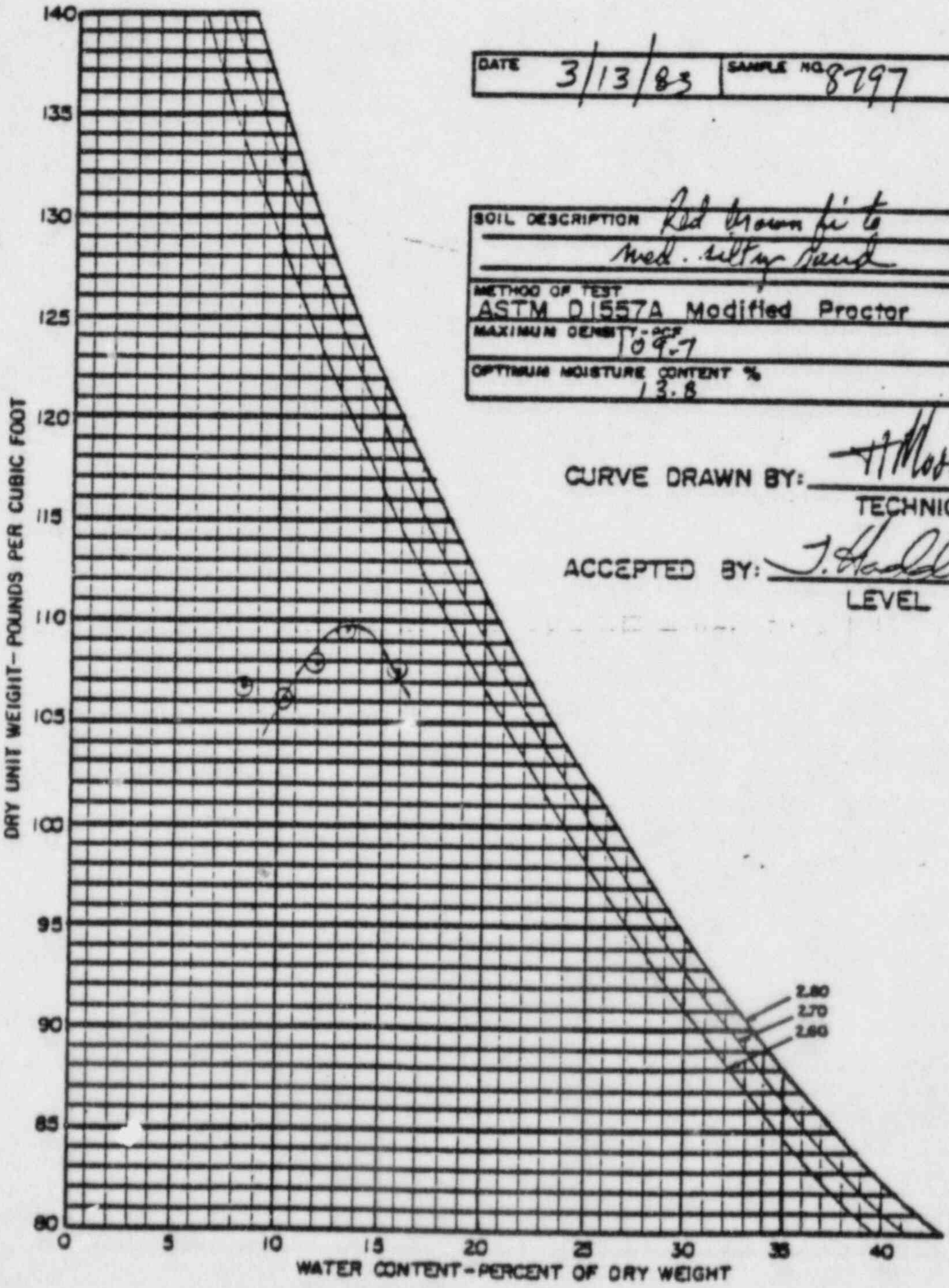
Moisture Density Test Data



DATE 3/13/83

SAMPLE NO. 8797

SOIL DESCRIPTION Red brown fi to med. silty sand

METHOD OF TEST
ASTM D1557A Modified Proctor

MAXIMUM DENSITY–PCF
109.7

OPTIMUM MOISTURE CONTENT %
13.8

CURVE DRAWN BY: H Mosley
TECHNICIAN

ACCEPTED BY: T. Haddon 3-15-83
LEVEL II

701193

Moisture Density Test Data

Date 5-17-83 Sample No. 9205

Soil Description LT. RED MED.-FINE GRAIN SILTY SAND

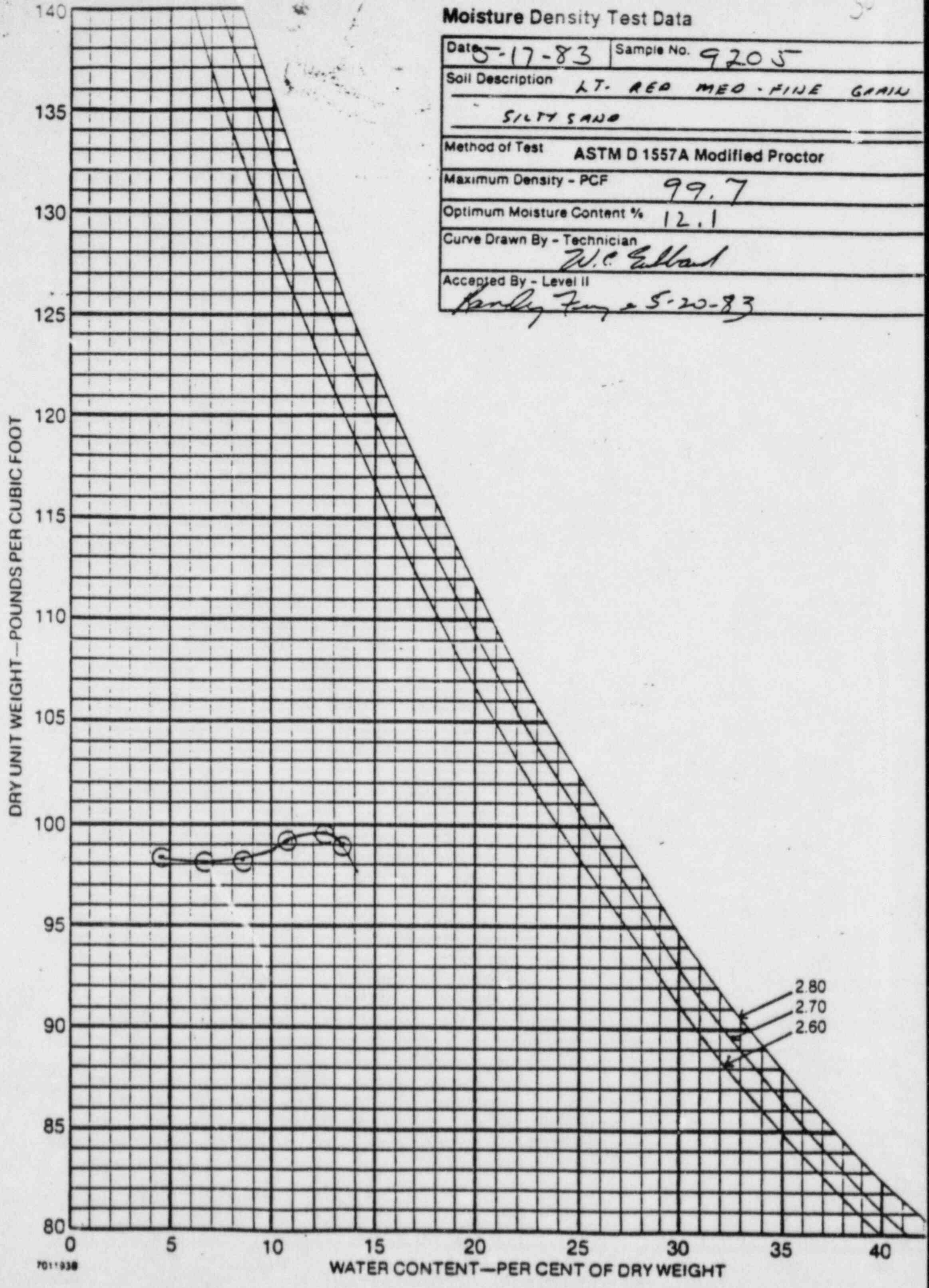
Method of Test ASTM D 1557A Modified Proctor

Maximum Density - PCF 99.7

Optimum Moisture Content % 12.1

Curve Drawn By - Technician W.C. Eubank

Accepted By - Level II 5-20-83



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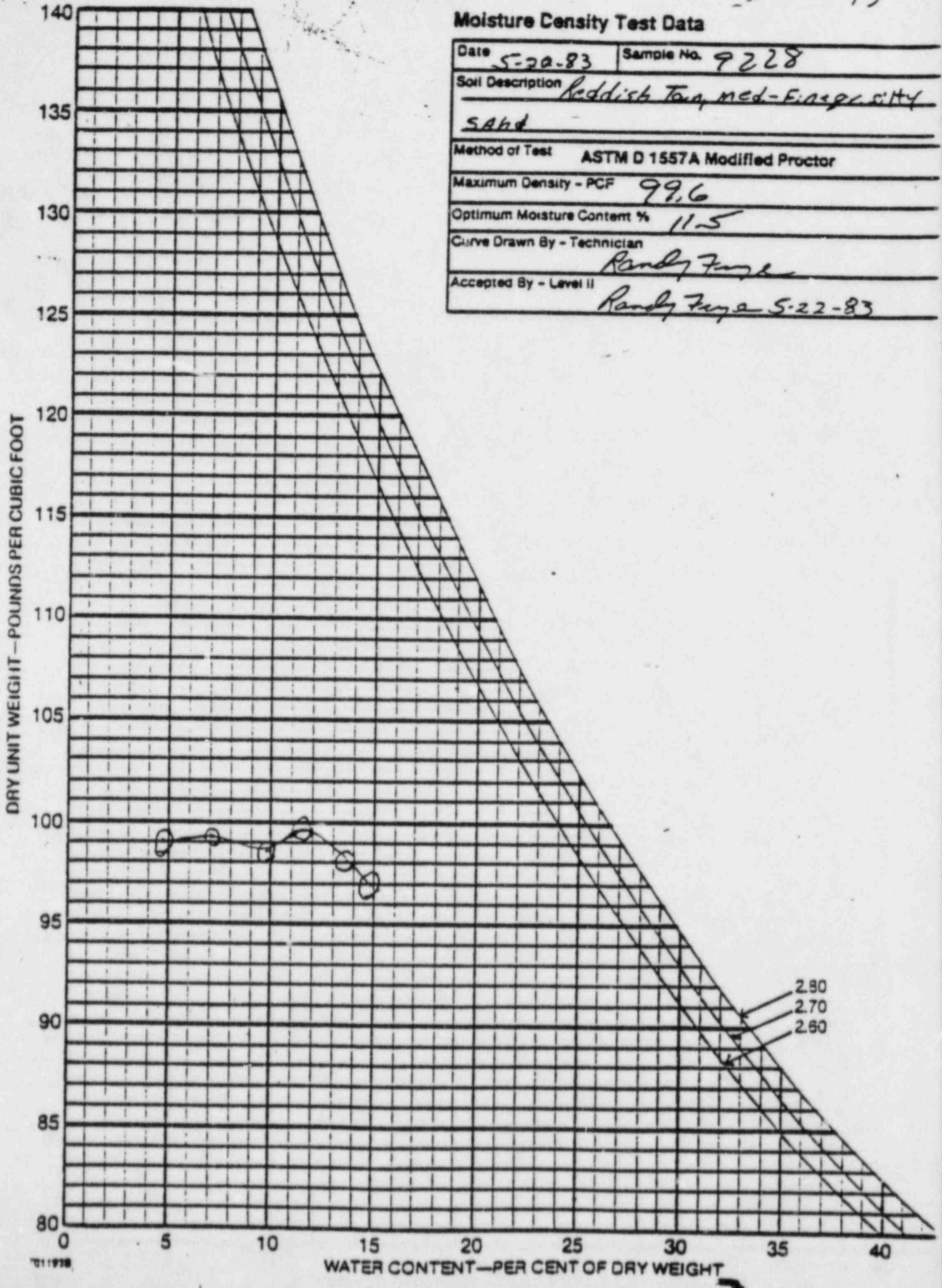
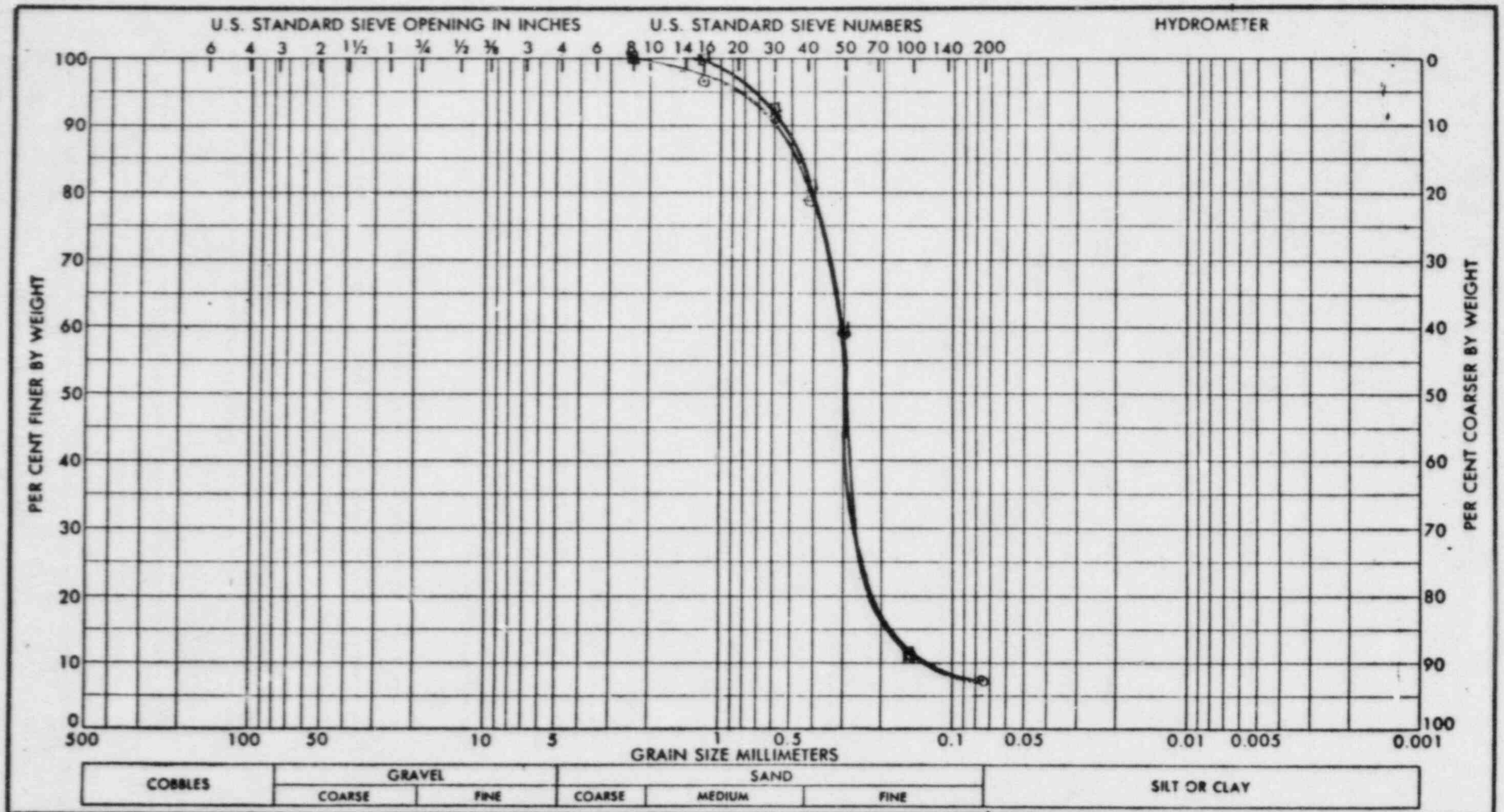
Moisture Density Test Data

Date 5-20-83
Sample No. 9228
Soil Description Reddish Tan, med-Fine gr. silty sand
Method of Test ASTM D 1557A Modified Proctor
Maximum Density - PCF 99.6
Optimum Moisture Content % 11.5
Curve Drawn By - Technician Randy Faye
Accepted By - Level II Randy Faye 5-22-83





SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	Test No.	γdry = pcf
9445	6/17/83 ⊙	Cu = 2.1			9451	115.4
9505	6/25/83 △	Cu = 2.1			9503	101.0

PROJECT Vogtle Project

Fill Soils w/Fines between 5 to 9%

AREA

BORING NO.

DATE Jun 12, 1984

GRADATION CURVES

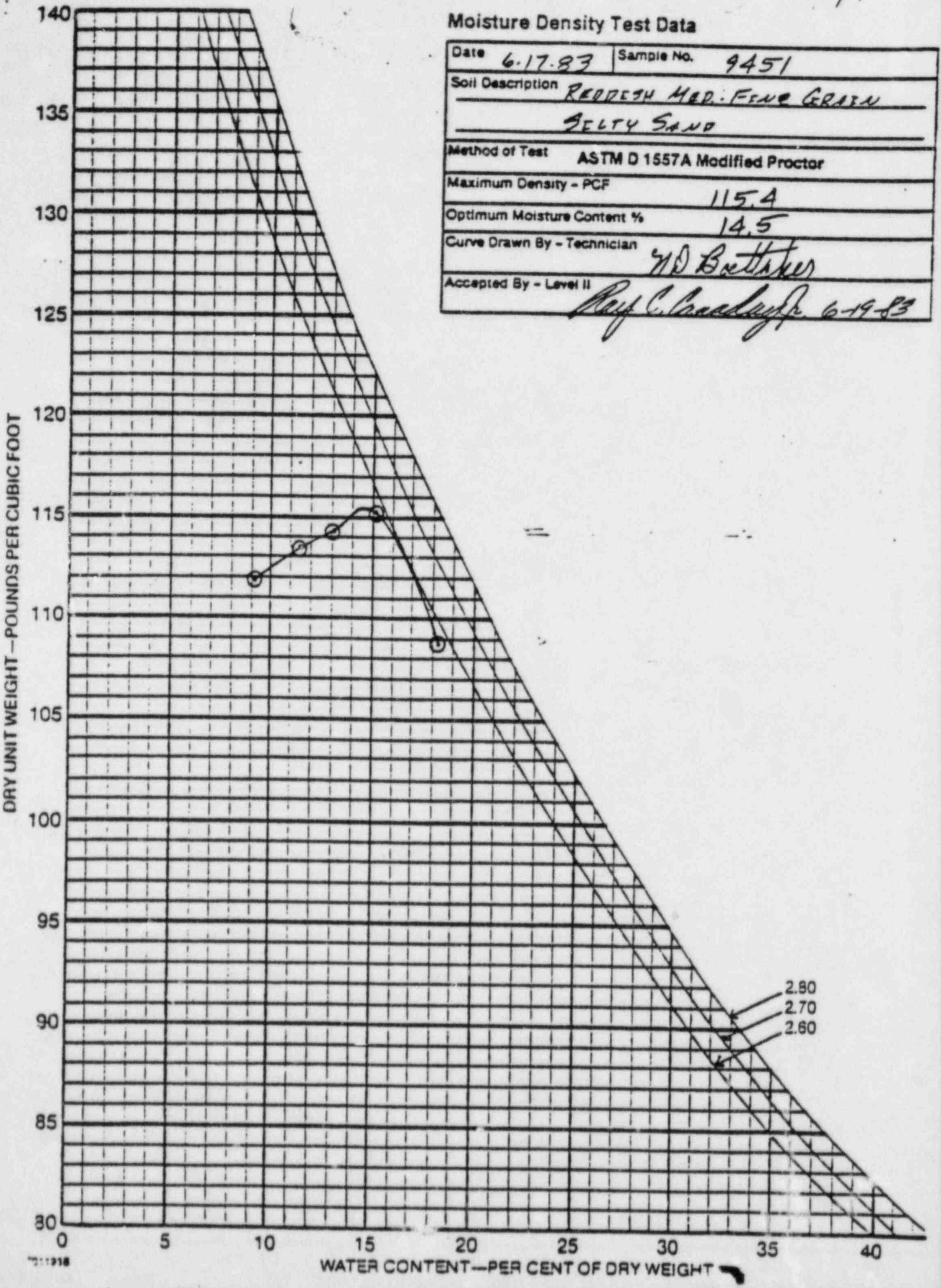
ENG FORM 1 MAY 63 **2087** REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE. *(TRANSLUCENT)*

U.S. GOVERNMENT PRINTING OFFICE 1963 OF—700-128

2 of

Moisture Density Test Data

Date 6.17.83
Sample No. 9451
Soil Description REDDISH MED.-FINE GRAIN SILTY SAND
Method of Test ASTM D 1557A Modified Proctor
Maximum Density - PCF 115.4
Optimum Moisture Content % 14.5
Curve Drawn By - Technician W D Bettaker
Accepted By - Level II Ray C. Crossley Jr. 6-19-83



'7:1918

Moisture Density Test Data

Date 6 25-83

Sample No. 5503

Soil Description REDDISH TAN MED FINE GRAIN SILTY SAND

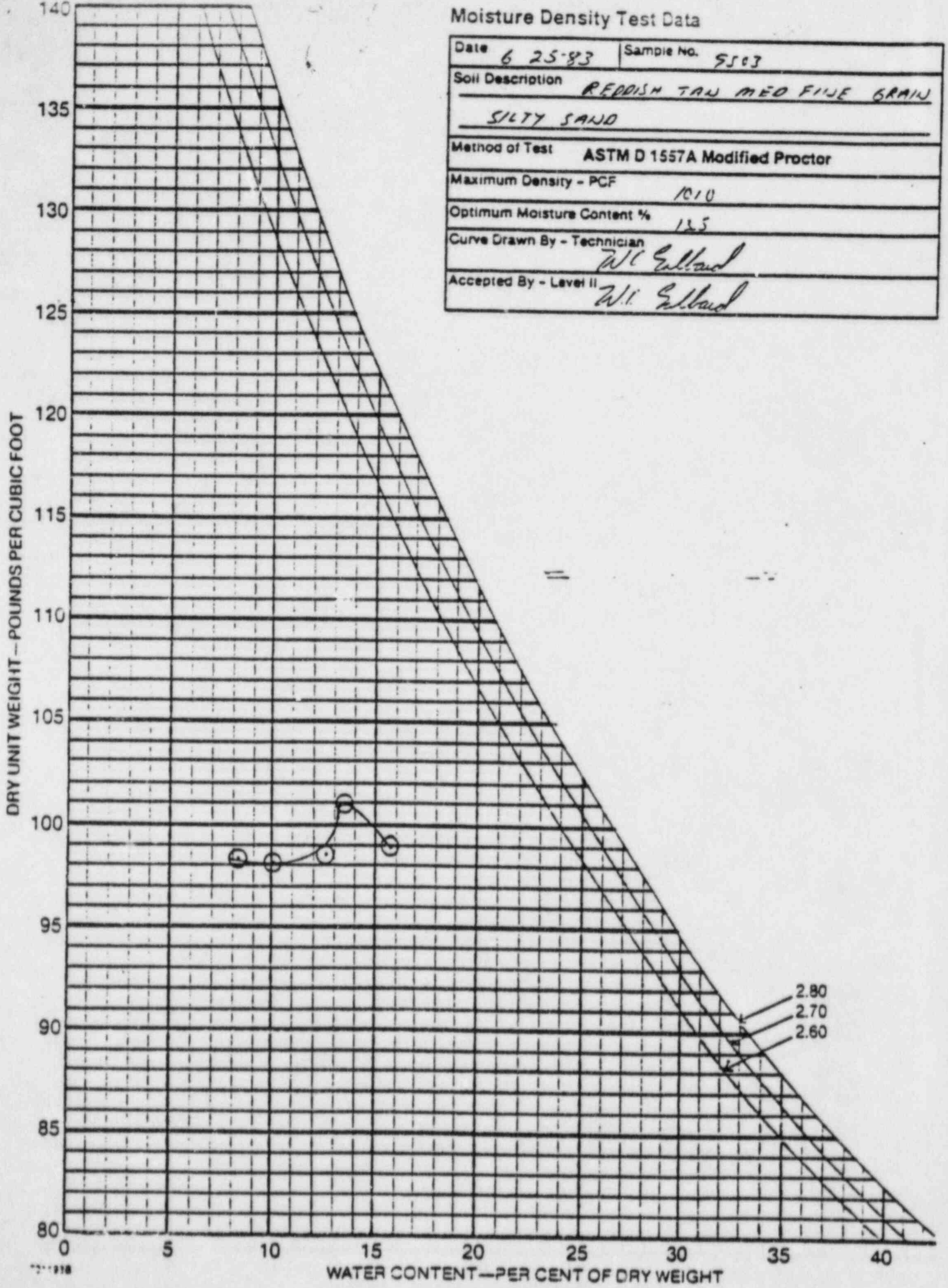
Method of Test **ASTM D 1557A Modified Proctor**

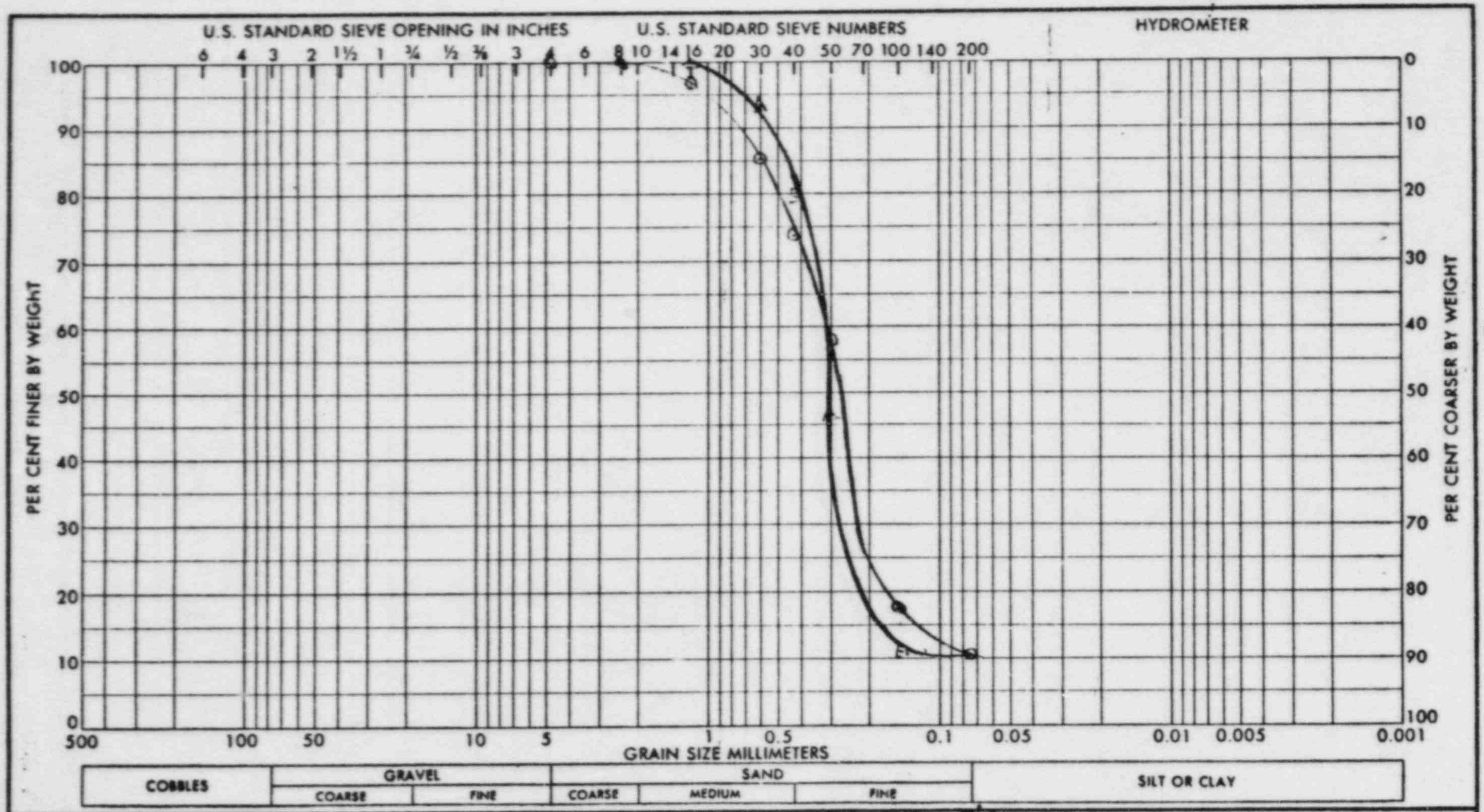
Maximum Density - PCF 1010

Optimum Moisture Content % 135

Curve Drawn By - Technician W.C. Ellard

Accepted By - Level II W.C. Ellard





SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	Test No	γdry PI pcf
8650	2|5|83 ⊙	Cu = 4.6			8650	116.5
9040	4|26|83 ▲	Cu = 4.6+			9043	105.3

PROJECT Vogtle Project

Fill Soils w/Fines between 9 to 12%

AREA

BORING NO.

DATE Jun 12, 1984

GRADATION CURVES

ENG FORM 2087
1 MAY 63

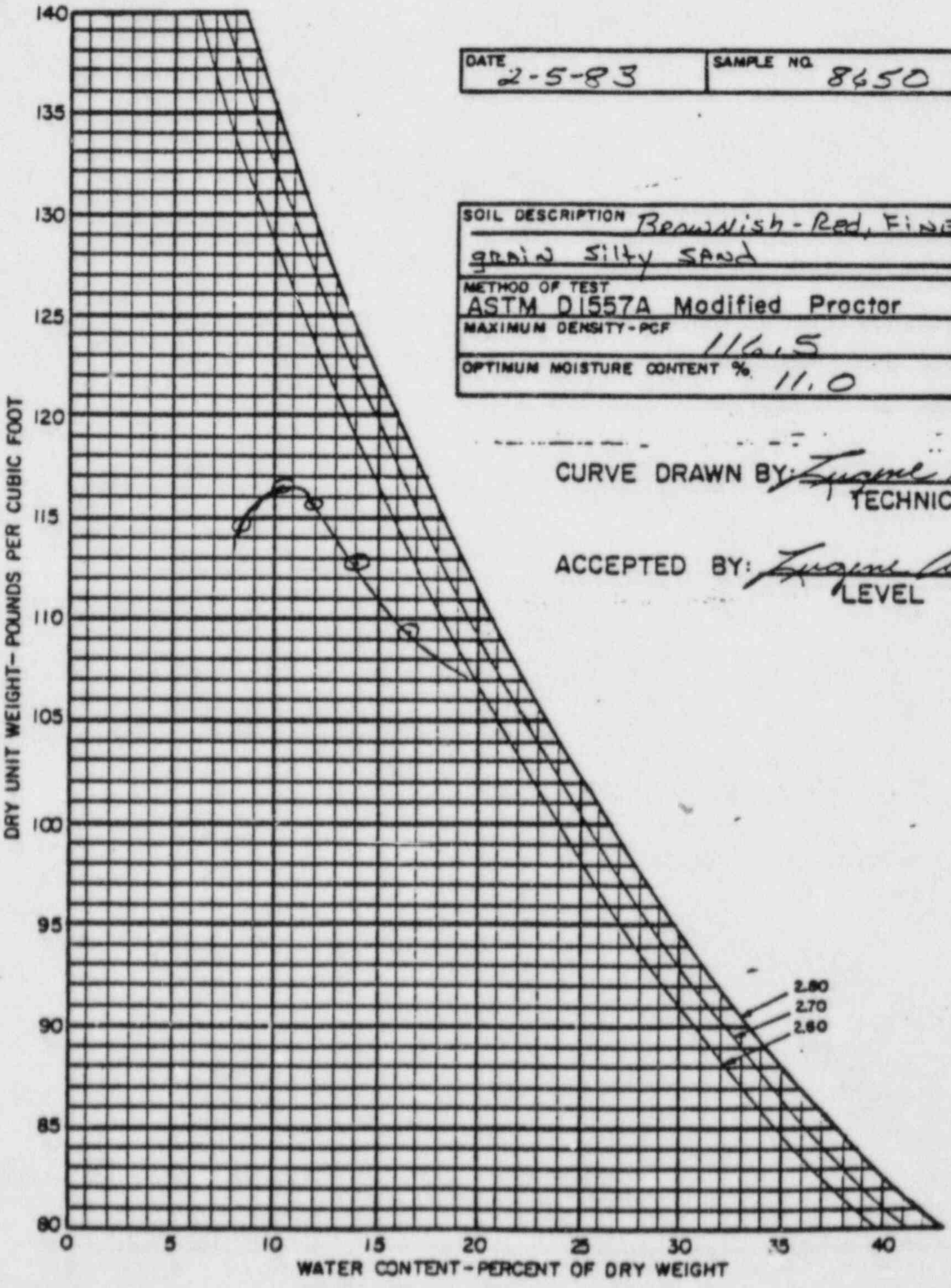
REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE.

(TRANSLUCENT)

U S GOVERNMENT PRINTING OFFICE 1963 OF—709-128

3 of

Moisture Density Test Data



DATE 2-5-83	SAMPLE NO. 8650

SOIL DESCRIPTION Brownish-Red, Fine grain silty sand
METHOD OF TEST ASTM D1557A Modified Proctor
MAXIMUM DENSITY-PCF 116.5
OPTIMUM MOISTURE CONTENT % 11.0

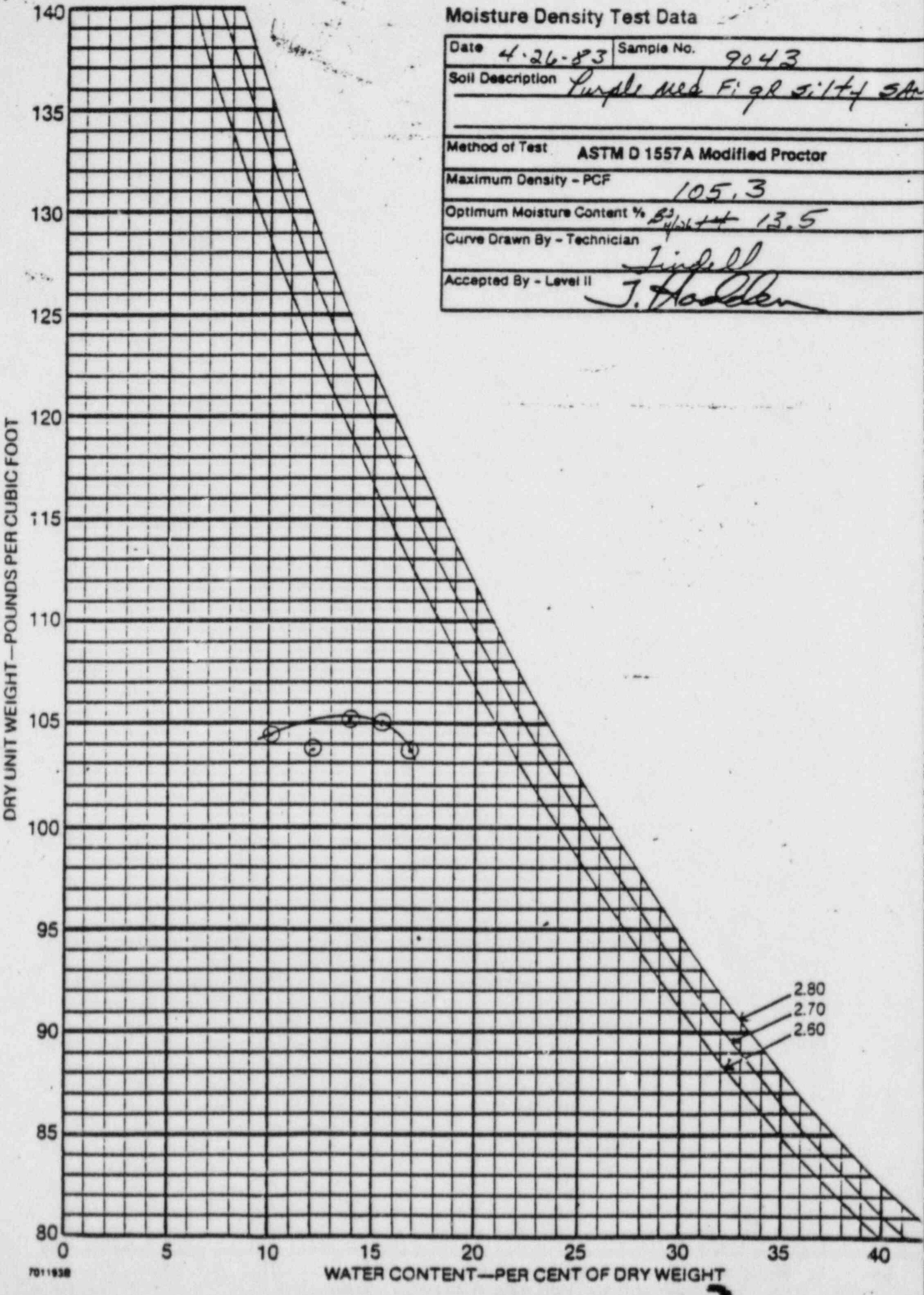
CURVE DRAWN BY: Eugene Anderson
TECHNICIAN

ACCEPTED BY: Eugene Anderson
LEVEL II

A

Moisture Density Test Data

Date 4·26-83
Sample No. 9043
Soil Description Purple red Fi gr silty SA
Method of Test ASTM D 1557A Modified Proctor
Maximum Density - PCF 105.3
Optimum Moisture Content % BJ 4/26 ~~[illegible]~~ 13.5
Curve Drawn By - Technician Tindell
Accepted By - Level II J. Hadden



7011938

'16. FOIA 84-463

6/13/84
1 of 1
J. Kane

Jack,

In order for you to understand my concern with Vogtle's backfill compaction I have enclosed the following:

Encl. 1 Pg. 257 from Winterkorn & Fang textbook.

I have underlined three soils on Table 7-3 which I believe are closest to Vogtle's plant fill. The maximum dry density range from 112 pcf to 116 pcf for these soils and this is considerably higher than the majority of lab compaction results which I have seen from Vogtle's test records. I am not certain, but I believe the unusually low max. dry densities being reported by Vogtle are mainly a result of bulking during lab compaction testing. Hopefully the independent testing will answer this question.

Encl. 2 Report on Compaction of Soils by Geotechnical Engineers, Inc.

I have also enclosed a draft report prepared for the Soil Conservation Service by Geotechnical Engineers, Inc. This report is one of the best treatments that I have read on the importance of good compaction procedures. The discussions on proper moisture control for cohesionless soils are found on pages 14 to 20. Best regards.

Joe Kane

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In uniform soils such as certain types of SP and GP, $e_{max} - e_{min}$ is small and e_{min} is large; hence F is small, and the soil more difficult to compact. Table 7.3 lists compactibilities for a variety of soils.

Burmister (1948) showed that the relative density of noncohesive soils was a more significant parameter than dry density alone insofar as engineering properties of the soil are concerned. His work has been verified and extended by other investigators (D'Appolonia, 1970).

As indicated in Eqs. 7.3 and 7.4, determination of the relative density of a soil requires measuring its dry density in place, its dry density in the loosest state, and its dry density in the densest state (or the three corresponding void ratios). The density in place and minimum density (loosest state) present no particular difficulty, but a generally accepted method of determining the maximum density (densest state) of all cohesionless soils has not yet been found (see section 7.4).

TABLE 7.3. COMPACTIBILITY (F) OF COHESIONLESS SOILS (where $F = (e_{max} - e_{min})/e_{min}$).

Classification	γ_{min}	γ_{max}	e_{min}	e_{max}	*Max. size*	D_{10}	C_u	C_c	F
SP-SM	90	108	0.54	0.84	#16	.058	6.0	2.2	.555
SM	75	97	0.83	1.36	¾"	.0065	31	5.5	.638
SP	92	112	0.48	0.80	#4	.15	3.0	.93	.667
SP	93	113	0.46	0.77	1½"	.16	2.4	.92	.674
SP	95	116	0.43	0.74	#4	.30	3.7	1.0	.721
SP-SM	92	113	0.46	0.80	¾"	.08	3.0	.88	.739
SP	85	107	0.54	0.94	#30	.10	2.3	1.3	.740
SP	97	118	0.40	0.70	1½"	.11	3.2	1.2	.750
SP	99	120	0.38	0.67	1½"	1.8	4.4	.76	.763
SM-ML	83	108	0.62	1.11	#4	.012	8.3	1.5	.790
SP-SM	79	103	0.60	1.08	#30	.09	2.4	1.5	.800
SP	103	124	0.33	0.60	⅜"	.17	5.0	.75	.818
SM	105	126	0.31	0.57	5"	.02	350	.30	.838
SP-SM	87	112	0.48	0.90	#4	.08	3.0	1.3	.875
SM	82	108	0.54	1.02	#16	.023	6.5	1.4	.889
SW-SM	95	119	0.39	0.74	3"	.05	10	1.4	.897
SP	98	122	0.36	0.69	#4	.37	5.1	1.2	.917
SW-SM	98	125	0.34	0.71	3"	.07	6.8	1.0	1.088
SP-SM	97	124	0.33	0.70	¾"	.10	5.0	1.4	1.121
SP-SM	84	115	0.44	0.97	1½"	.085	4.7	1.4	1.205
SP-SM	94	123	0.34	0.76	1½"	.12	4.4	1.3	1.235
SM	99	128	0.31	0.70	3"	.02	240	1.8	1.258
SP-SM	80	114	0.44	1.06	#16	.07	3.7	1.6	1.409
SW-SM	80	116	0.42	1.07	1½"	.074	6.6	2.4	1.547
SM	83	120	0.38	0.99	#4	.015	26	6.1	1.605
SM	102	134	0.23	0.62	¾"	.01	120	1.9	1.695
GN-GM	113	127	0.31	0.47	3"	.14	86	1.2	.517
GP-GM	112	129	0.32	0.52	3"	.03	200	.50	.625
GW-GM	116	133	0.26	0.44	5"	.17	171	2.2	.692
GP-GM	110	128	0.30	0.51	3"	.11	191	15	.700
GP-GM	117	133	0.24	0.41	5"	.125	160	4.0	.708
GW-GP	111	130	0.27	0.49	3"	.20	105	7.5	.815
GP	116	134	0.23	0.43	5"	.27	111	6.2	.870
GW	119	139	0.24	0.45	3"	.51	45	2.2	.875
GW	120	139	0.20	0.39	3"	.45	51	1.6	.950
GW	119	139	0.21	0.41	3"	.18	94	1.1	.952
GW	111	132	0.25	0.49	3"	2.9	9.7	1.8	.960
GP	115	136	0.22	0.44	5"	.38	29	.61	1.000
GP	114	135	0.22	0.45	3"	2.0	11	.77	1.045
GW-GM	121	141	0.19	0.39	3"	.30	77	2.3	1.052
GM	122	141	0.17	0.36	1½"	.025	381	3.0	1.118
GW-GM	114	137	0.21	0.45	3"	.60	16	1.2	1.143
GW	112	138	0.20	0.48	3"	2.0	12	1.3	1.400
GW	109	137	0.21	0.52	3"	2.0	14	2.8	1.476
GP	114	140	0.18	0.45	3"	1.7	10	.76	1.500
GM	101	132	0.25	0.84	1½"	.03	260	12	1.560
GW-GM	111	139	0.19	0.49	3"	1.8	13	2.3	1.578
GP	115	142	0.17	0.44	3"	.31	87	8.2	1.588
GW	123	146	0.13	0.34	3"	.21	124	1.1	1.615
GW-GM	110	139	0.19	0.50	5"	.42	43	2.1	1.631
GW-GM	115	142	0.17	0.45	3"	.15	133	1.1	1.647
GP-GM	112	140	0.18	0.48	3"	.42	26	4.2	1.667
GW-GM	112	140	0.18	0.48	5"	.25	56	1.0	1.667
GW-GM	114	142	0.16	0.45	3"	1.2	15	1.7	1.812
GP	112	141	0.17	0.48	3"	1.4	7.1	.73	1.823
GW-GM	118	147	0.12	0.40	3"	1.3	19	1.1	2.333

Vogtle: 1/11/84

6 hr 10 mi^2 PMP = 30.7 inches (HMR 51)

1 hr 1 mi^2 PMP = 19.1 inches (HMR 52 Fig 24)

$\frac{5}{60} = .325$ (.323)   5 min = .325(19.1) = 6.21

$\frac{15}{60} = .51$ (.506)   15 min = .51 (19.1) = 9.74

$\frac{30}{60} = .736$ 30 min = .736(19.1) = 14.06

intensity for 5 min T_c = 12(6.21) = 74.5 in/hr

" 15 min T_c = 4(9.74) = 39 in/hr

Q = 480,000 cfs for 2092 s.m. D.A between Clarks Hill & [illegible] Clarks Hill outflow PMF =

UHS

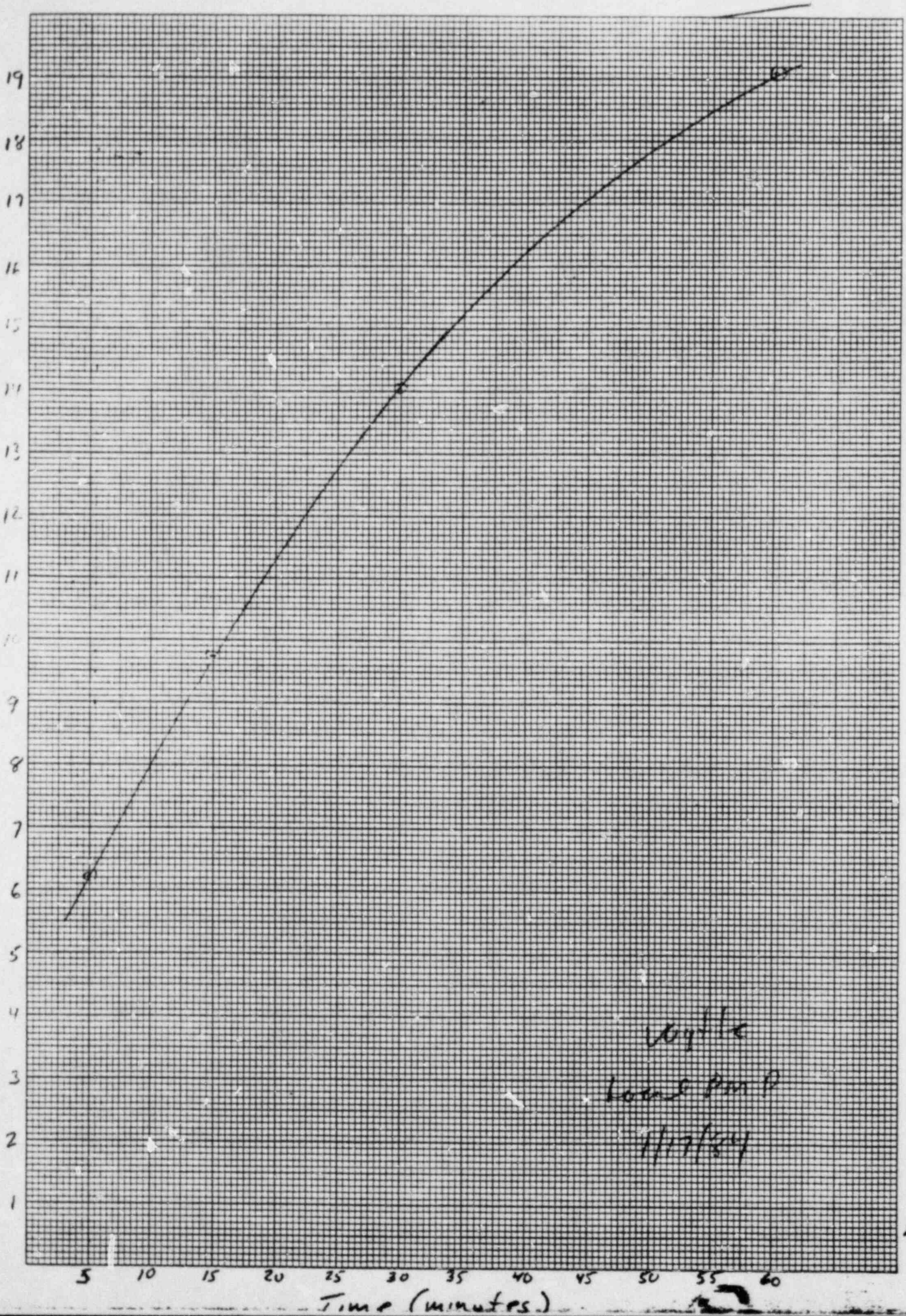
Tower Basin Volume

$A = \frac{\pi}{4} D^2 = \frac{\pi (88\,ft)^2}{4} = 6082\ ft^2$

$V = Ad = 6082 \times 80.25\,ft = 488090\ ft^3 \times 62.4\ \#/ft^3 = 30{,}456{,}811\ \#$

$\frac{}{8.33\ \#/gal} = 3{,}654{,}967$ gallons

Item 2



Vogtle
[illegible]
1/17/84