NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of:	CONSUMERS POWER COMPANY	: DOCKET NOS.
		:
	(Midland Plant Units 1 & 2)	: 50-329-OL
		50-330-OL
		50-329-CM
		50-330-CM

Deposition of LYMAN WAGNER HELLER

DATE: October 9, 1980 PAGES: 1 - 139

AT: Bethesda, Maryland

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UNITED STATES OF AMERICA

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In the Matter of:		
CONSUMERS POWER COMPANY	:	Docket Nos. 50-329 OL
	:	50-330-OL
(Midland Plant Units 1 and 2)	:	50-329-OM
	:	50-330-OM

Nuclear Regulatory Commission
10th floor
Maryland National Bank Building
7735 Old Georgetown Road
Bethesda, Maryland

DEPOSITION OF LYMAN WAGNER HELLER

The above-entitled matter came on for deposition, pursuant to notice, at 10:30 a.m., October 9, 1980.

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P R O C E E D I N G S

Thereupon,

GEORGE LYMAN HELLER

was called as a witness by counsel for Consumers Power Company, and after having been duly sworn by the Notary, was examined and testified as follows:

BY MR. BRUNNER:

Q The record should reflect this is the deposition of Lyman Heller, taken pursuant to notice, for purposes consistent with the Federal Rules of Civil Procedure and the Rules of Procedure applicable to NRC proceedings.

Would you state your full name, please.

A My name is Lyman Wagner Heller.

Q What is your address?

A I presently live at 18605 Rolling Acres Way in Olney, Maryland.

Q That is Olney?

A O-l-n-e-y, Maryland.

Q And you are presently employed by the Nuclear Regulatory Commission?

A That is correct.

Q What is your title?

A I am the section leader of the Geotechnical Engineering Section, Hydrologic and Geotechnical Engineering Branch, Division of Engineering.

Q Let me see if I got that right. You are the section leader, Geotechnical Engineering Section of the Hydrological and Geotechnical Branch of the --

A Division of Engineering.

If you will strike the "al" in hydrological and just make it hydrologic, that is the official designation.

Q Okay. Did you bring a resume with you to this deposition?

A Yes, I did.

Q Could I see it, please?

A Yes.

MR. BRUNNER: Off the record a second.

(Discussion off the record)

MR. BRUNNER: Back on the record.

I am looking at a document which I mark as Consumers Power Company Exhibit No. 1 - Heller Deposition. The document is entitled, "Professional Qualifications Synopsis, U. S. Nuclear Regulatory Commission, Lyman W. Heller, leader, Geotechnical Engineering Section."

(The above-mentioned document was marked Consumers Power Company's Exhibit No. 1 - Heller Deposition for identification.)

(Pause)

BY MR. BRUNNER:

Q I note that your resume states that you received bachelor of science degrees in both agricultural engineering and in civil engineering.

A That is correct.

Q Were you studying both of these subjects at the same time while you were in school?

A No, sir.

Q Which subject did you take up first?

A Agricultural engineering.

Q And you received your degree in that in 1950?

A Yes, sir.

Q While in an agricultural engineering curriculum, did you take ny civil engineering courses?

A No, sir.

Q At what time did you start studying civil engineering?

A In the fall of 1955.

Q What did you do between 1950 and 1955?

(Pause)

A I was employed by the John Deere Ottumwa Works in Ottumwa, Iowa in June of 1950 to January of 1951. I was a product engineer with that organization and was engaged in the design and detailing of farm machinery, hay rakes, bailer motors, adaptions, forage crop pickups, and the like.

Q Could you stop a second. You are reading from a page of your resume now. What page are you on?

A I am on the fourth page of the package that I gave to you, and I am reading from the fourth entry on that page.

Q Okay. While employed with the John Deere Ottumwa -- I am sorry. Could you read the words following "Deere." I cannot make them out in my copy.

A "O-t-t-u-m-w-a."

Q The next word?

A "Works." W-o-r-k-s.

Q The next word is also "Ottumwa"?

A Yes.

Q What is the word after that?

A "Iowa." I-o-w-a.

Q All right. While working for the Ottumwa Works in

Ottumwa, Iowa, did you do any projects of a civil engineering nature?

(Pause)

A In part.

Q Explain by what parts -- explain what you mean by "in part."

A In the design of an adaptation for an engine on a hay bailer, it was necessary to perform certain structural type analyses on the vibration characteristics and the load carrying characteristics of the frame of that particular machine.

Q So you were involved in the design of engines for hay bailers as one of your jobs?

A No, sir.

Q Would you explain what connection your job had with the design of these engines for hay bailers?

A The work I was asked to do was to adapt a different engine, a different power unit to supply power for the bailer itself. This is not what I would characterize as motor design, but an adaptation or use of a motor in a particular application.

Q Would that involve any modification to the motor?

A No, sir.

Q So your job was to determine whether or not this motor

could work in different applications?

A No, sir.

Q I am having difficulty with what you mean by "adaptation."

Why don't you just start from -- why don't you just tell me basically what you were doing on a day to day basis while engaged in that project?

A The problem was that the supplier of the motor for this particular bailer, for the production of this farm machine sale, was no longer available, and a different motor from a different manufacturer had to be adapted to or incorporated into the total design of that machine.

And so my work was only to take a given motor from a new supplier and to design the mouring and evaluate the adaptability of that particular motor to this particular machine.

Q What other projects did you work on while at the Ottumwa works?

A I worked on the design of a new product, a new hay rake, and I worked on the pickup for a bailer, a new pickup for a bailer.

Q Are these mechanical devices, the hay rake and the pickup for the bailer?

A Yes, sir.

Q When you say you did work on the design of it, is that a grass roots level design starting from scratch or was it an adaption of known technology?

A It was an adaptation of known technology.

Q Why don't you briefly describe what other projects you worked on while working for the Ottumwa works?

A I will describe what I characterize as design of a hay rake. This machine, the basic function is to move a swath of forage crop from a uniform distribution on the field, agricultural field, into a more concentrated line of product in order that that crop may properly cure for its use -- for its gathering and use as food for an animal.

This hay rake has a number of functions. The thing that was particularly new about this one is that it was designed for use on the three point hitch of the John Deere tractor, and it was power takeoff driven rather than ground driven.

And as such, it had to be designed from essentially the ground up; meaning that the frame had to be constituted; the raking teeth had to conform to a new pattern of motion; and the ground speed for this particular rake, the criteria for that was that it had to move much faster than the previous models that

had been offered by the company.

Q Now, was your work in the area of the bailer motors and forage crop pickups, which I note that you have listed in your resume, of a mechanical nature, similar to the hay rake which you have just described?

A Yes, sir.

Q Did you do any work while employed by John Deere Ottumwa Works which was not of a mechanical nature similar to what you just described?

A No, sir.

Q I note from your resume that in 1951 you were drafted by the U. S. Army.

A That is correct.

Q How long were you in the Army?

A Two years.

Q Did you work at anyprojects of a civil engineering nature while in the Army?

A Yes.

Q What were those projects?

A I was assigned to Third Army Headquarters in Atlanta, Georgia, and I worked in the Military Mapping and Planning Office in that organization. And I would characterize mapping as a civil

engineering function.

Q Could you describe what mapping involves?

A Mapping involves here the updating of older military maps to conform to new needs and to new studies that were ongoing by this particular headquarters.

Q What type of maps were they?

A They were for military purposes, primarily topographic maps, and of course road and terrain maps.

Q I take it this work did not include civil engineering work involving the design of building foundations or structures.

A No, sir, it did not.

Q How long did you work in that mapping project?

A Approximately four months.

Q Okay. Did you work on any other projects of a civil engineering nature while you were in the Army?

A No, sir.

Q I note you were discharged from the Army in 1953. Is that correct?

A That is correct.

Q And after that you were employed by Herman Nelson Corporation in Moline, Illinois?

A Yes, sir.

Q Describe what your work involved as a product engineer on heating and ventilating equipment.

A The company was engaged in the development and eventual marketing of a new, at that time new, heating, cooling, and ventilating unit that was eventually named the Amervent unit.

The purpose of this unit was to supply either heated air or cooled air to a number of -- for a number of schoolroom applications. The units were mounted against the wall where a vent to the outside air was available. The units could be supplied with either hot water or cold water. The units would, as the room demanded, provide either cooled air or heated air and always supplied the mandated amount of ventilating air to the classroom.

My work involved the adaptation of components from older model heating and ventilating units to newly designed and manufactured by this company cabinets, control units, and electrical motors.

Part of my work was also to observe, evaluate, and report the results of laboratory tests to establish the qualification -- classifications of these units for sales literature, and the like.

I was also involved in improved -- rather, improvements to unit ventilators and cooling fans.

Q I take it from what you just said that while working for Herman Nelson Corporation you did not do any work which could be classified as of a civil engineering nature?

A That is correct.

Q I notice in 1954 you entered the University of Illinois Law School. Is that correct?

A That is correct.

Q And you withdrew from the law school in October of 1954?

A That is also correct.

Q Could you tell me why you withdrew from law school?

A I could.

Q Would you?

(Pause)

A I determined that my previous life and my previous experiences and my previous perceptions of a career in law were not what I was experiencing in this educational environment. And I felt a career in this line would be incompatible with my life goals.

Q All right. After that you were employed by Bendix Aviation Corporation.

A Yes.

Q And you worked on the design and detailing of oxygen breathing apparatus, experimental model checkouts?

A Yes.

Q Could you describe in more detail what your work in the design and detailing of oxygen breathing apparatus involved?

A These apparatus were designed for supplying oxygen to military aircraft that have to fly at high altitudes, and the primary function of the breathing apparatus is to take oxygen from a very high pressure and insulated tank; pass it through a stage of pressure reduction in a safe manner; control the rate of oxygen supply to the breathing demands of the individual using the breathing apparatus; and to ensure reliability and failsafe manual overrides in cases of malfunctioning of that particular device.

Experimental checkouts I think are self-explanatory. But it is simply a matter of taking the model shop's version and debugging it in its physical state.

Q After working for Bendix Aviation Corporation, you entered the University of Illinois College of Engineering in civil engineering. Is that correct?

A Yes.

Q Did you have any particular reason for switching over to civil engineering at that time?

A Yes.

Q What was that?

A I felt that civil engineering offered a greater career flexibility than advanced graduate education in mechanical engineering, which would have been my second choice.

Q I believe you testified you graduated from the Universit of Illinois in civil engineering in 1957?

A No, I did not testify to that.

Q I'm sorry. When did you graduate from the University of Illinois in civil engineering?

A In June of 1957.

Q Now, I note that you worked part time for a consulting engineering firm, Clark, Daily, and Dietz while in school. That was while you were an undergraduate in civil engineering?

A May I correct the record?

Q Certainly.

A I may have testified while you were looking over the resume on page 1 that I did graduate in June of 1957. But my recollection was only that I did say 1957.

Q Fine.

A The facts are I did graduate in June of 1957 with a bachelor of science in civil engineering.

Q Fine.

A Thank you.

Q I don't think you have to worry about it too much.

Okay. We are back on your consulting experience with Clark, Daily, and Dietz. Were you working part time while you were an undergraduate in the civil engineering program for the Clark firm?

A Yes, sir.

Q And you have down that you worked on bridges, pile caps, and retaining walls for interstate highway interchanges. Could you describe specifically what work you were doing with regard to bridges, pile caps, and retaining walls?

A For the bridges I constructed influence diagrams, deflected shapes of the structure itself on a two span continuous bridge.

Q Before you go on, could you explain what that is?

A Yes. An influence line is a graphical plot of the influence of a load that moves across the span on a particular point on that span.

The influence value could be shear in a member, moment

at a connection, or any other structural quantity of interest. It is necessary to construct this diagram in order to determine the stresses imposed upon the bridge by the ASHO loading parameters established for that particular bridge.

Q What is ASHO?

A It is an acronym meaning Association of State Highway Officials.

Q Okay. What else did you do with regard to the design of bridges by working on bridges?

A Helped establish the geometric configuration of those bridges that must become a part of a curve, either vertical or horizontal, in the alignment of that bridge with the highways involved. This is just a matter of establishing elevations, control elevations for that structure, such that the bridge will have adequate clearance and will properly align with the roadways and pile caps, and so forth.

Q All right. You also --

A A three dimensional geometric problem.

Q You also mentioned pile caps and retaining walls. What work did you do with regard to pile caps?

A The one job I recall was that the piles were driven in the wrong location, and it was necessary to check and redesign

the pile cap that was to go on that particular bent in order to accommodate a longer and heavier span of the main structure.

Q Did that project involve the design of piles from a bearing capacity standpoint?

A No. The piles had already been emplaced, so there was no design involved. It was simply a matter of checking the cap to see that the loads imposed upon the cap were within code allowable values.

Q Was that the only project you worked on in the area of pile caps?

A Yes, the only one to my recollection.

Q Did you work on any other projects involving piles?

A Not for this firm.

Q You also have that you were working on a project for a retaining wall for interstate highway interchanges.

A Yes.

Q Could you explain what the retaining wall was and what it did?

A The purpose of the retaining wall was to retain the earth in a vertical attitude in order to allow the roadway to pass very closely to that wall.

A retaining wall is used whenever it is necessary to

support a soil or a rock that would otherwise slide into a new position that is needed for the traffic itself.

This was a reinforced, concrete retaining wall, the conventional L-shape.

Q Did that design -- I am sorry. Were you involved in the design of the retaining wall?

A Yes, sir.

Q Did your design take into account -- strike that.

Was the retaining wall designed either to sit on or to support fill material?

A Yes, sir.

Q Was it sitting on the fill material?

A Yes, it was.

Q Did your design take into account the amount of predicted settlement for that fill material?

A No, sir.

Q Why not?

A The loads that are imposed upon the retaining wall are also prescribed by the ASHO specifications, and to the best of my knowledge, these specifications do not provide for increased lateral loadings on the wall due to settlement of the fill.

Q Did your design take into -- I'm sorry. Did you

finish?

A Yes.

Q Did your design include a slope stability analysis for the retaining wall?

A Yes.

Q That is required by the ASHO specifications?

A Yes, it is.

Q Did your design include any consideration of the retaining wall from a bearing capacity standpoint?

A Yes, sir.

Q That is also required by ASHO specifications?

A Yes, it is.

Q Now, while working for the Clark, Daily firm, did you do any other projects of a civil engineering nature, other than the three that we have talked about?

(Pause)

A Yes.

Q What were those projects?

A One was a steel culvert, corrugated steel culvert that was necessary to pass storm water from one side of the roadway to the other. There was drafting work that located sidewalks and lighting fixtures and drainage for the overpass structure.

There was material quantity takeoffs from the prepared drawings for bid purposes and a number of other miscellaneous consulting engineering tasks, some professional and some sub-professional.

Q I note from your resume that in the summer of 1956 you worked for the county engineer's office in Tuscaloosa, Illinois. Was this while you were still working for the Clark, Daily firm?

A No, sir.

Q What years were you working for Clark, Daily? What dates?

A Beginning roughly in the fall of '56 and terminating essentially in the fall of 1970 -- 1957.

Q Okay. Well, that includes the summer of 1956, doesn't it? No, I am sorry. That is incorrect. I withdraw the question.

Okay. While you were working for the county engineer's office in Tuscaloosa, Illinois, you helped survey oil well locations and elevations and sidewalks and street and gutter work. Was this surveying sidewalks or designing sidewalks?

A Surveying sidewalks.

Q Did you do any civil engineering design work for the county engineer's office?

A No, sir.

Q It was all surveying, then?

A That particular aspect was all surveying work.

Q What other aspects were there?

A Well, the City of Tuscaloosa widened and replaced one of their main streets; the curbs and gutters were replaced, and the sidewalks were replaced, and the wearing surface of the street was replaced.

My job was to assist the survey party to plot the profiles that were obtained from that survey work and to check the drawings that were made by another civil engineering firm, a registered civil engineer who was also employed by that office; and then when the work was done to confirm the pay quantities for the work that was done.

Q All right. You graduated with a BS in civil engineering in June of 1957.

A Yes, sir.

Q And then you went back to work for the Clark, Daily, and Dietz firm; is that correct?

A Yes, sir.

Q Was your work for Clark, Daily, and Dietz similar to the work you had done previously for Clark, Daily, and Dietz?

A Yes, sir.

Q While you were working for the Clark, Daily, and Dietz firm, both on this occasion and on the previous occasion when you had worked for them, did you -- were you engaged in any projects which involved calculating the settlement of fill material?

A No, sir.

Q Were you engaged in any projects that involved the design of a dewatering system?

A No, sir.

Q Other than the experience with pile caps to which you have previously testified, were you engaged in any projects involving the design of underpinnings, such as piles for caissons?

A Not in the design, no, sir.

Q Other than your experience with pile caps which you had previously testified to, what projects did you have while working for Clark, Daily, and Dietz which involved underpinnings such as piles or caissons?

A I am not sure I gathered all of that question. Would you mind repeating it, please?

MR. BRUNNER: Could you read the question back?

THE REPORTER: "Other than your experience with pile caps which you had previously testified to, what projects did you have while working for Clark, Daily, and Dietz which involved underpinnings such as piles or caissons?"

THE WITNESS: None that I can recall.

BY MR. BRUNNER:

Q In September of 1957, you entered the University of Florida Graduate School; is that correct?

A Yes, sir.

Q What was your degree program at that time?

A I was working towards a master's degree in civil engineering.

Q I notice while you were doing that you were also acting as a teaching assistant for the Department of Civil Engineering; is that correct?

A That is correct.

Q You taught drafting and strength of materials laboratory. Could you describe what strength of materials laboratory class involved?

A The strength of materials laboratory involves a supplement to the formal classroom work in the strength of materials. The laboratory work used testing machines, strength

testing machines, impact testing machines.

It involves the instrumentation and measurement of material properties and teaches the student proper documentation of the purpose of the work, results obtained, conclusions drawn, and accuracy of the work.

Materials tested are primarily metals and concrete.

Q Did you test any soils in this class?

A No, sir.

Q What was your area of concentration in the civil engineering field for your master's thesis?

A Soil mechanics, foundation engineering.

Q What particular subject did you write your master's thesis on?

A My master's thesis was written on the topic of the pullout resistance of piles.

Q I note while you were in graduate school you worked the summer of 1958 in the Army Engineering School, Fort -- it looks like Belvue, Virginia. Is that correct?

A No, sir.

Q Could you tell me what the words are?

A Ft. Belvoir. B-e-l-v-o-i-r.

Q Your resume states that you wrote a series ten

correspondence course on reinforced concrete.

Could you describe what that involved?

A The Army Engineer School writes a number of courses on different topics for their field officers that can be studied at remote areas, such as in the field. These are correspondence courses.

The purpose of series ten of this instructional series was to prepare the field grade officers for successfully passing the professional engineers examination in any state.

Q I take it you wrote one section of the whole course, then? Is that --

A Yes. There were a number of sections of the course: foundations, and so forth. The topic that I was assigned was reinforced concrete.

Q What did you do after graduating with an MS in January of 1959?

A I was employed as an instructor in the Department of Engineering Mechanics at the University of Florida.

Q Now, the course you taught at this time was entitled "Strength of Materials." Is that correct?

A Yes.

Q Were the type of materials considered in your course

things like steel or metals as opposed to soils?

A The strength of materials course covers strength considerations without reference to a particular kind of material.

It is an engineering mechanics course that essentially assumes elastic behavior of the materials and teaches how to calculate the stresses imposed by the loads that would be carried by a variety of structural shapes, such as H-beams, columns, pressure vessels; no particular emphasis on any particular material, concrete, steel,or soil.

Q Did the classes include study of soil properties such as bearing capacity or resistance to settlement?

A No, sir.

Q Now,starting 6/59, I note from your resume that you worked for the U. S. Naval Civil Engineering Laboratory at Port Hueneme, California. Is that correct?

A That is correct.

Q Why don't you explain what work you did in connection with laterally loaded pilingsat the U. S. Naval Civil Engineering Laboratory?

A When I came to the laboratory a research project had been underway for a few years to determine the behavior of pilings

subjected to lateral loads.

The purpose of the research project was to understand how imposed loads on the pile are carried by the soil into which the pile had been driven. The laboratory work was a study of a single pile surrounded by sand and surrounded by clay.

The head of the pile was subjected to moment and lateral load such as to maintain either free head conditions or fixed head conditions.

The variables measured were the soil pressures on the face and back of the pile and the deflected shape of the pile.

Q Did you consider the soil pressures below the pile?

A No, sir.

Q Did you work on any other projects while at the U. S. Naval Civil Engineering Laboratory?

A Yes, sir.

Q What other projects?

Strike that question. Maybe it would be faster if I just went through them.

A I can read the above one if you wish me to.

Q I note that starting in the tenth month of 1960 you worked on another project, apparently in connection with laterally loaded piles. How did this second project differ from your first

project in the area of laterally loaded piles?

A This was a continuing phase of the laboratory work that had been done previously and involved the contractual arrangements with consultants. It involved a summary and evaluation of all tests run and involved the integration of the laboratory work into design criteria to be used by the Navy for designing laterally loaded piles for their applications.

Q Did your analysis of laterally loaded piles include a seismic analysis of those piles?

A No, it did not.

Q Now, in your consideration of design criteria for laterally loaded piles, what particular design parameters were taken into account?

A The design parameters were the stiffness of the piles, the load deflection characteristics of the soil into which they were embedded, the degree of fixity of the head of the pile, and the deflections of thepile.

Q I note from your resume -- I note from your resume the next project you became involved in in the U. S. Naval Civil Engineering Laboratory was what you described as complex research activities on projects involving soil mechanics, foundations, and related disciplines as applied to problems of

buried, protected structures subjected to dynamic loading by the effects of nuclear weapons.

When you referred to "buried, protected structures," are you referring to things like fallout shelters?

A No, sir.

Q What are you referring to?

A I am referring here to an underground structure whose purpose is to store Naval ordnance and Naval supplies such that the actual loadings imposed by a nuclear weapon would not adversely affect their functional survival, rather than protecting only from the radiation or fallout effects.

Q While you were working for the U. S. Naval Civil Engineering Laboratory, did you do any work in connection with prediction of the settlement of fill material?

(Pause)

A Yes.

Q What was that?

A For the performance of some of our tests related to lateral load capacities and behavior of piles, it was convenient to compact the sands around a test pile by means of flooding the sand with water to allow seepage pressures to improve the density of that material.

Since the pile was placed prior to surrounding it with sand, the downdrag effects of the upper portion of the fill sand had to be considered with respect to the at-rest pressures on the sensing device in the pile.

So in this sense, the settlement aspects of soils were considered.

Q Were there any other projects where you had to consider the settlement aspects of soils?

A The projects that considered the blast loading of the soil, which of course is necessary to design or consider an underground protective structure did involve the settlement of soils. Model studies of the behavior of buried structures to overpressure blasts also involved the instrumentation and evaluation of settlements in a container of soil.

Q Were these settlements that would occur as a result of a nuclear blast?

A Yes.

Q Are there any other projects in which you considered settlement of soils?

(Pause)

A Not for which I was responsible.

Q All right. I note from your resume that starting 6/65

and up to February of '74 you worked on the U. S. Army Engineer Waterways Experiment at Vicksburg, Mississippi. Is that correct?

A No, sir. It should read, "U. S. Army Engineer Waterways Experiment Station," rather than an "experiment," as you had quoted.

Q I am sorry; that is the way it does read. I just did not read the entire title.

A Thank you.

Q I note that while engaged in this project you performed analysis of ground motion - foundation structure interaction and the earthquake resistance of earth and rock filled dams. Is that a correct statement?

A Yes, sir.

Q Did this involve the design of dams or only the analysis of dams which had already been designed and built?

A Both.

Q Did your work in this area include any analysis of settlement of fill material?

(Pause)

A Would you clarify -- strike that.

Could you --

Q Would you like me to clarify my question?

A Would you clarify your question, please, and make it more specific with respect to rock filled dams or other foundation dam projects.

Q All right. I take it from your response that you were working on projects other than rock filled dams while on this particular job; is that correct?

A That is correct.

Q Did you do any analysis of fill material while working particularly on the rock filled dams?

A Yes.

Q Could you briefly describe what that involved?

A Yes. The analyses that were conducted were based on the conduct of laboratory tests and the evaluation of the measured characteristics of soil materials,and the analysis necessary to anticipate the settlement of the dam was based on the results of those tests and the assumptions of similar properties in the dam itself.

Q All right. Starting in -- I'm sorry. Did you finish your answer?

A I think that is as short as I can make it.

Q Starting in 2/1974, I note from your resume you worked for the U. S. Atomic Energy Commission in Washington, D. C. Is

that correct?

A Yes, sir.

Q What was your title when you first started working for the Atomic Energy Commission?

A I believe the record will show I was classified as a nuclear engineer.

Q Were you a member of any particular branch or section of the NRC -- I am sorry -- of the Atomic Energy Commission?

A Yes, sir.

Q What was that?

A I was a member of the Site Analysis Branch.

Q Now, it indicates on your resume that you made recommendations for accepting, rejecting, or modifying proposed designs for foundations and the geotechnical features of nuclear facilities.

A That is correct.

Q I take it from that description that you were involved in more than just evaluating the suitability of sites for nuclear power plants at that time?

A Yes.

Q Maybe -- what six plants did you work at?

A I worked on Comanche Peak; I worked on South Texas;

I worked on Farley 1 and 2; I worked on Three Mile Island 2; I worked on Cherokee and Perkins.

Q Cherokee and Perkins?

A Cherokee and Perkins and a number of others that have not materialized.

Q Did you do any work with regard to the Midland Plant site?

A No, sir.

Q Did any of these particular nuclear stations or proposed nuclear stations involve or incorporate a design wherein structures were to be placed on compacted fill material?

A Yes, sir.

Q Which ones?

A South Texas.

Q Any others?

A Farley, Allens Creek, which is still in CP, however.

Q Could you stop for a second. Allens Creek was not one of the plants you mentioned before, I believe, when you answered my question as to which plants you had worked at. Were there any other plants besides the six that you gave me in your previous answer that you worked on in your initial position at the U. S. Atomic Energy Commission?

A I would need to go over the list to give you a complete listing of those plants I worked on and the time period I worked on them. I had meant to indicate when I indicated a number of other plants that had not materialized that Allens Creek would have fallen into that category.

I am sorry if I misled you.

Q Continue on with your list of plants which made use of compacted fill material for foundation structures. You have given me so far South Texas, Farley, and Allens Creek.

Were there any others?

A River Bend, Beaver Valley, Shoreham, Jampesport.

Q Let me stop you a second.

Are you giving me a list of plants which you have worked on or proposed sites which you have worked on and which made use of compacted fill, or are you giving me all of the plants that have compacted fill as a foundation for structures?

A Both: ones I have worked on and ones that have compacted fill as well.

Q All right.

A I did not complete my list when you gave me the first question. I would need to refer to my file in order to give you a complete list of the plants I have worked on. I am

sorry if they are not consistent with these other plants I have worked on that do have compacted fill.

Q All right. So your answer is with regard to South Texas, Farley, Allens Creek, River Bend, Beaver Valley, Shoreham, and Jamesport, that these are all plants that you have worked on?

A Yes, sir.

Q And they all have compacted fill as a foundation for at least one structure?

A Yes, sir.

I was having -- may I make a comment?

Q Certainly.

A I had interpreted your question as those plants I had worked on while I was with the AEC. I have now included that period of time when AEC was changed into ERDA and NRC.

Q You have not included it?

A Yes, I have included it.

Q You have given me the complete list of all the plants you have worked on, either in AEC or NRC?

A Yes.

Q Did any of these plants upon which you have worked make use of underpinnings, as the term is used in civil engineering practice, to support Class 1 structures?

A Would you mind repeating that please? May I simply ask a question?

Q Okay.

A Are you now indicating just the plants that I have mentioned or any plant that uses --

Q Why don't you just -- why don't you first give me the answer with regard to those plants upon which you have worked in your capacity as a reviewer for either the Atomic Energy Commission or the NRC and which make use of underpinnings for Class 1 structures.

A Byron uses piles under its pumphouse at the river; Ft. Calhoun, Unit 2, I believe, proposed to use piles to support that addition to that particular plant.

Q When you say, "that addition," are you referring to the entire Unit 2?

A Unit 1 is supported on piles. I was not the reviewer of that particular plant. They intended to expand at one point in time, and they proposed to also support that plant .. pilings.

Q This is the entire plant including the reactor?

A Yes. However, that plant was dropped; so it was one of the casualties of high interest rates and low power demands.

Q Any others?

A The Bailly Nuclear Plant.

Q What structures at Bailly are supported by underpinnings?

A All of the structures, safety and nonsafety, are proposed to be supported by pile foundations at the Bailly Plant. May I comment?

Q Certainly.

A The term underpinnings usually is reserved for a remedial construction action, as opposed to caissons and piles being designated as original foundation designs.

Q I understand.

A It is only terminology.

Q What I intended to do was refer to the use of piles and caissons as original foundation designs or for remedial construction work.

You state that Bailly has proposed the use of piles. Has Bailly been granted a construction permit yet by the NRC?

A Yes, sir.

Q And that construction permit was granted on the basis of a design involving piles for all of the Class -- all the major Class 1 structures for the station?

A Yes, sir.

Q Are there any others that you can recall?

A I am sure there are many minor structures supported on piles at a number of stations. My memory is not good enough to give you all of those. I can just relate those that come to mind now.

Q All right. Could you do that?

A Waterford at one time had a pile founded portion which has since been changed to structural backfill rather than piles.

Q Is there any particular reason for that change?

A The reason that is given to me by applicant's AE was one of economics. There appears to be an inappropriate charge being made for the pilings by a subcontractor. They elected to revise their design.

I believe those are all I can recall.

Q All right. Now, I note from your resume that starting in 12/74 you worked as a reviewer for the U. S. Nuclear Regulatory Commission. Was there any change in your job from 12/74 as far as what your duties were and what your responsibilities were?

A Yes.

Q What was that change?

A The Site Analysis Branch was reorganized to include a Geotechnical Engineering Section, a Geology-Seismology Section,

and a hydrology section, hydrology and meteorology section. With this change it was necessary for me to assist and oversee the work of those geotechnical engineers assigned to the foundation engineering section.

The record should be corrected. The sections were the foundation engineering section plus the other two.

Q What were the other two?

A The other two were the geology and seismology section and hydrology and seismology section.

Q There was one question I forgot to ask you when I was on the subject of the plants in which you worked which used compacted fill material.

Did any of those plants encounter any problems with unusual settlement of any structures, to your knowledge?

(Pause)

A To my knowledge, none of them have undergone unexpected settlements.

Q Did any of those plants make use of a dewatering system?

A Not as permanent features of the plant.

Q I presume you mean by that that some of them may have had temporary dewatering systems installed?

A Yes, sir.

Q For purposes of construction activities?

A Yes, sir.

Q Did any of those plants make use of the preloading process design in structural backfill?

A No, sir.

Q When you use the term "structural backfill," what does that mean?

A Structural backfill is materials used to support a structure and usually it is -- its characteristics and properties are known,and it is engineered and controlled during construction such that its properties, expected properties are attained.

In other words, it is materials used to support the structure.

Q Has any nuclear plant, including those which you may not have worked on, made use of a preload design at any stage in the process of design or construction?

A No, sir, not to my knowledge.

Q Now, you refer in your resume to having a responsibility for earth dams and stability of mine tailing dams; are those earth dams dams that are built in connection with nuclear power

facilities?

A Yes.

Q And what, in your experience -- to what use have these earth dams been put in connection with nuclear power plants?

A The earth dams are used to impound a body of water to be used as either the source of cooling for the operation of a plant or for the purposes of the safe shutdown of that plant in case of an emergency of some kind.

Q Have your responsibilities changed since 12/74?

A Yes.

Q What are your present job responsibilities?

A The present responsibilities include a greater degree of administrative work than was the situation in 1974, December of 1974, primarily with respect to budget preparations, personnel actions, training, and duties of this kind in the support of our management.

Q Are you still connected with the seismology, the hydrology and seismology and geology -- hydrology branches?

A No, sir.

Q Okay. Which branch are you connected with at the present time?

A At the present time, Hydrologic and Geotechnical

Engineering Branch.

Q Who do you report to?

A My immediate supervisor is Mr. George E. Lear.

Q What is his title?

A His title is chief of the aforementioned branch.

Q Is there anyone else in the branch besides you and Mr. Lear?

A Yes.

Q Who is that person or persons?

A The persons in Mr. Lear's branch include myself, Dr. Thompson, Dr.Pichumani, Dr. Gupta.

Q I think you are going to have to slow down. The court reporter is having trouble picking up the names.

Dr. Pichumani, did you say?

A Yes.

Q How do you spell that?

A P-i-c-h-u-m-a-n-i.

Mr. Greeves, Mr. Kane, and Mr. Bivins, Dr. Codel, Dr. Fliegle, Mr. Johnson, Mr. Rico, Mrs. Crane, Ms. Smith.

Q Are you limiting your answer to engineers and/or technical support people?

A No, sir. I was listing all the members of Mr. Lear's

branch.

Q Okay. Why don't you stop. Limiting yourself to engineers and technical people, would you just quickly -- I will ask you a question as to whether these particular people are engineers or technical people.

Dr. Thompson, is he an engineer or technical person?

A Yes, sir, he is.

Q And Pichumani, is he?

A Yes, sir.

Q Gupta?

A Yes, sir.

Q Mr. Greeves?

A Yes, sir.

Q Mr. Bivins?

A Yes, sir.

Q Dr. Codel?

A Yes, sir.

Q Dr. Fliegle?

A Yes, sir.

Q Mr. Johnson?

A Yes, sir.

Q Mr. Rico?

A Yes, sir.

Q Mrs. Crane?

A No, sir.

Q Are there any others who are either engineers or technical support people who are members of your branch?

A Yes. Dr. Chen and Dr. Pearring. And I may have missed one or two members in the hydrology group. I would have to get a complete branch listing, since we have been reorganized about two months now.

Q Other than yourself and Mr. Kane, have any of those people worked on the Midland project review?

A No, sir.

MR. BRUNNER: I guess we are going to break for lunch if that is agreeable.

(Thereupon, at 12:18 p.m., the deposition in the above-entitled matter was recessed to reconvene at 1:15 p.m. that same day.)

AFTERNOON SESSION

(1:20 p.m.)

MR. BRUNNER: Back on the record.

This is the continuation of the deposition of Mr. Lyman Heller.

Mr. Heller, I remind you that you are still under oath for the purposes of this afternoon's proceedings.

BY MR. BRUNNER:

Q Before adjourning for lunch we were talking about your resume. I notice in addition to receiving a master of science degree, you received your doctor of philosophy degree from the University of Florida in 1971; is that correct?

A That is correct.

Q While you were working for your PhD degree, were you a fulltime student at the University of Florida?

A For a year and a half I was, yes, sir.

Q After that you became a part time student, I presume?

A Yes.

Q What did you write your doctoral thesis on?

A The title of my dissertation was: "The Particle Motion Field Generated by the Torsional Oscilation of a Rigid Circular Foundation on Sand."

Q Within the NRC organization, what persons who are eithe engineers or technical support people report to you?

A Dr. Thompson, Dr. Pichumani, Dr. Gupta, Mr. Greeves, Mr. Kane, Dr. Chen, and Dr.Pearring.

Q Now, as the head of the geotechnical section -- is that a correct statement, that you are the head of the geotechnica section?

A I am designated as section leader.

Q As the leader of the geotechnical section, what review responsibilities -- strike that question.

What particular technical areas are normally reviewed by your section in the process of considering a license for a nuclear power plant or construction permit?

A Those items normally encompassed by the geotechnical engineering disciplines.

Q Does that include soils engineering?

A That would include soil mechanics and foundation engineering.

Q Does that include an analysis of stresses in structures

A No, it does not.

Q When I used the term "structures," I include building foundations as a part of the term. Does your section engage in

structural analysis of building foundations?

A No.

Q Would your section review a proposed dewatering system if one were proposed for a nuclear power plant?

A We would participate in the review of the geotechnical features of that dewatering system.

Q What are the geotechnical features of a dewatering system?

A For example, it would include the filter criteria for surrounding the well points, if that was the particular design submitted. If it were a passive system, we would review the filters, the gradations, zonation; those are examples of the features.

Q Would you consider the permeability of soils or any analysis regarding the permeability of soils supplied by the applicant?

A Yes.

Q Does your review authority include the area of seismic analysis?

A Yes.

Q In what respects?

A With respect to earthwork dams, properties of

foundations or site materials assumed to exist during the earthquake; slope stability.

There are probably other areas, but these are the main areas.

Q Does your area of responsibility include seismic analysis of structures?

A No, sir.

Q Does your area of authority include criteria with regard to shear wave velocity in soils?

A Yes, sir.

Q Does your area of authority include an analysis of the stresses that may be induced in underground piping in a nuclear facility?

A In part.

Q What part?

A We would review the assumptions used for the properties of the soils surrounding those pipes or structures and the loads imposed by the soils under structures.

Q Would your review include the effect on those structures of the loads you just described? In other words, would you do an analysis of the effect of the loads you have just described on the structures?

(Pause)

A In general, no. There are some exceptions to that.

Q Could you describe the exceptions?

A One exception would be the conduits or tunnels through and under earth dams wherein the movements, long term movements of the soil would have an influence on the loads assumed and the structural behavior.

Q With regard to underground buried pipes, buried electrical conduit or electrical ducts, would your review authority ever include an analysis of the effect of soil imposed loads on those structures?

A No.

Q What was your title in September of 1978 if you recall?

A I was the leader of the geotechnical engineering section of the Geosciences Branch, Division of Systems Safety, Office of Nuclear Reactor Regulation.

Q Who, if anyone, reported to you in 1978, September. Limit your answer to engineers and/or technical support persons.

(Pause)

A Mr. Gillen, Mr. Greeves, Mr. Kane, and Mr. Thompson.

Q When did you first learn there was a problem with the foundation soils at the Midland site?

A In the fall of 1978.

Q Do you know how that problem I have referred to was made known to the NRC?

A I understand that there was a report made by Consumers Power to Region III, but I was not involved in that communication.

Q What was the nature of the problem?

A I think that the correspondence indicated that the settlement of the diesel gererator building either had or was approaching the expected lifetime settlement for that structure.

Q Why is that a problem?

A It was determined by Consumers Power, it is my understanding, that it was not -- that it was a reportable item under the regulations governing their construction permit and a reportable deficiency under those regulations.

Q From a technical standpoint, why is it a problem if a building settles more than what had beenexpected at the time it was designed?

A It is a problem because the designers of that building would not have anticipated its behavior and would not have incorporated the appropriate features to accommodate that unexpected settlement in a way which would assure the function of that building would be maintained.

Q What particular functions of the building might be impaired by unusual amounts of settlement?

A Well, it could be stressed in a way that was not anticipated such that the imposition of the design loads, in addition to those unexpected settlement loads -- settlement stresses, rather -- would exceed that anticipated in the design.

Q After this problem was reported to the NRC in the fall of 1978, did you keep abreast of the materials that were submitted to Consumers Power Company in reporting the various aspects of the problem?

A No, not abreast. We generally obtained our information from our I & E offices because most of the communciation, I understand, was through the Region III I & E office.

Q Did you visit the Midland site at any time in 1978?

A Yes.

Q Was that in December of 1978?

A Yes.

Q What was the purpose of your visit?

A The purpose of our visit was to learn more about the reported deficiency and to accompany and support our I & E representatives on that site visit.

Q When this problem was first reported to the NRC, did

your section have any responsibilities with regard to reviewing the data that had been submitted by Consumers Power Company in connection with it?

A No.

Q Did you later obtain any such responsibility?

A Yes.

Q When did you first have the responsibility with regard to reviewing the problem?

A The responsibility became -- the responsibility came to us through a mechanism known as a transfer of lead responsibility, which is an NRC mechanism to transfer or share the review aspects of problems that are not resolvable by I & E on a QA or inspection basis.

Q You mentioned "transfer or share." After this transfer took place, did your section have the lead responsibility with regard to those particular technical aspects of the problem in which you normally deal?

A My answer would have to be yes because although other sections, branches would support our review within NRR, we would be looked to as the lead review group for this particular problem.

Q When did that transfer take place, if you can recall. If you like, you can refer to your documents to aid your

recollection.

A I do not believe my documents show them, but I believe someone's documents, probably Darrell's documents, would indicate it was in January of 1979. That is the closest recollection I can make at this point.

Q You visited the site in December of '78. Did Consumers Power Company propose any remedial action with regard to the unusual settlement of the diesel generator building?

A They did describe an experiment that they had planned for consolidating the fill beneath the diesel generator building i a presentation, I believe, on the 4th of December.

Q You used the word "experiment." What experiment are yo referring to?

A They described to us a scheme for applying sand around an interior tube of the diesel generator building in order to load that fill and compress it.

Q Was the purpose of this "experiment" really to gain data with regard to the fill under the diesel generator building, or was there some other purpose that they had in mind?

A I really cannot speak to their total purpose; it was my impression that they wished to conduct this activity and were simply informing us of their intentions and schedule to

carry out this activity.

Q You used the word "experiment." Was that particular word used by Consumers Power Company to refer to the preload project, the project you just described?

A I am not sure whether they used the word "experiment." From the description of the instrumentation and the planned loading of the fill, many would classify that activity as an experiment.

Q Why would that particular term be used?

A There was -- I would use that term because of the instruments that were proposed to make the measurements from the schedule of loading that was proposed and from the expectation that a large variation in the resulting settlement was anticipated.

Q What in particular with regard to the instruments that were proposed led you to describe this as an "experiment"?

A The instruments were to be installed at a number of depths and quite extensively throughout the areal extent of loaded area. The loads, as I recall, were to be increased in five foot increments with delays between each increment and the resulting settlements were not offered until we asked for those resulting settlements.

And there was a factor of three, I believe, between the

minimum expected settlement and the maximum expected settlement of the fill.

Q In your opinion, was the instrumentation that was proposed adequate to measure the results of the preload program?

A At the time I was certainly not able to make that kind of judgment based on the verbal presentation and the visual aids that were presented to us.

So I would have to answer that I do not know.

Q Have you since drawn any conclusion as to whether or not the instrumentation that was used to measure the effects of the preload was adequate to do so?

A No, I have not.

Q Prior to this occasion when Consumers Power Company informed you of the proposed remedial action with regard to the diesel generator building, had you ever heard of a case where anyone attempted to preload fill material?

A Yes.

Q What was the occasion?

A The occasions are presented in the literature, and they are generally used for reclaiming organic soils to support light structures.

Q Had you ever had any personal experience with the use o

preloading prior to that meeting at Consumers Power Company's Midland site?

A Not personally, no.

Q Does the literature to which you referred regard a preload program as a suitable method for obtaining adequate characteristics of fill material where it is used?

A The literature is divided on this issue. In some cases it has been successful; in some cases it has not been successful, the applications for which it was originally designed.

Q Does the literature include any examples of the use of preload programs in situations other than for the purposes of reclaiming organic soils?

A Well, it is used for consolidating landfills or industrial fillsalong waterfronts, for example, and in some cases natural materials that have not had time to consolidate: clays. So there are situations other than peaty soils or organic soils that have been treated by preloading.

Q Is the preloading technique generally accepted as a method for consolidating soils in the civil engineering field?

A It is accepted in some applications, yes.

Q Would you say that it would be generally accepted in the application of compacting fill material that had been placed a

a particular site under which a building was to be built?

A No.

Q Why not?

A Well, it is expensive. That is the main reason.

Q Any other reasons?

A The resulting support characteristics are generally less well known than would be the characteristics obtained by normal compaction procedures following usual construction practices with usual compaction devices.

Q Do you know of any cases in which a preload program was used for purposes of compacting fill material, compacting or consolidating fill material and in which settlement in excess of that which would be predicted following the preload later occurred?

A There are none reported that I know of, of preload of a manmade fill that was intended to be the support for a structure.

Q You gave me two reasons why preloads are not, in your opinion, generally accepted for the purposes of compacting manmade fill.

Are there any other reasons that you know of?

A Well, a reason, even I guess as good as the high cost,

is that the resulting material is likely to have the potential for differential settlements. Part of the reason for that on natural materials is the variable occurrence of peaty or organic material as it occurs in nature.

Q If you limit your answer only to the use of the preload for purposes of consolidating manmade -- man-placed fill material, does that same differential settlement reason apply?

A In general, it should not; for the case under consideration, it may well be the case because of the variable materials analogous to the natural soils.

Q What various materials are you referring to?

A Materials that are reported to be present in the fill beneath the diesel generator building.

Q What are those materials?

A Materials like sands, clays, concrete, cobbles.

Q What was the last one?

A Cobbles. C-o-b-b-l-e-s. Cobbles. And that kind of material normally found in glacial deposit.

Q Which is what?

A Sands, clays, cobbles, but not concrete.

Q Are you saying that the existence of the materials you just referred to -- namely, sand, clays, concrete, and cobble --

in a fill material following a preload program would create a potential for differential settlements?

A If I may amplify --

Q Please do.

A -- the materials were present before the preload program. I believe you said present after the preload program. Those materials do have variable compaction characteristics. And since there is the potential for differential settlement in naturally occurring materials that are different, one would by analogy expect different and differential settlement characteristics in this particular geologic configuration.

Q You used the term "consolidation" in one of your previous answers. Could you define the meaning of that term?

A Well, consolidation in a very, very general terminology would mean the reduction in volume of a given volume of soil without a change in the weight of the solid constituents of that defined volume.

Q Are you familiar with what is commonly referred to as a consolidation test?

A Yes.

Q Are you also familiar with the terminology, "primary consolidation" and "secondary consolidation"?

A I believe so, yes, sir.

Q Could you define primary consolidation?

A Primary consolidation is that portion of the consolidation of a soil under a given loading during which the water that occupies the voids in that specimen of soil is at a greater pressure than would exist at the boundaries of that specimen during the laboratory test.

Q Could you also define secondary consolidation?

A Secondary consolidation would be that portion of the consolidation of that sample that would occur under the same given loading wherein the pressure in the voids in that soil was the same as the pressure at the boundaries of that sample. Or a simpler way of saying it, using perhaps other terms -- I perceive you wish me to stop.

Q No, go ahead.

A Using other terms, one would say that the secondary portion of the consolidation is that portion of the consolidation under a constant effective stress.

Q If one runs a consolidation test and plots the amount of displacement in the sample as a function of the logarithm of the time after a load is applied, is there any generally accepted curve or configuration which would result?

A One can interpret the measured displacement of the loaded portion of the consolidometer and the time in a way that allows one to determine the primary and secondary portions of the consolidation curve.

Q If you would, could you use this sheet of paper -- before doing that, could you explain how one does that.

A The movement of the loaded portion of the consolidometer under a constant load is interpreted as the change in the void ratio of the sample that is in the consolidometer.

And this void ratio that is calculated is then plotted against the logarithm of time under this constant, and the characteristic shape of the e-log p curve is interpreted so as to distinguish between the primary consolidation portion and the secondary consolidation portion.

Q I think you maybe misunderstood my question. The question I asked was whether or not a particular characteristic curve occurs when you plot the displacement in the sample versus time.

Maybe your answer did address that question. Did it or did it not?

A It did. May I explain?

Q Please do.

A The difference between your question and my answer was in the conversion of the displacement log time to a void ratio log time plot which is the usual mechanism for establishing the break point between primary consolidation and secondary consolidation.

Q Is there any way to do the experiment without having to make the conversion from void ratio to displacement or from displacement to void ratio?

(Pause)

A I suppose one could make up his own rules and interpret it that way. The usual practice is to put it in terms of void ratio versus the log of the time such that tested procedures to interpret the real secondary consolidation point can be applied. I am not aware of tested procedures for plotting directly -- interpreting directly displacement log time data to determine primary consolidation and secondary consolidation in portions of the consolidation process.

Q Do you know of any procedures for measuring strain versus log time?

A Well, one would of course read the dial indicator or whatever you are using to record the compression of the sample. And if you wish to use the average thickness of that sample as the

base for your strain and assume the strain is constant throughout, one could interpret it in terms of strain. You can plot strain or displacement.

It is only a matter of a dimensionless plot versus the log of time.

Q Is there a correlation?

A One can do it many ways: I was just describing the conventional interpretation of primary and secondary consolidation.

Q Is there a correlation between the strain and void ratio?

A Yes.

Q What is the correlation?

A I would have to work it out.

(Pause)

It turns out that it is a complicated, nonlinear function, but it could be worked out in time. Do you wish me to pursue this?

Q No. Perhaps we can arrive at it by a different route; instead of looking at a laboratory sample, if you looked at a field test and measured settlement versus log time in a situation where a preload had been applied to particular materials for purposes of consolidating it, would you expect any particular --

strike that.

Let me go back to the beginning of the question. In a situation where a preload is applied to a body of fill material for purposes of consolidating it, if you measured the settlement as a function of the log of time in that sample or in that case where preload has been applied, would you expect any particular characteristic plot or any characteristic curve to occur?

(Pause)

A Probably not.

Q Is your testimony, then, if I apply a preload such as what was applied in the case of the diesel generator building and I measure total settlement as a function of the logarithm of time and plot the results, that there is no predicted shape of the curve?

There is no particular configuration which I could predict as the final result of my plot? Is that your testimony?

A The only way you could expect a characteristic plot was if you assumed that all portions of that fill were undergoing the same stress and that all portions of that fill would respond to the same stress in the same way, which would mean that the materials would have to be uniform sand or uniform clay or uniform something in order to have a "characteristic load times

settlement."

I interpret "characteristic" as something we have seen before and something that is commonly understood among engineers.

Q If I applied my preload in such a way as to produce -- reach the stage of secondary consolidation in this field test, would a plot of settlement versus the log of time result in a straight line?

A Not unless allother material was of the same type, and the reason for that is that in the secondary consolidation of sand, it is generally somewhat different than the secondary consolidation of clays in terms of the characteristic curves.

Q Let me see if I understand your answer and make sure you understand the question.

I am talking about a field test such as what is actually done in the field in the use of preload for the purpose of consolidating soils. I am limiting the question to fill material that has been placed in an area.

I presume that by placing the load on the material you could expect some of the -- at least some of the material to consolidate. Is that a correct statement?

A Oh, yes, yes.

Q Now, you have defined primary and secondary consolidati

for us, and I am limiting my question now to the stage of secondary consolidation, when that is reached.

And my question is: if you are in a stage of secondary consolidation with regard to field tests and you plot settlement marked at the top of the fill material as a function of the logarithm of time, do you end up with a straight line?

(Pause)

A In my opinion you could or you could not, depending upon the distribution and the initial characteristics of the fill itself. Now, if this was a normally consolidated clay all on the same side of the A line and every other situation idealized, I would answer yes.

For random fill -- call it random fill -- I guess that's what you would have; I don't see how one could make that statement on a scientific basis.

And therefore I hesitate to -- I cannot answer yes to your question.

Q Is it your understanding of the statement I just made that has been made by Consumers Power Company's consultants with regard to the soil fills?

A I am aware that a statement similar to that has been made .. Consumers Power's consultants.

Q Could you make the exact statement which you feel has been made by Consumers Power Company consultants which is similar to that?

A It is my recollection the statement is that the curve portion of the load -- rather, the displacement log time plot approaches or looks like a straight line.

Q And is that true with time when the secondary consolidation is reached in the field test?

A I do not know, and I do not know for the reasons I have previously stated, the non-uniformity of the fill, the differe kinds of materials.

It could be coincidence; it could be fact. I really don't know.

Q So in other words, what you are saying is the conclusion drawn by Consumers Power Company consultants with regard to the lower portion of the curve where it approaches a straight line, that conclusion being that in that stage of the curve you have entered into secondary consolidation, is not necessarily true, in your opinion?

A It may not be. It may be true. I cannot testify either way.

Q If that had been taken by Consumers Power Company such

that the straight line characteristic was observed over a longer period of time, which you refer to as a curve approximating a straight line, was observed over a longer period of time, could you then conclude in your opinion that secondary consolidation had been introduced?

A Well, I feel that my definition of secondary consolidation, those conditions would have been met without doubt; given enough time, eventually the core pressure will completely dissipate,and therefore you are by definition in secondary consolidation.

How much time is something else.

Q I take it, then, that it is your opinion, the fact that there is no particular point on this plot of settlement versus log time just by looking at the shape of the curve one could conclude that you had entered into secondary consolidation. Is that a correct statement of your opinion?

A Based on the data I have seen, that would be my opinion at this point, yes.

Q In your opinion, can the straight line section of the curve, the section of the curve which is approximately a straight line -- and again I am referring to the settlement versus log time curve -- can that straight line portion be used to predict

future settlements?

A In my opinion for this case, yes it can.

Q Can that straight line portion be used to predict settlements with a reasonable degree of assurance in this case?

A May I consult with my attorney?

MR. JONES: Do you have any objection?

MR. BRUNNER: No.

(Discussion off the record)

THE WITNESS: Can I have the question reread, please?

MR. BRUNNER: Yes. Can you reread the question?

THE REPORTER: "Can that straight line portion be used to predict settlements with a reasonable degree of assurance in this case?"

THE WITNESS: On advice of counsel, I would like to put a framework around my answer since I cannot reply yes or no to this question.

The reason I cannot reply yes or no is because the phrase "reasonable degree of assurance" in this case encompasses many other disciplines than just mine. One must ask himself: "assurance of what?" That has not yet been defined. What is reasonable has also not been defined, to my understanding by our own Commission.

I will give you my opinion for what it is worth, that the portion of the curve that has been determined at this point appears to be a straight line, but it is a very, very short straight line on the log time plot.

I guess I would have to respond that at this point I cannot agree that there is a reasonable degree of assurance provided by that short straight line to cover all of the variables involved in this case.

BY MR. BRUNNER:

Q What -- how much longer would the plot have to be for you to conclude that there was a reasonable degree of assurance?

A The uncontestable length of time necessary to have reached secondary consolidation in all of the types of materials under the diesel generator building would have to be based on conservative assumptions. Such assumptions might be samples of the fattest clay obtainable under that building; permeability--permeability characteristics; drainage paths; times for reaching secondary consolidation.

Based on the characteristics of that clay, if it was demonstrated that the load was on long enough to drain even that portion of the fill, to me that would be an airtight case for secondary consolidation. Those assumptions are very, very

restrictive, but I could answer your question yes if that was in fact the case.

Q Could any of the -- strike that.

How could any of the conditions you just mentioned be determined for the fill under the diesel generator building at the Midland site as it presently exists?

A Well, you already have a number of samples from the diesel generator area; physical characteristics; permeability; time for 50 to 90 percent consolidation can be determined for those materials.

And the time necessary to consolidate the fill, 90 percent or whatever, is a straightforward calculation.

Q Are you taking into account in that answer the known heterogeneity of the soils under the diesel generator building at the Midland site?

A No, sir.

Q Does the known heterogeneity of the soil under the diesel generator building at the Midland site change your previous answer with regard to how it could be determined for sure whether or not the soils are in secondary consolidation?

A The known heterogeneity of the fill soils certainly makes the assumption of a uniform fill composed of the fattest

obtainable clays, a very conservative assumption.

But heterogeneity in itself, which one might say means we really are not sure what we have, except this is a lot of stuff there, makes it difficult to quantify the contribution of the heterogeneity to the consolidation process in any kind of rational way.

Q My question was directed to whether or not given materials which have been used for fill under the diesel generator building and given your previous answer with regard to what samples have to be looked at in order to determine if you are at secondary consolidation in that fill; my question is: given those two factors, can you in fact go through the process which you have described in order to determine that you are in fact in secondary consolidation?

A I did not follow the line of reasoning. Could you repeat it or perhaps rephrase it to help me, please?

Q I believe your previous answer was that you took samples at the site of the fattest clays and if the load was placed on long enough to drain those fattest clays, then you would feel a high degree of assurance that secondary consolidation had been reached.

Is that a correct statement?

A That is correct.

Q What I am saying is: in your opinion, given the known heterogeneity of the soil under the diesel generator building, would it be -- isn't it a fact that the samples you would take -- strike the question.

Let's go back to the beginning. You probably have forgotten.

A I was following it very carefully. I understood it the second time, I believe.

Q Wouldn't you agree that the heterogeneity of the fill under the diesel generator building affects your ability to extract or obtain representative samples?

A Yes.

Q If you had a mixture of clay and sandy soils, which I believe are at least two or the components of the Midland fill, clays, and I believe the other one you mentioned was concrete or cobbles --

A I believe materials of that nature have been found.

Q Isn't it a fact that given those materials in a field test preload, the clay will dominante the final result from a settlement standpoint?

A Yes.

Q Is that why you believe it is necessary to obtain a sample of the fattest clay in order to predict whether or not you are at secondary consolidation, what you refer to as the fattest clay?

A The fattest clay or that with lowest permeability would be the material that would control the length of time necessary to obtain secondary consolidation. I do not know that any sampling would be necessary.

You have already dug a lot of test bits in that area. You already know very well the range of materials that are present.

Q What is the expected shape of the settlement versus log time for clay?

A Well, the secondary consolidation of clay materials eventually approaches a straight line for a portion of its void ratio log time curve.

The eventual tail end, it departs from that straight line. It has been observed to depart from a straight line, hopefully on the conservative side.

Q I believe my question went to settlement versus log time. I think you have answered it by qualifying it and changing it to void ratio versus log time. Could you answer the question

with regard to settlement versus log time?

A Settlement log time behavior of the clay would eventually approach the same characteristic shape for the clay. By "characteristic shape" I mean now an essentially straight line portion at the end of consolidation time.

Q What is the overall shape of that curve? You can use this sheet of paper and draw it if you like.

MR. JONES: Can you mark this somehow and put it on the record?

MR. BRUNNER: Yes.

(Pause)

THE WITNESS: You have a shape something like that. (Indicating)

MR. JONES: Go ahead and note on the bottom just what he is drawing so we can show what it is.

MR. BRUNNER: You just handed me a piece of paper which I am going to mark as Consumers Power Company Exhibit Number 2 - Heller Deposition. It is dated 10/9/80.

(The above-mentioned document was marked Consumers Power Company's Exhibit No. 2 - Heller Deposition for identification.)

BY MR. BRUNNER:

Q On this drawing you have indicated the horizontal axis log time and on the vertical axis settement under constant load, uniform clay.

Is that a correct statement?

A Yes. That is where I think it would go.

Q This is what in your opinion is a typical -- this in your opinion is a plot of a typical uniform clay under the constant load.

A Similar to that.

Q Now, you have on the vertical axis plotted what looks like a line that is gradually going up as you go to the right. Is the way you have plotted this showing the total amount of settlement as a function of time?

A Yes.

Q A function of log of the time, rather?

A Yes.

Q Are you familiar with Casagrande's theory with regard to primary and secondary consolidation?

A Probably I have read it sometime or other. I am not sure I could give you the statement of that theory. I probably couldn't.

Q Do you recall Dr. Casagrande's method for determining the point at which you have entered upon secondary consolidation?

A From that particular plot?

Q From a plot similar to this, yes.

A No, I do not recall his construction for displacement or settlement log time.

Q Earlier you said that with regard to the diesel generator building area, Consumers Power Company already has a large number of samples which have already been taken. Is that a correct statement?

A I think they had some test bits under there and took some materials out for classification and whatnot.

Q In your opinion, is the data which Consumers Power Company already has sufficient to, if analyzed, to determine whether or not secondary consolidation has been reached?

A I am not sure whether that is the case. I believe they had two test bits, and they ran into a wide variety of clay consistencies in that bit.

I guess I would be surprised if the rest of the fill ran outside of the ranges that they had uncovered. It could be.

Q Referring again to your plot of settlement versus log time, which is contained in Exhibit No. 2, in your opinion, would

a plot of settlement versus log time for the diesel generator building foundation differ in any substantial way from the plot which you have shown here in Exhibit 2?

A I do not have a sufficient background to answer that question because I have not looked at the kinds of materials discovered at depth under that building.

Q If you assume that the fill material under the diesel generator building consists of clay with low plasticity sands and some cobbles and concrete, then in your opinion, would the observed behavior of the diesel generator building foundation under preload differ substantially from the plot which you have exhibited here in Consumers Power Company's Exhibit No. 2?

(Pause)

A Probably not in a substantial manner in terms of the shape of the curve.

Q I would like to have you take a look at a document which I am marking as Consumers Power Company's Exhibit No. 3 - Heller Deposition, dated 10/9/80.

(The above-mentioned document was marked Consumers Power Company's Exhibit No. 3 - Heller Deposition for identification.)

BY MR. BRUNNER:

Q In particular I would like you to take a look at figure three of that document which is entitled "Discussion of the Applicant's Position on the Need for Additional Borings for Midland Plant, Units 1 and 2, Consumers Power Company, Docket Numbers 50-329 and 50-330," dated September 14, 1980.

If you look at figure three of that document, could you tell me basically what that figure purports to be?

(Counsel handing document to witness)

(Witness reviewing document)

A The figure purports to be a plot of measured and predicted settlement versus a log of time. There are some notations on the figure that indicate that the permanent marker could not be monitored from March of 1979 to September of 1979 due to emplacement of surcharge,and temporary markers were used at another elevation during this period.

Q Does the plot indicate which settlement marker is bei implied?

A It indicates that the data is based on a temporary marker from the settlement of the zero until roughly 180 or so days later.

Then there is data based on the permanent marker up

to and including June 12, 1980.

Q Could I see the document a second?

(Pause)

Looking at the plot, can you determine how much the marker, the settlement marker being plotted settled between 9/14/79 and 6/12/80, assuming the plot has correct data on it.

A According to this plot, the permanent marker did not move from the period September 14 to June 12, 1980, to the resolution of this plot; one would say it did not move.

Q Looking again at the plot, again assuming that the data has been plotted correctly and accurately, can you observe anything with regard to the rate of settlement or change in the rate of settlement which occurred at approximately the 90th day into the plot on the time scale?

A According to this plot, roughly the 90th day it appears that the rate of settlement changed quite dramatically. I cannot see the data points so it is difficult to say whether that would have been a curve or whether they are two straight lines.

Q Again looking at this plot,which is contained in figure three of Exhibit No. 3, if you look at the portion of the curve which has been plotted between that day that you just indicated when there was a dramatic change in the settlement rate noted on

the plot and 8/15/79, which is noted on the plot as the date of surcharge removal, could you characterize the shape of the curve between those two points?

A Well, it looks like a stair step to me; from the 90th day on out to August 15, there are a number of straight line portions through which either a line could be interpolated or an average line could be -- probably be drawn.

One could also, I suppose, plot a curve through those points if he so desired. There is some slight curvature to that line. It appears to be approaching a straight line, however. (Indicating)

Q Are you familiar with optical surveying techniques?

A Yes, sir.

Q Is it consistent with your understanding of those techniques that when used to monitor settlement you obtain the stair step pattern to which you referred when characterizing the plot between the 90th day and 8/15/79?

A I am not familiar with the physics of optical surveying that would indicate an expectation for a stair step plot; no, sir.

Q Is it true that the resolution of optical surveying devices can cause or could cause a stair step shaped plot?

A Sure, it could happen.

(Pause)

MR. ZAMARIN: Shall we take about five minutes?

(Recess)

BY MR. BRUNNER:

Q Taking a last look, hopefully a last look at figure three to Consumers Power Company Exhibit No. 3, which, as previously described, is a plot of settlement in inches versus time counted in days plotted on a logarithmic scale of what purports to be a settlement marker or settlement markers at a particular location in the diesel generator building area, Midla Plant site, if you look at that plot, and again assuming the date that appears on it is reported accurately on the plot, can -- do you have any opinion as to whether or not that plot can be used to predict future settlement at the location which is plotted thereon?

A Well, you use the best information you have, and thi is the best information you have. So one would therefore use that to make an estimate of the settlement that is likely to occur in the future.

Q What is your estimate of that settlement which is likely to occur in the future?

A I personally do not have enough information to make a guess or have an opinion on what that future settlement would be

Q What other information would you need?

(Pause)

A Well, we talked at one time about how long the line would have to be with respect to log time in order to arrive at an extrapolation of that line for an upper bound settlement estimate.

Certainly, that would be helpful, to have a data base for the extrapolation of that line to a later point in time. I am not prepared at this time to say what complete information would be necessary to make that prediction.

I would think, as a minimum, at least one other confirmatory approach would be prudent to gain confidence in the extrapolation procedures based on these data.

Q What is a piezometer?

A A piezometer is a device that is inserted into the ground that is free to communicate with the groundwater for the purpose of measuring the pressure of the groundwater at a particular point.

Q By using piezometers in connection with the preload program -- strike that.

If piezometers were installed in an area where the preload program was instituted, would you expect any particular behavior of the piezometer indicative of the fact that you had entered into secondary consolidation?

A If the piezometer was sufficiently sensitive to detect pressure changes, one would expect the piezometer at the time of secondary consolidation to record a constant pressure versus time.

Q What sort of behavior would you expect from a piezometer during the phase of primary consolidation?

A One would expect the pressure recorded by a sufficientl sensitive piezometer that in fact measured the core water pressure to record a pressure higher than that that one would expect due to the static groundwater table elevation.

Q Do you know whether or not Consumers Power Company installed piezometers in the area of its diesel generator building?

A I believe that they did.

Q And have they provided data from those piezometers to the NRC in connection with their application?

A I believe so, yes, sir.

Q Have you reviewed that piezometer data?

A No, sir, I have not.

Q Do you know if anyone in your section has reviewed that piezometer data?

A I understand that Mr. Kane has reviewed that data.

Q Do you know or have you heard of one Dr. R. B. Peck?

A Yes, sir, I have.

Q Is Dr. Peck a recognized authority in soils engineering?

A Yes, sir, he is.

Q In fact, is he not an internationally known, recognized authority in soils engineering?

A He is one of the internationally recognized authorities

Q Do you know one Dr. A. J. Hendron, Jr?

A Yes, sir, I do.

Q Is he, too, recognized as an authority in the area of soils engineering?

A Yes.

Q Do you know or have you heard of Dr. M. T. Davisson?

A Yes, sir, I have.

Q And is he a recognized authority in the field of soils engineering?

A Yes.

Q Is he also a recognized authority in the area of piles

and caissons?

A Yes.

Q Are you familiar with the document which has been marked as Consumers Power Company Exhibit No. 3 and is entitled, "Discussion of the Applicant's Position of the Need for Additional Borings"?

A I have leafed through it. I have not read it in detail.

Q On page 6 of the document there is a section that is entitled, "Bearing Capacity." Have you read that section in detail?

A No, sir, I have not read it in detail.

Q Have you read it with enough detail to express an opinion as to the correctness of the analysis that is provided in that section?

A The analysis appears to be the same as that presented on September -- August 29 at Midland, Michigan. And I did not read it because of the similarity between this information and that which was presented at that meeting. It appeared to be correct .

Q The analysis in this section is entitled, "Bearing Capacity." In view of your conclusion as to the apparent

correctness of the analysis, do you have an opinion as to whethe or not Consumers Power Company has demonstrated adequate acceptability of its Class 1 structures at the Midland site from the standpoint of bearing capacity?

A Again, I will have to qualify my answer; I do agree that the method of analysis appears to be correct as presented in this exhibit.

I do not agree that it has been demonstrated that th appropriate parameters for insertion into that method of analys has been determined and demonstrated.

Q If you need to, you may refer to that section for my next question. My next question concerns which parameters you feel have not been applied correctly or used correctly in bearing capacity analysis so as to limit your ability to find adequate assurance from a bearing capacity standpoint.

A The variable C, the variable N_C, and possibly the variable N_Q.

Q Would you explain why you have a problem with variab C?

A Variable C is an indication of the strength assumed for the soils beneath the footing of the diesel generator building. To my knowledge, no strength test of an appropriate

nature to define "C" has been determined for the materials beneath the footings of the diesel generator building. N_C and N_Q --

Q Excuse me. Before you go on, what is your understanding of the way Consumers Power Company obtained its value for C for use in that analysis?

A Okay. I have been told by members of my staff and by our consultants that the materials tested to obtain these parameters were obtained not from beneath the diesel generator building, but from a portion of the random fill in the area of the borated water tanks.

Q Is it true that --

A And that the driving resistance characteristics for that fill were also interpolated from the area of the borated water tanks to the material beneath the footings of the diesel generator building.

I have not confirmed this on a personal basis, but that is my reason for stating that the analysis method appears correct, but the input parameters appear to be questionable.

Q Do you have the same problem with N_C and N_Q?

A Yes.

Q Do you have any other problems with regard to these parameters?

A None that have been brought to my attention.

(Pause)

Q On page 7 of this Exhibit No. 3, about half way through the page it states, and I am quoting: "The drain angle of bearing resistance is known to be primarily a function of the plasticity characteristics of the soil. And as the plasticity of the sample tested is within the range found beneath the diesel generator building, these tests are representative, and testing of samples below the diesel generator building would not result in significantly different design values."

Do you agree or disagree with that opinion?

A I would have to disagree.

Q On what basis?

A On the basis of some of the reported strengths that were obtained in the test bit in the diesel generator building area.

Q Is there any other basis for your disagreement with the conclusion or opinion expressed?

A The fill is known to be highly non-homogenetic. I am unable to conclude that there are not soils of similar strengths beneath the diesel generator building that were discovered in the test bit. Certainly, those soils are variable. And whether one

is justified in averaging those conditions is to me questionable.

Q Has Joe Kane ever expressed to you his opinion concerning whether or not there is a bearing capacity problem at the Midland diesel generator building?

A He has.

Q And what was his opinion, as expressed to you?

A I believe he said that he did not have a problem with the bearing capacity.

Q Is it a normal practice in design and construction to take shear strength and -- shear strength tests and blow counts under each and every footing of all structures in a nuclear project?

A No, it is not required by any regulatory guide that we have available to us at this time.

Q Is it the normal practice of the NRC to require shear strength and blow count tests under each and every footing of buildings which are founded on glacial till material when considering an application for an operating license or construction permit?

A Not for footings, no.

Q Is it not also true that glacial till typically exhibit a fairly broad variability in soil properties?

A It definitely can.

Q Have you reviewed a Consumers Power Company prediction for settlement which is likely to occur as a direct result of the proposed dewatering system that they have at the site?

A No, sir, I have not.

Q Do you have an opinion as to the necessity of taking additional borings in the area of the diesel generator building in order to demonstrate adequate soil properties? Such additional borings have been requested by the NRC.

A Yes, I have an opinion.

Q What is your opinion?

A I believe it would be highly prudent to do so.

Q Would it be necessary, in your judgment, to take these additional borings in order to demonstrate adequate acceptability of the soils below the diesel generator building?

A It seems to me this would be the most economical way of doing it. There are probably other approaches to obtaining the necessary information that could be utilized, all of which would probably be more expensive than the sampling and testing program requested by the staff.

Q Concerning your conclusion on bearing capacity which was addressed on page 7 of Exhibit No. 3, are you aware that in

this analysis the factor C with a bar over it was taken as zero and the factor C was based on samples of lowest density?

A I believe that Professor Hendron so stated in his presentation at the meeting on August 29.

Q Does that change your conclusion at all with regard t bearing capacity?

A No, because the investigation was done on materials that appear to be the best materials in the entire fill, those i the area of the borated water tank. And I am not at all convinc that they are representative of the material here.

Q You stated that the samples upon which this analysis was based were taken at the borated water storage tank?

A I believe that is correct.

Q If you assumed the samples were taken at the borated water storage tank, the condensate tank, and the Unit 1 transformer, would that change your opinion at all?

A I am not familiar with the conditions at those areas, so I do not have an opinion.

Q Do you agree that the drain angle of friction for a soil is a function of plasticity and not of density?

(Pause)

A I would agree for a static test those do seem to be

correct correlations.

Q Have you reviewed the Consumers Power Company proposed fix in the tank farm ar-

A No, I have not.

Q Have you reviewed Consumers proposed fix in the area of the service water pump structure, the part of it that is founded on fill?

A I have not reviewed the latest submittals. I am aware of the general scheme for both the service pump house and the borated water storage tank, but I have not gone into a detailed review at all.

(Discussion off the record)

MR. BRUNNER: Back on the record.

BY MR. BRUNNER:

Q What is your understanding of the applicant's -- Consumers Power Company's proposed fix with regard to the service water pump structure?

A I understand they are going to drive some piling on the cantilever side of the pump structure and to attach these piles to the pump structure with some bolts.

Q In the NRC's latest request for borings, did they request a boring in the area of the service water pump structure,

to your knowledge?

A Yes, sir. I am pretty sure they did; they should have.

Q I am going to hand you a document which I am marking as Consumers Power Company's Exhibit No. 4 - Heller Deposition. It is dated 10/9/80. It is a document which purports to be a letter to Mr. J. W. Cook, Consumers Power Company, from A. Schwencer, acting chief, licensing branch number three, Division of Licensing, dated June 30, 1980, along with an attached service or cc. list, and an enclosure one consisting of three pages, figure 37-1 and figure 37-2, each consisting of one page.

(The above-mentioned document was marked Consumers Power Company's Exhibit No. 4 - Heller Deposition for identification.)

BY MR. BRUNNER:

Q Looking at this Exhibit No. 4 at the page that is marked table 37-1, could you tell me for certain the NRC has requested boring in the area of the service water pump structure?

(Counsel handing document to witness)

A The lefthand column of table 37-1 on the third entry under location indicates service water pump structure and

retaining walls.

Q Can you tell from that how many borings have been requested?

A I believe one boring has been requested.

Q And would that be in the area of the service water pump structure or in the area of the retaining wall adjacent to the service water pump structure?

A I would have to look at the plot plan to make sure; they are not terribly far apart.

Q Is there a plot plan attached to that exhibit?

A I believe so.

Q Go ahead and look at it.

(Witness reviewing document)

Do you have an answer?

A I would like to correct that. The table 37-1 indicates one boring at the service water pump structure and two borings at the retaining walls. The plot plan shows COE boring 16 relating to the service water pump structure, and for the two borings related to retaining walls, COE 15 and COE 14 would locate those two exploration points.

Q Are you aware of the reason why the staff has requested a boring at location COE 16?

A Yes.

Q What is that reason?

A The reason is stated in column five of table 37-1 and would be used for confirmation of pile foundation design feasibility for vertical and lateral loading.

Q Are any samples requested to be taken in connection with that boring?

A Yes.

Q Would those samples be in the fill material, in the glacial till, or both?

A I believe the intention is for both materials to be evaluated.

Q Why is it necessary to take a sample in the glacial till material?

A To determine the properties of the glacial till that will assure expected support for the underpinnings of the pump house.

Q Are you familiar with any of the borings that were taken by Dames & Moore in the glacial till at the Midland site?

A No, I am not.

Q I take it, then, you are also not familiar with the location of the borings that were taken by Dames & Moore in the

glacial till?

A I have not checked those locations, no, sir.

Q Did you review this request for additional borings before it was submitted to Consumers Power Company?

A Yes, sir.

Q And did you concur with all of the boring locations which have been requested?

A Yes, I did.

Q Did you originate the idea that Consumers should have to take extra borings at the Midland site, or was that originated by someone else?

A It was originated by someone else.

Q Who was that person?

A I am not sure who that person or group of persons was who made that determination. I am fairly certainly it came from our consultants.

Q Now, again, looking at table 37-1 of Exhibit No. 4, has the staff requested any borings in the area of the auxiliary building?

A Yes, they have.

Q Are those borings in the area of the electrical penetration part of the auxiliary building?

A They are very close to the electrical penetration areas of the auxiliary building.

Q Do you know what Consumers proposed fix is with regard to the electrical penetration area?

A As I recall, the proposed fix was a fill concrete under that particular part of the structure.

Q Have you reviewed Consumers Power Company's submitted information with regard to the electrical penetration area of the auxiliary building?

A I have not reviewed it. I have been briefed on the concept that is to be used. As I recall, the fill concrete was to be used beneath the small portion of the auxiliary building. The caissons were to be used to support the main portion of the building that required remedial support.

Q Do you have any objections to the basic concept which the applicant has proposed in those two areas that you have just mentioned?

A Yes, in one area.

Q Which one is that?

A The portion of the auxiliary building that is to be supported on caissons.

Q What is your objection?

A The objection is basic in that the structure will not be supported in the manner for which it was designed, and the consequences of that are likely to be indeterminant with or without analysis.

Q What is the difference between what Consumers has presently proposed and the way the structure was designed which creates a problem in your mind?

A The assumptions for the support conditions made for a spread footing or for the mat foundation are different than the support conditions and loads that would be imposed on this presently existing foundation by the placement of caissons beneath only a portion of the foundation.

Q Is your problem with the loads which will be introduced to the structure by the caisson itself?

A Yes.

Q Do you have any other problems, or is that an accurate statement of your entire problem?

A Well, they are all factors that come into play when you support a structure in a manner differently than that for which it was designed, including its response to dynamic loads, wind loads, or any other combination of loading that the structure was expected to resist and perform satisfactorily.

In all cases, the changed conditions at the foundation level would have some influence, and I cannot address how much or the consequences of that, but certainly the conditions are different and would impose different stresses and strains on that structure.

Q Are you familiar with Consumers Power Company's proposed fix with regard to the underground diesel tanks?

A As I recall, in response to questioning on the diesel generator tanks, fuel tanks, was that there was no planned remedial action in this area.

Q It is my understanding the diesel fuel tanks were loaded by filling them up with water. Settlement was then observed following that; is that consistent with your understanding?

A I believe that is correct.

Q Did you observe the settlement data that was obtained during that process, during that stage when the tanks were filled up with water?

A No, I did not.

Q Referring again to Exhibit No. 4, figure 37-2, I believe you earlier stated that there are two retaining walls shown in this figure.

Are both of those retaining walls Class 1 structures?

A They are both related to the safety of the plant and its ability to provide for the safe shutdown of that plant I do not know whether they have been classified by Consumers Power as "Class 1 structures."

Q Looking in particular at the retaining wall which is in the area of boring designated COE 14, can you explain why, in your opinion, that retaining wall is related to the safety of the plant?

A Our reviewers have brought it to my attention and the attention of others, that that particular wall retains fill soil into which the diesel generator fuel storage tanks have been buried along with the associated lines for moving that fuel to the diesel motors themselves.

Our reviewers have pointed out that should that wall move and the fill with it and the tanks with the fill, that the fuel lines could be disrupted such that fuel could no longer reach the diesel generator building.

It becomes reasonable, then, to provide some measure of assurance that the retaining wall adjacent to boring 14 has a sufficient degree of reliability to prevent such an occurrence.

Q When you refer to "our reviewers," what particular individuals are you referring to?

A I was referring to our Corps of Engineer Consultants who are presently stationed in Detroit, Michigan.

Q Do you know which particular individuals amongst the Corps of Engineer consultants have that opinion?

A I cannot identify the individual because there is a team of reviewers who are cooperating in this review, both in a parallel and in a line of command nature.

Q Looking at the retaining wall adjacent to the boring location designated COE 15, have you reviewed Consumers Power Company's submitted data with regard to that location?

A No, sir, I have not.

Q Do you know whether or not your consultants have done so?

A I cannot make a positive statement. I am assuming that they have reviewed the latest submittals on that particular retaining wall.

Q Do you know what the staff's position is with regard to the adequacy of the materials in that retaining wall?

A I do not believe a conclusion has been reached in the review process with respect to that retaining wall nearest to COE 15. I believe it is still in a review mode.

Q Why did the staff retain the services of the Corps of

Engineers as a consultant on this review?

A We retained them because we realized that the scope of the review and the time and the resources necessary to successfully conclude this review would be far beyond that that is usual for an OL review in the geotechnical area. And the staff would not be able to handle it in a timely or sufficiently detailed manner.

Q When did the staff retain the services of the Corps of Engineers as a consultant?

A For the Bailly project we requested their assistance in the fall of 1979.

Q What about for the Midland project?

A For the Midland project we requested their services in the fall of 1979.

Q You stated earlier that you personally were aware of the existence of the problem with soils at the Midland site in the fall of 1978. Isn't that true?

A That is correct.

Q Why did you wait for what looks like a period of a year before retaining consultants to help with the review on this problem?

A During this time period I approached individuals in

whom I had confidence with this problem, outlining the scope of the problem, and was unsuccessful in obtaining their services.

Because I was unsuccessful a number of months of delay occurred before I could -- we could engage persons to undertake this review.

Q What persons did you attempt to -- rather, what persons did you contact with regard to obtaining their services in this review?

A I contacted Mr. Leroy Mac Inear at the Waterways Experiment Station in Vicksburg, Mississippi and requested that he also supplement his resources with an overseeing consultant by the name of Stanley Johnson.

Q When did you contact Mr. MacInear?

A I contacted him in the spring of 1979.

(Pause)

I believe I have answered your question.

Q What about Mr. Johnson? When did you contact him, if you contacted him personally.

A At about the same time or a couple of weeks earlier.

Q Are these persons members of the NRC staff?

A No, they are not.

Q Was there anyone in your section, other than yourself,

who was reviewing this problem: namely, the Midland soils problem?

A Yes, there was.

Q And that person, I take it, is Mr. Kane?

A No, sir. That person was Mr. Dan Gillen.

Q When did Mr. Gillen start his review efforts?

A Very shortly after information became available from our I & E office and from Consumers Power.

Q Was anyone else in your section assigned to review the Midland soils problem at that time?

A No, sir.

Q When did Mr. Kane start working on that problem?

A Mr. Kane started working on the problem in the fall of 1979 -- I am sorry. Strike that.

Mr. Kane started working on that about the first of the year, 1980.

Q Was Mr. Gillen working on it up until the time Mr. Kane started working on it?

A No, sir.

Q When did Mr. Gillen terminate his efforts working on the problem?

A Mr. Gillen transferred from our office to another office within NRC -- I cannot recall the exact date -- late 1979.

Q Has anyone else other than Gillen and Kane from your section worked on the review of the Midland soils problem since its inception?

A The date I gave you on the last question, if I may correct it, it would have had to have been in early 1979. No other person was available to work on this task during the interim period.

Q Your statement is that Mr. Gillen transferred in the early part of 1979?

A Yes, sir.

Q And that Mr. Kane came on board in the early part of 1980?

A That is correct.

Q Between those two times, there was no other person assigned to the project other than yourself?

A No other person than myself was available for any assignment.

Q I would like you to take a look at a document which I will mark as Consumers Power Company's Exhibit No. 5 - Heller Deposition, dated 10/9/80.

(The above-mentioned document was marked Consumers Power

Company's Exhibit No. 5 - Heller Deposition for identification.)

BY MR. BRUNNER:

Q I am looking at a document which is a letter to Mr. J. W. Cook, vice president, from A. Schwencer, dated August 4, 1980. The subject is Corps of Engineers report and request for additional information on the plant fill. The letter is two pages long with an attached cc. list consisting of four pages and another attachment styled enclosure one, entitled "Department of the Army, Detroit District, Corps of Engineers, Box 1027, Detroit, Michigan," which consists of 16 pages.

Enclosure one contains some crossouts and some renumbering of paragraphs. It appears to be handwritten text. On page 2 there is a "39" of handwritten text; page 3 there is a "40" of handwritten text. Before that there is a paragraph crossed out, and on page 5 there is a "41" handwritten text and some interlineations written in handwriting.

On page 6 there is a "42" in handwriting and a circled section, some cross-outs, and an arrow pointing from one paragraph to another, and various other interlineations and cross-outs in the rest of the enclosure.

Would you take a look at this enclosure and tell me

whether or not you are familiar with it.

(Counsel handing document to witness)

(Witness reviewing document)

A Yes, I have read this letter.

Q Who made the cross-outs and put in the numbers in the left margin, if you know?

A I believe Mr. Darrell Hood performed that task.

Q Do you know whether or not that particular letter and enclosure was sent to Consumers Power Company?

A I do not have personal knowledge that it was sent to Consumers Power Company. Darrell could confirm that, if you would ask him.

Q You have no reason to doubt that it was at this time?

A I have no reason to doubt it, but I don't have any personal knowledge.

Q Now, what was the purpose of sending that enclosure -- letter to Consumers Power Company, according to your understanding

A The purpose of this letter was to first clarify the details of the borings that were being requested as a supplement to a letter to Mr. Cook dated June 30, 1980.

The purpose of the entire text of the Corps of Engineer letter is to inform Consumers Power of the questions and

issues that would need to be resolved and answered to continue the operating license review for this particular plant.

Q The questions renumbered by Darrell Hood contained in enclosure one were those questions, as far as you know, authored by the Corps of Engineers?

A Yes. The entire letter was authored by the Corps of Engineers. The deletions, the numbering were provided by Mr. Kane and concurred in via telephone with the Corps representatives responsible for the letter.

Q Is the Corps of Engineers providing assistance, consulting assistance to any particular section of the NRC, other than your section, in connection with this Midland soils problem?

A In connection only with the Midland soils problem?

Q That is right.

A I believe they have been requested to provide some updated flooding data for the use of our staff. I believe it was Midland, but I could be mistaken on that. To my knowledge, there is no Corps personnel presently working on other aspects of the review for the soils issue itself.

Q You testified earlier, I believe, that your review authority or the review authority within your section does not include an analysis of the effects of particular loadings due to

soils or other sources on structures.

If that is the case, do you believe that it would be proper for your section to submit questions to an applicant,such as Consumers Power Company,which requests analyses of the effects of such loads on structures?

A The enclosure to the letter to Mr. Cook is coordinated by the project manager with other review personnel who have responsibilities for other factions of the review. And it is my understanding that those persons responsible for areas of review, interfaces, or affected areas of review fully concurred in the questions being provided to Consumers Power.

So the letter itself is not a total reflection of the review responsibilities of our particular section. It has been coordinated with those other parts of the review with persons involved in the review of this plant.

Q It is your testimony that this particular letter has been reviewed by those persons who are responsible for analyzing structures?

A They are aware and it is my understanding they do concur in the need to ask the question or raise the issue, as the case may be, in that letter.

Q Do you know who these persons who have concurred are?

A If I may, I would prefer to defer that question to Mr. Kane who was personally involved with that and could give you firsthand testimony.

Q Your answer is no, you don't know who those persons were?

A I could give you a guess, but you would be -- have better information from Mr. Kane.

Q Is Mr. Kane the person who told you that these other people had concurred with the questions that were submitted?

A Mr. Kane and Mr. Hood.

Q Are you familiar with the December 6, 1979 order issued by the NRC concerning the Midland site?

A Yes, sir.

Q You testified earlier that with regard to this enclosure that has been submitted by the NRC containing what you stated were issues that would have to be resolved by the staff in conducting an operating license review of the Midland soils problem, is it your understanding that all the questions in this enclosure would have to be answered to provide the acceptance criteria which is referred to in the December 6, 1979 order modifying Consumers Power Company's construction permit?

A Yes. It has been my experience, not necessarily on

this plant, but on others, that on this set of questions, it could be considered a precursor and that depending upon the answers to these questions, whether additional questions are necessary or whether the answer to one question might answer three or four others.

So it is --

Q I think my question was directed to the fact that the December 6 order modifies Consumers Power Company's construction permit, and the way you have categorized the need for answers to the question in the enclosure was that they were needed to conduct an operating license level review.

So my question is: in your opinion, as a reviewer, is it necessary for Consumers to answer all questions in this enclosure in order to meet the acceptance criteria in the order which relates to construction permit level review?

A Thank you for explaining that. My opinion woud be no, it would not be necessary to answer all of those questions to establish basic criteria for the remedial actions necessary at Midland.

Q Is there any way that Consumers Power Company can tell which questions would have to be answered and which ones would not have to be answered in order to provide the basic

criteria?

A I would not be able to distinguish at this point, and I do not believe that the reviewers had that distinguishing requirement in the order of or the requirements for answers-- I don't believe that distinction was made.

Q With regard to the preload program at the diesel generator building, do you believe that direct field tests, such as what the preload may be termed, provide a more accurate indication of future settlement than would laboratory samples and analyses done on laboratory samples?

A Yes, they will provide a more accurate measurement of past settlement.

Q Would it provide a more accurate prediction for future settlement?

A Yes, it could provide a more accurate estimate of future settlement.

Q I believe my question was: would it in this case provide a more accurate prediction of future settlement than would analyses done on laboratory samples?

A Yes, it would provide a more accurate assessment of future settlement.

Q On page 4 of Exhibit No. 3, which is the discussion of

applicant's position on need for additional borings, what is the second full paragraph from the top, there is a description by the author of the errors incident to measuring settlement using laboratory samples and using direct field data.

Could you read that paragraph and tell me if you disagree with anything in it?

(Counsel handing document to witness)

Starting with the words, "The technique of extrapolating."

A "The technique of extrapolating from full scale test results is the most reliable method for predicting settlement. Normally at the start of a job sampling and testing are utilized to predict settlements. In this particular situation the surcharge program provided the opportunity for direct measurements and thereby eliminates the need for sampling and testing."

Should I go on?

Q You can either read it to yourself or read it out loud.

(Witness reviewing document)

A Okay.

Q Do you disagree with any portion of that paragraph?

A Yes, I do.

Q What portion do you disagree with and in what respect

do you disagree with it?

A The part I disagree with is in the second sentence: "Normally at the start of a job sampling and testing are utilized to predict settlements."

In this case we have no sampling, and we have no testing, and we have no parallel understanding of the materials that are involved in the consolidation process and in the resulting settlement.

So when you simply lump together the statement that, "Normally at the start of a job sampling and testing are utilized to predict settlements," we are dealing here with a reasonable understanding of the constituents and the conditions that are present in a soil material.

In this case we do not have that parallel body of information and data from which to judge the sensibility of the results that are being obtained from the measurements. Now, I do agree with all of the sensitivity and accuracy statements that are made with respect to comparing laboratory measurements directly with field measurements of settlement.

The missing link here and the important missing link is the understanding of the soils themselves. And that is why I have to say that the phrase, "Normally at the start of a job,"

is not realized in this particular case.

Q In your opinion as a reviewer, is it necessary for Consumers Power Company to meet the original -- its original PSAR commitments with regard to soil compaction for the staff to make a finding that the proposed remedial action provides adequate assurance to the health and safety of the public?

A No.

Q At a meeting that was recently held at the Midland site, I believe you made the statement that the staff was burned twice -- quote, "burned twice," unquote -- at the North Anna proceeding by using field data rather than laboratory samples.

I may have misquoted you slightly. If I have, you can correct my quotation and then explain what you meant by it.

A May I have a minute to leaf through the same things I have given you to try to clarify my last answer before we continue with this one?

Q Yes.

A I think it is an important sort of clerical oversight.

(Pause)

I had provided to you a number of papers similar to this one, and --

Q Before you continue, would you identify for the record

which paper you are referring to.

What you are referring to is a document dated 12/4/78; in the upper lefthand corner, it has the word "Midland" underlined twice, and is apparently written in handwriting. It has a couple of graphs on the front page. The first two lines are "Meeting Notes, Agenda, 9:30 a.m."

It consists of four pages; it has an attached agenda consisting of two pages and then a list of names along with organizations consisting of two pages. I may want to mark this for the record later, but why don't you just tell me what you are going to do with it.

A I wanted to make a clarifying remark with respect to your last question as to whether it was necessary to obtain the original PSAR compaction of the fill beneath the diesel generator building as a requirement for support of that building.

The document I gave you a moment ago is dated December 1978. And our notes that I made at the presentation and at the first knowledge that I gained firsthand of the settlement situation at Midland, on page 4 I have in my notes something different than is recorded in the NRC meeting notes.

The statement I wish to make at the conclusion of that meeting is that NRC has no choice but to use PSAR criteria in

evaluating the FSAR in terms of commitments realized.

And I would like to state that the meaning of this was not that the fill had to be exactly as was determined in th PSAR, but that the support for that building would need to meet the same rigid standards as were anticipated at the PSAR stage.

Q Could you make that same statement with regard to ot class 1 structures at the Midland site?

A I could make that statement. I am not the reviewer, I could make that statement, yes.

Q Well, with regard to the soils problems, if any, whi have been unidentified in areas other than the diesel generator building at the Midland site, would it be necessary for Consume Power Company to meet all of the original PSAR requirements wit regard to those soils in order to satisfy the staff that an adequate degree of insurance to the public health and safety ha been realized?

A It is my opinion that it is not necessary to demonst that the same criteria were adhered to. It is, I think, essent to demonstrate the same degree of reliability, the same risk o adverse circumstances are obtained with whatever fix is propose and completely implemented and checked out.

Q Do you recall the question I asked about North Anna

A Yes, I do.

Q Can you answer that question?

A I was afraid you would ask. Yes, I will. North Anna was a situation almost the reciprocal of Midland. The tests that they had done for the service water pump house were consolidation tests from a sampling operation in this case in a sapprolite that probably is no more variable in compression characteristics than the constituents of the fill at Midland.

And their PSAR predicted a reasonable degree of settlement, something less than one inch. They built the structure, and it began to settle. And it settled up to the predicted limit, and the appropriate amendments were submitted and reviewed and little concern was given to that.

Measurement monuments were placed all around the structure to continue to monitor settlement, and although the settlement had stopped, according to the monuments, there was a period of time over which the settlements began to increase for no apparent reason, with no apparent increase in load, and no directly observable cause.

That happened once and a prediction of settlement was made based on the settlement records over a period of time and extrapolating a settlement log time curve.

A couple of years later the structure began to settl more rapidly, and at this point some mechanical modifications were made to accommodate this settlement. The magnitude of the accommodation was in the neighborhood of three inches of additi settlement.

A technical specification was written with a reasona warning period, as this structure could possibly approach the new limits for the new accommodation of that settlement. The structure again began to settle and approached the limiti value established in the technical specifications by the appli And it was necessary to re-evaluate the entire system.

So my comment, elaboration on my comment is not so that laboratory tests are more reliable than the field direct measurements, but that a complete understanding of the materia characteristics and the factors affecting the settlement need be obtained and understood before either approach to settlemen predictions is treated with a serious vein -- treated in a serious vein.

Q You mentioned the word "sapprolites" in referring t the fill at North Anna. Are there any differences between sapprolites and the fill material that was used at Midland wi regard to soil properties that are useful and important for

building foundations?

A There is really no relationship between the naturally occurring sapprolites supporting the North Anna pump house and the fill materials supporting the diesel generator building. They are geologically black and white.

My point was that laboratory tests and direct measurements both need to be addressed with some degree of caution until you are confident you understand the soils you are dealing with and the loading effects that can come into play on those structures.

Q As a --

A That was perhaps my misinterpreted point and not perhaps completely explained point.

Q Do you have an opinion as to whether or not more is known about the properties of the fill material used at Midland than is known about sapprolites?

A No, I do not have an opinion on that.

Q Do you have an opinion as to whether or not the cooling pond dike at the Midland plant or a portion thereof is a safety related structure as defined by NRC reg guides or other applicable guidances on the subject of safety related structures?

A Some portions of the dike are important to safety, and

some portions of the dike are less important to the safety of that plant.

MR. BRUNNER: I am going to hand you a document which I am marking as Consumers Power Company's Exhibit No. 6 - Heller Deposition, 10.9/80.

(The above-mentioned document was marked Consumers Power Company's Exhibit No. 6 - Heller Deposition for identification.)

BY MR. BRUNNER:

Q This is a document which appears to be a map or a top view of portions of the Midland cooling pond dike. Have you seen any drawings of the Midland cooling pond dike in the past?

A Yes, I have seen cross-sections.

Q Does that drawing comport with your memory of the way the cooling pond dike is set up, at least in the sections that are shown there?

A Oh, it looks similar to the other drawings I have seen

Q Now, you just testified that in your opinion a portion of the dike is important to safety or more important to safety than other portions of the dike.

Is it your testimony, then, that the entire dike is a

safety related structure as defined by NRC in guidances on the subject of what structures are safety related?

A Well, the portion of the dike that is adjacent to the service water pond is without doubt a seismic category one, safety related structure. Those portions of the dike at a great distance from the excavated pond could reasonbly be assumed as unable to affect the ability of that pond to hold and supply water for the safe shutdown of the two nuclear units.

Q Why do you believe sections of this dike that are immediately adjacent to the pond are, in your words, undoubtedly safety related?

A Because their failure would lead to the inability of supplying water for the immediate needs, after the borated water is used, of course, immediate needs for water to cool that plant. The design of the submerged pond, as it is called, requires a circulation of water within this particular pool.

(Indicating)

And disruption of this line or the redundant line on the other side would not allow sufficient cooling of this trapped water to fulfill the cooling function.

Q For the record, when you refer to "this line," I believ you pointed to what looks like a black line.

A I was referring to the discharge lines.

Q These two lines go around either side of the emergency cooling pond and terminate in the back section of the cooling pond, if I may use that --

A Yes.

Q The back section is a section which is a section furthest down on this drawing, down and to the right on this drawing.

A Farthest from the pump house, yes.

Q Fine. It is your testimony, then, that a failure of the dike in areas adjacent to these pipes --

A Areas adjacent to those pipes could disrupt and break those pipes, disrupt the flow in those pipes. And it would cause a safety problem for the plant.

Q Is there any other reason why a failure of the dikes in the area in close proximity to the pump house could cause a safety problem?

A Well, their failure would reduce the volume of water available in the cooling pond itself and therefore would result in an insufficient supply as calculated to be necessary for cooling the plant.

Q If you assume that the emergency cooling pond provides enough water for an ultimate heat sink, as that term is used in NRC practice, an ultimate heat sink being the amount of water necessary to maintain a safe shutdown condition of the plant, does that change your answer to the previous question?

A No, it does not change my answer because I couched the answer in terms of the degree of safety and not in terms of the essentiality of the dikes that appears necessary in those areas adjacent to the submerged pond.

Q Would you restrict your answer to just a determination as to whether or not a failure of the dike in a particular mode would make it into a safety related structure as used, as that term is used in NRC guidance on the subject?

If you restricted your answer to that consideration, then is there any reason, other than possible rupture of the two pipes you have referred to, why the dike and the area adjacent to the pump house could be considered safety related?

A Do you mean are there other reasons?

Q Are there other reasons why you would consider this dike to be safety related, other than the possibility that it may adversely impact on one of the two pipes that you mentioned?

A Those are the major reasons. There are of course

supplementary concerns, such as the failure of the dike in this area could possibly block the intake; the failure, in a certain manner -- I am not sure what the materials are, but they could be composed of fine sands and silts -- would definitely provide a large degree of turbidity for the water.

And this turbid water or mud, as it would be called, would then be pumped into and circulated into the emergency cooling system. So there is that aspect. One could go on, but it seems those reasons are enough to classify the dikes in this area as being necessary for the safe shutdown of the plant, safe and reliable shutdown of the plant.

Q Is it your understanding that this dike area has not been Q-listed?

A I have not examined the Q-list. I believe that those discharge lines were not shown on the FSAR. I believe that those lines are now shown only as a result of our questioning and I assume that the Q-listing of this portion of the plant is simply an oversight at the FSAR stage, since they were not so identified earlier.

Perhaps another reason they were not Q-listed is that these dikes were authorized to be constructed under an LWA. And perhaps they just never got on the list of items to be controlled

Q When you use the term "oversight," are you referring to an oversight by Consumers or an oversight by the NRC?

A Possibly both; we are talking about a period of time, 10 or 12 years ago.

Q Do you know when the NRC received information that the two pipes you referred to were going to be built at their present locations?

A No, I do not know that date.

Q In your answer to the previous question or the question right before that, you left me with the feeling that you still had not stated all the reasons why you think that the dike might be safety related. Are there any other reasons? I would like to know all of them right now.

A Those are all that come to mind at the present time. Those are the only postulations that I can see. Others that have other concerns may also see other things that need to be resolved.

Q When you state "other concerns," you mean concerns other than soils concerns?

A Yes, sir.

Q In your opinion as a soils engineer, if the fill material which had been used by Consumers Power -- strike that.

In your opinion as a soils engineer, if the fill material which actually was used by Consumers Power Company under the diesel generator building had been adequately compacted at the time it was installed or put into place, would the unusual settlement problems which have developed and which have been documented by Consumers have occurred?

A I do not think it would have, no, considering all of the controls that would have been necessary to meet the original specifications.

I would say, no, the likelihood is very small.

Q When you state "original specifications," you are referring to the specifications in the PSAR?

A Yes, sir.

Q Which group within the NRC or rather which section has the lead responsibility with regard to the proposed dewatering system at the Midland site?

A I think our hydrologic section probably is spending mos of their time on that aspect of it.

Q You stated earlier that your group has some responsibil for considering the dewatering system.

A Yes, sir.

Q And I believe one of the particular areas of concern to

your group was soil permeability. Is that a correct statement?

A I think for this particular review our concern would be for the filters for the packing for the dewatering wells and installation of the permanent piezometers, for example. We probably would not be concerned about the time for drawdown, the rate of recharge under accident conditions. The hydrologic reviewers appear to be sufficiently informed to take care of that matter.

On a generic basis we would review the soil permeability say, at another plant just to be sure that the values assumed are consistent with the nature of the soils, identification of the soils.

Q Do you have an opinion as to whether the proposed dewatering system can if properly designed provide an adequate solution to the potential problem of liquefaction at the Midland site?

A It should handle the liquefaction problem.

Q Have you held this opinion all along, or have you changed your opinion on this subject recently?

(Pause)

A I think I have held the opinion that the dewatering system would handle the liquefaction problem if it is properly

designed, and so forth.

Q Are there any particular problems that you are aware of associated with designing a dewatering system for the Midland plant?

A There are always a number of precautions that have to be taken for a dewatering system, either permanent or temporary, but particularly for a permanent system. I am sure that the designers are capable of taking those precautions.

Q Have you reviewed Consumers Power Company's submission concerning shear wave velocity measurements at the Midland site?

A No, sir, I have not.

Q I take it, then, you have not reviewed data from cross-hole tests either?

A I have not reviewed that data.

Q Is that something your section would have responsibility to review?

A Yes.

Q To your knowledge, that review is being undertaken by your section?

A Yes.

Q Is that a subject which has been referred to your consultants?

A I assume that it has. I do not have personal knowledge that it has, but I am confident that it is supposed to be.

Q Who has responsibility for seeing that that review is done?

A Mr. Kane. Mr. Kane is overseeing the Corps' review for this plant.

Q Do you have any idea when your section will be done with its review to the extent that -- strike that question.

Do you have any idea when your section will have done sufficient review to submit -- to support a staff SER on the Midland soils fix?

A I will have to again give a schedule kind of answer rather than a direct date answer. In general, we can review whatever is submitted and come to a collegial conclusion in about three months, in terms of an SER from the technical people to the licensing group.

The date of completion of course is dependent upon the information that is submitted, the sufficiency of the information, the reliability of the proposed fixes, let's say, and a number of other factors.

An SER of course can be written positively or negatively, depending upon the demands that our licensing people

make upon us. We can write an SER at any point in time.

Q I would like you to refer to Exhibit No. 3. There is a figure there which is titled figure number two. In parentheses it says "See reference one." My understanding of this figure is that it purports to show the loading placed on the plant fill material under the diesel generator building at various times in the history of that particular plant fill.

Are you familiar with that diagram?

A I have -- it is the same diagram that Professor Peck used, I believe, at the presentation. I am familiar with it, yes.

Q Looking at the various loading factors shown in that diagram, do you have an opinion as to whether Consumers Power Company used adequate weight in its preload program, assuming that the data there is actually correct?

A The question you have asked is a very complex question, and it needs to be answered at least in two steps. The first step is: has enough load been applied to sufficiently reduce the potential for future settlement? I think in that case one would have to say that the usual procedure is to surcharge to a somewhat higher level than has been obtained here, particularly for those soils at deeper depths.

As to whether the surcharge has improved the shear strength characteristics of the soil beneath the footing, one needs to examine what effect that areal load had on consolidating and improving the shear strength and whether or not the soils that would receive the shearing stresses by the footings has been sufficiently consolidated such that the shear strength along those shear potentials is realized.

I am not really prepared to answer that question. I suspect there has been some improvement, but I suspect that it has not been large.

Q You are referring -- you are referring to improvement --

A Of bearing capacity.

Q Just with regard to settlement, do you believe the load that was applied in the preload program is adequate to meet the design purposes of Consumers Power Company using preload?

A I honestly do not know. It is on the short side of usual practice.

Q What are you basing your opinion as to usual practice on?

A Well, it is common to surcharge to roughly twice the carry load and in certain cases down to one and a half times the imposed loadings. Here we are approaching perhaps on the low side

of that ratio.

Q You say it is commonly done. Is that based on your experience?

A No, it is not. It is based on the literature and reports of other people's experiences with surcharging operations.

Q You testified earlier that surcharges are often used to compact organic soils or soils with organic material in them. Is the statement you made with regard to the multiple of the seen load that is used in the surcharge, the multiple of the load which is actually seen by the soil in normal operation, is that applicable to cases where preloads are used for nonorganic fill material?

A I would think it would be. I think it has been applied for nonorganics as well as organics.

Q If you neglected the effect of dewatering, would the load be adequate according to the criteria you used to answer the previous questions?

In other words, if you neglected the original load caused by dewatering, which I believe is one of the loads that is noted in the diagram, in that situation would the load that was applied be adequate according to the criteria you used earlier?

A Well, the fill was not dewatered at the time the preload was applied to this area. So we are interested in the maximum load applied, rather than, you know, what one could hypothesize. Perhaps I am missing the point of your question. Would you oike to repeat it or rephrase it?

Q Are you familiar with any ACRS review of soils concerns?

A Yes, I am.

Q Could you tell me why the ACRS has gotten interested in reviewing soils?

A No, I could only speculate, and I prefer not to.

Q Have you briefed any members of the ACRS staff with regard to the Midland soils problem?

A Yes, I have.

Q What persons did you brief.

A I briefed a consultant to the ACRS. His name is Professor Osterberg.

MR. BRUNNER: I have a couple more areas of questions I wanted to go into, but we have to take off. Do you have any objections to -- I do not think we will probably want to further depose Mr. Heller. But we may want to.

Do you have any objections to adjourning this sine die?

MR. JONES: No objection

MR. BRUNNER: Okay. I think that way we can all leave in a timely fashion. We've finally had enough.

So, I thank you for your cooperation.

THE WITNESS: Thank you.

MR. JONES: Do you want to give me the exhibits and I will get them copied.

MR. BRUNNER: All right. The understanding is that I am going to leave the exhibits to this deposition here, and Mr. Jones has agreed to copy those and send the copies to me.

MR. JONES: I'll send the originals back to you.

MR. BRUNNER: Yes. You are going to send the originals back to me. Fine.

So the deposition is then adjourned sine die.

(Thereupon, at 5:55 p.m., the deposition in the above-entitled matter was adjourned, sine die.)

CERTIFICATE OF REPORTER

UNITED STATES OF AMERICA	)	
	)	Docket Nos. 50-329-OL
NUCLEAR REGULATORY COMMISSION	)	50-330-OL
		50-329 OM
		50-330-OM

I, DAVID S. PARKER, the officer before whom the foregoing deposition was taken, do hereby certify that the witness whose testimony appears in the foregoing deposition was duly sworn by me; that the testimony of said witness was taken by me by stenomask and thereafter reduced to typewriting under my direction; that I am neither counsel for, related to, nor employed by any of the parties to the action in which this deposition was taken, and further that I am not a relative or employee of any attorney or counsel employed by the parties thereto, nor financially or otherwise interested in the outcome of the action.

DAVID S. PARKER
NOTARY PUBLIC STATE OF MARYLAND
My Commission Expires: 1992