Energy Technology Engineering Center
Energy Systems Group
P.O. Box 1449
Canoga Park, CA 91304
(213) 341-1000

Operated for U.S. Department of Energy

Rockwell International

October 21, 1980

80ETEC-DRF-4465

Mr. R. J. Bosnak, Chief
Mechanical Engineering Branch
Division of Engineering
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Subject: Questions for Consumers Power Company Concerning the Deformation of Buried Piping Due to Differential Soil Settlement at Midland Plant Units 1 & 2

Dear Mr. Bosnak:

Enclosed is a list of questions for Consumers Power Company concerning the settlement of buried piping at the subject plant. The answers to these questions are required so that the problem can be properly evaluated and to help determine what effect the proposed remedies, or lack of same, will have on safety related items. These questions are submitted in connection with the Discovery Period related to the proposed hearings on the "Order Modifying Construction Permits No. CPPR-81 and No. CPPR-82. Additional questions, if they arise, will be transmitted during the Discovery Period.

Sincerely yours,

J. O. Bates, Program Manager
Energy Programs Office
Energy Technology Engineering Center

Enclosures

cc: H. L. Brammer, NRC
A. J. Cappucci, NRC
D. S. Hood, NRC

CPCo Deposition #8
(Clark) 1/21/81

QUESTIONS FOR CONSUMERS POWER COMPANY CONCERNING THE DEFORMATIONS OF BURIED PIPING DUE TO DIFFERENTIAL SOIL SETTLEMENT AT MIDLAND PLANT UNITS 1 AND 2

Reference Responses to the NRC 10 CFR 50.54(f) Request Regarding Plant Fill for Midland Plant Units 1 and 2, Consumers Power Company, Docket Numbers 50-329 and 50-330.

1) What were the criteria for determining which of the Category I buried lines were to be profiled and what was the justification for these criteria?

2) It appears that in some sections of the profiled lines the stresses are considerably higher than those listed in the reference. What is the method used to calculate the stresses in these lines due to the differential soil settlement?

3) There are sections of the profiled lines where the slope changes rather rapidly. This would indicate high local bearing loads. What are the magnitudes of these loads, type of load and their probable cause?

4) The sections of line where the slope changes rapidly could have high bearing loads and also high bending stresses. What assurance is there that local buckling will not occur in these areas?

5) What action is contemplated for buried pipes if the stresses due to the ground settlement are greater than the Code allowable for 3 S_c?

6) What assurance is there that the deformed lines do not induce high nozzle or component loads? Some of the profiled lines have considerable slope at attachment points to other pipes, tanks etc., and at building penetrations. If these lines were forced into position to make the final closure weld or the settlement occured mainly after the final closure welds were made, high stresses could be induced into the piping, components, and supports.

7) Have methods for measuring in situ stresses in the deformed piping been investigated or tried? If not, why not? This may be the only method of determining the stresses in some areas where the final closure welds have been made before the major portion of the settlement occurred or where there is a concentrated load due to some unknown phenomenon.

8) If the stresses in the profiled lines exceed code allowables, how will this be related to the non-profiled lines?

9) Current profiles reflect present settlement only. How do you plan to account for the additional settlement that occurs over the life of the plant?

10) What are the criteria for the minimum rattle space of Category I piping at building penetrations and do all the Category I piping penetrations meet these criteria? If not, what corrective action is proposed?

11) Due to the slope of some of the lines at building penetrations it appears that there could be clearance on one side of the penetration and contact on the other. What assurance is there that there is sufficient clearance over the length of the penetration to accommodate the differential settlement between the pipe and the building and the expected seismic excitations?

12) The accuracy (and reliability) of the method used to profile the pipes should be clarified.

Distribution

__Adler, KL	__Granger, RA	__Zweig, HR
__Akamine, KS	__Hall, J	__Zweng, DJ
__Anderson, WG	__Haroldsen, OO	X Wieseneck, HC
__Archbold, P	__Hinze, RB	X Brammer, JM
__Atz, RW	__Hoffman, NJ	__ _____
X Auge, LJ	__Holwager, TL	__ _____
__Baker, RS	__Homer, RS	__ _____
__Balkwill, JK	__Hutmacher, ES	__ _____
__Barber, HE	__Ingle, WB	__ _____
__Barrett, EM	__Jassak, RM	__ _____
X Bates, JO	__Johnson, Ron A	__ _____
__Bierfreund, AI	__Karwowski, A	__ _____
__Boise, MW	__Kern, AO	__ _____
__Bryan, RL	__Klea, JA	__ _____
__Budney, GS	__Klein, A	__ _____
__Burns, WE	__Larson, DA	__ _____
__Campbell, DR	__Leppard, JA	__ _____
__Carpenter, DM	__Mantle, JG	__ _____
X Chen, WP	__Marrazzo, NA	__ _____
__Cleveland, JR	__McCarty, JW	__ _____
__Cochran, JC	__McDowell, MW	__ _____
__Copeland, LB	__Meyer, JH	__ _____
__Cox, FJ	__Miller, AE	__ _____
__Cusimano, S	__Miller, NJ	__ _____
__Cygan, R	__Naish, RK	__ _____
__Darley, DK	__Neely, HH	__ _____
__Davis, KA	__Nicholson, JO	__ _____
__DeBear, WS	__Olson, PS	__ _____
__DeMuri, RJ	__Parks, JC	__ _____
__DeVita, V	__Penman, RB	__ _____
__DeWitt, HW	__Peters, WL	__ _____
__DeZotell, ML	__Pilling, BS	__ _____
__Dewart, WG	__Polino, DL	__ _____
__Donohue, HF	__Poucher, FW	__ _____
__Douglas, RE	__Roberts, JK	__ _____
__Drazich, NH	__Rock, WF	__ _____
__Droher, JJ	__Schmidt, GL	__ _____
__Eichelberger, RL	X Schnurstein, RE	__ _____
__Ervin, G	__Shepard, RC	__ _____
__Fenton, RE	__Shinnaman, S	__ _____
__Ferguson, E	__Skogstad, L	__ _____
__Fischer, BE	__Soucy, RC	__ _____
__Fletcher, FL	__Stafford, KT	__ _____
__Forster, EG	__Stearns, JD	__ _____
__Freede, WJ	__Sturtevant, WC	
__Garland, MD	__Tabor, W	
__Gaylord, GG	__Tessier, MJ	__A/C Coordinator
__Gilder, TE	__Thompson, EG	x DRF Control
__Gillies, BB	__Twa, GJ	__Library
__Glumace, RJ	__Wagner, RK	__Prog. Adm. (SS)
__Goggin, DE	__Weigand, MA	__Purchasing (SS)
__Gould, MI	__Werth, RL	__Safety (SS)
__Graner, SG	__Wiese, RW	x With enclosure

FORM 735-A-174 REV 8-79

ETEC LETTER REVIEW RECORD

Prepared by: J.M. Brammer(J.O. Bates)

Typed by: Cecilia

Addressee: Mr. R. J. Bosnak - NRC

TWX/Ltr No.: 80 ETEC-DRF-4465

Date: October 21, 1980

DOE Lead Branch: _____

Completes action in: DRF-____-____

Subject: Questions for Consumers Power Co. Concerning the Deformation of Buried Piping Due to Differential Soil Settlement at Midland Plant-Units 1&2

Req. action: __ETEC __Other __None

Remarks: _____

Department/Unit	Rev./ Appr.	Signature
Vice President		
Mgr, System Engr.	X	
Mgr, Stress	X	
Mgr, Test Eng.		
Mgr, QA		
Mgr, Construct.		
Mgr, Tech.Serv.		
Mgr, Operations		
Prog/Proj Mgmt	X	
Other		
J. M. Brammer	X	

9/19/80

Midland Plant Units 1&2
Bending Stresses in Underground
Piping Due to Differential
Soil Settlement

Chendepo Ex 9 1-21-81 WB

Incomplete
(was one inch thick)

INTRODUCTION

THE PROFILES OF SEVERAL OF THE LINES OF FIGURES 17.2 AND 19.1 OF REF. 1 WERE ANALYSED BY AN ETEC IN HOUSE COMPUTER PROGRAM IN AN ATTEMPT TO VERIFY THE MAXIMUM STRESSES FOR THESE LINES PER REF. 1. THE MAXIMUM STRESSES OBTAINED FROM THIS ANALYSIS WERE CONSIDERABLY HIGHER THAN THOSE OF REF 1. HAND CALCULATIONS WERE ALSO MADE AS AN ADDITIONAL CHECK, WITH THE RESULTS BEING SIMILAR TO THOSE OF THE COMPUTER ANALYSIS

COMPUTER ANALYSIS

1) THE DEFLECTIONS OF THE PIPES AS OBTAINED FROM THE PROFILES OF FIGURES 17.2 AND 19.1 WERE INPUT INTO THE PROGRAM AT THE NODAL POINTS SHOWN ON THE NODAL MAPS ENCLOSED WITH THE COMPUTER PRINT OUT

2) TWO CASES WERE RUN FOR EACH LINE. CASE 1 ASSUMED THE ENDS OF THE LINES WERE COMPLETELY FIXED. CASE 2 ASSUMED THE ENDS OF THE LINES HAD NO MOMENT CARRYING CAPABILITY

3) WALL THICKNESSES OF STANDARD PIPE WERE USED IN THE ANALYSIS. AS THE ACTUAL WALL THICKNESSES WERE NOT KNOWN. THIS WOULD NOT AFFECT THE STRESSES AS THEY ARE

STRAIN CONTROLLED. IT WOULD HOWEVER AFFECT THE LOADS REQUIRED TO CAUSE THESE DEFLECTIONS

4) THE CLOSER THE NODE SPACING THE MORE ACCURATE THE ANALYSIS AS THE ACTUAL SHAPE OF THE CURVE IS MORE NEARLY APPROXIMATED. HOWEVER, IT IS FELT THE SPACING USED WILL GIVE FAIRLY REALISTIC VALUES AND IS PROBABLY AS GOOD AS THE ORIGINAL MEASUREMENTS

5) THE RAPID CHANGE IN SLOPE IN SOME AREAS OF THE LINES WOULD INDICATE THERE ARE SOME HIGH LOCAL LOADS. THIS IS VERIFIED BY LOADS AT THESE NODAL POINTS IN THE COMPUTER OUTPUT.

6) THE NODAL LOADINGS SHOWN IN THE COMPUTER OUTPUT ARE THE RESULTANT EXTERNAL LOADS ON THE PIPE THAT WOULD BE REQUIRED TO DEFORM THE PIPE AS PROFILED. THEY ARE NOT THE ACTUAL PIPE LOADS.

7) SUMMARY OF THE MAXIMUM BENDING STRESSES DUE TO GROUND SETTLEMENT ONLY

LINE NO.	FIG	CASE	NODE	STRESS
26"-OHBC-54	19.1	1	6	212200 PSI
"	19.1	2	6	216200 PSI
26"-OHBC-55	17.2	1	25	179200 PSI
"	17.2	2	2	46000 PSI
8'-1HBC-81	19.1	1	20	84700 PSI
"	19.1	2	20	85200 PSI
20" 1HCO-169	17.2	1	54	191800 PSI
"	17.2	2	54	192700 PSI

7) CONT
THE STRESSES SHOWN WERE BASED ON AN ELASTIC ANALYSIS. OBVIOUSLY PLASTIC DEFORMATION WOULD OCCUR LONG BEFORE SOME OF THESE STRESSES WERE REACHED

HAND CALCULATIONS

SIMPLE HAND CALCULATIONS WERE MADE TO VERIFY THE COMPUTER ANALYSIS FOR THE SECTION OF LINE R6"SHSC-ST IN THE AREA OF THE BIG DEFLECTION NODES 5 AND 7

1) THE SECTION OF THE LINE BETWEEN NODES 5 & 7 WAS ASSUMED TO BE A SIMPLY SUPPORTED UNIFORMLY LOADED BEAM WITH THE MAXIMUM DEFLECTION AT NODE 6

$$MAX\ Y = \frac{5wl^3}{384EI}$$

$$w = \frac{(Y)(384)(EI)}{5l^3}$$

$$MAX\ M = \frac{wL}{4} = \frac{(Y)(48)(E)(I)}{(5)(l^2)}$$

$$\sigma = \frac{MC}{I} = \frac{(Y)(46)(E)(D/2)}{(5)(l^2)}$$

$Y = 2.46$ in $l = 240"$ $D/2 = 13"$

$$\sigma = \frac{(2.46)(46)(29)(10)^6(13)}{(5)(840)^2} = 154{,}570\ PSI$$

PREPARED BY / DATE 1/8/9-19-80 CHECKED BY
SUBJECT PIPING STRESSES IN UNDERGROUND PIPING DUE TO DIFFERENTIAL SOIL SETTLEMENT - A CLOSED PLANT

2) AS THE SLOPE OF THE LINE CHANGES AT NODES 5 & 7 THE LINE IS NOT SIMPLY SUPPORTED AT THESE POINTS BUT IS CARRYING MOMENT.

ASSUME THE SECTION OF THE LINE BETWEEN NODES 5&7 IS UNIFORMLY LOADED WITH BOTH ENDS FIXED.

$$Y = \frac{Wl^3}{384EI}$$

$$W = \frac{384EI}{l^3}$$

$$\text{MAX } M = \frac{WL}{12} = \frac{(Y)(384)(E)(I)(\ell)}{(12)(\ell^2)}$$

$$\sigma = \frac{(Y)(32)(E)(D/2)}{(\ell^2)}$$

$$\sigma = \frac{(2.14)(32)(29)(10)^4(13)}{(240)^2} = 51523 \text{ PSI}$$

THE ACTUAL STRESS WOULD BE BETWEEN CASE 1 & 2. CLOSER TO 1

3) SINCE THE LINE TAKES A SUDDEN DIP BETWEEN NODES 5&7 ASSUME THAT THIS SECTION OF THE LINE IS A SIMPLY SUPPORTED BEAM ABOUT AT NODE 6

$$Y = \frac{Wl^3}{48EI}$$

$$W = (Y)(48)(E)(I)/\ell^3$$

$$M = \frac{(Y)(48)(E)(I)(\ell)}{(\ell^2)^3(I)(12)}$$

$$\sigma = \frac{(12)(Y)(E)(I)(D/2)}{L^2 I}$$

$$\sigma = \frac{(12)(2.46)(29)(10)^6(13)}{(240)^2} = 193,500 \text{ P.S.I.}$$

4) SAME AS 3 EXCEPT NODES 5 & 7 ASSUMED FIXED.

$$Y = \frac{W L^3}{192 EI} \qquad W = \frac{(Y)(192)(E)(I)}{L^3}$$

$$M = \frac{(Y)(\cancel{192}\ 24)(E)(I)(\cancel{A})}{(\cancel{8})(L^2)}$$

$$\sigma = \frac{(Y)(24)(E)(D/2)(\cancel{I})}{(L^2)(\cancel{Z})}$$

$$\sigma = (Y)(24)(29)(10)^6(13)/240^2 = 386,400 \text{ P.S.I.}$$

5) THE METHOD GIVEN IN RESPONSE TO QUESTION 12 OF REF 1 IS AT BEST A ROUGH APPROXIMATION, BUT EVEN THIS METHOD GIVES VERY HIGH BENDING STRESSES FOR THE AREA BETWEEN NODES 5 & 7

$$\sigma_B = \frac{(E)(D)(8)(E)}{2 L^2}$$

$$\sigma_B = \frac{(29)(10)^6(26)(8)(2.46)}{(2)(240)^2} = 154,800 \text{ P.S.I.}$$

ETEC

NO. 6

PAGE ____ OF ____

PARED BY / DATE B / 6-16-80 CHECKED BY

JECT BENDING STRESSES IN UNDERGROUND PIPING DUE TO DIFFERENTIAL SOIL SETTLEMENT-MIDLAND UNITS 1 & 2

DATE

REV / DATE

THE HAND CALCULATIONS OF THE BENDING STRESSES [CASES 1-47] CONFIRM THE COMPUTER OUTPUT STRESSES IN GENERAL. IF THE END FIXITY AT NODES 5 & 7 WERE FACTORED IN THERE WOULD BE BETTER AGREEMENT

IN ALL CASES THE STRESSES WERE WELL ABOVE THE YIELD STRENGTH OF THE MATERIAL AND ALSO THE CODE ALLOWABLES

Ref:

(1) "RESPONSES TO THE NRC 10 CFR 50.54(f) REQUEST REGARDING PLANT FILL FOR MIDLAND PLANT UNITS 1 AND 2, CONSUMER POWER COMPANY, DOCKET NUMBERS 50-329 AND 50-330" Rev. 6, APRIL 1, 1980

FORM 7154-A4 REV 12-78

26" CHBC-54

MAP & COMPUTER OUTPUT

ETEC

NO. _____

PAGE _____ OF _____

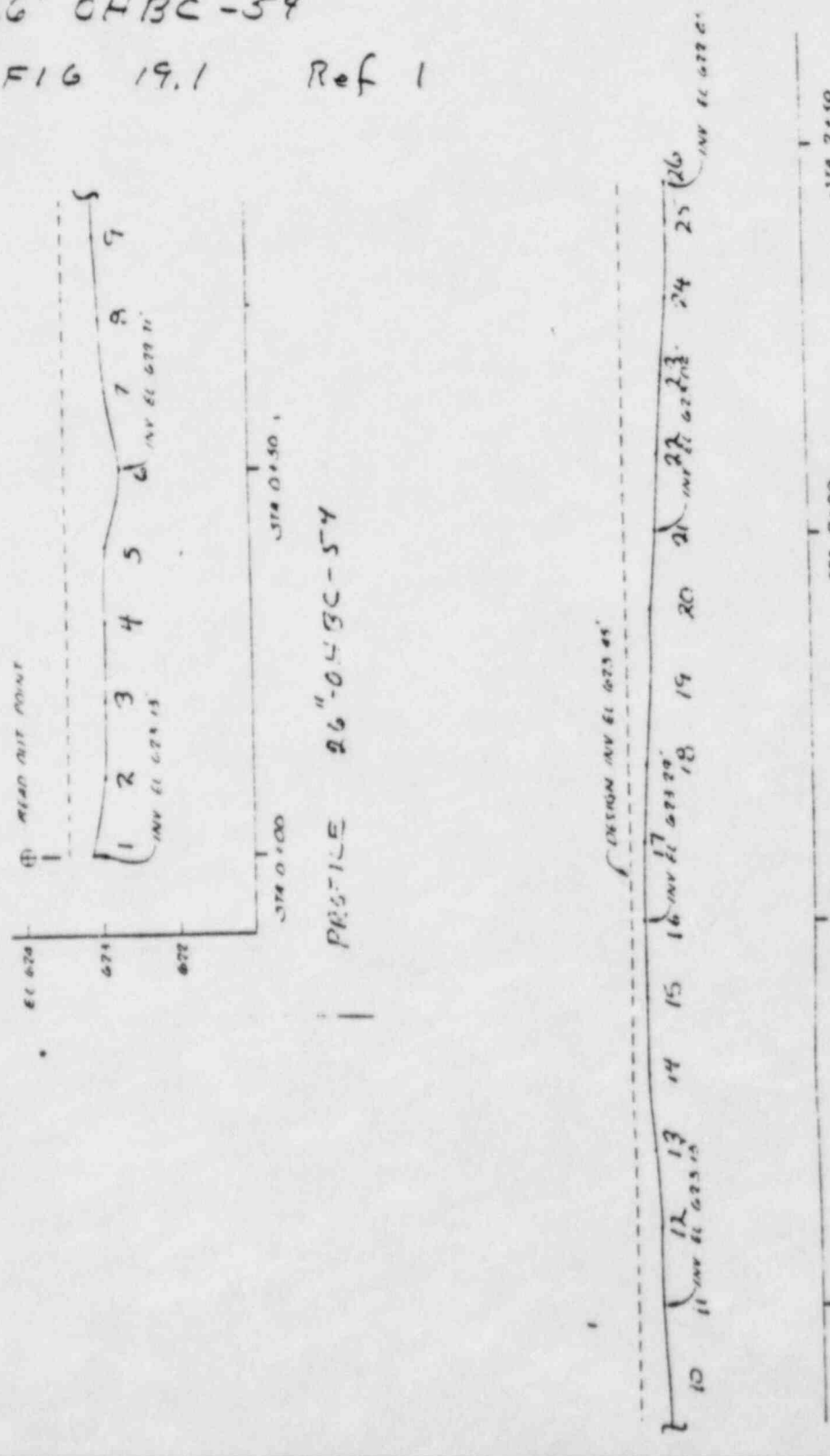
PREPARED BY / DATE JBT 9-13-79 CHECKED BY _____ DATE _____

SUBJ: STRESSES IN UNDERGROUND PIPING DUE TO DIFFERENTIAL SOIL SETTLEMENT - MIDLAND

REV / DATE _____

26" OHBC-54

FIG 19.1 Ref 1



PRODUCED & DIRECTED BY RVL INC 0
MIDLAND PLANT SURVEYED PIPELINE PROFILE 0

RUN OPTION CODE	1
PLOT OPTION CODE	1
MULTIPLE LOAD CASE CODE	2
RIGID BODY OPTION CODE	0
SKEW RESTRAINT OPTION CODE	0
NON-LINEAR OPTION	0
RENUMBERING OPTION CODE	0
COORDINATE UNITS CODE	1
DATA CHECK OPTION CODE	1
INPUT FORMAT OPTION CODE	1
NATURAL FREQ. OPTION CODE	0

		** GEOMETRY DATA **						
BP	NODE	X-COORD	Y-COORD	Z-COORD	BND RAD	MATL ID	PIPE ID	INSL ID
1	1	0.0	0.0	0.0		1	1	1
	2	10.000	0.0	0.0		1	1	1
	3	20.000	0.0	0.0		1	1	1
	4	30.000	0.0	0.0		1	1	1
	5	40.000	0.0	0.0		1	1	1
	6	50.000	0.0	0.0		1	1	1
	7	60.000	0.0	0.0		1	1	1
	8	70.000	0.0	0.0		1	1	1
	9	80.000	0.0	0.0		1	1	1
	10	90.000	0.0	0.0		1	1	1
	11	100.000	0.0	0.0		1	1	1
	12	110.000	0.0	0.0		1	1	1
	13	120.000	0.0	0.0		1	1	1
	14	130.000	0.0	0.0		1	1	1
	15	140.000	0.0	0.0		1	1	1
	16	150.000	0.0	0.0		1	1	1
	17	160.000	0.0	0.0		1	1	1
	18	170.000	0.0	0.0		1	1	1
	19	180.000	0.0	0.0		1	1	1
	20	190.000	0.0	0.0		1	1	1
	21	200.000	0.0	0.0		1	1	1
	22	210.000	0.0	0.0		1	1	1
	23	220.000	0.0	0.0		1	1	1
	24	230.000	0.0	0.0		1	1	1
	25	240.000	0.0	0.0		1	1	1
	26	245.000	0.0	0.0		1	1	1

Attachment 3

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D C. 20555
301-492-7000

FACSIMILE SERVICE REQUEST

DATE: July 18, 1980

MESSAGE TO: Paul Chen, Energy Technology Engineering Center (ETEC)

TELECOPY NUMBER: (213) 341-1000 X6349

AUTOMATIC: Yes No

VERIFICATION NUMBER (213) 341-1000 X6534

NO. OF PAGES 1 PLUS INSTRUCTION SHEET

STATE & CITY Canoga Park, California

MESSAGE FROM: A. J. Cappucci, MEB/NRR

TELECOPY NUMBER 492-8110 RAPIFAX AUTOMATIC
492-7617 3M VRC AUTOMATIC

VERIFICATION NUMBER 492-7371

BUILDING Philips OFFICE PHONE 49-29476 MAIL STOP P-924

CLASS OF SERVICE: ____ Overnight ✓ 4 hour ____ 2 hour
____ 1 hour ____ Immediate

SPECIAL INSTRUCTIONS:

Received/Time-Date	Transmitted/Time-Date
[illegible] AM 9 34	[illegible]
[illegible]	Chen dep Sep 10 1-21-81 CAB

T. Cappucci

[COVER SHEET FOR 7/17/80 TRANSMITTAL]

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
BOX 1027
DETROIT, MICHIGAN 48231

REPLY TO ATTENTION OF
NCEED-T

7 JUL 1980

SUBJECT: Interagency Agreement No. NRC-03-79-167, Task No. 1 - Midland Plant Units 1 and 2, Subtask No. 1 - Letter Report

THRU: Division Engineer, North Central
ATTN: NCDED-G (James Simpson)

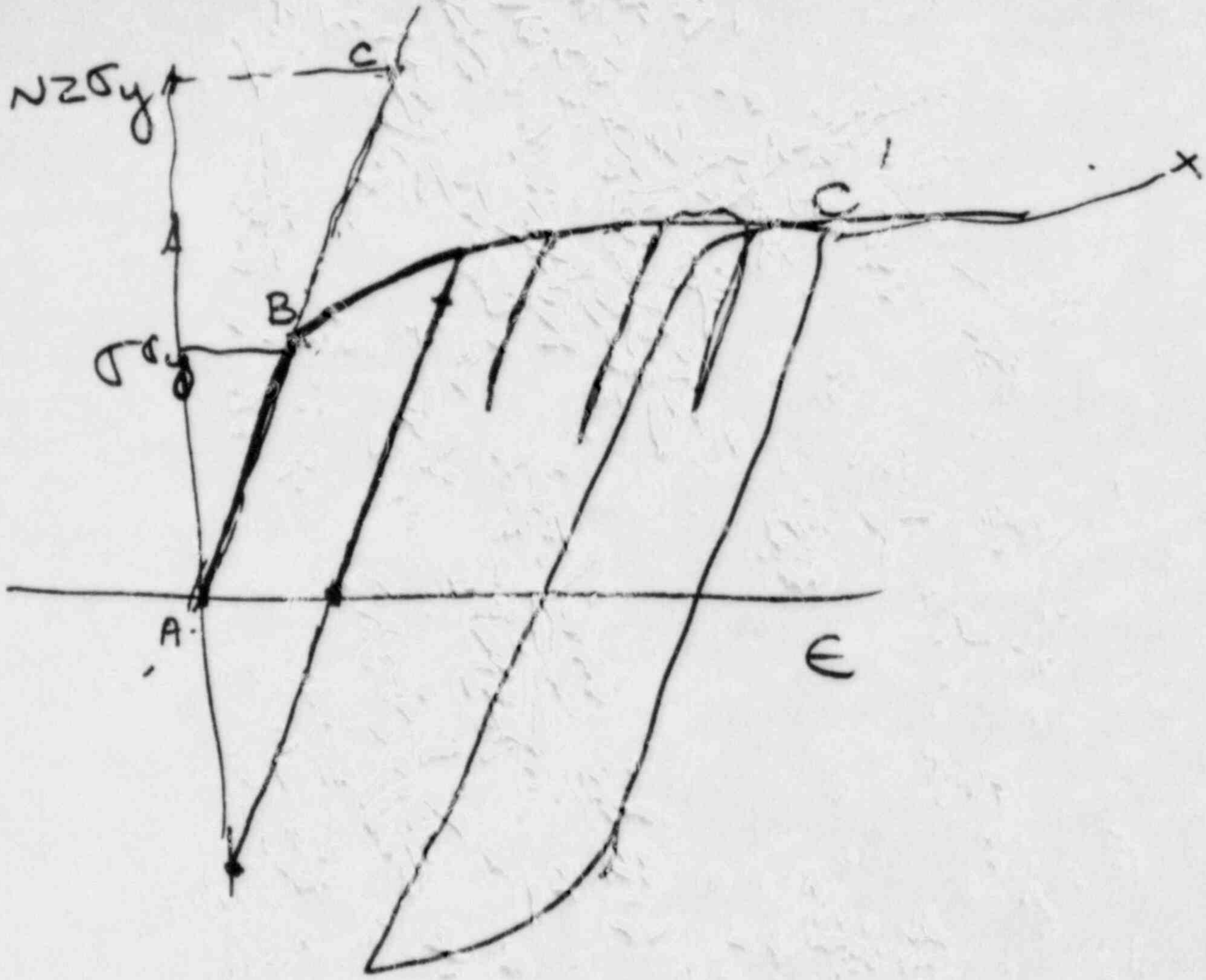
TO: U.S. Nuclear Regulatory Commission
ATTN: Dr. Robert E. Jackson
Division of Systems Safety
Mail Stop P-314
Washington, D. C. 20555

1. The Detroit District hereby submits this letter report with regard to completion of subtask No. 1 of the subject Interagency Agreement concerning the Midland Nuclear Plant, Units 1 and 2. The purpose of this report is to identify unresolved issues and make recommendations on a course of action and/or cite additional information necessary to settle these matters prior to preparation of the Safety Evaluation Report.

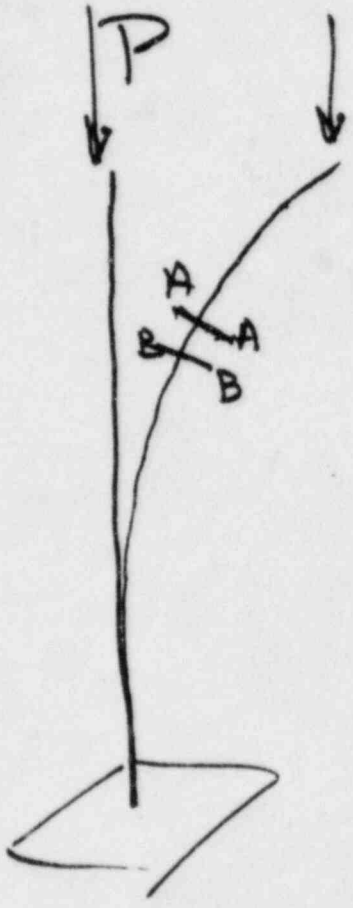
2. The Detroit District's team providing geotechnical engineering support to the NRC to date has made a review of furnished documents concerning foundations for structures, has jointly participated in briefing meetings with the NRC staff, Consumers Power Company (the applicant) and personnel from North Central Division of the Corps of Engineers and has made detailed site inspections. The data reviewed includes all documents received through Amendment 78 to the operating license request, Revision 28 of the FSAR, Revision 7 to the 10 CFR 50.54(f) requests and MCAR No. 24 through Interim Report No. 8. Generally, each structure within the complex was studied as a separate entity.

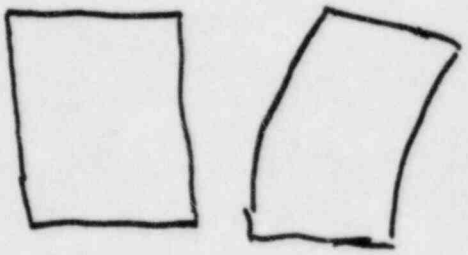
3. A listing of specific problems in review of Midland Units 1 and 2 follows for Category I structures. The issues are unresolved in many instances, because of inadequate or missing information. The structures to be addressed follow the description of the problem.

a. Inadequate presentation of subsurface information from completed borings on meaningful profiles and sectional views. All structures.

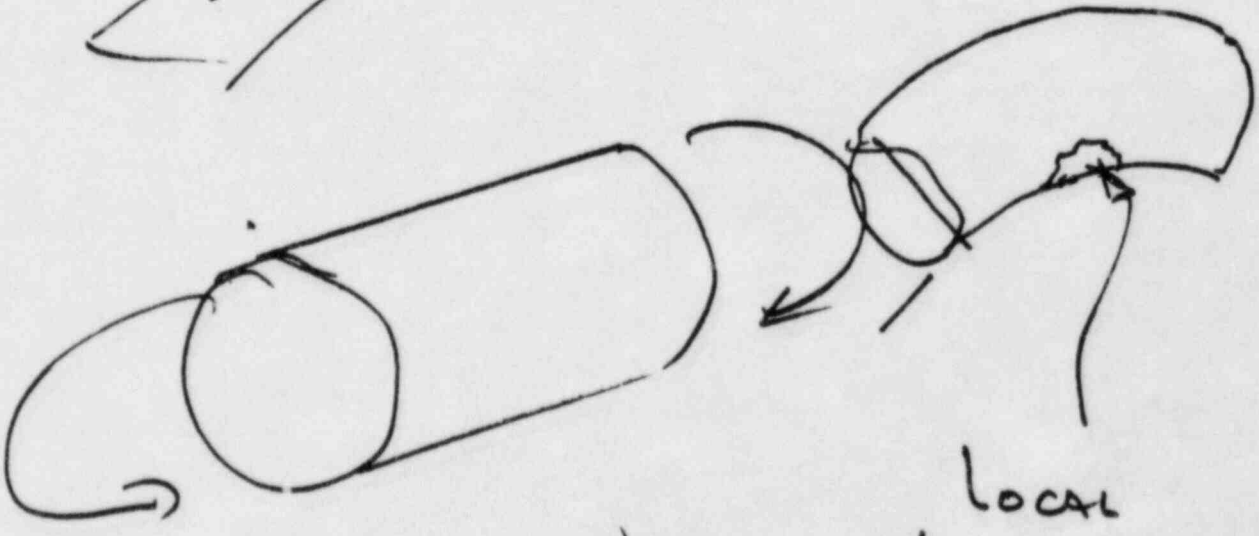


Cohen depo Ex. 11
1-21-81 | WRB

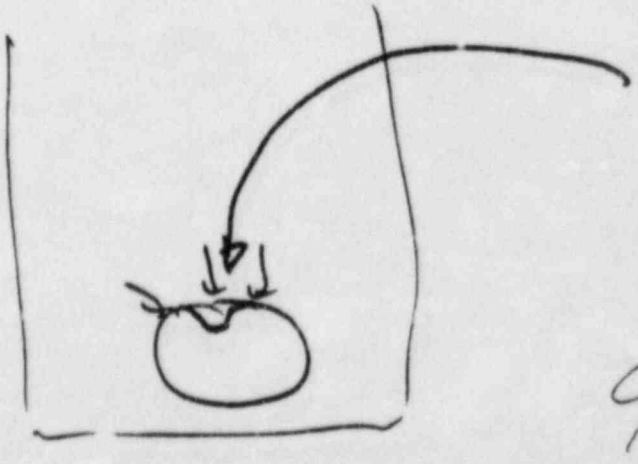




COLUMN BUCKLING



LOCAL WRINKLING & BUCKLING



Chen dep Ex 12
1-21-81 CTB

Attachment 3

Verification ~~Mandel~~ CK

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555
301-492-7000

FACSIMILE SERVICE REQUEST

DATE: July 17, 1980

MESSAGE TO: PAUL CHEN, ENERGY TECHNOLOGY ENGINEERING CENTER (ETEC

TELECOPY NUMBER: (213) 341-1000 X6349

AUTOMATIC: Yes No

VERIFICATION NUMBER (213)341-1000 X6534

NO. OF PAGES 3 PLUS INSTRUCTION SHEET

STATE & CITY CANOGA PARK, CALIF.

MESSAGE FROM: A. J. CAPPUCCI, JR MEB/NRR

TELECOPY NUMBER 492-8110 RAPIFAX AUTOMATIC

492-7617 3M VRC AUTOMATIC

VERIFICATION NUMBER 492-7371

BUILDING PHILIPS OFFICE PHONE 29476 MAIL STOP P924

CLASS OF SERVICE: ____ Overnight ____✓____ 4 hour ____ 2 hour

____ 1 hour ____ Immediate

SPECIAL INSTRUCTIONS:

Received/Time-Date	Transmitted/Time-Date
TELECOPY-OR-OFOS	TELECOPY-OR-OFOS
[illegible] PM 3 59	[illegible] PM 4 28
[illegible] REGULATORY [illegible]	[illegible] REGULATORY [illegible]

Chen depo Ex 13
1-21-81 WFB

(3) What will be effects of uplift pressure on the stability of the tanks and the associated piping system if the dewatering system becomes inoperable?

g. Underground Utilities:

(1) Settlement

(a) Inspect the interior of water circulation piping with video cameras and sensing devices to show pipe cross section, possible areas of crackings and openings, and slopes of piping following consolidation of the plant fill beneath the imposed surcharge loading.

(b) The applicant has stated in his response to NRC Question 7 (10 CFR 50.54f) that if the duct banks remain intact after the preload program has been completed, they will be able to withstand all future operating loads. Provide the results of the observations made, during the preload test, to determine the stability of the duct banks, with your discussion regarding their reliability to perform their design functions.

(c) The response to Question 17 of "Responses to NRC Requests Regarding Plant Fill" states that "there is no reason to believe that the stresses in Seismic Category I piping systems will ever approach the Code allowable." We question the above statement based on the following:

Profile 26" - OHBC-54 on Fig. 19-1 shows a sudden drop of approx. 0.2 feet within a distance of only 20 feet. Using the procedure on p. 17-2,

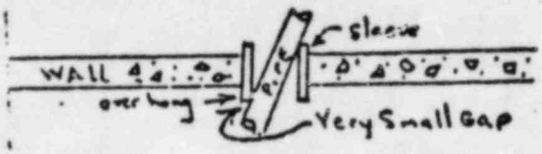
$$\sigma_b = E(e) = E\left(\frac{D}{2R}\right) = E\,\frac{D}{2}\,\frac{8\delta}{L^2}$$

$$\sigma_b = 30000\ \frac{26}{2}\left[\frac{8(0.2)(12)}{(20\times12)^2}\right] = 130.0\ \text{KSI}$$

Furthermore, the Eq. 10(a) of Article NC-3652.3, Sec. III, Division 1, of the ASME code requires that some Stress Intensification Factor "i" be assigned to all computed settlement stresses. Yet, Table 17-2 lists only 52.5 KSI stress for this pipe. This matter requires further review. Please respond to apparent discrepancy and also specify the location of each computed settlement stress at the pipeline stationing shown on the profiles. More than one critical stress location is possible along the same pipeline.

(d) During the site visit on 19 February 1980, we observed three instances of what appeared to be degradation of rattlespace at penetrations of Category I piping through concrete walls as follows:

West Borated Water Tank - in the valve pit attached to the base of the structure, a large diameter steel pipe extended through a steel sleeve placed in the wall. Because the sleeve was not cut flush with the wall, clearance between the sleeve and the pipe was very small.



Service Water Structure - Two of the service water pipes penetrating the northwest wall of the service water structure had settled differentially with respect to the structure and were resting on slightly squashed short pieces of 2 x 4 placed in the bottom of the penetration. From the inclination of the pipe, there is a suggestion that the portions of the pipe further back in the wall opening (which was not visible) were actually bearing on the invert of the opening. The bottom surface of one of the steel pipes had small surface irregularities around the edges of the area in contact with the 2 x 4. Whether these irregularities are normal manufacturing irregularities or the result of concentration of load on this temporary support caused by the settlement of the fill, was not known.

These instances are sufficient to warrant an examination of those penetrations where Category I pipe derives support from plant fill on one or both sides of a penetration. In view of the above facts, the following information is required.

(1) What is the minimum seismic rattlespace required between a Category I pipe and the sleeve through which it penetrates a wall?

(2) Identify all those locations where a Category I pipe deriving support from plant fill penetrates an exterior concrete wall. Determine and report the vertical and horizontal rattlespace presently available and the minimum required at each location and describe remedial actions planned as a result of conditions uncovered in the inspection. It is anticipated that the answer to Question (1) can be obtained without any significant additional excavation. If this is not the case, the decision regarding the necessity to obtain information at those locations requiring major excavation should be deferred until the data from the other locations have been examined.

(e) Provide details (thickness, type of material etc.) of bedding or cradle placed beneath safety related piping, conduits, and supporting structures. Provide profiles along piping, and conduits alignments showing the properties of all supporting materials to be adopted in the analysis of pipe stresses caused by settlement.

(f) The two reinforced concrete return pipes which exit the Service Water Pump Structure, run along either side of the emergency cooling water reservoir, and ultimately enter into the reservoir, are necessary for safe shutdown. These pipes are buried within or near the crest of Category I slopes that form the sides of the emergency cooling water reservoir. There is no report on, or analysis of, the seismic stability of post earthquake residual displacement for these slopes. While the limited data from this area do not raise the specter of any problem, for an important element of the plant such as this, the earthquake stability should be examined by state-of-the-art methods. Therefore, provide results of the seismic analysis of the slopes leading to an estimate of the permanent deformation of the pipes. Please provide the following: (1) a plan showing the pipe location with respect to other nearby structures, slopes of the reservoir and the coordinate system; (2) cross-sections showing the pipes, normal pool levels, slopes, subsurface conditions as interpreted from borings and/or logs of excavations at (a) a location parallel to and about 50 ft from the southeast outside wall of the service water pipe structure and (b) a location where the cross section will include both discharge structures. Actual boring logs should be shown on the profiles; their offset from the profile noted, and soils should be described using the Unified Soil Classification System; (3) discussion of available shear strength data and choice of strengths used in stability analysis; (4) determination of static factor or safety, critical earthquake acceleration, and location of critical circle; (5) calculation of residual movement by the method presented by Newmark (1965) or Makdisi and Seed (1978); and (6) a determination of whether or not the pipes can function properly after such movements.

h. Cooling Pond.

(1) Emergency Cooling Pond. In recognition that the type of embankment fill and the compaction control used to construct the retention dikes for the cooling pond were the same as for the problem plant fill, we request reasonable assurance that the slopes of the Category I Emergency Cooling Pond (baffle dike and main dike) are stable under both static and dynamic loadings. We request a revised stability analysis for review, which will include identification of locations analyzed, adopted foundation and embankment conditions (stratification, seepage, etc.) and basis for selection, adopted soil properties, method of stability analysis used and resulting factor of safety with identification of sliding surfaces analyzed. Please address any potential impact on Category I pipes near the slopes, based on the results of this stability study. Recommendations for location of new exploration and testing have been provided in a separate letter.