MIDLAND - UNDERGROUND PIPING

Kane

Any comments on this?

GL 2/17

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

FEB 5 1982

Docket Nos. 50-329
and 50-330 OM, OL

APPLICANT: Consumers Power Company

FACILITY: Midland Plant, Units 1 and 2

SUBJECT: SUMMARY OF OCTOBER 6-7,1981 MEETING ON UNDERGROUND PIPING

On October 6 and 7, 1981, the NRC staff met in Bethesda, Maryland with Consumers Power Company, Bechtel, and consultants to discuss underground piping in inadequately compacted plant fill at the Midland site.

A summary of this meeting is provided by Enclosure 1.

Darl Hood/[illegible]

Darl S. Hood, Project Manager
Licensing Branch No. 4
Division of Licensing

Enclosure:
As stated

cc: See next page

MIDLAND

Mr. J. W. Cook
Vice President
Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

cc: Michael I. Miller, Esq.
Ronald G. Zamarin, Esq.
Alan S. Farnell, Esq.
Isham, Lincoln & Beale
Suite 4200
1 First National Plaza
Chicago, Illinois 60603

James E. Brunner, Esq.
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Myron M. Cherry, Esq.
1 IBM Plaza
Chicago, Illinois 60611

Ms. Mary Sinclair
5711 Summerset Drive
Midland, Michigan 48640

Stewart H. Freeman
Assistant Attorney General
State of Michigan Environmental Protection Division
720 Law Building
Lansing, Michigan 48913

Mr. Wendell Marshall
Route 10
Midland, Michigan 48640

Mr. Roger W. Huston
Suite 220
7910 Woodmont Avenue
Bethesda, Maryland 20814

Mr. R. B. Borsum
Nuclear Power Generation Division
Babcock & Wilcox
7910 Woodmont Avenue, Suite 220
Bethesda, Maryland 20814

Mr. Don van Farrowe, Chief
Division of Radiological Health
Department of Public Health
P.O. Box 33035
Lansing, Michigan 48909

William J. Scanlon, Esq.
2034 Pauline Boulevard
Ann Arbor, Michigan 48103

U.S. Nuclear Regulatory Commission
Resident Inspectors Office
Route 7
Midland, Michigan 48640

Ms. Barbara Stamiris
5795 N. River
Freeland, Michigan 48623

Mr. Paul A. Perry, Secretary
Consumers Power Company
212 W. Michigan Avenue
Jackson, Michigan 49201

Mr. Walt Apley
c/o Mr. Max Clausen
Battelle Pacific North West Labs (PNWL)
Battelle Blvd.
SIGMA IV Building
Richland, Washington 99352

Mr. I. Charak, Manager
NRC Assistance Project
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

James G. Keppler, Regional Administrator
U.S. Nuclear Regulatory Commission, Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

cc: Commander, Naval Surface Weapons Center
ATTN: P. C. Huang
White Oak
Silver Spring, Maryland 20910

Mr. L. J. Auge, Manager
Facility Design Engineering
Energy Technology Engineering Center
P.O. Box 1449
Canoga Park, California 91304

Mr. Neil Gehring
U.S. Corps of Engineers
NCEED - T
7th Floor
477 Michigan Avenue
Detroit, Michigan 48226

Charles Bechhoefer, Esq.
Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Mr. Ralph S. Decker
Atomic Safety & Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dr. Frederick P. Cowan
Apt. B-125
6125 N. Verde Trail
Boca Raton, Florida 33433

Jerry Harbour, Esq.
Atomic Safety and Licensing Board
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Geotechnical Engineers, Inc.
ATTN: Dr. Steve J. Poulos
1017 Main Street
Winchester, Massachusetts 01890

To	File 0485.16	
From	GSKeeley, P-14-113B *G.S. Keeley*	**CONSUMERS POWER COMPANY**
Date	October 23, 1981	
Subject	MIDLAND PROJECT - UNDERGROUND PIPING MEETING WITH - STAFF ON OCTOBER 6 AND 7, 1981 - FILE 0485.16 SERIAL 14704	Internal Correspondence

CC JWCook, P-26-336B (w/o att)
AJBoos, Bechtel-AA (w/o att)
JEBrunner, M-1079 (w/att)
WJCloutier, P-24-611 (w/att)
DFLewis, Bechtel-AA (w/att)
MIMiller, IL&B (w/att)
DESibbald, Midland (w/att)
DMBudzik/TJSullivan, P-24-624A (w/o)
~~Roger Huston, Washington (4 copies w/att)~~

I. Introduction - G S Keeley (CP Co)

The meeting is intended to provide an update for the NRC Staff regarding activities related to underground piping at Midland. A previous meeting on this subject was held May 5, 1981. This meeting addressed actions taken since the earlier discussion in January 1981 when results of profiles taken in 1979 were discussed as well as stress calculations resulting from these profiles.

It is Consumers Power Company's belief, based on the work done to date, that the piping in its present configuration does not present a safety problem. CP Co's approach includes proposed acceptance criteria intended to show that the piping is capable of performing its intended function over the plant's design life. This performance-based acceptance criteria is similar to that recently accepted in a board decision on North Anna.

The specific discussions principally concern the Service Water Piping. Previous activities included a profile of one line in each trench (1979). A reprofiling and ovality check of the B Train Service Water Supply and return lines was completed on September 23, 1981. The techniques used for this reprofiling allowed for a more accurate measurement (± 1/16 inch). Reprofiling and ovality measurements on the A Train are scheduled to start the week of October 12 and should be completed by November 15 for turnover to Consumers Testing.

We will also discuss the problem of modeling since we have difficulty interpreting profile readings as being due to 100% settlement that has occurred since installation.

W J Cloutier (CP Co) indicated that telephone conferences were held between CP Co, ETEC and NRC on August 10 and 25, 1981. In the first of these conferences, it was noted that CP Co's intent was to show the piping is not in distress and adequate for use as a Class 2 safety grade system.

II. Intent of Current Efforts W J Cloutier (CP Co)

It was noted that Standard Review Plan Section 3.9.3 allows alternatives to an acceptance based on evaluation of stress calculations provided dimensional stability and functional capability can be maintained. Upon review of this position, NRC MEB personnel responded in the second telephone conference that the principal concern is assuring system functionality. Discussed during the telecon was using a hydro, sizing pig and performance (functional) tests to determine functionality. It was reported that the current availability of the piping (system being open) had prompted efforts to obtain ovality measurements as a more accurate indication of the current condition of the piping, rather than passing a sizing pig through the piping. The acceptance criteria to be used to assure functionality throughout life was addressed in this meeting.

Soil Settlement is a long term, noncyclic process. The concern, therefore, is to demonstrate that settlement loading will not cause pipe collapse reducing the flow area to below that required for functionality. The effect of settlement loading on pipe is principally a bending action and thus measurement of out-of-roundness (ovality) was chosen as an appropriate indicator of pipe distress. A criteria of 8% is being used for acceptance; this value is based on ASME codes for installation and fabrication (NC3642 and NC4223.2) and is widely used throughout industry (ASME B31.1, B31.2 and B31.3).

Proposed Continuing Testing Program - D F Lewis (Bechtel)

There was a discussion on the construction hydro test.

Flow verification test - A full flow verification test will be conducted annually. A requirement to perform this test will be proposed for inclusion in the Technical Specifications (Assuming NRC acceptance of this approach). The continuing monitoring program will include a trending evaluation of this test data to detect any decreases in flow even though acceptance criteria are met. The proposed testing is expected to be performed during plant operations.

This type of testing will not explicitly show that no pipe deformation is occurring; rather, it demonstrates that deformation sufficient to reduce the flow below that necessary is not occurring. It was noted that deformation considerably greater than the 8% ovality acceptance criteria being used would be required to cause any appreciable decrease in flow. Slides were presented (see attached) on location of flow measurement devices.

D Gupta and A Cappucci (NRC) questioned the appropriateness of this type of testing. Their concern is that small deformations go undetected. It is not apparent that pipe deformation could not progress so far by the time any flow effect is noted that collapse might be imminent. Such collapse might then occur between testing periods and go undetected for some period.

In Service Inspection - ISI will initially be based on ASME Section XI 1980 Edition with Addenda through winter 1980. ISI inspections present an additional check on functionability of this piping (see attachment).

(A correction to the slide on acceptance criteria was noted; the entry reading 0.5 gpm should read 0-5 gpm.)

III. Analytical Difficulties - W J Cloutier (CP Co)

There have been difficulties in analyzing the piping to determine stresses. The problem is not the computer codes, it is the availability and reliability of input data. Field data is input by placing artificial rigid restraints at locations measured; this has resulted in artificially high bending and stresses being calculated at these locations.

Measurement inaccuracies also affect these results. In 1979, profiling was done to ± 1/4 inch accuracy with measurements every 10 feet. A parametric study over a 20 foot span using worst case measurement errors (1/2 inch deflection) yields a calculated stress of 55 ksi. The current reprofiling is being done to ± 1/16 inch; this helps the problem of "artificial" calculated stresses but current measuring techniques intensify the effect of local discontinuities. Fitup and installation differences ("discontinuities") result in very high calculated stresses unless the curve is "smoothed."

SMA has performed calculations (results on attached slide) to determine the soil loading which would have been required to cause the observed deformations if settlement were the only deformation mechanism. This study showed soil loadings necessary to be as much as three times the conservative estimate of the soil capacity. The limited information available about presettlement, as-built conditions thus is shown to provide an unrealistic calculational solution. H Singh (COE) questioned the assumptions used in this analysis; specifically that of a uniform soil spring constant. It was explained that the analysis showed that in order to force the pipe into its present condition the soils could not apply enough force to do this.

D Hood (NRC) questioned whether the nonsafety grade piping was installed and fit up to the same requirements. CP Co and Bechtel personnel present were not sure this was the case and committed to check this point and inform Mr Hood of the answer. (A subsequent check indicates that nonsafety grade pipe was installed per ASME B31.1 which requires the same alignment tolerances as safety grade.) The QCIs for safety grade piping showed that the pipe was installed per the spec with no actual measurements on the QCI. It was pointed out that fit up measurements are made prior to welding and that distortion occurs during the welding process. Hood asked why we don't remove the pipe, surcharge the soil, then replace the pipe at proper elevation. We said we don't believe we have a problem with the pipe that warrants this.

Basis for Acceptance Criteria - J Tsacoyeanes (TES)

Previous calculations were done to 3 S_c. Some members of the working group on design codes felt there would be no real problem involved in exceeding this. There is reasonable assurance that the pipe would function and not fail if stressed beyond this limit since it is based on a fatique concern which is not present in this case. Settlement is a strain limited or deflection controlled problem and does not have a continuous force to drive the pipe to failure once a maximum bending stress is reached. A theoretical calculation using BOSOR indicates no pipe failure with a 50% increase in stress; such a calculation assumes unrestricted deformation whereas the real case includes restrictions on pipe movement caused by the soil. The uncertainties involved with predicting failure based on stresses, combined with the difficulty of calculating stresses from field measurements, thus led to a conclusion that an acceptance criteria on deformation was more applicable.

The 8% limit used is based on fabrication codes as noted above. It was noted also that the existence of ovality on out-of-roundness does not in itself imply a structural failure of the pipe.

IV. Measurement Techniques - D Sibbald (CP Co)

Profiling and ovality measurement has been completed for the B Service Water Train. This involved cleaning the interior surface and marking it at a minimum of 5 foot increments for measurement. Measurements at some locations, particularly in elbows, were as close as 1.5 ft. Measurements were also taken 2-1/2 inches on either side of pipe welds.

The Pipe Evaluation Profile Measurement System developed by SWRI for this effort was described (see attachments). The device uses a pressure transducer moved within the pipe and positioned on the pipe bottom (as determined using a bubble level on the transducer). The measurement is of the differential pressure between a reference water column and a column ending at the transducer. The system used in 1979 was similar but involved a visual measurement rather than sensed dp. (In 1979 the pipe was not completely drained leading to possible additional uncertainties in the preciseness of locating the pipe bottom.)

The 20" condensate piping to be profiled will be measured by a similar method utilizing a "crawler" being developed by SWRI. This will basically be a fully automated version of the technique used on the SWS piping measured to date. Piping 26" or larger in diameter will continue to be measured using personnel in the pipe.

Ovality is measured at the same locations as elevation and using another SWRI instrument. The device uses rotating arms to obtain both maximum and minimum diameters. Their azimuthal orientation is also recorded along with the azimuthal location of the longitudinal fabrication weld. Fittings were measured using the same measurement arm, however, this required removing it from the rolling platform (dolly) which was used in straight pipe sections for accurate positioning.

The preliminary (reviews not yet completed) results of a portion of the 1981 measurements were reviewed (drawings provided to NRC Staff). The 1979 data was plotted on the same drawings for reference purposes. Ovality measurements were also presented (see attachments). They generally were less than 2% compared to a required manufacturing tolerance in straight pipe of approximately 1%. (Approx 1.76% in fittings.) The ovality measurements have not yet been plotted but will be shown along with the profile data in future plots.

The Staff expressed concern regarding the unavailability of stresses calculated from this data. CP Co agreed to provide such calculations.

V. Overburden Loads - D F Lewis (Bechtel)

A question has been raised regarding overburden loads where live loads could be present at the surface. It was noted that this issue was addressed in Question 34 of CP Co's 50.54(f) responses. Mr Lewis pointed out that the fuel oil line at approximately 2-1/2 ft depth is a small diameter line; some SWS piping is at approximately 5-1/2 ft depth but most piping is below 6 ft obviating major concern for live load overburdens.

VI. Other lines - W J Cloutier

Fuel oil lines to the diesel generators were installed after the building surcharge. They were installed on unistruts imbedded in concrete and their actual elevations were measured. CP Co concludes that this treatment implies no settlement concern with these lines. J Kane (NRC) questioned this conclusion since no survey data exists since the original measurements in 1980; since no calculation of stresses assuming worst case settlement has been made, this conclusion may be inappropriate.

The 8" and 10" Lines near the east side diesel generator building which have not been rebedded previously will be rebedded. (OHBC 27, 2HBC311, 2HBC310) since this effort is more straightforward than data collection would be on these lines.

A sizing pig will be used to detect deformation in the remaining 8" lines which will not be rebedded. (8"-1HBC-310, 8"-1HBC-311, 8"-2HBC-82, 8"-2HBC-81.)

Lines associated with the BWST will be rebedded from the valve pit to the dike area. The service water system pipes will be repositioned at the SWPS where it enters the structure. It was noted that a question remains open regarding the rattle space at this penetration. This problem will be corrected as part of the SWPS underpinning. (The write-up on the history of this issue has been provided to the NRC subsequent to the meeting.)

VII. Summary

The data on installed profiles and ovality measurements indicate that the SWS piping is not presently in distress. Plans for a post-construction hydrostatic test, periodic flow monitoring and the required ISI program will demonstrate continued functionability and provide adequate assurance of safety.

The Staff and the Corps of Engineers questioned the problems posed by seismic considerations. They requested that a stress analysis due to seismic events considering post-settlement piping conditions be documented. Concern was raised that a seismic input could lead to a pipe failure due to a prestressed condition which might go undetected by the proposed testing regimen. CP Co responded by stating that the ASME Code equations for combining stresses do not require settlement stresses to be combined with seismic stresses. The staff restated their concern was principally with the effect of the present and future profile curvature on the seismic analysis.

Meeting Continuation - October 7, 1981

This meeting was reconvened briefly on October 7, 1981 to permit the NRC Staff to provide comments on the October 6, 1981 meeting after their in-house caucus with their Branch Chief (Bosnack). The Staff indicated the following:

1. A quantitative evaluation is needed demonstrating that a safe shutdown earthquake will not rupture the pipe and how to separate settlement from installed conditions.

2. Appendix A of 10 CFR 100 requires that it be demonstrated an OBE will not impact operation.

3. Quantification of stresses sufficient to permit Staff acceptance is lacking.

4. A seismic margin analysis will also be required.

5. The scope of NRC concern is all safety Class 1 buried piping. The primary concern is the SWS piping. Some Staff personnel believe the data presented indicates this piping is presently overstressed. Others believe the ovality shows no problem. Input is still needed relating pipe ovality to a predicted pipe failure.

6. Seismic and settlement loadings cannot be decoupled.

7. The piping must meet code and must be shown to meet functional requirements. If enough good data is available, use of the 3 S_c stress limit could possibly be waived. Likewise if we met 3 S_c as piping is now, then would have a better argument of future acceptability of pipe.

The major concern remaining is the effect of earthquakes and whether a margin to seismically-induced failure can be established from ovality measurements. The staff asked, and we agreed to provide results of BOSOR as to where buckling takes place.

If the ovality reduction which will be measurable by flow verification can be defined and it can be demonstrated that such a reduction is not a concern during an SSE, this issue could likely be resolved. There has to be more technical justification on this.

In conclusion, the Staff noted that reprofiling was done externally at Summer Plant with stress calculations showing 1/2 code allowable.

When questioned whether the Staff would reconsider curve fitting as an approach, Mark Hartsman indicated he would talk to ETEC and let us know.

NRC MEETING AGENDA

I. Introduction

  A. Meeting Purpose
  B. Previous Activities and Meetings
  C. Schedule and Activities
  D. Recent Telecons

II. Proposed Demonstration Solution

  A. Acceptance Criteria

    1. Ovality Measurements
    2. Construction Hydro
    3. Periodic Verify of Acceptable Flow
    4. Inservice Inspection

III. Limitations of Analytical Solution

  A. Difficulty in Truly Modeling the Problem.
  B. SWA Study on Soils Forces Required
  C. No as Built Dimensions of Installed Conditions.
  D. QCI Requirements
  E. Basis of Acceptance Criteria

IV. Preliminary 1981 Measurements Results

  A. SRI Measurement Techniques

    1. Profiling
    2. Out of Roundness

  B. Data Presentation

    1. Profiles for 1981 Data Compared with 1979 Data
    2. Ovality Measurements Results

V. Miscellaneous Concerns

  A. Overburden Loads - 50.54(f) Question 34
  B. Fuel oil lines
  C. Rebedding and Realignment

    1. 10"-OHBC-27, 8"-2HBC-311, 8"-2HBC-310
    2. 36" Service Water Header Fix for Adequate Rattle Space

  D. Sizing Pig Operation

    1. 8"-1HBC-310, 8"-1HBC-311, 8"-2HBC-81, 8"-2HBC-82

  E. BWST Lines

VI. Summary

ATTENDANCE 10/6/81

D. F. Lewis	Bechtel
D. E. Sibbald	CPCo.
J. C Tsacoyeanes	TES
D. M. BUDZIK	CPCO
F.C. Cherny	NRC/DE/MEB
Mark Hartzman	NRC/DE/MEB
A.J. Cappucci	NRC/DE/MEB
W.P. Chen	ETEC
H.L. Brammer	NRC/DE/MEB
Darl Hood	LB#4/DL/NRR
BILL CLOUTIER	CPCo
TED SULLIVAN	NRC/ASB
Roger Huston	Consumers Power
James Brunner	"
Joseph Kane	NRC, DE, HGEB
Hari Narain Singh	U.S. Army Corps of Engineers Detroit
DINESH GUPTA	NRC, DE, HGEB
Gil Keeley	CPCo.
~~W. Cloutier~~	~~CPCo~~

CONSTRUCTION HYDRO TEST

ASME III NC-6221 NC6129

- TEST PRESSURE - 1.25 X SYSTEM DESIGN PRESSURE
- HOLD INTERVAL - 1 HOUR, INACCESSIBLE WELD JOINTS
- TEST PUMPS LEAKAGE - MONITOR FLOW FOR FUTURE LEAKAGE CRITERIA

FLOW VERIFICATION

- ENSURE ABILITY OF BURIED PIPING TO MAINTAIN FLOWS REQUIRED FOR SAFETY FUNCTIONS
- ESTABLISH PUMP AND SYSTEM LINEUPS TO OBTAIN KNOWN CONFIGURATION THAT PROVIDE REQUIRED FLOWS
- UTILIZE INSTALLED INSTRUMENTATION TO VERIFY REQUIRED FLOW IN EACH BURIED LINE
- ONCE PER YEAR
- TO BE INCLUDED IN TECHNICAL SPECIFICATIONS

MINIMUM REQUIRED FLOWS

Line	Description	Required Flow (gpm)
8"-1HBC-310	DG 1A Supply	1,600
8"-2HBC-81	DG 2A Supply	1,600
8"-1HBC-81	DG 1B Supply	1,600
8"-2HBC-310	DG 2B Supply	1,600
8"-1HBC-311	DG 1A Return	1,600
8"-2HBC-82	DG 2A Return	1,600
8"-1HBC-82	DG 1B Return	1,600
8"-2HBC-311	DG 2B Return	1,600
10"-0HBC-27	DG 1B/2B Supply	3,200
10"-0HBC-28	DG 1B/2B Return	3,200
26"-0HBC-53	DG 1A/2A + TB Supply	9,225
26"-0HBC-54	DG 1A/2A + TB Return	9,225
26"-0HBC-55	DG 1B/2B + TB Supply	9,225
26"-0HBC-56	DG 1B/2B + TB Return	9,225
26"-0HBC-15	Aux Bldg A Supply	15,894
26"-0HBC-16	Aux Bldg A Return	15,894
26"-0HBC-19	Aux Bldg B Supply	15,894
26"-0HBC-20	Aux Bldg B Return	15,894
36"-0HBC-15	A Supply	25,119
36"-0HBC-16	A Return	25,119
36"-0HBC-19	B Supply	25,119
36"-0HBC-20	B Return	25,119

Required flows are based on FSAR tables 9.2-1 and 9.2-2. Worst-case values for each line were determined from the six operation modes and the ESF mode in those tables. Turbine building flows are based on potential flow under accident conditions (Mode 6).

FLOW MEASUREMENT

Line	Description	Flow Element	Location
8"-1HBC-310	DG 1A Supply	1 FE 1841	Cooler Outlet
8"-2HBC-81	DG 2A Supply	2FE 1851	Cooler Outlet
8"-1HBC-81	DG 1B Supply	1FE 1846	Cooler Outlet
8"-2HBC-310	DG 2B Supply	2FE 1855	Cooler Outlet
8"-1HBC-311	DG 1A Return	1FE 1841	Cooler Outlet
8"-2HBC-82	DG 2A Return	2FE 1851	Cooler Outlet
8"-1HBC-82	DG 1B Return	1FE 1846	Cooler Outlet
8"-2HBC-311	DG 2B Return	2FE 1855	Cooler Outlet
10"-0HBC-27	DG 1B/2B Supply	1FE 1846 + 2FE 1855	Cooler Outlet Cooler Outlet
10"-0HBC-28	DG 1B/2B Return	1FE 1846 + 2FE 1855	Cooler Outlet Cooler Outlet
26"-0HBC-53	DG 1A/2A + TB1 Supply	1FE 1876	Supply Line - Metering Pit
26"-0HBC-54	DG 1A/2A + TB1 Return	1FE 1876	Supply Line - Metering Pit
26"-0HBC-55	DG 1B/2B + TB2 Supply	2FE 1876	Supply Line - Metering Pit
26"-0HBC-56	DG 1B/2B + TB2 Return	2FE 1876	Supply Line - Metering Pit
26"-0HBC-15	Aux Bldg A Supply	0FE 1995A + 1FE 1914A + 1FE 1990A + 2FE 1990A	Aux Bldg A - Supply Line Booster Pump Discharge Chiller Outlet Chiller Outlet
26"-0HBC-16	Aux Bldg A Return	0FE 1995A + 1FE 1914A + 1FE 1990A + 2FE 1990A	Aux Bldg A - Supply Line Booster Pump Discharge Chiller Outlet Chiller Outlet
26"-0HBC-19	Aux Bldg B Supply	0FE 1995B	Aux Bldg B - Return Line
26"-0HBC-20	Aux Bldg B Return	0FE 1995B	Aux Bldg B - Return Line
36"-0HBC-15	A Supply	1FE 1876 + 0FE 1995A + 1FE 1914A + 2FE 1990A 2FE 1990A	Supply Line - Metering Pit Aux Bldg A - Supply Line Booster Pump Discharge Chiller Outlet Chiller Outlet
36"-0HBC-16	A Return	1FE 1876 + 0FE 1995A + 1FE 1914A + 1FE 1990A + 2FE 1990A	Supply Line - Metering Pit Aux Bldg A - Supply Line Booster Pump Discharge Chiller Outlet Chiller Outlet
36"-0HBC-19	B Supply	2FE 1876 + 0FE 1995B	Supply Line - Metering Pit Aux Bldg B - Return Line
36"-0HBC-20	B Return	2FE 1876 + 0FE 1995B	Supply Line - Metering Pit Aux Bldg B - Return Line

(This list confirms capability to measure flows in buried service water system piping using installed instrumentation. In some areas, additional measurement devices are installed that may be considered preferable alternatives.)

INSERVICE INSPECTION

- ENSURE PRESSURE BOUNDARY INTEGRITY
- ASME XI - 1980 EDITION, THROUGH WINTER 1980 ADDENDA
- INSERVICE TESTS WITH LEAKAGE TESTS
- HYDROSTATIC TESTS WITH LEAKAGE TESTS

INSERVICE INSPECTION (cont'd)

- ONE UNIT AT POWER DURING TEST
- TEST DURATION WITHIN TECHNICAL SPECIFICATION LIMITS
- RAPID RESTRORATION POSSIBLE

INSERVICE TESTS - LEAKAGE TESTS

- EACH INSPECTION PERIOD: 3, 7, 10, 13, 17...YEARS
- NOMINAL SYSTEM OPERATING PRESSURE: 57 PSIG
- ISOLATE BURIED PIPING
- PRESSURIZE WITH TEST PUMP
- MAINTAIN PRESSURE 4 HOURS
- MEASURE FLOW

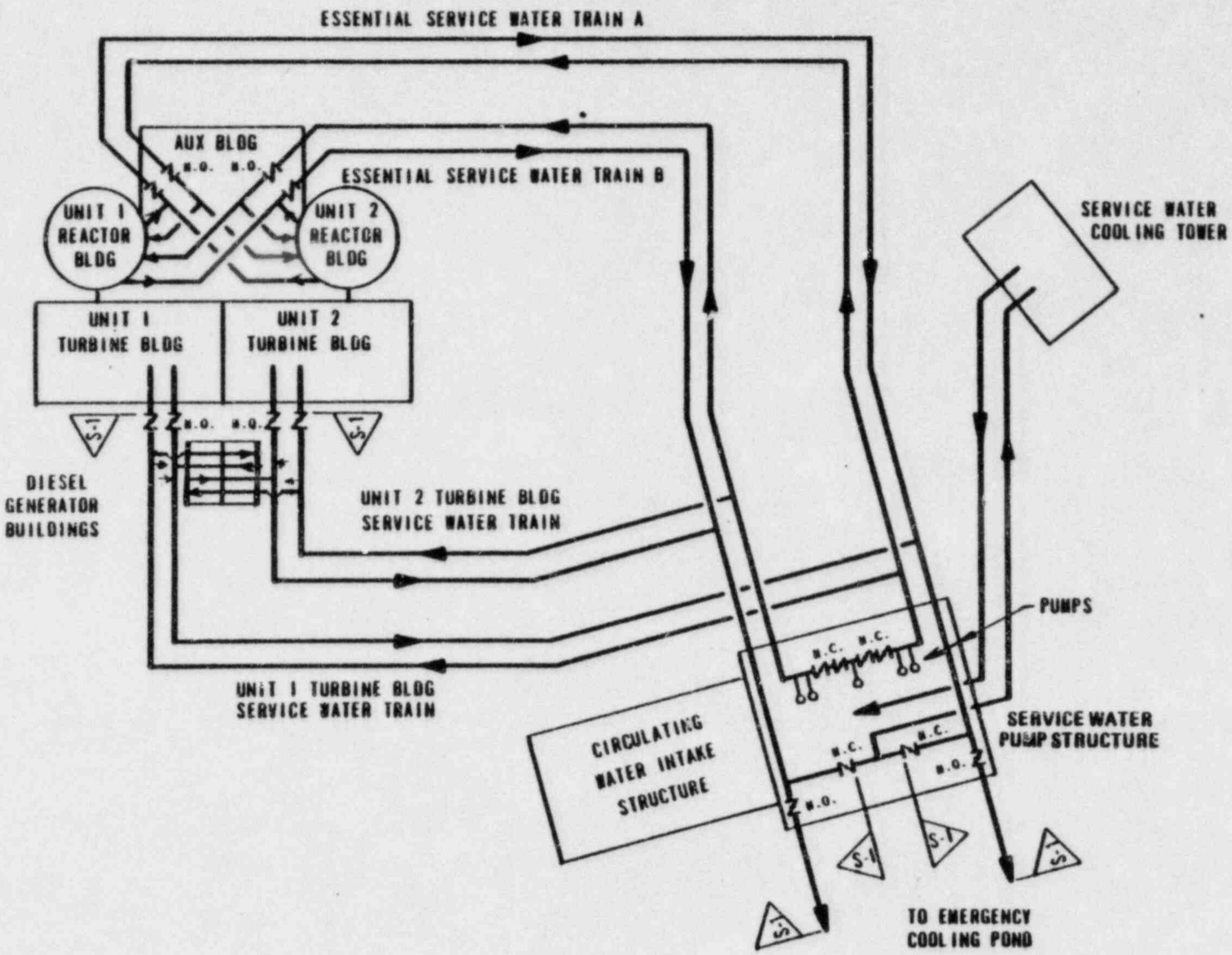
HYDROSTATIC TESTS - LEAKAGE TESTS

- EACH INSPECTION INTERVAL: ONCE EACH 10 YEARS
- 1.10 × DESIGN PRESSURE: 115.5 PSIG
- ISOLATE BURIED PIPING
- PRESSURIZE WITH TEST PUMP
- MAINTAIN PRESSURE 4 HOURS
- MEASURE FLOW

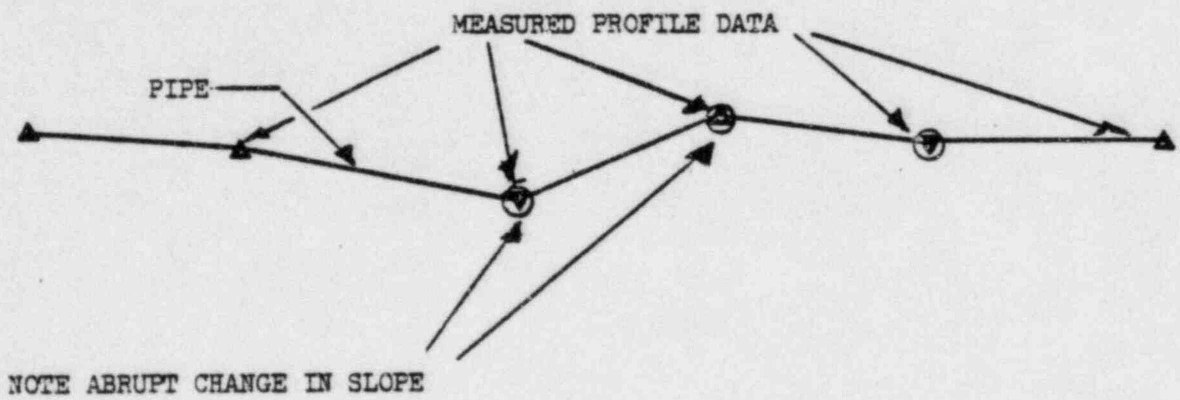
LEAKAGE TEST ACCEPTANCE CRITERIA

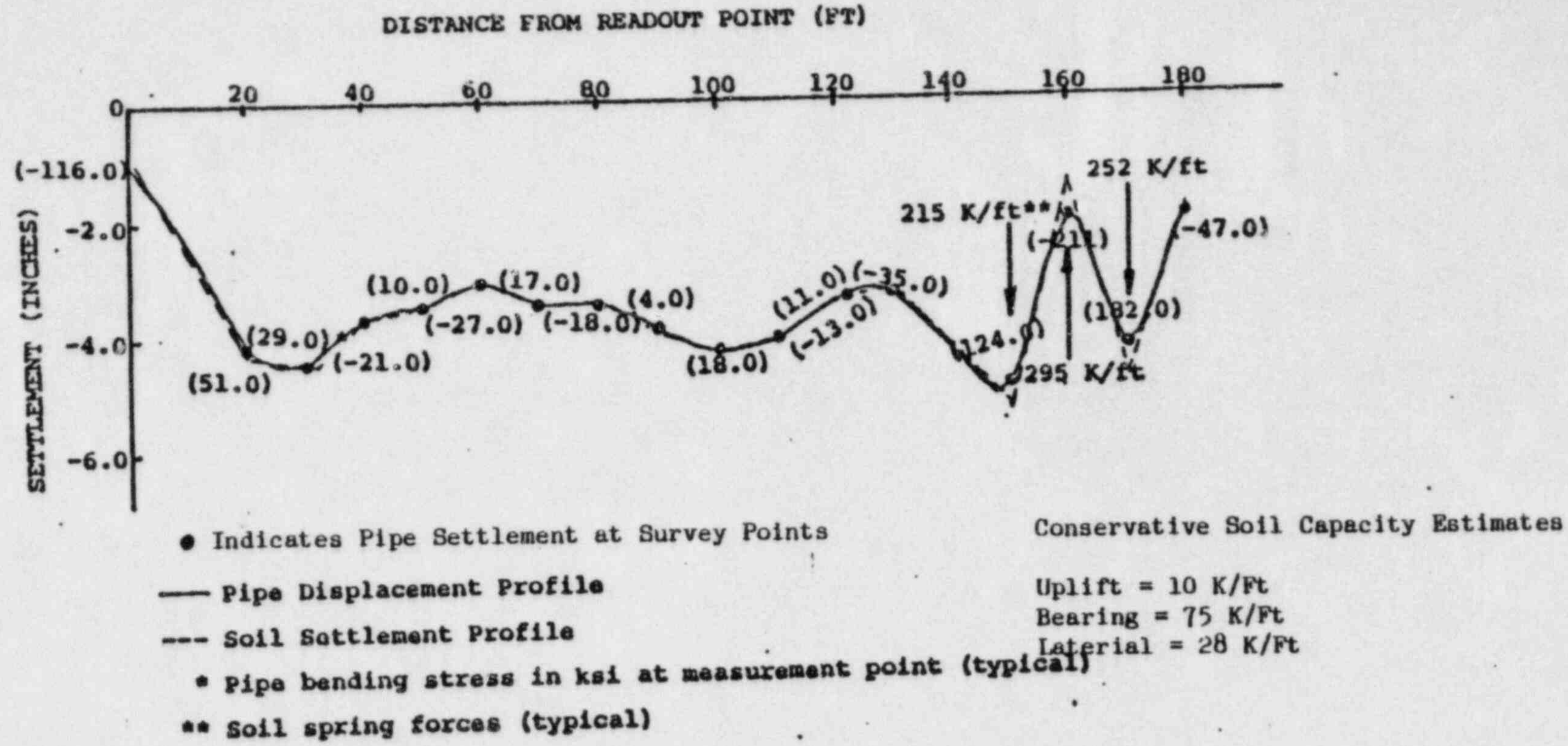
- SMALL ENOUGH TO DETECT PRESSURE BOUNDARY FAILURE
- LARGE ENOUGH TO ACCOMMODATE ANTICIPATED BOUNDARY VALVE LEAKAGE
- ~~0.5~~ 0-5 GPM
- RESULTS IN INSIGNIFICANT FLOW LOSS
- TO BE REVIEWED FOLLOWING PRESERVICE TESTS

SCHEMATIC DIAGRAM SERVICE WATER SYSTEM



SOIL SETTLEMENT PROFILE





LINEAR ELASTIC ANALYSIS RESULTS FOR UPPER
BOUND SOIL PROPERTIES

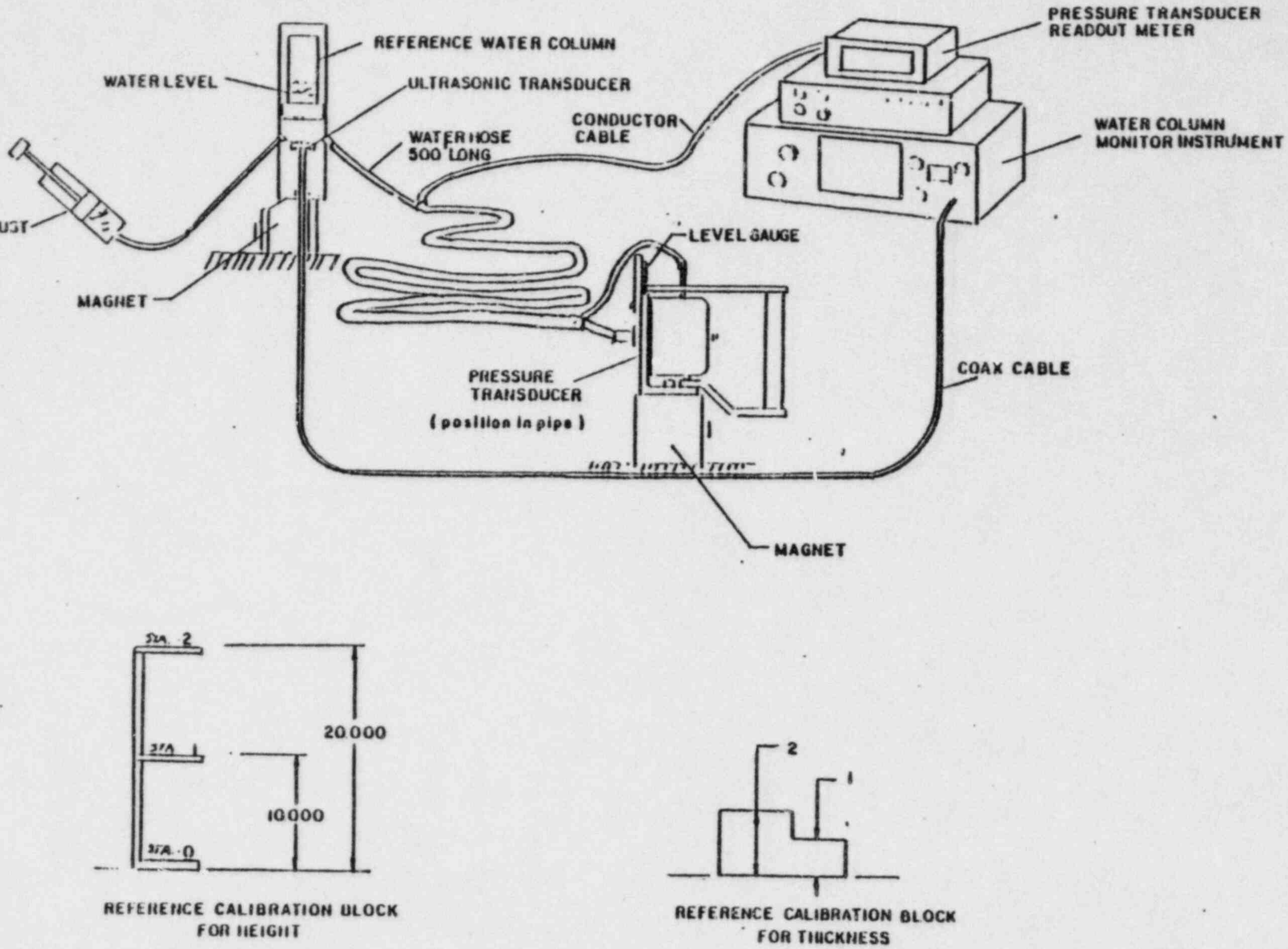
BASIS FOR ACCEPTANCE CRITERIA

LIMITS ON STRESS:

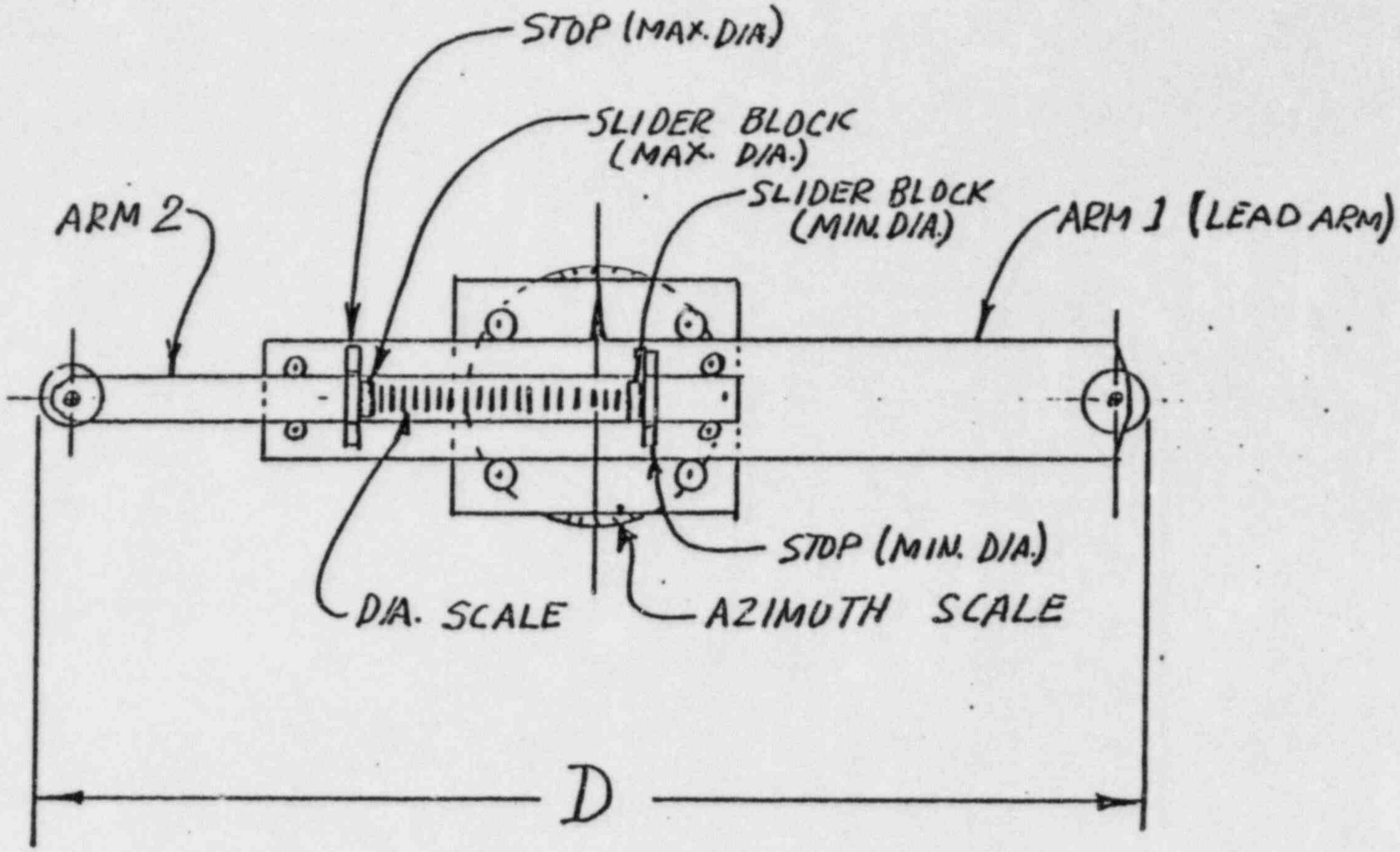
- $3S_c$ (NC-3652.3) - SECONDARY STRESS
- BASED ON BUCKLING - BOSOR
- REFLECT LOAD-CONTROLLED SITUATION

LIMITS ON DEFORMATION:

- MEASURED BY OVALITY
- CODE LIMIT 8% (NC-3642, NC-4223.2)



SCHEMATIC- PIPE ELEVATION PROFILE MEASURMENT SYSTEM



SKETCH - SwRI OUT-OF-ROUNDNESS MEASUREMENT INSTRUMENT

OUT OF ROUNDNESS

$\% = 100 \frac{DMAX - DMIN}{Do}$

PIPELINE: SERVICE WATER FITTINGS

Do = Average I.D. = 25.25"
Do = 64.135cm
DMAX = Maxinum I.D.
DMIN = Minimum I.D.

Pipe Position	% Ovalness	Pipe Position	% Ovalness	Pipe Position	% Ovalness
26"-OHBC-56					
13A	1.87				
13B	1.40				
13C	1.56				
12D	1.56				
21D	0.78				
22A	1.09				
22B	0.9				
22C	0.9				
26"-OHBC-55					
38D	1.09				
39A	1.40				
39B	0.9				
39C	0.47				
47D	1.56				
48A	1.87				
48B	1.25				
48C	2.03				
26"-OHBC-20					
95A	1.72				
94C	1.40				
94B	1.72				
94A	1.72				
86A	0.9				
85D	1.09				
85C	0.9				
85B	1.09				
85A	0.6				
26"-OHBC-19					
134A	1.56				
133C	1.09				
133B	1.56				
133A	2.03				
124A	1.72				
123D	1.56				
123C	1.72				
123B	1.09				
123A	1.40				

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OUT OF ROUNDNESS

$\% = 100 \frac{DMAX - DMIN}{Do}$

PIPELINE: 26/36"-OHBC-20

Do = Average I.D. = 25.25"
Do = 64.135cm
DMAX = Maxinum I.D.
DMIN = Minimum I.D.
Do = 35.25 = 89.535cm

Pipe Position	% Ovalness	Pipe Position	% Ovalness	Pipe Position	% Ovalness
74C	1.72	98A	0.9	90B	0.9
70A	1.09	97D	0.9	90A	0.6
70B	1.09	97C	0.9	89D	0.78
70C	1.25	97B	0.9	89C	0.9
70D	1.09	97A	0.78	89B	0.78
71A	1.40	96D	0.6	89A	0.9
71B	1.87	96C	1.09	88D	0.78
71C	1.56	96B	0.9	88C	0.78
71D	1.56	96A	0.9	88B	0.78
72A	0.6	95D	0.78	88A	1.4
72B	0.78	95C	0.6	87D	0.9
72C	1.25	95B	0.6	87C	0.9
72D	0.9	93D	3.12	87B	0.9
73A	0.9	93C	1.87	87A	0.9
73B	0.78	93B	1.09	86D	0.78
73C	0.78	93A	0.78	86C	1.09
73D	0.78	92D	0.78	86B	0.9
74A	0.6	92C	1.09	84D	0.6
74B	0.78	92B	1.09	84C	0.6
100D	0.6	92A	1.09	84B	0.9
100C	1.40	91D	0.6	84A	0.16
100B	1.40	91C	1.87	83D	0.78
100A	1.40	91B	1.25	83C	0.9
99D	1.25	91A	1.72	83B	1.25
99C	1.56	90D	1.56	83A	1.25
99B	0.9	90C	1.40	76C	0.78
99A	1.25	80A	0.6	76B	0.47
98D	0.9	79D	1.09	76A	0.6
98C	0.78	79C	0.9	75D	0.78
98B	0.78	79B	0.9	75C	0.6
82D	1.25	79A	0.9	75B	0.9
82C	0.78	78D	0.6	75A	1.09
82B	0.9	78C	0.9	103A	1.79
82A	0.78	78B	1.09	103C	0.78
81D	0.9	78A	0.9	103D	0.34
81C	0.16	77D	1.25	104A	0.45
81B	0.47	77C	1.09	104B	0.67
81A	0.78	77B	0.78	104C	0.78
80D	0.78	77A	0.47	104D	1.12
80C	1.25	76D	0.78	105A	1.12
80B	1.09			105B	1.23

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OUT OF ROUNDNESS

Pipeline: 26/36" OHBC-20 (cont'd)

Pipe Position	% Ovalness	Pipe Position	% Ovalness	Pipe Position	% Ovalness
105C	1.90				
105D	2.90				
106A	2.79				
106B	2.12				
106C	1.56				
106D	1.45				
107A	1.23				
107B	1.45				
107C	1.45				

OUT OF ROUNDNESS

$\% = 100 \frac{DMAX - DMIN}{Do}$

PIPELINE: 26-OHBC-56

Do = Average I.D. = 25.25"
Do = 64.135cm
DMAX = Maxinum I.D.
DMIN = Minimum I.D.

Pipe Position	% Ovalness	Pipe Position	% Ovalness	Pipe Position	% Ovalness
1A	2.49	11D	0.78		
1B	0.60	12A	0.9		
1C	0.78	12B	0.9		
1D	0.78	12C	0.9		
2A	0.9	14A	1.87		
2B	0.47	14B	1.40		
2C	0.9	14C	1.40		
2D	1.09	14D	0.6		
3A	1.40	15A	0.9		
3B	0.90	15B	1.09		
3C	0.6	15C	0.9		
3D	0.78	15D	0.78		
4A	1.09	16A	0.78		
4B	1.25	16B	0.9		
4C	1.40	16C	0.9		
4D	0.78	16D	1.09		
5A	0.9	17A	1.09		
5B	1.09	17B	0.6		
5C	1.09	17C	0.6		
5D	0.78	17D	0.9		
6A	0.9	18A	0.78		
6B	0.78	18B	0.78		
6C	0.9	18C	1.40		
6D	0.6	18D	0.78		
7A	0.78	19A	0.3		
7B	1.25	19B	0.6		
7C	1.09	19C	0.47		
7D	0.47	19D	0.47		
8A	0.9	20A	0.6		
8B	0.9	20B	0.78		
8C	1.09	20C	0.6		
8D	0.78	20D	1.09		
9A	0.9	21A	0.78		
9B	1.40	21B	0.47		
9C	1.40	21C	0.47		
9D	0.9	23B	0.6		
10A	0.9	23C	0.6		
10B	0.9	24A	1.09		
10C	0.9	24B	0.47		
11A	0.9	24C	0.6		
11B	0.78	24D	0.78		
11C	0.78				

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OUT OF ROUNDNESS

$\% = 100 \frac{DMAX - DMIN}{Do}$

PIPELINE: 26-OHBC-55

Do = Average I.D. = 25.25"
Do = 64.135cm
DMAX = Maxinum I.D.
DMIN = Minimum I.D.

Pipe Position	% Ovalness	Pipe Position	% Ovalness	Pipe Position	% Ovalness
25A	0.78	37B	1.40		
25B	1.25	37C	1.72		
25C	0.78	37D	0.3		
25D	0.78	38A	0.6		
26A	0.48	38B	0.6		
26B	0.6	38C	0.78		
26C	0.6	40A	0.9		
26D	0.6	40B	0.9		
27A	0.3	40C	0.6		
28A	0.3	40D	0.6		
29A	0.48	41A	0.78		
29B	0.60	41B	0.6		
29C	0.48	41C	0.78		
29D	0.60	41D	0.6		
30A	1.09	42A	0.6		
30B	0.6	42B	0.78		
30C	0.48	42C	0.78		
30D	1.40	42D	0.9		
31A	1.40	43A	0.78		
31B	0.9	43B	0.78		
31C	0.9	43C	0.6		
31D	1.09	43D	0.47		
32A	1.25	44A	0.78		
32B	0.9	44B	1.09		
32C	0.6	44C	1.09		
32D	0.6	44D	0.9		
33A	0.48	45A	0.78		
33B	1.09	45B	0.9		
33C	0.78	45C	1.09		
33D	0.78				
34A	0.9	45D	1.56		
34B	1.56	46A	0.9		
34C	1.09	46B	0.78		
34D	1.09	46C	0.6		
35A	1.09	47A	0.3		
35B	1.25	47B	0.78		
35C	1.25	47C	1.09		
35D	0.6	49A	1.40		
36A	0.78	49B	1.40		
36B	0.9	49D	1.25		
36C	1.09	50A	0.78		
36D	0.47	50B	1.09		
37A	0.6	50C	0.6		
		50D	1.56		

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OUT OF ROUNDNESS

$$\% = 100 \frac{DMAX - DMIN}{Do}$$

PIPELINE: 26/36"OHBC-19

Do = Average I.D. = 25.25"
Do = 64.135cm
Do = 35.25 = 89.535cm
DMAX = Maxinum I.D.
DMIN = Minimum I.D.

Pipe Position	% Ovalness	Pipe Position	% Ovalness	Pipe Position	% Ovalness
108A	0.6	125A	1.09	113B	0.6
108B	0.3	124D	1.09	113A	1.09
108C	0.78	124C	1.09	139D	0.78
108D	0.3	124B	1.72	139C	1.25
109A	0.48	122D	0.6	139B	0.9
109B	0.16	122C	0.9	139A	0.78
109C	0.3	122B	1.09	138D	0.9
109D	0.16	122A	0.78	138C	0.6
110A	0.3	121D	0.6	138B	0.9
110B	0	121C	0.78	138A	0.9
110C	0.6	121B	0.9	137D	1.25
110D	0	121A	1.4	137C	1.72
111A	0.9	120D	0.9	137B	1.87
111B	0.6	120C	1.25	137A	1.40
111C	0.16	120B	0.78	136D	1.25
111D	0.16	120A	0.9	136C	1.09
112A	0.48	119D	0.9	136B	0.48
112B	0.3	119C	1.72	136A	1.09
112C	0.48	119B	1.87	135D	0.9
130D	1.25	119A	1.72	135C	1.72
130C	1.56	118D	1.40	135B	1.56
130B	1.56	118C	1.25	135A	1.87
130A	1.56	118B	1.72	134D	1.25
129D	0.9	118A	1.09	134C	1.40
129C	0.78	117D	1.09	134B	1.40
129B	0.78	117C	1.40	132D	1.87
129A	0.78	117B	1.09	132C	0.9
128D	0.78	117A	0.9	132B	1.25
128C	0.6	116D	0.6	132A	1.72
128B	0.78	116C	0.6	131C	0.9
128A	0.9	116B	0.9	131B	0.9
127D	0.78	116A	1.09	131A	0.78
127C	1.40	115D	1.09	142A	0.89
127B	1.72	115C	1.25	142B	1.45
127A	1.25	115B	0.9	142C	1.79
126D	1.56	115A	0.3	142D	0.89
126C	1.25	114D	0.3	143A	1.01
126B	0.6	114C	0.3	143B	1.56
126A	0.78	114B	0.9	143C	1.79
125D	0.6	114A	0.9	143D	1.23
125C	1.40	113D	0.9	144A	1.23
125B	1.40	113C	0.6	144B	1.34

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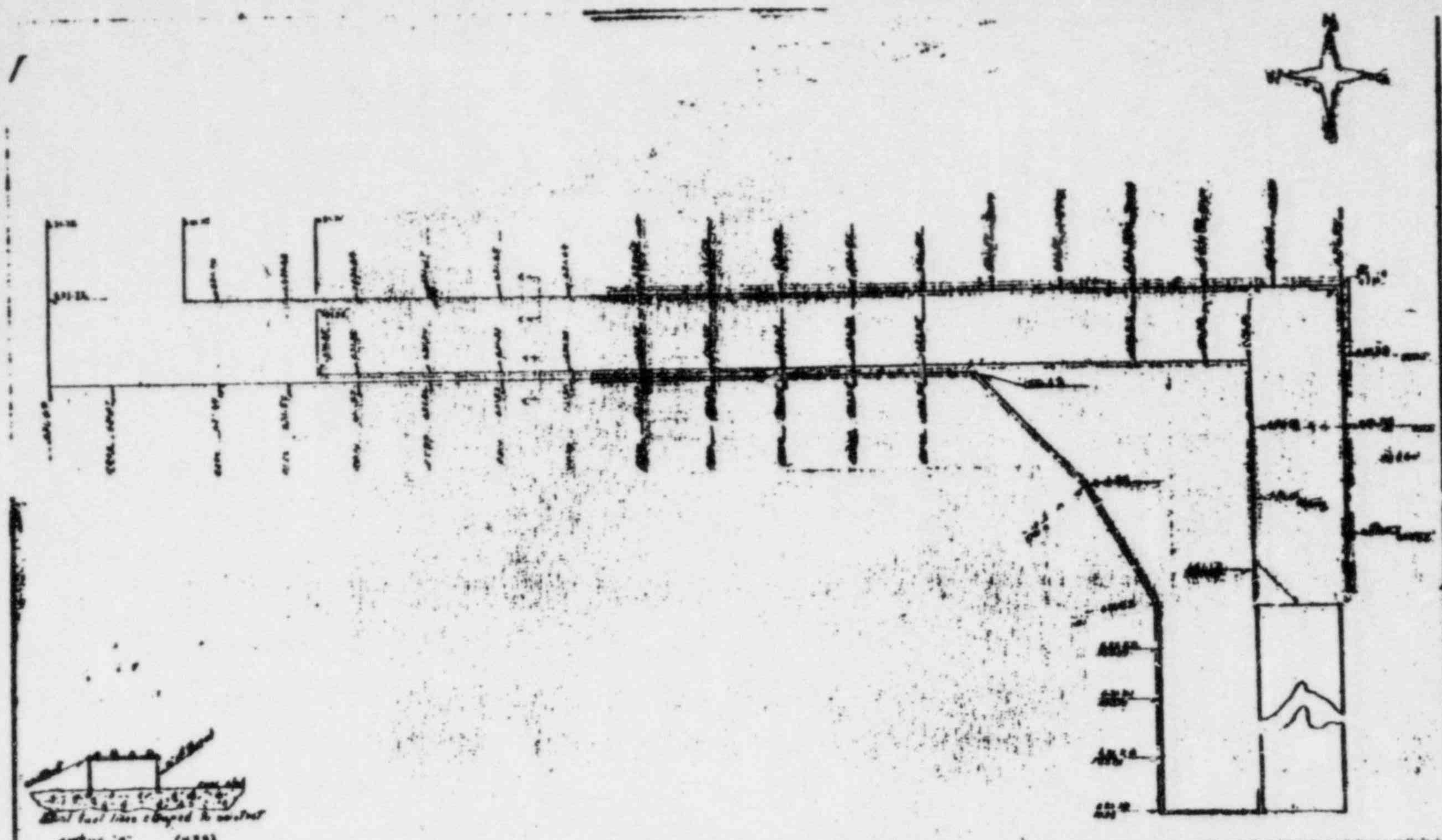
OUT OF ROUNDNESS

PIPELINE: 26/36" OHBC - 19 (Cont'd)

Pipe Position	% Ovalness	Pipe Position	% Ovalness	Pipe Position	% Ovalness
144C	2.12				
144D	2.12				
145B	2.35				
145B	2.01				
145C	1.90				
146A	1.80				
146C	1.12				



Detail fuel lines changed to conduct

SECTION "A" (N.T.S.)

Q — Revised to reflect As-Built Condition

Scale: 1"=20'

BECHTEL POWER CORP
MIDLAND, MICHIGAN

CONSUMERS POWER COMPANY
MIDLAND PLANT, UNITS 1 & 2

TOP LINE ELEVATIONS OF DIESEL FUEL LINES

7220 FSK-MPY-138 Q — 0

NOT TO BE USED FOR CONSTRUCTION

Underground Piping: Slide 4