Westinghouse
Savannah River Company

P.O. Box 616
Aiken, SC 29802

ESH-FSS-94-0612

October 11, 1994

CERTIFIED

Mr. John J. Schnabel, P. E.
Facility Engineering Section
Division of Solid Waste Management
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, SC 29201

Dear Mr. Schnabel:

INFORMATION REQUESTED BY SCDHEC REGARDING THE Z-AREA SALTSTONE FACILITY (IWP-217) (U)

John, per South Carolina Department of Health and Environmental Control's (SCDHEC) request Westinghouse Savannah River Company (WSRC) is submitting information regarding the Z-Area Saltstone Facility requested in your letter of August 15, 1994. (In that letter you reference Ms. Bobbi Suski's memo to you dated August 11, 1994).

The information enclosed includes as requested, site specific maps showing structural irregularities, holes drilled through vault walls, water collection points and soil sample collection points. Analytical results and results of experiments performed on saltstone samples are also enclosed.

Also included is a proposed groundwater monitoring plan for the Z-Area Saltstone Facility that WSRC believes would ensure early detection of any groundwater contamination. If you have any questions or if I can be of further help, please let me know.

Sincerely,

Larry C. Haney

Larry C. Haney
RCRA Recordkeeping, Compliance & Permitting
Environmental Protection Department

LCH:sam
Enclosures

CC: without attachment *

Tim Fox, SCDHEC - Aiken
Bob Benson, SCDHEC - Aiken
A. L. Towns, DOE-ECD, 704-S
D. G. Thompson, 704-Z*
Ron Reeves, 704-15S*
Sandra J. Carroll, 742-A*
J. V. Odum, 742-A*
J. S. Roberts, 742-A*
EPD File, 742-A
Records Administration, 773-52A

WESTINGHOUSE SAVANNAH RIVER COMPANY

INTER-OFFICE MEMORANDUM

OPS-DTW-940065

keywords: Saltstone
Vaults
SCDHEC

October 11, 1994

TO: L. C. HANEY, 742-A

FROM: R. D. REEVES, 704-15S
(7-8617)

RE: SCDHEC REQUEST REGARDING Z-AREA SALTSTONE FACILITY (U)

Ref: ESH-FSS-94-0506

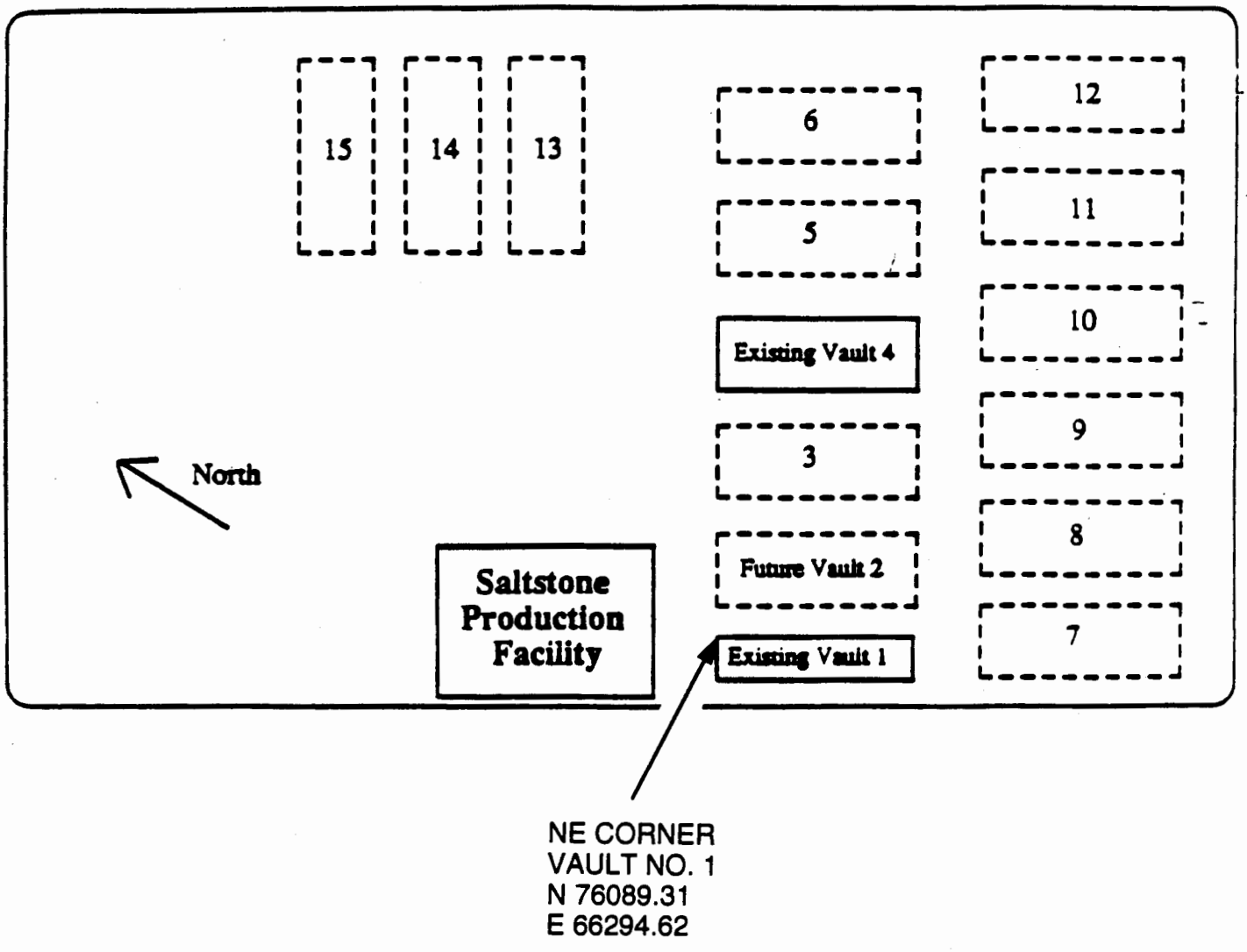
The attached information is provided in response to the South Carolina Department of Health and Environmental Control (SCDHEC) request that was transmitted in the referenced memorandum. This information was prepared and reviewed by personnel from Saltstone Engineering, DWPF-EC and EPD. Please forward this information to SCDHEC by the required date.

Contact me if you have any questions regarding the content of this information. Thank you.

CC: D. G. Thompson, 704-Z
D. T. Bignell, 719-4A
R. K. Cauthen, 704-15S
A. L. Towns, 704-S
D. G. Wells, 742-A
Area Files, 704-71S

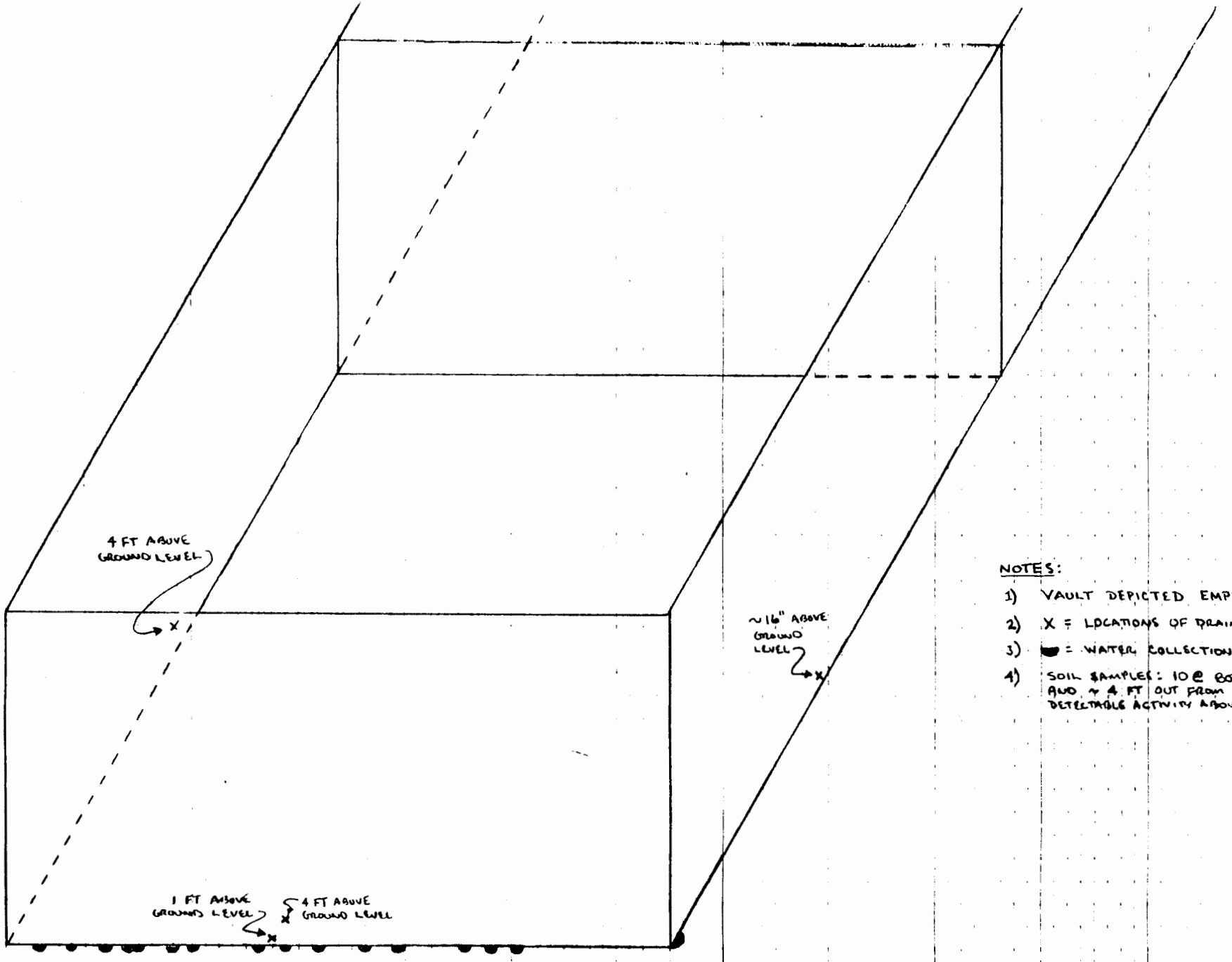
Contents

ATTACHMENT 1



Saltstone Disposal Facility - Plan View

ATTACHMENT 2



NORTH WALL FACING SOUTH

NOTES:

1) VAULT DEPICTED EMPTY.
2) X = LOCATIONS OF DRAIN/SAMPLE POINTS (4)
3) ▬ = WATER COLLECTION POINTS ON GROUND.
4) SOIL SAMPLES: 10 @ BOTH ALONG NORTH FACE AND @ 4 FT OUT FROM NORTH FACE - NO DETECTABLE ACTIVITY ABOVE BACKGROUNDS.

ATTACHMENT 3

The following drawings represent cracks in the Saltstone Disposal Vault. The **bold** cracks shown in cells A & B were existing cracks that had been repaired. The cracks shown in cell A not in bold are new, and a result of wall deflection caused by the recent rainwater intrusion. The remaining cracks in cells C through F were existing, and have been sealed from the vault interior.

ENGINEERING COMPUTATION SHEET

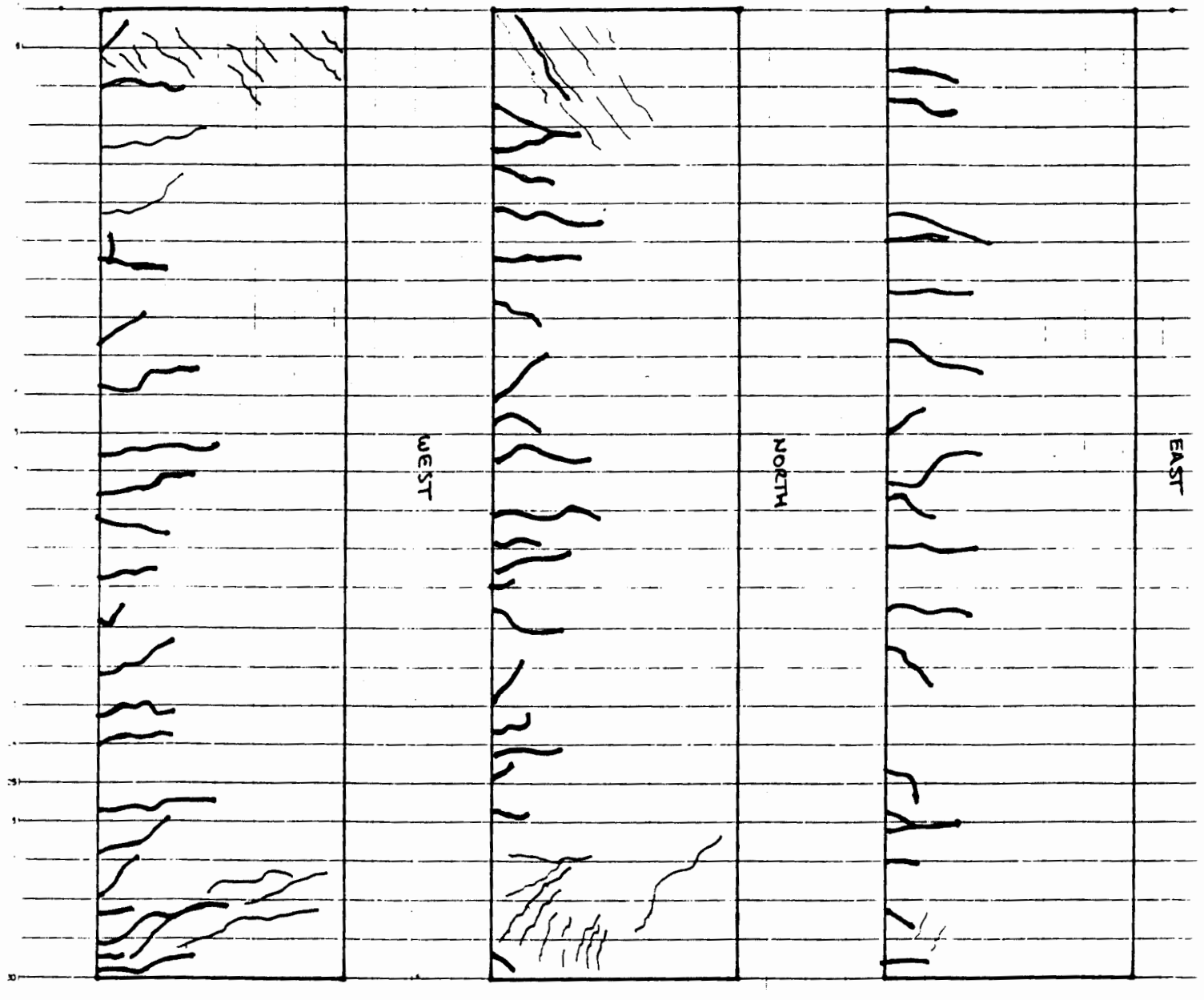
SR
SAVANNAH RIVER

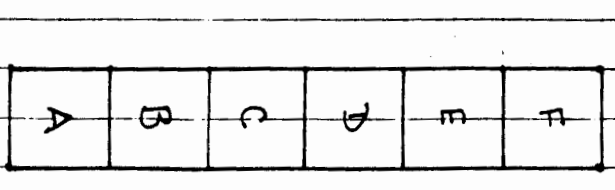
Title or Project _____ Project No. _____

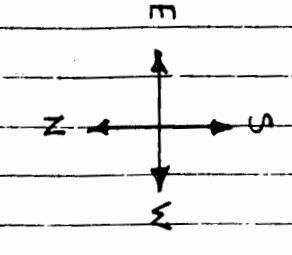
Subject VAULT #1 - CELL A Works _____

_____ Computer _____ Date _____ Sheet No.

NOTE: BOLD CRACKS (CELLS A & B) PREVIOUSLY REPAIRED.







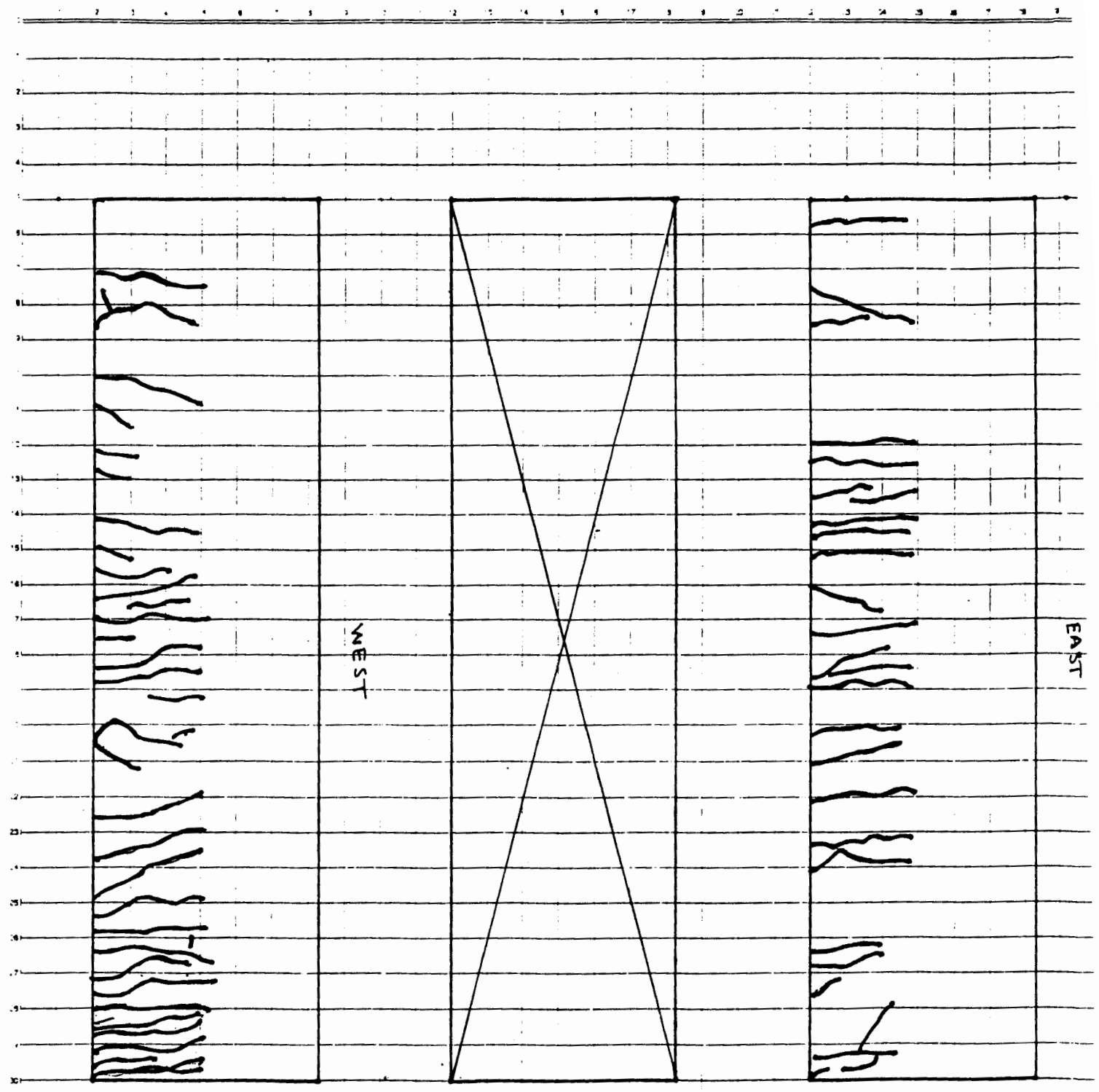
ENGINEERING COMPUTATION SHEET

SR
SAVANNAH RI

Title or Project _____ Project No. _____

Subject - CELL B Works _____

_____ Computer _____ Date _____ Sheet No.



ENGINEERING COMPUTATION SHEET

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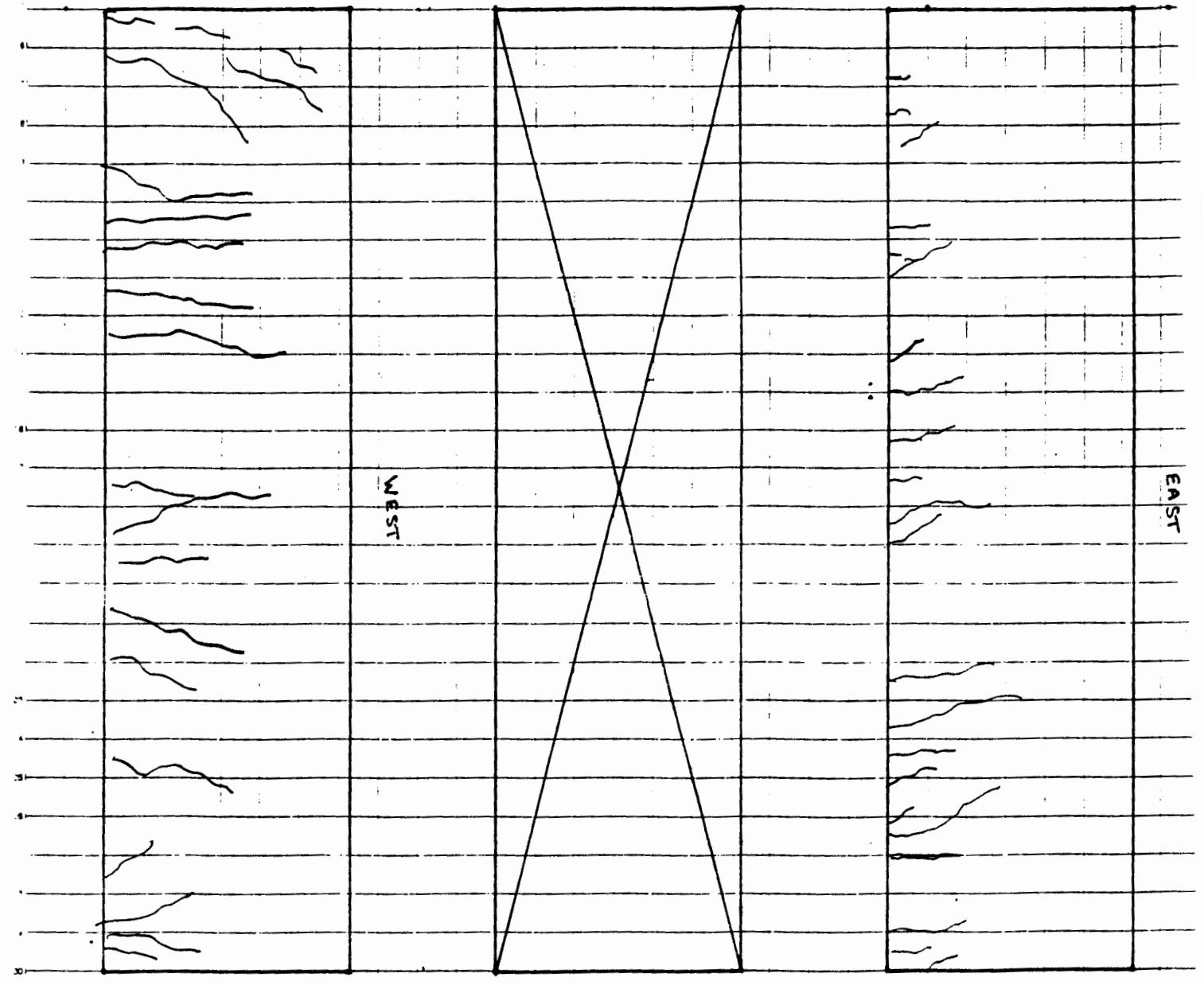

ENGINEERING COMPUTATION SHEET

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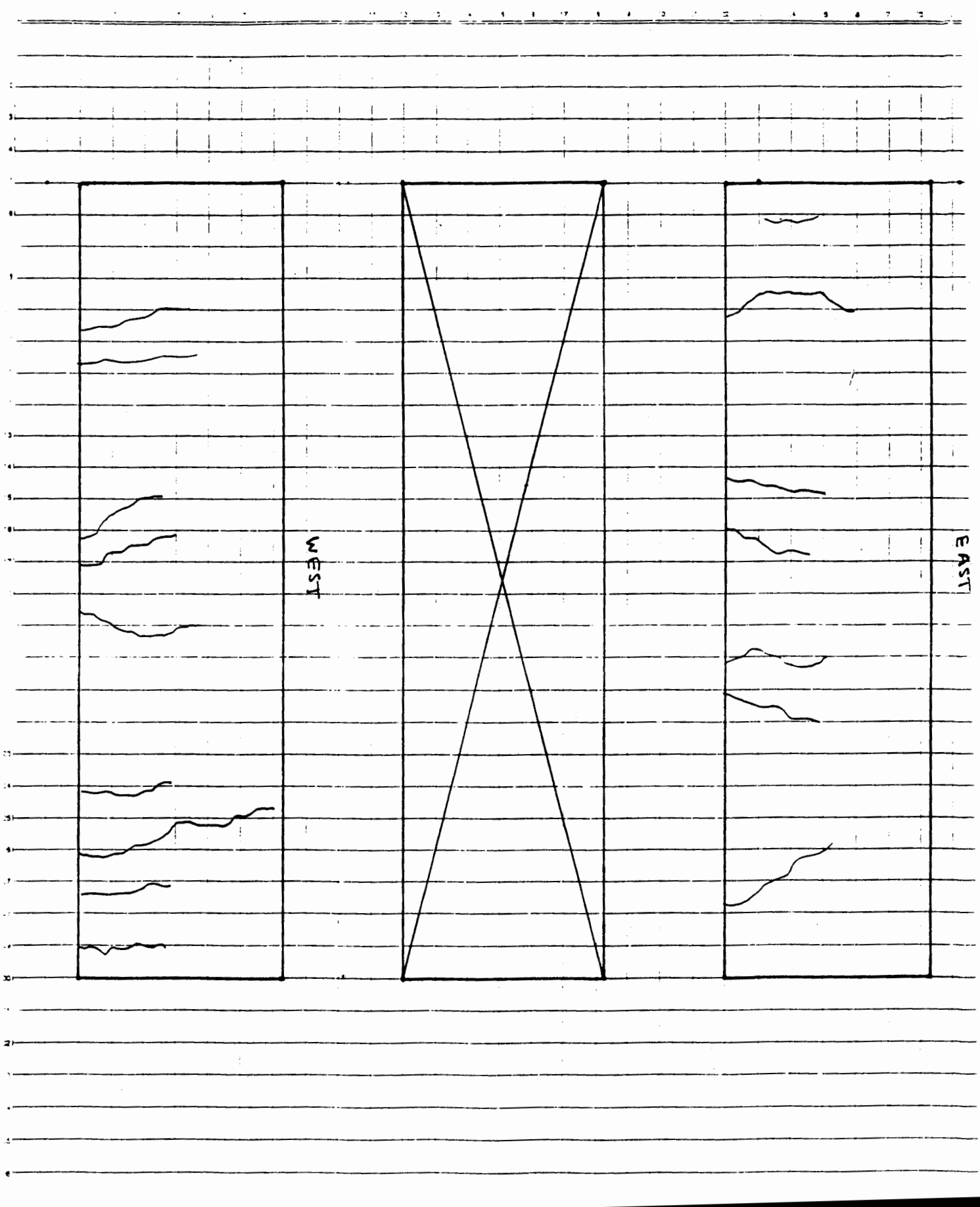
Subject - CELL D Works _____

_____ Computer _____ Date _____ Sheet No



ENGINEERING COMPUTATION SHEET

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Subject CELL E Works _____

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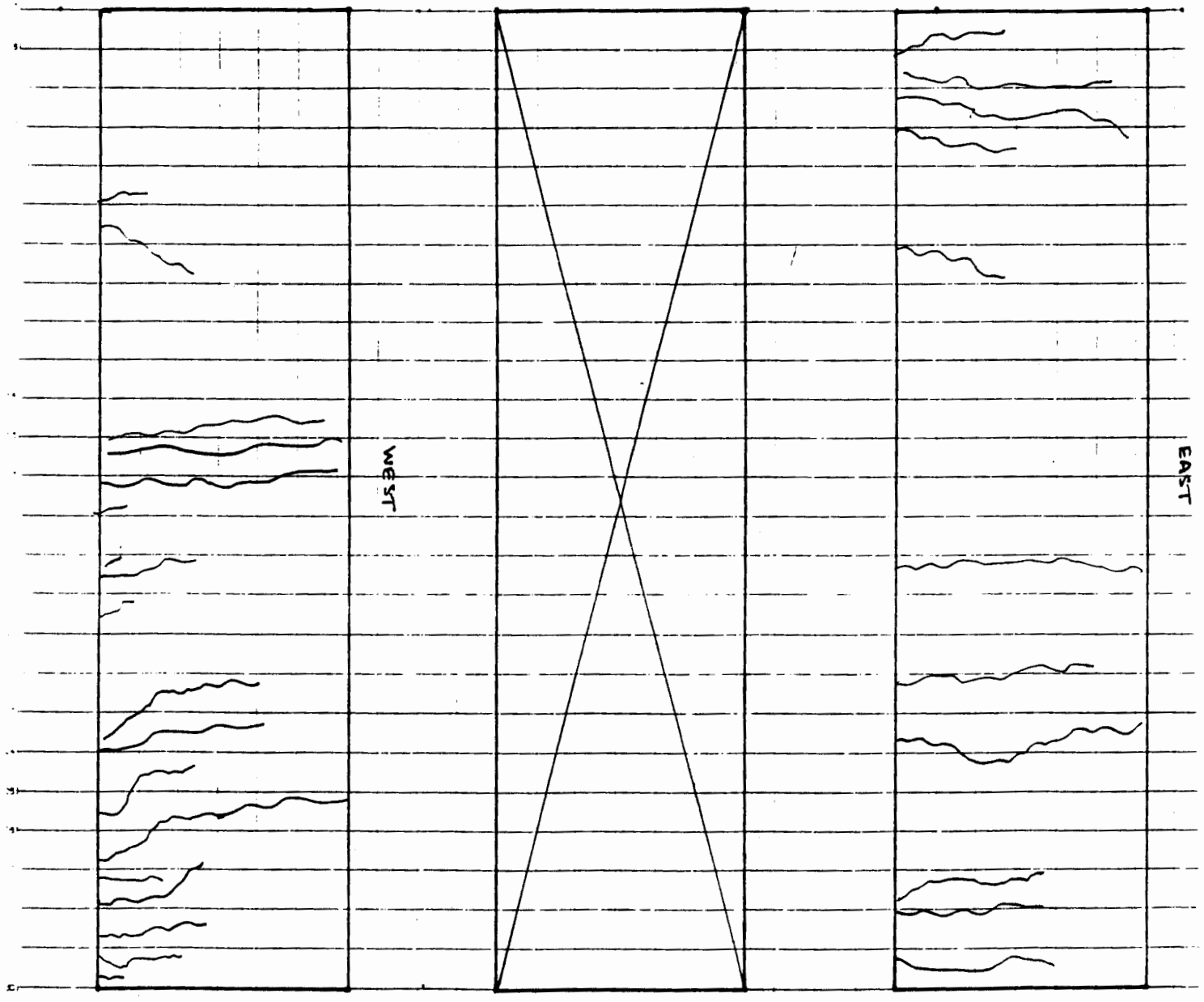


ENGINEERING COMPUTATION SHEET

Title of Project

Project No.

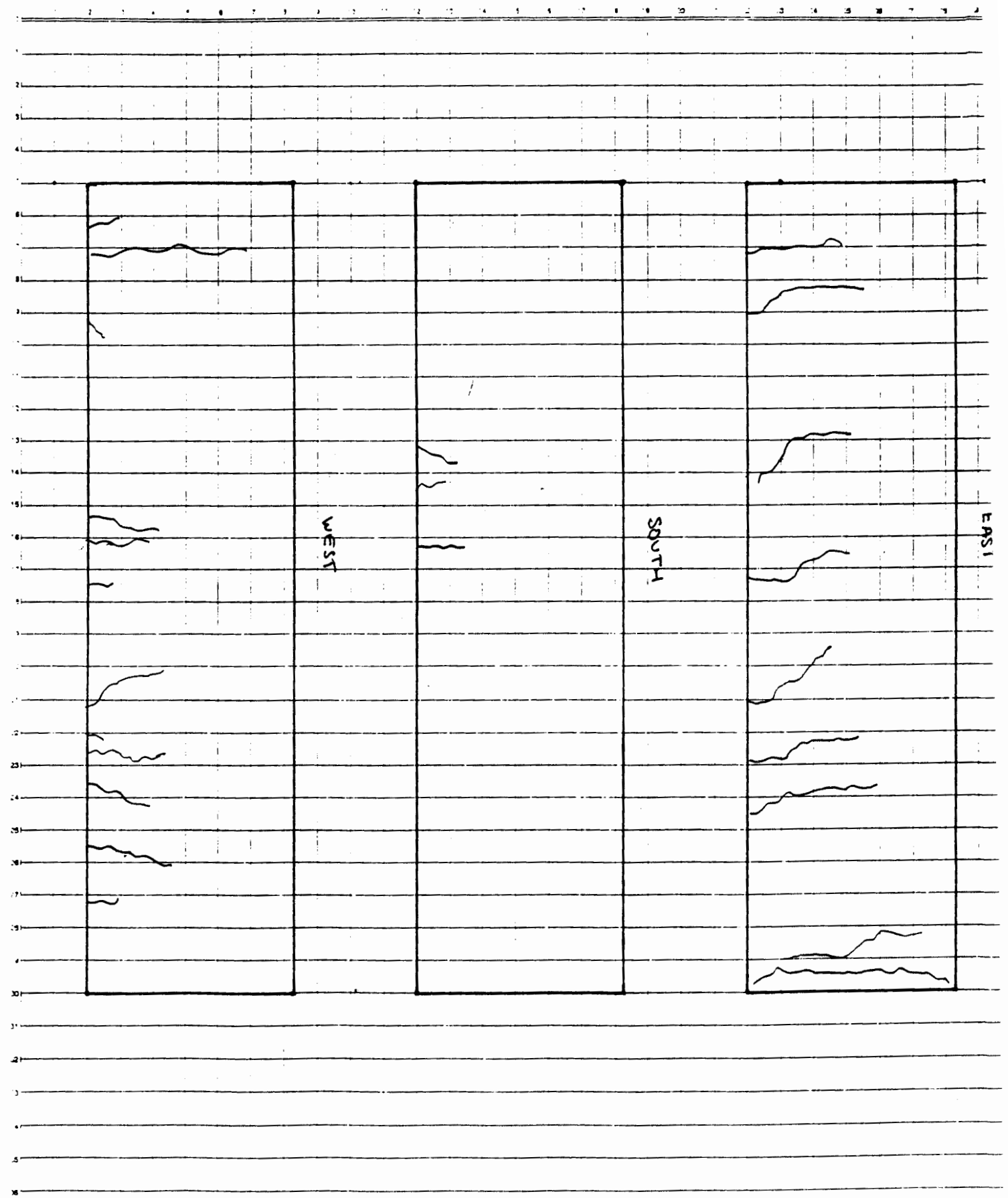
Subject CELL F

Works

Computer

Date

Sheet No



ATTACHMENT 4

VAULT #1 - CELL 'A' MOVEMENT DUE TO HYDROSTATIC PRESSURE

ALL MEASUREMENTS AT TOP CENTER OF WALL:

WALL	6/23/94	8/5/94
NORTH	+4.20 in.	+2.28 in.
EAST	+2.40 in.	+1.56 in.
WEST	+3.72 in.	+2.40 in.

THESE WALL DEFLECTIONS WERE CALCULATED FROM SURVEY DATA BASED ON VAULT CORNERS AT GRADE LEVEL. THIS DATA AND STRUCTURAL DATA WERE USED TO DETERMINE THAT NO MASSIVE FAILURE OF THE VAULT WALLS WOULD OCCUR. IN ADDITION TO THIS SURVEY, A PROGRAM OF VISUAL INSPECTIONS OF VAULT #1 CONTINUES, ON AT LEAST A DAILY BASIS.

ATTACHMENT 5

SAMPLE ANALYSES

These samples from tankers into which water from pumping vault and groundwater was transferred. Sample LLWT 3113 was half full of water originating in the Reactor areas.

SAMPLE	LLWT 3113	LLWT 3112
DATE	06/19/94	06/30/94
pH	10.06	11.65
COND (umhos)	1250	3940
Cl (ppm)	44	440
Co60 (dpm/ml)	<1	16
Cs137 (dpm/ml)	12	42
Beta-Gamma (cpm/ml)	<1	4
H3 (uci/ml)	6.3	7.0E-04

D2O was <0.1 mol.% and Alpha was <1 dpm/ml in both samples.
D-Lab Sample #'s SZ-1916 & SZ-2076.

These samples taken from void space through drilled holes.

SAMPLE	EAST WALL	NORTH WALL	WEST WALL
Chloride (ug/ml)	114	110	377
Nitrate (ug/ml)	49460	45013	71291
Nitrite (ug/ml)	1025	1016	2732
Sulfate (ug/ml)	2306	2079	4086
Alpha (dpm/ml)	54	54	34
Beta/H3 (dpm/ml)	309	293	179
H3 (uci/ml)	1.22E-03	1.25E-03	8.16E-04
Cs137 (uci/ml)	4.33E-05	4.83E-05	3.93E-05

Fluoride was <20 ug/ml and Formate, Oxalate & Phosphate were all <100 ug/ml in all.
ADS ID#'s: North - 3-30703, East - 3-30704, West - 3-30705.

Soil samples from the north end of Vault #1, Samples 1-10 at base of wall, from east to west, and Samples 11-20 approximately 4 feet from wall, from west to east.

SAMPLE	Beta-Gamma (uci/g)	Alpha (uci/g)
1	3.105E-5	2.025E-6
2	4.658E-5	1.35E-6
3	1.98E-5	1.688E-5
4	1.665E-5	2.25E-6
5	2.79E-5	2.36E-6
6	4.74E-5	1.35E-6
7	5.78E-5	1.35E-6
8	2.63E-5	2.4E-6
9	1.8E-5	1.8E-6
10	3.6E-5	1.24E-6
11	3.3E-5	2.25E-6
12	1.24E-5	2.5E-6
13	1.35E-5	1.69E-6
14	4.9E-5	1.35E-6
15	3.4E-5	1.4E-6
16	3.3E-5	2.25E-6
17	2.25E-6	1.46E-6
18	1.8E-5	1.24E-6
19	3.3E-5	2.4E-6
20	4.07E-5	1.91E-6

RCO Survey #531, 6/29/94.

Liquid samples from puddles at base of Vault wall.

SAMPLE	A	B
Beta	600 pCi/ml	540 pCi/ml
Alpha	4 pCi/ml	<2.4pCi/ml
H3	930 pCi/ml	810 pCi/ml

No Gamma activity detected other than attributable to naturally occurring isotopes.

ADS ID#	3-30147	3-30148

ATTACHMENT 6

WSRC-RP-94-688

Keywords: Saltstone
Z-Area

cc: W. E. Stevens, 773-A
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R. Schwamberger, 704-Z
D. B. Amerine, 704-S
S. K. Formby, 730-B
T. J. Lex, 719-4A
F. Lopez, 966-W
C. L. Peckinpaugh, 719-4A
E. P. Rahe, 730-B
A. B. Scott, 719-4A
C. A. Chiappetto, 704-58S
L. R. Cross, 719-3A
J. R. Fowler, 704-Z
M. S. Higgenbottom, 704-20S
T. D. Lookabill, 704-Z
J. F. Ortaldo, 704-S
N. Rajendran, 704-65H
P. Reinhardt, 966-W
J. W. Wilson, 210-S
R. W. Brandon, 719-4A
R. Palaniswamy, 966-W
S. K. Thomas, 966-W
R. K. Cauthen, 704-15S
M. Jeric, 704-58S
R. Reeves, 704-15S
D. J. Fields, 773-A
SRTC Records (4)

June 27, 1994

TO: R. H. Hsu, 773-43A

FROM: C. A. Langton, 773-43A, L. W. Wingard, 773-11A

Evaluation of Saltstone Dimensional Changes During Underwater Exposure (U)

Summary

A scoping experiment was designed and conducted to measure dimensional changes for Saltstone submerged in water. Results of this study indicate that the Saltstone made in Z-Area does not expand when immersed in water. It is very

unlikely that dimensional changes of the saltstone could have been responsible for the observed deformation of the walls in Vault 1, Cell A.

Background

Cracking and deformation of the Z-Area vault walls for Vault 1, Cell A in June, 1994, gave cause for concern that the Saltstone wasteform may have absorbed rainwater and expanded, thereby causing the observed damage to the vault walls. The vault deformation occurred shortly after the portable water-protection roof was moved from Cells A and B to Cells B and C. A sloped roof made of concrete was installed over cell A immediately after the protective steel roof was moved.

Five Saltstone samples collected from Z-Area process runs made between 1990 and 1992 were obtained from the Z-Area sample archive collection. The dates that these samples were prepared are shown in Table 1. These samples were submerged in water and monitored for dimensional changes (expansion) over 6 1/2 days. Visual inspection for cracking and micrometer readings of the sample diameter and height were used as indicators of dimensional changes.

Results

Results of this scoping test are reported in Tables 2-6. A photograph illustrating the sample measuring points and submersion experiment is shown in Figure 1. Each sample was marked and labeled with permanent ink so that the micrometer could be accurately repositioned over the period of the experiment. Two different micrometers were used. A more accurate instrument was located for readings on and after June 22. Samples were examined before and after soaking, and no cracks or deformations were observed (Figure 2). This indicates that no significant expansion took place.

Conclusion

Results collected to date support previous observations that Saltstone does not expand when soaked in water (Tables 2-6). Previous observations are based on visual examination of ANS 16.1 leach samples which were in the form of 2 X 5-inch (D X L) cylinders or disks two inches in diameter and one inch high. ANS 16.1 samples leached in deionized water for up to 156 days showed no cracking or chipping. The disk samples fit loosely into a plexiglass sample holder. The tolerance between the sample and holder has never been reported or observed to change over the longest experiments (156 days).

Quality Assurance

Results are recorded in notebook WSRC-NB-92-194.

Table 1. Samples of actual saltstone made in the Z-Area process which were selected for dimensional change experiments

Coupon #	Z-Area Sample #	Date of Z-Area Product Run
1	421	7/2/90
2	487	12/4/90
3	667	7/30/91
4	746	12/17/91
5	751	1/7/92

TABLE 2. RESULTS OF WATER EXPOSURE FOR SALTSTONE COUPON 1

DAY	SOAK TIME (HR)	ELAPSED TIME (HR)	MEASUREMENT BETWEEN POINTS SHOWN IN FIG. 1 (IN)* A-B	C-D	E-F	G-H	I-J	COUPON WEIGHT (GRAMS)	WATER BATH TEMP (C)	OBSERVATIONS
6/21	14:15	0.00	2 13/32	1 9/32	1 7/32	1 1/4	1 7/32	73.44	26.2	NO CRACKS. Actual readings taken with
(DAY 1)			[2.410]	[1.280]	[1.220]	[1.250]	[1.220]			micrometer measuring 1/32 in.
	15:00	0.75	2 13/32	1 1/4	1 7/32	1 1/4	1 7/32		29.0	SAME
			[2.410]	[1.250]	[1.220]	[1.250]	[1.220]			
	16:30	2.25	2 13/32	1 7/32	1 1/4	1 1/4	1 1/4		30.0	SAME
			[1.410]	[1.220]	[1.250]	[1.250]	[1.250]			
6/22	10:00	19.75	2 11/32	1 7/32	1 1/4	1 1/4	1 1/4		27.9	NO CRACKS. Actual readings taken with
(DAY 2)			2.342	1.203	1.159	1.189	1.187			1/32 and 1/1000 micrometers.
	15:00	24.75	2.355	1.202	1.159	1.188	1.185		30.8	SAME
6/23	9:30	43.25	2.344	1.203	1.160	1.189	1.182	75.33	27.4	Actual measurements taken with 1/1000
(DAY 3)										micrometer.
	13:15	47.00	2.346	1.203	1.158	1.188	1.177		29.0	NO CRACKS
6/24	9:50	67.50	2.347	1.203	1.160	1.189	1.177	75.38	26.3	NO CRACKS
(DAY 4)										
	14:30	72.50	2.342	1.205	1.163	1.184	1.179	75.28	28.7	NO CRACKS
6/27/94	10:20	140.50	2.347	1.203	1.160	1.189	1.177	75.25	24.8	NO CRACKS
(DAY 5)										
	15:00	145.00	2.345	1.204	1.160	1.190	1.177	75.15	26.3	NO CRACKS

* Values in brackets are calculated

TABLE 3. RESULTS OF WATER EXPOSURE FOR SALTSTONE COUPON 2

DAY	SOAK TIME (HR)	ELAPSED TIME (HR)	MEASUREMENT BETWEEN POINTS SHOWN IN FIG. 1 (IN)* A-B	C-D	E-F	G-H	I-J	COUPON WEIGHT (GRAMS)	WATER BATH TEMP (C)	OBSERVATIONS
6/21	14:15	0.00	2 13/32	1 1/4	1 7/32	1 7/32	1 7/32	78.82	29.0	NO CRACKS. Actual readings taken with
(DAY 1)			[2.40]	[1.25]	[1.220]	[1.22]	[1.220]			micrometer measuring 1/32 in.
	15:00	0.75	2 13/32	1 1/4	1 7/32	1 7/32	1 7/32		29.9	SAME
			[2.4]	[1.250]	[1.220]	[1.22]	[1.220]			
	16:30	2.25	2 13/32	1 1/4	1 7/32	1 1/4	1 7/32		30.0	SAME
			[2.4]	[1.25]	[1.22]	[1.25]	[1.22]			
6/22	10:00	19.75	2 3/8	1 3/16	1 5/32	1 3/16	1 3/16		27.8	NO CRACKS. Actual readings taken with
(DAY 2)			2.360	1.194	1.163	1.175	1.178			1/32 and 1/1000 micrometers.
	15:00	24.75	2.380	1.192	1.160	1.175	1.181		30.6	SAME
6/23	9:30	43.25	2.359	1.192	1.156	1.177	1.175	78.89	27.5	Actual measurements taken with 1/1000
(DAY 3)										micrometer.
	13:15	47.00	2.354	1.192	1.157	1.177	1.178		28.9	NO CRACKS
6/24	9:50	67.50	2.357	1.192	1.157	1.177	1.178	78.96	26.3	NO CRACKS
(DAY 4)										
	14:30	72.50	2.357	1.192	1.157	1.177	1.178	78.9	28.6	NO CRACKS
6/27/94	10:25	140.50	2.357	1.192	1.157	1.177	1.178	78.97	24.9	NO CRACKS
(DAY 5)										
	15:00	145.00	2.356	1.193	1.157	1.176	1.177	78.9	26.4	NO CRACKS

* Values in brackets are calculated

TABLE 4. RESULTS OF WATER EXPOSURE FOR SALTSTONE COUPON 3

DAY	SOAK TIME (HR)	ELAPSED TIME (HR)	MEASUREMENT BETWEEN POINTS SHOWN IN FIG. 1 (IN)* A-B	C-D	E-F	G-H	I-J	COUPON WEIGHT (GRAMS)	WATER BATH TEMP (C)	OBSERVATIONS
6/21	14:15	0.00	2 3/8	1 1/4	1 7/32	1 7/32	1 7/32	78.05		NO CRACKS. Actual values reported were
(DAY 1)										obtained using a 1/32 and 1/1000
	15:00	0.75	2 3/8	1 1/4	1 7/32	1 7/32	1 7/32		28.6	micrometer
	16:30	2.25	2 3/8	1 1/4	1 7/32	1 7/32	1 7/32		30.3	
6/22	10:00	19.75	2 5/16	1 3/16	1 5/32	1 3/16	1 3/16		27.8	
(DAY 2)			2.319	1.199	1.151	1.183	1.182			
	15:00	24.75	2.318	1.199	1.151	1.184	1.180		30.6	
6/23	9:30	43.25	2.321	1.200	1.155	1.181	1.182	78.12	27.5	
(DAY 3)										
	13:15	47.00	2.317	1.200	1.153	1.180	1.185		28.9	
6/24	9:50	67.50	2.321	1.200	1.156	1.181	1.184	78.12	26.3	
(DAY 4)										
	14:30	72.50	2.321	1.200	1.156	1.181	1.184	78.1	28.7	
6/27/94	10:30	140.50	2.321	1.199	1.156	1.180	1.183	78.13	25.0	NO CRACKS
(DAY 5)										
	15:00	145.00	2.321	1.199	1.155	1.180	1.183	78.12	26.0	NO CRACKS

TABLE 6. RESULTS OF WATER EXPOSURE FOR SALTSTONE COUPON 5

DAY	SOAK TIME (HR)	ELAPSED TIME (HR)	MEASUREMENT BETWEEN POINTS SHOWN IN FIG. 1 (IN)* A-B	C-D	E-F	G-H	I-J	COUPON WEIGHT (GRAMS)	WATER BATH TEMP (C)	OBSERVATIONS
6/21	14:15	0.00	2 5/16	1 7/32	1 1/4	1 1/4	1 7/32	74.55		NO CRACKS. Actual values reported were
(DAY 1)										obtained using a 1/32 and 1/1000
	15:00	0.75	2 5/16	1 1/4	1 1/4	1 1/4	1 1/4		28.6	micrometer
	16:30	2.25	2 3/8	1 1/4	1 1/4	1 1/4	1 7/32		30.6	
6/22	10:00	19.75	2 9/32	1 3/16	1 3/16	1 3/16	1 5/32		28.0	NO CRACKS
(DAY 2)			2.269	1.202	1.156	1.188	1.166			
	15:00	24.75	2.263	1.204	1.159	1.186	1.165		30.6	
6/23	9:30	43.25	2.263	1.203	1.155	1.189	1.165	76.12	27.5	NO CRACKS
(DAY 3)										
	13:15	47.00	2.260	1.203	1.155	1.186	1.165		29.0	
6/24	9:50	67.50	2.265	1.203	1.153	1.186	1.165	76.12	26.4	NO CRACKS
(DAY 4)										
	14:30	72.50	2.265	1.203	1.153	1.186	1.165	76.07	29.1	
6/27/94	10:40	140.50	2.265	1.202	1.152	1.186	1.165	76.13	25.2	NO CRACKS
(DAY 5)										
	15:25	145.00	2.265	1.203	1.151	1.186	1.165	76.13	26.0	NO CRACKS

TABLE 5. RESULTS OF WATER EXPOSURE FOR SALTSTONE COUPON 4

DAY	SOAK TIME (HR)	ELAPSED TIME (HR)	MEASUREMENT BETWEEN POINTS SHOWN IN FIG. 1 (IN)* A-B	C-D	E-F	G-H	I-J	COUPON WEIGHT (GRAMS)	WATER BATH TEMP (C)	OBSERVATIONS
6/21	14:15	0.00	2 3/32	1 1/4	1 7/32	1 7/32	1 7/32	66.84		NO CRACKS. Actual values reported were
(DAY 1)										obtained using a 1/32 and 1/1000
	15:00	0.75	2 3/32	1 1/4	1 7/32	1 7/32	1 7/32		28.8	micrometer
	16:30	2.25	2 3/32	1 1/4	1 7/32	1 7/32	1 7/32		30.3	
6/22	10:00	19.75	2 1/32	1 3/16	1 5/32	1 5/32	1 5/32		27.9	
(DAY 2)			2.019	1.199	1.156	1.184	1.170			
	15:00	24.75	2.022	1.199	1.166	1.184	1.176		30.7	
6/23	9:30	43.25	2.021	1.196	1.153	1.185	1.172	67.89	27.4	
(DAY 3)										
	13:15	47.00	2.023	1.198	1.154	1.185	1.175		28.3	
6/24	9:50	67.50	2.022	1.197	1.154	1.185	1.172	67.88	26.3	
(DAY 4)										
	14:30	72.50	2.022	1.197	1.154	1.185	1.172	67.86	28.9	
6/27/94	10:35	140.50	2.022	1.197	1.155	1.185	1.173	67.83	25.0	
(DAY 5)										
	15:00	145.00	2.022	1.197	1.155	1.185	1.173	67.82	26.4	

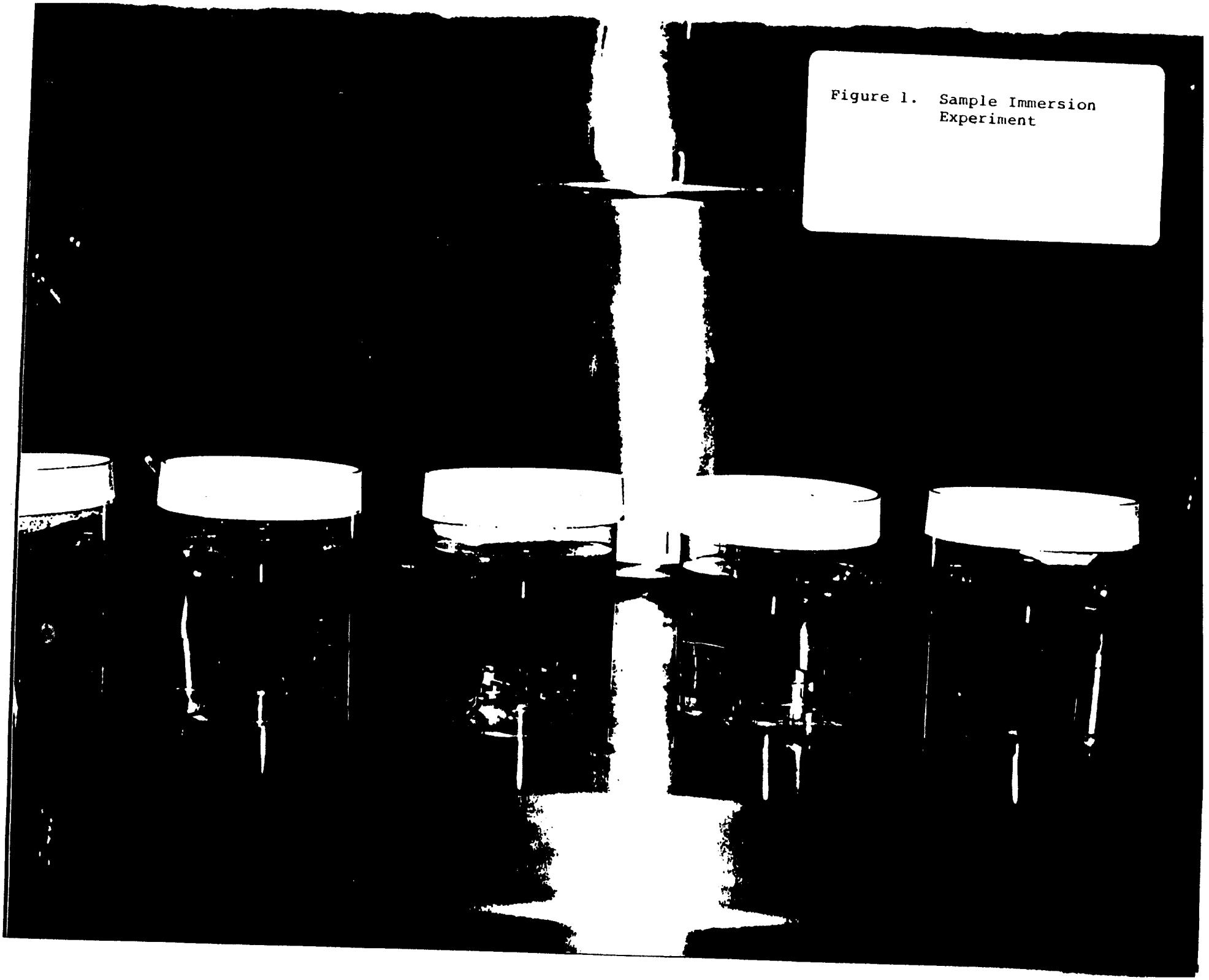


Figure 1. Sample Immersion Experiment

Figure 2. Sample #5 after hours of soaking. The appearance of this sample is also representative of samples 1 - 4 after soaking.

ATTACHMENT 7

Proposed Groundwater Monitoring Plan for the Saltstone Disposal Facility

Summary

The SCDHEC Bureau of Solid and Hazardous Waste Management has requested WSRC to submit a plan to upgrade groundwater monitoring at the Z-Area Saltstone Disposal Facility (IWP-217). This request was a result of the Bureau's belief that the Saltstone vaults are not functioning as designed, thereby compromising the assumptions used to model peak contaminant concentrations in groundwater. Although WSRC is confident that the recent structural irregularities at the facility will not occur in newly designed vaults (application submitted 7/16/93), an enhanced groundwater monitoring plan has been developed. This plan uses readily available methods to provide early contaminant detection without being detrimental to facility closure.

Monitoring Plan

The concept of this plan provides a routine to monitor groundwater which WSRC feels is adequate to provide early detection of any possible groundwater contamination which may result from operation of the Z-Area Saltstone Disposal Facility. The plan is flexible in that it uses a groundwater sampling technique, hydro-cone sampling, that doesn't require the installation of a typical monitoring well. The hydro-cone technology is explained further in the attached *Hydrogeologic Data Collection Procedures and Specifications*. The plan also takes advantage of continued visual inspections of the vaults until final closure of the Saltstone facility.

WSRC proposes that the Saltstone facility implement the following schedule immediately after incorporation of this plan in permit IWP-217.

- using hydro-cone technology, collect a background groundwater sample at an appropriate location upgradient of vault 1.

- using hydro-cone technology, collect a groundwater sample at an appropriate location immediately downgradient (within 25') of vault 1, cell A.

- compare upgradient hydro-cone sample to statistical upper tolerance limits constructed from background data, and to the downgradient hydro-cone sample.

- report the results of this sampling to the Bureau within 90 days.

- using hydro-cone technology, collect biennial samples at appropriate locations immediately downgradient (within 25') of vault 1, cell A.

- report the results of this sampling to the Bureau within 90 days.

- continue a program of documented daily visual inspections of every vault containing saltstone.

- immediately implement the same groundwater monitoring as described for vault 1, cell A, at other locations if visual inspections indicate a particular cell may not be functioning as designed.

- all groundwater samples will be analyzed for nitrate (as N) since this is the most mobile compound of concern.

- if nitrate is found to be above the background upper tolerance limit, the sample will be repeated within 60 days.

- the sampling frequency will increase to quarterly if nitrate is found to be above the background upper tolerance limit in the second sample.

- the results of any such investigation will be submitted to the Bureau in a timely fashion.

- the sampling will revert to a biennial schedule if two consecutive quarterly samples are below the maximum contaminant level.

- WSRC will submit closure plans to the Bureau that include phasing out the use of hydro-cone sampling and replacing it with a long term groundwater monitoring network.

In addition to this groundwater monitoring plan, WSRC intends to conduct research for the development of alternative methods for contaminant detection. It is expected that this research will begin sometime in FY 1995 and focus on techniques for monitoring the vadose zone under a vault. The Bureau will be informed as this research progresses.

Conclusion

At this time, there appears to be no real advantage to implementing a groundwater monitoring plan which would include a significant number of wells. The wasteform and the facility have been studied exhaustively, both before and after the discovery of irregularities at vault 1. WSRC feels that the proposed method of combining hydro-cone technology and visual inspections and replacing it with a long term monitoring network as previously described, along with the vault repair plan previously approved by the Bureau, is an appropriate method of meeting WSRC's and the Bureau's goals of ensuring protection of public health and the environment.

CONE PENETROMETER TESTS

Approved by

J S Roberts
EPD Manager

1.0 PURPOSE

The purpose of this document is to establish specifications for the performance of Cone Penetrometer Tests (CPTs) at the Savannah River Site.

2.0 SCOPE

This document is applicable to any department, organization, group, contractor or person planning to perform subsurface investigations utilizing the cone penetrometer or related equipment (Peizo-Cone, Hydro-Cone, Seismic-Cone tests, etc.).

3.0 TERMS/DEFINITIONS

Refer to glossary for terms/definitions.

4.0 RESPONSIBILITIES

- The Westinghouse Project Manager or other Project Manager shall submit a Program Plan (Chapter 1) and a Safety Plan (Chapter 2) to the Site Groundwater Coordinator's (SGC's) office for approval. All appropriate permits shall be obtained prior to the start up of the project. Periodic safety and performance inspection audits will be conducted by representatives of the Environmental Protection Department (EPD). A CPT Field Report (Attachment 1) shall be submitted to the STR upon completion of the test hole. This information will be incorporated into the existing permanent subsurface information files.

- The drilling subcontractor shall provide South Carolina-certified drill rig operators for work at SRS, meet all applicable Occupational Safety and Health Administration (OSHA) requirements, and ensure that all required SRS safety precautions are being followed.

- The Cone Penetrometer subcontractor shall provide South Carolina-certified drill rig operators, meet all applicable Occupational Safety and Health Administration (OSHA) requirements, and ensure that all safety requirements are being followed.

- The STR will arrange safety, security, and environmental orientations for the drilling subcontractor and the Technical Oversight (TO) prior to commencement of the project.

- The STR will coordinate activities with the drilling subcontractor and TO. The STR will schedule drilling activities and make field decisions as necessary.
- Independent TO, as detailed in Chapter 4, will be present at the drill site to document that the specifications and procedures outlined herein are followed. The TO is responsible for completing and providing to the STR a Cone Penetrometer Field Report (Attachment 1).
- The TO is responsible for the quality control of the project, and shall be present at all times during groundwater sampling activities, and is responsible for completing all required documentation.
- The TO or authorized sampling personnel shall collect groundwater and/or soil samples from the hydro-cone sampler and complete all necessary documentation, including sample labels and chain of custody forms.
- The TO or authorized sampling personnel is responsible for proper preservation, handling and custody of the samples.
- The laboratory designated to analyze the groundwater samples shall provide contaminated sample bottles and all coolers needed for sample shipment, unless other arrangements are made.
- SCDHEC personnel shall visit the proposed cone penetrometer test hole sites which are to be used to collect groundwater samples. SCDHEC shall provide approval of each site prior to beginning the test hole. The following information shall be submitted to SCDHEC:
  - proposed cone penetrometer test sites on a scaled map or plat
  - total depth of penetration for each test hole and the depth(s) at which any groundwater samples are proposed. Information regarding the collection of groundwater samples (if different from standard procedures)
  - latitude and longitude of the CPT locations
  - potentiometric map, showing groundwater flow in the vicinity of the project
  - information concerning any groundwater contaminants within the test area, consisting of a list of the contaminants and an anticipated concentration within each aquifer being penetrated

5.0 PROCEDURES

5.1 General Information

Cone penetrometer tests (CPTs) have been used for many years in geotechnical subsurface investigations. Recently, the tests have found application in the field of environmental characterizations. The cone penetrometer consists of an instrumented probe which is forced into

the ground using a hydraulic load frame mounted on a truck. The weight of the truck provides the necessary mass to force the length of rods further into the subsurface. The probe has a conical tip and a friction sleeve which independently measures vertical resistance beneath the tip as well as frictional resistance on the side of the probe as functions of the depth. A pressure transducer can be installed in the cone to measure the pore water pressure as the probe is pushed into the ground (Piezo-Cone). The probe may also include an array of seismic transducers, which are used to perform downhole seismic surveys (Seismic-Cone), and a multi-axis tilt sensor, which can be used to determine the inclination of the probe during penetration. Other tips can provide a sampling device for extracting groundwater, soil or gas. New technologies are being tested which involve the use of fiber optic sensors and spectroscopic sensors in association with the CP probe.

5.2 Test Equipment

The cone penetrometer subcontractor shall use rigs that are approved by the STR and are equipped with the necessary accessories to push the specified test hole to the desired depth in a safe manner. The rig and all downhole equipment shall be steam cleaned with potable water prior to drilling and between each cone penetrometer test hole. The downhole tools shall be free of paint.

The cone penetrometer subcontractor will not be allowed to push any test holes within regulated areas of the SRS. The cone penetrometer subcontractor shall ensure that the rig is being operated by a South Carolina-certified drill rig operator and that safety procedures are followed during daily operation.

The following is a list of equipment which will be used in performing cone penetrometer investigations. The list can vary given the variety of applications used in association with the standard electric cone penetrometer equipment.

- cone penetrometer truck (rig) in good mechanical condition and with a current SRS inspection sticker, with all necessary equipment to complete the specified work
- specified groundwater sampling equipment and sample containers
- grout pumps, water pumps, tubing, tips, hoses and pipe to grout the completed test hole
- plastic sheeting (minimum four mil thickness) for leaking equipment and decontamination of equipment
- plastic or metal pans or buckets to collect any dripping oil or fuel leaks
- steam cleaner with an operating range of 800 to 1500 psi and 180 59 212°F
- air compressor and connectors
- gloves, steel-toed boots, hard hats, safety glasses and dust masks

5.3 Test Procedures

The procedure to be followed in performance of CPTs at the SRS will be the American Society for Testing and Materials (ASTM) procedure, "Standard Method for Deep Quasi-Static Cone and Friction-Cone Penetration Tests of Soil" (ASTM-D3441, 1986). Any deviation from this procedure must be approved in advance by the SGC's office.

5.4 Cone Penetrometer Field Report

Information gained from performing the cone penetrometer tests should be recorded on the Cone Penetrometer Test Field Record (See Attachment 1). The information captured on this record includes:

- project name
- project manager
- department of project manager
- project location
- CPT subcontractor
- type of tests being performed
- operator name™
- technical oversight (field geologist)
- date
- test hole designation
- coordinates (Lat/Long and SRP Coordinates)
- surface elevation
- depth of any samples (if any)
- depth to the interpreted Water Table Unit
- types of tests (logs) used on the test hole
- abandonment technique
- theoretical and actual volume of grout used in abandonment

5.4.1 CPT Data Reporting

The subcontractor providing the cone penetrometer services will be responsible for providing to the STR a computer generated log depicting all data generated during each penetration. This data shall be provided as a hard copy and on disk in ASCII format.

5.5 Groundwater Sample Collection and Analysis

Groundwater sampling using the Hydro-cone™ sampling tool and soil sampling using the Geocone™ may be accomplished with the cone penetrometer truck. The cone penetrometer subcontractor's procedures shall be followed to obtain the samples. The Technical Oversight (TO) personnel will direct the sampling activities and, with guidance from the STR and WPM, will be responsible for making field decisions concerning the best techniques to use in obtaining a representative sample. The standard operating procedures relating to sampling as outlined in this manual shall be adhered to at all times.

5.6 Grouting Techniques

Cone penetrometer tests leave holes which could become pathways for the downward migration of contaminants to groundwater supplies. To prevent this occurring, the test holes must be grouted to seal the hole and eliminate this potential contaminant pathway.

5.6.1 Vadose Zone Test Hole Grouting Technique

If the test hole is being completed entirely within the vadose zone, the Tremmie Grouting Method is an acceptable method of ensuring an adequate grout seal of the test hole. Prior to grouting the test hole, the TO should calculate the theoretical volume of grout required to fill the test hole and record this on the CPT Field Report.

5.6.2 Saturated Zone Test Hole Grouting Technique

If the test hole is being performed to depths which may involve saturated zones, the CP Rod-Grouting Method is required to ensure an adequate grout seal of the test hole. Prior to grouting the test hole, the TO should calculate the theoretical volume of grout required to fill the test hole and record this in the CPT Field Report.

5.7 Reporting Requirements

Upon completion of the cone penetrometer project, a record of each test hole shall be prepared by the Technical Oversight (TO) for the permanent record. The Cone Penetrometer Field Report, along with a copy of each graphic (log) run on the test hole, shall be submitted by the TO to the STR within 20 days of completion of the project. The STR will submit the information to the SGC's office for transmittal to SCDHEC if the transmittal is a condition of the test hole approval.

6.0 Decontamination of Test Equipment

Immediately upon completion of grouting, clean the grout equipment by flushing the pump and related hoses, cone tip, sleeve and rods with potable water. Before mobilizing the cone penetrometer truck to the next penetration hole, all re-usable parts of the push rod and grouting assemblies must be steam cleaned.

7.0 REFERENCES

1. American Society for Testing and Materials, "Standard Method for Deep Quasi-Static Cone and Friction-Cone Penetration Tests of Soil", ASTM designation: D3441, 1986

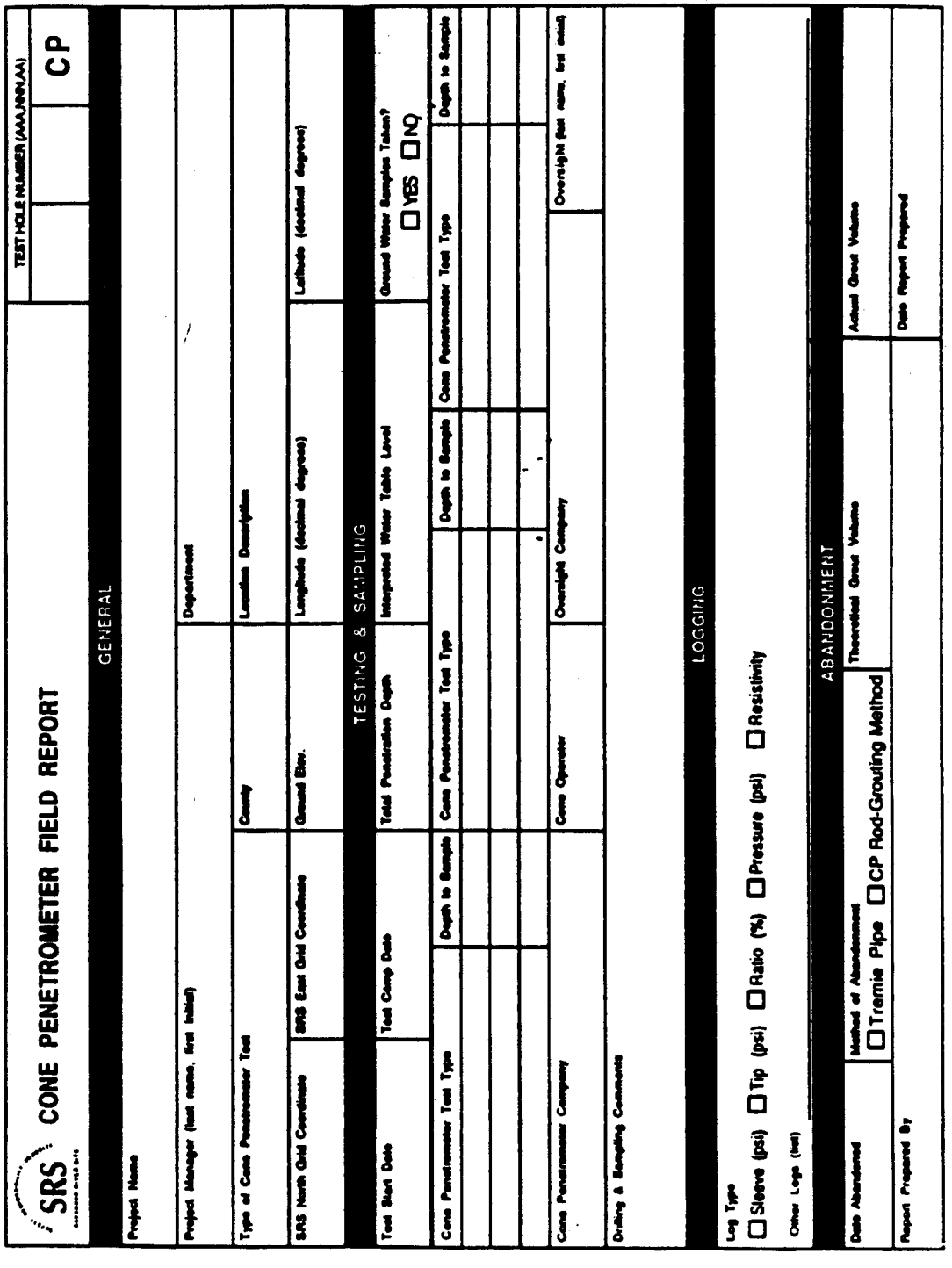
2. Applied Research Associates, Inc., 1991, Electric Cone Penetrometer User's Manual, Box 120-A, Waterman Road, South Royalton, Vermont 05068

8.0 ATTACHMENTS

1. Cone Penetrometer Field Report

ATTACHMENT 1

CONE PENETROMETER FIELD REPORT


SRS CONE PENETROMETER FIELD REPORT

TEST HOLE NUMBER (AA,NNN,AA) CP

GENERAL

Project Name

Project Manager (last name, first initial) | Department

Type of Cone Penetrometer Test | County | Location Description

SRS North Grid Coordinate | SRS East Grid Coordinate | Ground Elev. | Longitude (decimal degrees) | Latitude (decimal degrees)

TESTING & SAMPLING

Test Start Date | Test Comp Date | Total Penetration Depth | Interpreted Water Table Level | Ground Water Samples Taken? ☐YES ☐NO

Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample	Cone Penetrometer Test Type	Depth to Sample

Cone Penetrometer Company | Cone Operator | Overnight Company | Overnight (last name, first initial)

Drilling & Sampling Comments

LOGGING

Log Type
☐Sleeve (psi) ☐Tip (psi) ☐Ratio (%) ☐Pressure (psi) ☐Resistivity

Other Logs (list)

ABANDONMENT

Date Abandoned | Method of Abandonment ☐Tremie Pipe ☐CP Rod-Grouting Method | Theoretical Grout Volume | Actual Grout Volume

Report Prepared By | Date Report Prepared

92X0760.MWO

ATTACHMENT 1 (Contd)

CONE PENETROMETER FIELD REPORT