4.4

NEW BEDFORD
SUPPLY CABLES RELOCATION
ESTIMATES & SCHEDULES

BY
COM/ELECTRIC

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Agenda
March 18th 1998 meeting
EPA Region 1 for Acushnet River Crossing

1) Introductions
2) Project Status Discussion
   a) Overview of HDD and Micro tunneling
   b) Cost Differential and Engineering Comparison of HDD and Micro tunneling
3) Meeting Objectives
   a) Gantt chart and timetable review
   b) Estimate specifics
   c) Crossing method determination HDD or MT
4) Apportionment of costs and process for Com/Electric reimbursement
5) Agreements to be ratified
   a) Belleville road and Belleville avenue intersection-- letter of commitment
   b) Engineering costs
   c) Total project to completion
6) Meeting Summary
   a) Specific conclusions
   b) Responsibility for follow up items by designated parties
   c) Next meeting date tentative schedule

Estimate Summary

probably out of the question
upper parking lot

HDD BORING CONSTRUCTION

J.D. HAIR--Option B--$ 4,325,553 HDD Construction
J.D. HAIR--Option A--$ 3,762,465 HDD Construction
Difference cost option A $ B--$ 563,088
Conclusion: Option A chosen,Based on 4 Bores 24" or less — (bore for new cable 75%
75% of Option A =$ 2,821,848.---COST BURDEN TO EPA

MICROTUNNEL CONSTRUCTION

J.D. HAIR-- 84 inch-- $ 1,988,644 MT Construction
J.D. HAIR-- 96 inch-- $ 2,156,137 MT Construction
96 inch--Recommended by Electrical Consultant
Conclusion: 96" chosen---Total Cost--$ 2,156,137
75% Cost 96"=$ 1,617,102---COST BURDEN TO EPA (based on HDD basis)

HDD ELECTRICAL CONSTRUCTION

Zimnoch-- $ 2,260,021--- Excludes new 115kv line cost – from TAB 6
+ $ 50,000--- Easement cost Estimate – rights purchasing, relocating parking
Total $ 2,310,021--- Cost of HDD Electrical Construction
$ 225,000--- Total cost Items 14 & 15 & Easement – TAB 6
25% of $ 225,000 = $ 56,250--COM\ELECTRIC COST
TOTAL COST BURDEN EPA---$ 2,310,021-$ 56,250=$ 2,253,771.

MICROTUNNEL ELECTRICAL CONSTRUCTION – TAB 7

Zimnoch--$ 2,938,196--- Excludes new 115kv line cost – includes pipe, whereas J. Moran's est. does not ~$600,000
+ $ 50,000--- Easement cost Estimate
Total $ 2,988,196--- Cost of MT Electrical Construction
$ 1,180,000--- Total cost Items 1, 2, 4, 5, 6, 18, 19, & Easement
25% of $ 1,180,000 = $ 295,000--COM\ELECTRIC COST
TOTAL COST BURDEN TO EPA---$ 2,988,196-$ 295,000=$ 2,693,196.

TOTAL COST HDD CONSTRUCTION

Sum of $ 2,821,848+$ 2,253,771=**$ 5,075,619**= TOTAL EPA COST BURDEN

TOTAL COST MICROTUNNEL

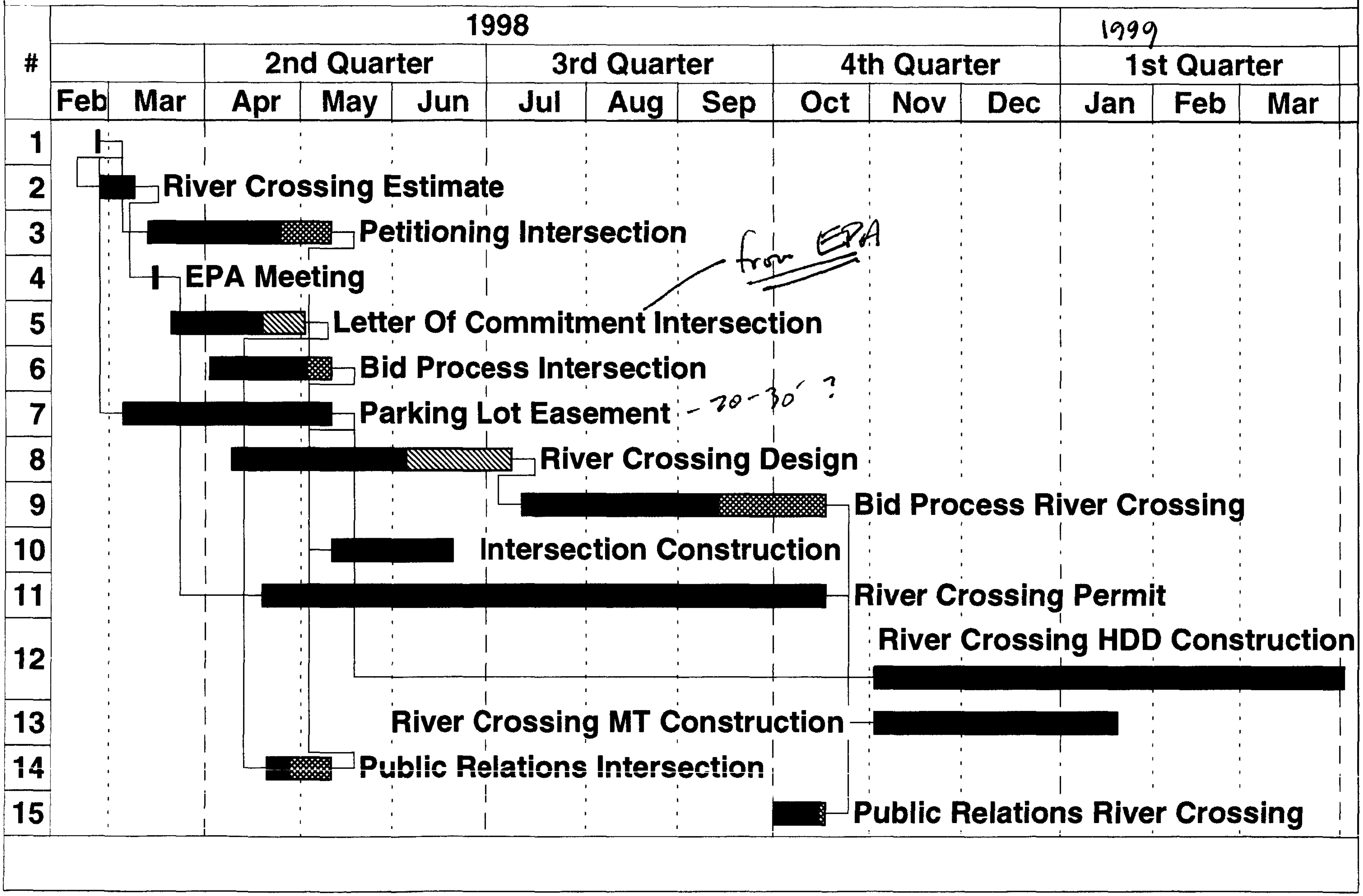
Sum of $ 1,617,102+$ 2,693,196=**$ 4,310,298**= TOTAL EPA COST BURDEN

COST DIFFERENTIAL HDD & MICROTUNNEL

$5,075,619-$4,310,298=**$ 765,321** COST DIFFERENT

3

INTERSECTION & RIVER CROSSING NON--ELECTRICAL



J.D.Hair&Associates,Inc.
Consulting Engineers

FACSIMILE TRANSMISSION

2815 East Skelly Drive, Suite 820
Tulsa, Oklahoma 74105
Telephone: 918-747-9945
Facsimile: 918-742-7408

DATE: February 13, 1998

PLEASE DELIVER TO: Mr. Henry F. Pankowski, P.E.

FAX NUMBER: 508-291-2748

FROM: Jeff Scholl JS.

JDH&A FILE: COM/9803/B

NUMBER OF PAGES TRANSMITTED INCLUDING THIS PAGE: 11

SUBJECT: HDD COST ESTIMATES
COMMONWEALTH ELECTRIC COMPANY

In accordance with our recent telephone conversations, J. D. Hair & Associates, Inc. (JDH&A) has prepared cost estimates for the Acushnet River Crossings, proposed for installation by horizontal directional drilling (HDD). Two options concerning horizontal drill length have been considered. Option A is based on an approximate horizontal length of 1,532 ft. with the entry point located east of Belleville Avenue at station 4+23 and the exit point located at station 19+46. Option B is based on an approximate horizontal length of 1,813 ft. with the entry point located west of Belleville Avenue at station 1+33 and the exit point located at station 19+46. Based on the information now in hand, bids to install these crossings are expected to fall at or around the figures listed below.

- **OPTION A Four (4) 1,523 ft. crossings** **$ 3,762,465**

- **OPTION B Four (4) 1,813 ft. crossings** **$ 4,325,553**

These estimates cover typical construction services. They do not include costs for right-of-way, materials, permits, or engineering. Detailed breakdowns of the estimates are bound with this letter. The estimates have two principal components: direct job cost and mark-up. The estimated installation costs (contractor's bid prices) have been determined by adding a mark-up to each crossing's direct job cost to cover the contractor's overhead, contingencies, and profit. The major component of mark-up is contingency. This is included to cover cost increases which might result from unanticipated operational problems. The resulting estimated bid prices are the figures which should be used for budgeting and decision making purposes. Actual bid prices will vary from these figures based on commercial considerations at the time bids are called for (i.e., work load, perception of risk). Factors affecting costs such as proximity of equipment to the job sites, union vs. non-union labor, etc., will also have an impact. The specific tasks included in the estimates are described below.

Mobilization	Transportation of men and equipment to the jobsite
Site Preparation	Clearing and grading of the jobsite on both river banks to accommodate construction operations
Rig-Up	Erection of the drilling rig at the jobsite ready for pilot hole drilling
Pilot Hole	Directional drilling of the small diameter pilot hole complete for reaming and pulling back
Prereaming	Enlarging the pilot hole to a diameter sufficient to facilitate installation of the pull section
Pull Back	Installation of the prefabricated pull section by pulling the pipe through the reamed hole to the drill rig
Pull Section Fabrication	Stringing, welding, coating, and pretesting the pull section and preparing the section for installation
Rig-Down	Disassembly of the drilling rig at the jobsite ready for demobilization
Site Restoration	Clean-up and restoration of the jobsite
Demobilization	Transportation of men and equipment from the jobsite
Drilling Mud	The cost of drilling mud used in the crossing installation
Supervision	Contractor's jobsite management and overhead

If you have any questions concerning these estimates, please don't hesitate to contact us.

CONTRACTOR'S COST ESTIMATES

Project: Acushnet River Crossings
COM/9803/B

Option A Total Drilled Length = 1,523 ft.		
Estimated Base Cost of First Crossing		1,118,436
Estimated Cost of Three Additional Crossings	(881,343 x 3)	2,644,029
Estimated Total Project Cost		3,762,465

Option B Total Drilled Length = 1,813 ft.		
Estimated Base Cost of First Crossing		1,259,208
Estimated Cost of Three Additional Crossings	(1,022,115 x 3)	3,066,345
Estimated Total Project Cost		4,325,553

PROJECT: Acushnet River Crossing - OPTION A Base
COM\9803\B

ESTIMATING PARAMETERS

WORK SCHEDULE	10.0	Hours/Day (single shift)
	7.0	Days/Week
LENGTH	1,523	Feet
PILOT HOLE PROD RATE	15.0	Feet/Hour
DRILLING MUD FLOW RATE	10.00	bpm
PILOT HOLE DURATION	10.2	Days
PILOT HOLE MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PILOT HOLE MUD QTY	609	Sacks
PREREAM PASSES	3	Quantity
PREREAM TRAVEL SPEED	0.50	Feet/Min
PREREAM MUD FLOW RATE	7.00	bpm
STD SINGLE SHIFT	1	(Enter 1 by the selected shift option
TWENTYFOUR HOUR SHIFT	0	and 0 by the remaining options)
PREREAMING DURATION	160	Hours
	16.0	Days
RIG FOR PREREAM	2.0	Days
PREREAMING MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PREREAMING MUD QTY	1,279	Sacks
PULL BACK TRAVEL SPEED	10.00	Feet/Min
PULL BACK MUD FLOW RATE	7.00	bpm
STD. SINGLE SHIFT	1	(Enter 1 by the selected shift option
TWENTYFOUR HOUR SHIFT	0	and 0 by the remaining options)
PULLBACK DURATION	5.2	Hours
	0.5	Days
RIG FOR PULLBACK	0.5	Days
PULL BACK MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PULLBACK MUD QTY	21	Sacks
MUD COST	12.00	$/Sack (100 lb)
TOTAL MUD QTY	1,970	Sacks (100 lb)

ESTIMATED COST

TOTAL JOB COST =	$639,106	U.S. DOLLARS
CONTINGENCY MARK-UP @ 75%	$479,330	U.S. DOLLARS
ESTIMATED INSTALLATION COST =	$1,118,436	U.S. DOLLARS

ESTIMATE RECAP

CREW	DAYS	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISC EXPENSES	NON-DAILY COST	TOTAL
SITE PREPARATION	1.0	2,923.35	610.00	0.00	546.30	0.00	4,080.15
MOBILIZATION	2.0	12,579.15	6,090.00	3,000.00	1,343.40	20,000.00	43,012.55
RIG-UP	1.8	11,321.24	5,481.00	2,700.00	1,209.06	0.00	20,711.30
PILOT HOLE	10.2	63,860.15	30,916.90	15,230.00	6,819.99	10,000.00	126,827.05
PREREAMING	18.0	98,568.18	54,924.70	0.00	12,115.90	25,000.00	190,608.78
PULL BACK	1.0	13,098.24	4,460.52	0.00	1,417.55	0.00	18,977.31
PULL SECTION FABRICATION	10.0	73,394.60	13,150.00	0.00	7,139.00	0.00	93,683.60
RIG-DOWN	2.0	12,579.15	6,090.00	3,000.00	1,343.40	0.00	23,012.55
FINAL HYDROSTATIC TEST		0.00	0.00	0.00	0.00	0.00	0.00
SITE RESTORATION	1.0	2,923.85	610.00	0.00	546.30	0.00	4,080.15
DEMOBILIZATION	2.0	12,579.15	6,090.00	3,000.00	1,343.40	20,000.00	43,012.55
FINAL TIE-IN		0.00	0.00	0.00	0.00	0.00	0.00
DRILLING MUD		0.00	0.00	0.00	0.00	23,638.10	23,638.10
		0.00	0.00	0.00	0.00	0.00	0.00
SUPERVISION	35.0	35,837.78	5,952.39	0.00	5,672.28	0.00	47,462.43
		0.00	0.00	0.00	0.00	0.00	0.00
TOTALS		$339,666.31	$134,375.51	$26,930.00	$39,496.58	$98,638.10	$639,106.50

COMPLETED BY: JMS DATE 2/13/98 CHECKED BY: JGP DATE: 2/13/98

DAILY CREW COST SUMMARY

CREW	NUMBER OF MEN	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISC. EXPENSES	TOTAL
SITE PREPARATION	5	2,923.85	610.00	0.00	546.30	4,080.15
MOBILIZATION	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
RIG-UP	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
PILOT HOLE	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
PREREAMING	9	5,464.58	3,045.00	0.00	671.70	9,181.28
PULL BACK	21	12,804.04	4,360.00	0.00	1,385.80	18,549.84
PULL SECTION FABRICATION	12	7,339.46	1,315.00	0.00	713.90	9,368.36
RIG-DOWN	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
FINAL HYDROSTATIC TEST	9	5,919.67	315.00	0.00	346.70	6,581.37
SITE RESTORATION	5	2,923.85	610.00	0.00	546.30	4,080.15
DEMOBILIZATION	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
FINAL TIE-IN	10	6,352.79	1,315.00	0.00	713.90	8,381.69
DRILLING MUD						0.00
						0.00
SUPERVISION	2	1,023.53	170.00	0.00	162.00	1,355.53
						0.00

NON-DAILY COST SUMMARY

CREW	ITEM COST	TOTAL COST	CREW	ITEM COST	TOTAL COST
SITE PREPARATION		$0.00	FINAL HYDROSTATIC TEST		$0.00
MOBILIZATION Lump Sum	$20,000.00	$20,000.00	SITE RESTORATION		$0.00
RIG-UP		$0.00	DEMOBILIZATION Lump Sum	$20,000.00	$20,000.00
PILOT HOLE Rock Bits, Mud Motor	$10,000.00	$10,000.00	FINAL TIE-IN		$0.00
PREREAMING Rock Reaming Tools	$25,000.00	$25,000.00	DRILLING MUD		$0.00
PULL BACK		$0.00			$0.00
PULL SECTION FABRICATION		$0.00	SUPERVISION		$0.00
RIG-DOWN		$0.00			$0.00

COMPLETED BY: JMS DATE: 2/13/98

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CONTRACTOR'S COST ESTIMATE

PROJECT: Acushnet River Crossing - OPTION A- ADDITONAL
COM\9803\B

ESTIMATING PARAMETERS

WORK SCHEDULE	10.0	Hours/Day (single shift)
	7.0	Days/Week
LENGTH	1,523	Feet
PILOT HOLE PROD RATE	15.0	Feet/Hour
DRILLING MUD FLOW RATE	10.00	bpm
PILOT HOLE DURATION	10.2	Days
PILOT HOLE MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PILOT HOLE MUD QTY	609	Sacks
PREREAM PASSES	3	Quantity
PREREAM TRAVEL SPEED	0.50	Feet/Min
PREREAM MUD FLOW RATE	7.00	bpm
STD. SINGLE SHIFT	1	(Enter 1 by the selected shift option
TWENTYFOUR HOUR SHIFT	0	and 0 by the remaining options)
PREREAMING DURATION	160	Hours
	16.0	Days
RIG FOR PREREAM	2.0	Days
PREREAMING MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PREREAMING MUD QTY	1,279	Sacks
PULL BACK TRAVEL SPEED	10.00	Feet/Min
PULL BACK MUD FLOW RATE	7.00	bpm
STD. SINGLE SHIFT	1	(Enter 1 by the selected shift option
TWENTYFOUR HOUR SHIFT	0	and 0 by the remaining options)
PULLBACK DURATION	5.2	Hours
	0.5	Days
RIG FOR PULLBACK	0.5	Days
PULL BACK MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PULLBACK MUD QTY	2[illegible]	Sacks
MUD COST	12.00	$/Sack (100 lb)
TOTAL MUD QTY	1,970	Sacks (100 lb)

ESTIMATED COST

TOTAL JOB COST =	$503,625	U.S. DOLLARS
CONTINGENCY MARK-UP @ 75%	$377,718	U.S. DOLLARS
ESTIMATED INSTALLATION COST =	$881,343	U.S. DOLLARS

ESTIMATE RECAP

CREW	DAYS	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISC. EXPENSES	NON-DAILY COST	TOTAL
SITE PREPARATION	0.0	0.00	0.00	0.00	0.00	0.00	0.00
MOBILIZATION	0.0	0.00	0.00	0.00	0.00	0.00	0.00
RIG-UP	0.8	5,031.66	2,436.00	1,200.00	537.36	0.00	9,205.02
PILOT HOLE	10.2	63,860.15	30,916.90	15,230.00	6,819.99	10,300.00	126,827.05
PREREAMING	18.0	98,568.18	54,924.70	0.00	12,115.99	25,300.00	190,608.78
PULL BACK	1.0	13,099.24	4,460.52	0.00	1,417.55	0.00	18,977.31
PULL SECTION FABRICATION	10.0	73,394.60	13,150.00	0.00	7,139.00	0.00	93,683.60
RIG-DOWN	0.0	0.00	0.00	0.00	0.00	0.00	0.00
FINAL HYDROSTATIC TEST		0.00	0.00	0.00	0.00	0.00	0.00
SITE RESTORATION	0.0	0.00	0.00	0.00	0.00	0.00	0.00
DEMOBILIZATION	0.0	0.00	0.00	0.00	0.00	0.00	0.00
FINAL TIE-IN		0.00	0.00	0.00	0.00	0.00	0.00
DRILLING MUD		0.00	0.00	0.00	0.00	23,638.10	23,638.10
		0.00	0.00	0.00	0.00	0.00	0.00
SUPERVISION	30.0	30,720.14	5,102.39	0.00	4,862.29	0.00	40,684.80
		0.00	0.00	0.00	0.00	0.00	0.00
TOTALS		$284,673.97	$110,990.51	$16,430.00	$32,892.09	$58,638.10	$503,624.66

COMPLETED BY JMS DATE 2/13/98

CHECKED BY JSP DATE: 2/13/98

DAILY CREW COST SUMMARY

CREW	NUMBER OF MEN	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISC. EXPENSES	TOTAL
SITE PREPARATION	5	2,923.85	610.00	0.00	546.30	4,080.15
MOBILIZATION	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
RIG-UP	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
PILOT HOLE	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
PREREAMING	9	5,464.58	3,045.00	0.00	671.70	9,181.28
PULL BACK	21	12,804.04	4,360.00	0.00	1,385.60	18,549.64
PULL SECTION FABRICATION	12	7,339.46	1,315.00	0.00	713.90	9,368.36
RIG-DOWN	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
FINAL HYDROSTATIC TEST	9	5,919.67	315.00	0.00	346.70	6,581.37
SITE RESTORATION	5	2,923.85	610.00	0.00	546.30	4,080.15
DEMOBILIZATION	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
FINAL TIE-IN	10	6,352.79	1,315.00	0.00	713.90	8,381.69
DRILLING MUD						0.00
						0.00
SUPERVISION	2	1,023.53	170.00	0.00	162.00	1,355.53
						0.00

NON-DAILY COST SUMMARY

CREW	ITEM COST	TOTAL COST	CREW	ITEM COST	TOTAL COST
SITE PREPARATION		$0.00	FINAL HYDROSTATIC TEST		$0.00
MOBILIZATION		$0.00	SITE RESTORATION		$0.00
RIG-UP		$0.00	DEMOBILIZATION		$0.00
PILOT HOLE Rock Bits, Mud Motor	$10,000.00	$10,000.00	FINAL TIE-IN		$0.00
PREREAMING Rock Reaming Tools	$26,000.00	$25,000.00	DRILLING MUD		$0.00
PULL BACK		$0.00			$0.00
PULL SECTION FABRICATION		$0.00	SUPERVISION		$0.00
RIG-DOWN		$0.00			$0.00

COMPLETED BY: JMS DATE: 2/13/98

CHECKED BY: JSP DATE 2/13/98

CONTRACTOR'S COST ESTIMATE

PROJECT: Acushnet River Crossing - OPTION B-Base
COM9803\B

ESTIMATING PARAMETERS

WORK SCHEDULE	10.0	Hours/Day (single shift)
	7.0	Days/Week
LENGTH	1,813	Feet
PILOT HOLE PROD RATE	15.0	Feet/Hour
DRILLING MUD FLOW RATE	10.00	bpm
PILOT HOLE DURATION	12.1	Days
PILOT HOLE MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PILOT HOLE MUD QTY	725	Sacks
PREREAM PASSES	3	Quantity
PREREAM TRAVEL SPEED	0.50	Feet/Min
PREREAM MUD FLOW RATE	7.00	bpm
STD SINGLE SHIFT	1	(Enter 1 by the selected shift option
TWENTYFOUR HOUR SHIFT	0	and 0 by the remaining options)
PREREAMING DURATION	190	Hours
	19.0	Days
RIG FOR PREREAM	2.0	Days
PREREAMING MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PREREAMING MUD QTY	1,523	Sacks
PULL BACK TRAVEL SPEED	10.00	Feet/Min
PULL BACK MUD FLOW RATE	7.00	bpm
STD. SINGLE SHIFT	1	(Enter 1 by the selected shift option
TWENTYFOUR HOUR SHIFT	0	and 0 by the remaining options)
PULLBACK DURATION	6.0	Hours
	0.6	Days
RIG FOR PULLBACK	0.4	Days
PULL BACK MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PULLBACK MUD QTY	26	Sacks
MUD COST	12.00	$/Sack (100 lb)
TOTAL MUD QTY	2,334	Sacks (100 lb)

ESTIMATED COST

TOTAL JOB COST =	$719,548	U.S. DOLLARS
CONTINGENCY MARK-UP @ 75%	$539,661	U.S. DOLLARS
ESTIMATED INSTALLATION COST =	$1,259,208	U.S. DOLLARS

ESTIMATE RECAP

CREW	DAYS	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISC EXPENSES	NON-DAILY COST	TOTAL
SITE PREPARATION	1.0	2,923.85	610.00	0.00	546.30	0.00	4,080.15
MOBILIZATION	2.0	12,579.15	6,090.00	3,000.00	1,343.40	20,000.00	43,012.55
RIG-UP	1.9	11,950.19	5,785.50	2,850.00	1,276.23	0.00	21,861.92
PILOT HOLE	12.1	76,020.00	36,803.92	18,130.00	8,118.61	10,000.00	149,072.51
PREREAMING	21.0	114,943.69	64,049.55	0.00	14,128.76	25,000.00	218,122.00
PULL BACK	1.0	12,850.27	4,375.74	0.00	1,390.60	0.00	18,616.62
PULL SECTION FABRICATION	12.0	88,073.52	15,780.00	0.00	8,566.80	0.00	112,420.32
RIG-DOWN	2.0	12,579.15	6,090.00	3,000.00	1,343.40	0.00	23,012.55
FINAL HYDROSTATIC TEST		0.00	0.00	0.00	0.00	0.00	0.00
SITE RESTORATION	1.0	2,923.85	610.00	0.00	546.30	0.00	4,080.15
DEMOBILIZATION	2.0	12,579.15	6,090.00	3,000.00	1,343.40	20,000.00	43,012.55
FINAL TIE-IN		0.00	0.00	0.00	0.00	0.00	0.00
DRILLING MUD		0.00	0.00	0.00	0.00	28,002.02	28,002.02
		0.00	0.00	0.00	0.00	0.00	0.00
SUPERVISION	40.0	40,966.19	8,804.19	0.00	5,483.99	0.00	54,254.36
		0.00	0.00	0.00	0.00	0.00	0.00
TOTALS		$388,389.01	$153,088.87	$29,980.00	$45,087.80	$103,002.02	$719,547.70

COMPLETED BY JMS DATE 2/13/98

CHECKED BY JSP DATE 2/13/98

DAILY CREW COST SUMMARY

CREW	NUMBER OF MEN	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISC. EXPENSES	TOTAL
SITE PREPARATION	5	2,923.85	610.00	0.00	546.30	4,060.15
MOBILIZATION	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
RIG-UP	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
PILOT HOLE	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
PREREAMING	9	5,464.58	3,045.00	0.00	671.70	9,181.28
PULL BACK	21	12,804.04	4,360.00	0.00	1,385.80	18,549.64
PULL SECTION FABRICATION	12	7,339.46	1,315.00	0.00	713.90	9,368.36
RIG-DOWN	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
FINAL HYDROSTATIC TEST	9	5,919.67	315.00	0.00	346.70	6,581.37
SITE RESTORATION	5	2,923.85	610.00	0.00	546.30	4,080.15
DEMOBILIZATION	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
FINAL TIE-IN	10	6,352.79	1,315.00	0.00	713.90	8,381.69
DRILLING MUD						0.00
____________						0.00
SUPERVISION	2	1,023.53	170.00	0.00	162.00	1,355.53
____________						0.00

NON-DAILY COST SUMMARY

CREW	ITEM COST	TOTAL COST	CREW	ITEM COST	TOTAL COST
SITE PREPARATION		$0.00	FINAL HYDROSTATIC TEST		$0.00
MOBILIZATION Lump Sum	$20,000.00	$20,000.00	SITE RESTORATION		$0.00
RIG-UP		$0.00	DEMOBILIZATION Lump Sum	$20,000.00	$20,000.00
PILOT HOLE Rock Bits, Mud Motor	$10,000.00	$10,000.00	FINAL TIE-IN		$0.00
PREREAMING Rock Reaming Tools	$25,000.00	$25,000.00	DRILLING MUD		$0.00
PULL BACK		$0.00	____________		$0.00
PULL SECTION FABRICATION		$0.00	SUPERVISION		$0.00
RIG-DOWN		$0.00	____________		$0.00

COMPLETED BY: JMS DATE: 2/13/98

CHECKED BY: JSP DATE: 2/13/98

CONTRACTOR'S COST ESTIMATE

PROJECT: Acushnet River Crossing - OPTION B-Additional
COM\9803\B

ESTIMATING PARAMETERS

WORK SCHEDULE	10.0	Hours/Day (single shift)
	7.0	Days/Week
LENGTH	1,813	Feet
PILOT HOLE PROD RATE	15.0	Feet/Hour
DRILLING MUD FLOW RATE	10.00	bpm
PILOT HOLE DURATION	12.1	Days
PILOT HOLE MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PILOT HOLE MUD QTY	725	Sacks
PREREAM PASSES	3	Quantity
PREREAM TRAVEL SPEED	0.50	Feet/Min
PREREAM MUD FLOW RATE	7.00	bpm
STD. SINGLE SHIFT	1	(Enter 1 by the selected shift option
TWENTYFOUR HOUR SHIFT	0	and 0 by the remaining options)
PREREAMING DURATION	190	Hours
	19.0	Days
RIG FOR PREREAM	2.0	Days
PREREAMING MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PREREAMING MUD QTY	1,523	Sacks
PULL BACK TRAVEL SPEED	10.00	Feet/Min
PULL BACK MUD FLOW RATE	7.00	bpm
STD SINGLE SHIFT	1	(Enter 1 by the selected shift option
TWENTYFOUR HOUR SHIFT	0	and 0 by the remaining options)
PULLBACK DURATION	6.0	Hours
	0.6	Days
RIG FOR PULLBACK	0.4	Days
PULL BACK MUD YIELD	10.0	Barrels/Sack
CIRCULATION LOSS	20%	
PULLBACK MUD QTY	25	Sacks
MUD COST	12.00	$/Sack (100 lb)
TOTAL MUD QTY	2,334	Sacks (100 lb)

ESTIMATED COST

TOTAL JOB COST =	$584,066	U.S. DOLLARS
CONTINGENCY MARK-UP @ 75%	$438,049	U.S. DOLLARS
ESTIMATED INSTALLATION COST =	$1,022,115	U.S. DOLLARS

ESTIMATE RECAP

CREW	DAYS	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISC. EXPENSES	NON-DAILY COST	TOTAL
SITE PREPARATION	0.0	0.00	0.00	0.00	0.00	0.00	0.00
MOBILIZATION	0.0	0.00	0.00	0.00	0.00	0.00	0.00
RIG-UP	0.9	5,660.62	2,740.50	1,350.00	604.53	0.00	10,355.65
PILOT HOLE	12.1	70,020.00	30,803.90	18,130.00	8,118.61	10,000.00	149,072.51
PREREAMING	21.0	114,943.69	64,049.55	0.00	14,128.76	25,000.00	218,122.00
PULL BACK	1.0	12,850.27	4,375.74	0.00	1,390.60	0.00	18,616.62
PULL SECTION FABRICATION	12.0	88,073.52	15,780.00	0.00	3,566.80	0.00	112,420.32
RIG-DOWN	0.0	0.00	0.00	0.00	0.00	0.00	0.00
FINAL HYDROSTATIC TEST		0.00	0.00	0.00	0.00	0.00	0.00
SITE RESTORATION	0.0	0.00	0.00	0.00	0.00	0.00	0.00
DEMOBILIZATION	0.0	0.00	0.00	0.00	0.00	0.00	0.00
FINAL TIE-IN		0.00	0.00	0.00	0.00	0.00	0.00
DRILLING MUD		0.00	0.00	0.00	0.00	28,002.02	28,002.02
________		0.00	0.00	0.00	0.00	0.00	0.00
SUPERVISION	35.0	35,848.57	5,954.18	0.00	5,673.99	0.00	47,476.74
________		0.00	0.00	0.00	0.00	0.00	0.00
TOTALS		$333,396.66	$129,703.87	$19,480.00	$38,483.30	$63,002.02	$584,065.86

COMPLETED BY: JMS DATE: 2/13/98 CHECKED BY: JSP DATE: 2/13/98

DAILY CREW COST SUMMARY

CREW	NUMBER OF MEN	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISC. EXPENSES	TOTAL
SITE PREPARATION	6	2,923.85	810.00	0.00	546.30	4,080.15
MOBILIZATION	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
RIG-UP	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
PILOT HOLE	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
PREREAMING	9	5,464.58	3,045.00	0.00	671.70	9,181.28
PULL BACK	21	12,804.04	4,360.00	0.00	1,385.60	18,549.64
PULL SECTION FABRICATION	12	7,339.46	1,315.00	0.00	713.90	9,368.36
RIG-DOWN	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
FINAL HYDROSTATIC TEST	9	5,919.67	315.00	0.00	346.70	6,581.37
SITE RESTORATION	5	2,923.85	610.00	0.00	546.30	4,080.15
DEMOBILIZATION	10	6,289.58	3,045.00	1,500.00	671.70	11,506.28
FINAL TIE-IN	10	6,352.79	1,315.00	0.00	713.90	8,381.69
DRILLING MUD						0.00
________						0.00
SUPERVISION	2	1,023.53	170.00	0.00	162.00	1,355.53
________						0.00

NON-DAILY COST SUMMARY

CREW	ITEM COST	TOTAL COST	CREW	ITEM COST	TOTAL COST
SITE PREPARATION		$0.00	FINAL HYDROSTATIC TEST		$0.00
MOBILIZATION		$0.00	SITE RESTORATION		$0.00
RIG-UP		$0.00	DEMOBILIZATION		$0.00
PILOT HOLE Rock Bits, Mud Motor	$10,000.00	$10,000.00	FINAL TIE-IN		$0.00
PREREAMING Rock Reaming Tools	$25,000.00	$25,000.00	DRILLING MUD		$0.00
PULL BACK		$0.00	________		$0.00
PULL SECTION FABRICATION		$0.00	SUPERVISION		$0.00
RIG-DOWN		$0.00	________		$0.00

COMPLETED BY: JMS DATE: 2/13/98 CHECKED BY: JSP DATE: 2/13/98

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J.D.Hair&Associates,Inc.
Consulting Engineers

FACSIMILE TRANSMISSION

2815 East Skelly Drive, Suite 820
Tulsa, Oklahoma 74105
Telephone: 918-747-9945
Facsimile: 918-742-7408

DATE: March 10, 1998
PLEASE DELIVER TO: Bob Hebert
FAX NUMBER: 508-291-2748
FROM: Jeff Scholl
JDH&A FILE: COM\9803|B

NUMBER OF PAGES TRANSMITTED INCLUDING THIS PAGE: 5

Bob,

Per our conversation, I have included in this transmission estimates for an 84" I.D. and a 96" I.D. tunnel. These estimates are based on a length of 1200 feet with the entry pit at station 5+00 and the reception shaft at station 17+00. Based on information now in hand, bids to install these crossings are expected to fall at or around the figures listed below.

12
94

- 84 inch I.D. $1,988,641
- 96 inch I.D. $2,156,137

Please remember that JDH&A has not yet evaluated the feasibility of installing an 84" or a 96" tunnel. At this point, the feasibility is questionable due to uncertainties concerning the elevation of the bedrock surface and amount of cover available. For this reason, you should consider these estimates preliminary and note that they may vary substantially as the large diameter tunnel option is investigated in more detail.

If you have any questions concerning these estimates, please don't hesitate to call.

FILE: COM98C1\B\ES84_MIC
CLIENT: COMMONWEALTH ELECTRIC COMPANY
PROJECT: ACUSHNET RIVER CROSSING
SUBJECT: Contractors Cost Estimate - Tunneling Installation 84" I.D.
DATE: 03/10/98

ESTIMATING PARAMETERS

WORK SCHEDULE	10.0	Hours/Day (single shift)
	7.0	Days/Week
LENGTH	1,200	Feet
PRODUCTION RATE	2.3	Feet/Hour
MICROTUNNELING DURATION	53.3	Days
STD. SINGLE SHIFT	1	(Enter 1 by the selected shift option
TWENTYFOUR HOUR SHIFT	0	and 0 by the remaining options)

ESTIMATED COST

TOTAL JOB COST =	$1,136,366	U.S. DOLLARS
CONTINGENCY MARK-UP @ 75%	$852,275	U.S. DOLLARS
ESTIMATED INSTALLATION COST =	$1,988,641	U.S. DOLLARS

ESTIMATE RECAP

CREW	DAYS	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISC. EXPENSES	NON-DAILY COST	TOTAL
SHAFT CONSTRUCTION	20.0	80,839.14	18,100.00	0.00	13,908.00	75,000.00	187,847.14
MOBILIZATION	2.0	7,844.14	1,210.00	9,000.00	1,974.00	20,000.00	40,028.14
RIG-UP	1.7	6,667.52	1,028.50	7,650.00	1,677.90	0.00	17,023.92
TUNNELING	53.3	209,176.95	32,266.67	240,000.00	52,640.00	0.00	534,083.62
RIG-DOWN	2.0	7,844.14	1,210.00	9,000.00	1,974.00	0.00	20,028.14
SITE RESTORATION	3.0	7,794.29	1,830.00	0.00	1,863.90	0.00	11,488.19
DEMOBILIZATION	2.0	7,844.14	1,210.00	9,000.00	1,974.00	20,000.00	40,028.14
		0.00	0.00	0.00	0.00	0.00	0.00
SUPERVISION	70.0	167,554.50	11,905.67	70,033.33	11,345.40	0.00	260,838.90
PIPE		0.00	0.00	0.00	0.00	25,000.00	25,000.00
TOTALS		495,564.81	68,760.83	344,683.33	87,357.20	140,000.00	1,136,356.17

DAILY CREW COST SUMMARY

CREW	NUMBER OF MEN	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISCELLANEOUS EXPENSES	TOTAL
SHAFT CONSTRUCTION	8	4,041.96	905.00	0.00	695.40	5,642.36
MOBILIZATION	6	3,922.07	605.00	4,500.00	987.00	10,014.07
RIG-UP	6	3,922.07	605.00	4,500.00	987.00	10,014.07
TUNNELING	6	3,922.07	605.00	4,500.00	987.00	10,014.07
RIG-DOWN	6	3,922.07	605.00	4,500.00	987.00	10,014.07
SITE RESTORATION	5	2,598.10	610.00	0.00	621.30	3,829.40
DEMOBILIZATION	6	3,922.07	605.00	4,500.00	987.00	10,014.07
						0.00
SUPERVISION	5	2,392.50	170.00	1,000.00	162.00	3,724.50
PIPE						0.00

NON-DAILY COST SUMMARY

CREW	ITEM COST	TOTAL COST	CREW	ITEM COST	TOTAL COST
SHAFT CONSTRUCTION Shoring - Jacking Shaft Shoring - Reception Shaft	 $50,000.00 $25,000.00	$75,000.00	SITE RESTORATION		$0.00
MOBILIZATION Long Haul	 $20,000.00	$20,000.00	DEMOBILIZATION Long Haul	 $20,000.00	$20,000.00
RIG-UP		$0.00			$0.00
TUNNELING		$0.00	SUPERVISION		$0.00
RIG-DOWN		$0.00	PIPE JACKING STATIONS	 $25,000.00	$25,000.00

FILE: COM98C1\B\ES54_MIC
CLIENT: COMMONWEALTH ELECTRIC COMPANY
PROJECT: ACUSHNET RIVER CROSSING
SUBJECT: Contractor's Cost Estimate - Tunneling Installation 96" I.D
DATE: 03/10/98

ESTIMATING PARAMETERS

WORK SCHEDULE	10.0	Hours/Day (single shift)
	7.0	Days/Week
LENGTH	1,200	Feet
PRODUCTION RATE	2.0	Feet/Hour
MICROTUNNELING DURATION	60.0	Days
STD SINGLE SHIFT	1	(Enter 1 by the selected shift option
TWENTYFOUR HOUR SHIFT	0	and 0 by the remaining options)

ESTIMATED COST

TOTAL JOB COST =	$1,232,078	U.S. DOLLARS
CONTINGENCY MARK-UP @ 75%	$924,059	U.S. DOLLARS
ESTIMATED INSTALLATION COST =	$2,156,137	U.S. DOLLARS

ESTIMATE RECAP

CREW	DAYS	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISC. EXPENSES	NON-DAILY COST	TOTAL
SHAFT CONSTRUCTION	20.0	80,839.14	18,100.00	0.00	13,908.00	75,000.00	187,847.14
MOBILIZATION	2.0	7,844.14	1,210.00	9,000.00	1,974.00	20,000.00	40,028.14
RIG-UP	2.0	7,844.14	1,210.00	9,000.00	1,974.00	0.00	20,028.14
TUNNELING	60.0	235,324.07	36,300.00	270,000.00	59,220.00	0.00	600,844.07
RIG-DOWN	2.0	7,844.14	1,210.00	9,000.00	1,974.00	0.00	20,028.14
SITE RESTORATION	3.0	7,794.29	1,830.00	0.00	1,863.90	0.00	11,488.19
DEMOBILIZATION	2.0	7,844.14	1,210.00	9,000.00	1,974.00	20,000.00	40,028.14
		0.00	0.00	0.00	0.00	0.00	0.00
SUPERVISION	77.0	184,222.23	13,090.00	77,000.00	12,474.00	0.00	286,786.23
PIPE		0.00	0.00	0.00	0.00	25,000.00	25,000.00
TOTALS		539,556.27	74,160.00	383,000.00	95,381.90	140,000.00	1,232,078.17

DAILY CREW COST SUMMARY

CREW	NUMBER OF MEN	LABOR COST	COMPANY EQUIPMENT	RENTED EQUIPMENT	MISCELLANEOUS EXPENSES	TOTAL
SHAFT CONSTRUCTION	8	4,041.96	905.00	0.00	695.40	5,642.36
MOBILIZATION	6	3,922.07	605.00	4,500.00	987.00	10,014.07
RIG-UP	6	3,922.07	605.00	4,500.00	987.00	10,014.07
TUNNELING	6	3,922.07	605.00	4,500.00	987.00	10,014.07
RIG-DOWN	6	3,922.07	605.00	4,500.00	987.00	10,014.07
SITE RESTORATION	5	2,598.10	610.00	0.00	621.30	3,829.40
DEMOBILIZATION	5	3,922.07	605.00	4,500.00	987.00	10,014.07
						0.00
SUPERVISION	5	2,392.50	170.00	1,000.00	162.00	3,724.50
PIPE						0.00

NON-DAILY COST SUMMARY

CREW	ITEM COST	TOTAL COST	CREW	ITEM COST	TOTAL COST
SHAFT CONSTRUCTION Shoring - Jacking Shaft Shoring - Reception Shaft	 $50,000.00 $25,000.00	$75,000.00	SITE RESTORATION		$0.00
MOBILIZATION Long Haul	 $20,000.00	$20,000.00	DEMOBILIZATION Long Haul	 $20,000.00	$20,000.00
RIG-UP		$0.00	____________		$0.00
TUNNELING		$0.00	SUPERVISION		$0.00
RIG-DOWN		$0.00	PIPE JACKING STATIONS	 $25,000.00	$25,000.00

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1 Sonia Court
Suffern, New York 10901

TEL (914) 357-8923
FAX (914) 369-6503

JOSEPH T. ZIMNOCH

Consultant

High Voltage Electrical Cables and Accessories

March 11, 1998

Mr. Robert Hebert
Commonwealth Electric Company
2421 Cranberry Highway
Wareham, MA 02571

Dear Bob:

Per our discussions, attached are two (2) estimates based on the following alternate arrangements:

a) Four (4) directional drilled bores - each 1523 feet long

b) One (1) microtunnel - 1300 feet long

If I can be of any further service, please don't hesitate to call.

Yours truly,

JTZ/rtp

Attachments

1 Sonia Court
Suffern, New York 10901

TEL (914) 357-8923
FAX (914) 369-6503

JOSEPH T. ZIMNOCH

Consultant

High Voltage Electrical Cables and Accessories

ESTIMATE
for
COM ELECTRIC - ACUSHNET RIVER CROSSING - NEW BEDFORD
BASIS FOUR (4) DIRECTIONAL DRILLED BORES - EACH 1523 FT. LONG

Item	Quantity	Description	Unit Cost	Total Cost
1.	21,322 ft.	5" PVC Duct for 14 Runs	$ 3.00	$ 63,966.
2.	6	Manholes for Both Ends of Crossing	20,000.	120,000.
3.	69,690 ft.	1/C 750 kcmil Copper 15kV 133% Insulation Level EPR Cable (for existing ten 15kV circuits)	7.80	543,582.
4.	60	15kV Straight Splice Kits for 1/C 750 kcmil EPR Cable	240.	14,400.
5.	20	15kV Transition Splice Kits for 3/C 500kcmil PILC to 3-1/C 750 kcmil EPR Cable	520.	10,400.

6.	2200 ft.	350 kcmil Grounding Conductor	2.00	4,400.
7.	2200 ft.	Fiber Optic Cable 10 Fiber - Single Mode	3.50	7,700.
8.	3,600 ft.	6-5/8" O.D. x .375" wall Pritec Coated Steel Pipe (For existing two 115kV pipe cable circuits)	15.00	54,000.
9.	10,800 ft.	1250 kcmil Copper 115kV Pipe Type Cable (6 reels)	30.00	324,000.
10.	4	115kV Pipe Cable Joints	4,000.	16,000.
*11.	1,800 ft.	10-3/4" O.D. x .365" wall Pritec Coated Steel Pipe For New 115kV HPGF Pipe Cable or Solid Dielectric Cable Circuit.	25.00	45,000.
*12.	1	Labor for Installation of all above items (Per attached Utec estimate)	Lot	878,355.

13.	1	Non-Electrical Items for Belleville Ave. and Belleville Rd. Intersection (Per attached Com Elec estimate)	Lot	112,010.
14.	1	Cathodic Protection System	Lot	25,000.
15.	1	Consulting Engineering Services (Civil, Electrical, Mechanical)	Lot	150,000.
		* Total (Not Including J.D.Hair Estimate)		$ 2,368,813.

* NOTE * For total excluding 10-3/4" O.D. Pipe for new 115kV circuit, deduct $ 45,000. for material (Item 11) and $ 63,792. for labor (portion of Item 12) $ 2,260,021.

3/11/98

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1 Sonia Court
Suffern, New York 10901

TEL (914) 357-8923
FAX (914) 369-6503

JOSEPH T. ZIMNOCH

Consultant

High Voltage Electrical Cables and Accessories

ESTIMATE

for

COM ELECTRIC - ACUSHNET RIVER CROSSING - NEW BEDFORD

BASIS ONE (1) 96" DIAMETER MICROTUNNEL - 1300 FT. LONG

Item	Quantity	Description	Unit Cost	Total Price
1.	1,300 ft.	96" I.D. Casing	$ 480/ft.	$ 624,000.
2.	1 Lot	Brackets, Supports & Floor Grating for 1300 ft. Tunnel	Lot	81,000.
3.	18,200 ft.	5" Fiberglass Duct for 14 Runs	4.00	72,800.
4.	2	Large Vaults for Both Ends of Crossing	50,000.	100,000.
5.	2	Butler Type Building Structure for Top of Large Vaults with Louvers for Air Circulation	50,000.	100,000.

6.	1	Forced Air Ventilation System With Monitors for Automatic Operation under high tunnel temperatures	Lot	50,000.
7.	63,000 ft.	1/C 750 kcmil Copper 15kV 133% Insulation Level, EPR Cable (for Existing ten 15kV Circuits)	7.80	491,400.
8.	60	15kV Straight Splice Kits for 1/C 750 kcmil EPR Cable	240.	14,400.
9.	20	15kV Transition Splice Kits for 3/C 500 kcmil PILC to 3-1/C 750 kcmil EPR Cable	520.	10,400.
10.	2,200 ft.	350 kcmil Grounding Conductor	2.00	4,400.
11.	2,200 ft.	Fiber Optic Cable 10 Fiber - Single Mode	3.50	7,700.
12.	2,800 ft.	6-5/8" O.D. x .250" wall Epoxy Coated Steel Pipe (For existing two 115kV Pipe cable circuits)	14.00	39,200.
13.	8,400 ft.	1250 kcmil Copper 115kV Pipe Type Cable (6 reels)	30.00	252,000.

14.	4	115kV Pipe Cable Joints	4,000.	16,000.
*15.	1,400 ft.	10-3/4" O.D. x .250" wall Epoxy Coated Steel Pipe for New 115kV HPGF Pipe Cable or Solid Dielectric Cable Circuit	23.00	32,200.
*16.	1	Labor for Installation of all above items (Per Attached Utec Estimate)	Lot	837,502.
17.	1	Non-Electrical Items for Belleville Ave. and Belleville Rd. Installation (Per attached Com Elec Estimate)	Lot	112,010.
18.	1	Cathodic Protection System	Lot	25,000.
19.	1	Consulting Engineering Services (Civil, Electrical, Mechanical)	Lot	150,000.
		*Total (Not Including J.D.Hair Estimate)		$3,020,012.

*NOTE For total excluding 10-3/4" O.D. Pipe for new 115kV circuit, deduct $32,200. for material (Item 15) and $49,616. for labor (Portion of Item 16) $2,938,196.

3/11/98

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Priliminary electrical estimate

COM ELECTRIC - ACUSHNET RIVER CROSSING-NEW BEDFORD
PREPARED BY: UTEC CONSTRUCTORS,INC.MARCH 9, 1998

For directional drill installation

ITEM	TASK DESCRIPTION	QUANITY	UNIT MEASURE	UNIT LBR/HRS	LBR/HRS EXTEN.	LABOR $	LABOR $ EXTEN.	MATERIAL COST	MATERIAL EXTEN.	SUB CONT.
1	Brackets & supports for 115 kv line pipe	[illegible]	sa	4.5	742.5	$ 88.60	$ 65,785.50	$ -	$ -	
2	Brackets & supports for 15 kv fiber conduit	[illegible]	sa	4.5	742.5	$ 88.60	$ 65,785.50	$ -	$ -	
3	5" conduit installation	21322	ft	0.08	1705.76	$ 88.60	$ 151,130.34	$ -	$ -	
4	6 5/8" O.D. steel line pipe	3600	ft	0.4	1440.	$ 88.60	$ 127584.00	$ -	$ -	
5	10 3/4" O.D. steel line pipe	1800	ft	0.4	720	$ 88.60	$ 63792.00	$ -	$ -	
6	1/c 750kcmil cu. 15kv epr cable installation	23230	cir/ft	0.015	348.45	$ 88.60	$ 30872.67	$ -	$ -	
7	1250kcmil cu. 115kv pipe type cable installation	3600	cir/ft	0.05	180.	$ 88.60	$ 15948.00	$ -	$ -	
8	350kcmil grounding conductor	2200	lin/ft	0.015	33	$ 88.60	$ 2,923.80	$ -	$ -	
9	fiber optic cable 10 fiber-single mode	2200	lin/ft	0.015	33	$ 88.60	$ 2,923.80	$ -	$ -	
10	15kv straight splice kits 1/c 750 kcmil cu.	60	sa	8	480	$ 88.60	$ 42,528.00	$ -	$ -	
11	15kv transition splice kits 3/c 500kcmil-3-1/c 750 kcmil	20	sa	8	160	$ 88.60	$ 14,176.00	$ -	$ -	
12	115kv pipe type cable joints	4	sa	288	1152	$ 104.60	$ 120,499.20	$ -	$ -	
13	Achushnet sub electrical labor	1	lot	480	480	$ 88.60	$ 42526.00	$ 25,000.00	$ 25,000.00	
14	Install freeze pits	1	sa	96	96	$ 88.60	$ 8505.60	$ -	$ -	
15	Manhole racking & bonding	6	sa	16	96	$ 88.60	$ 8505.60	$ 840.00	$ 5,040.00	
16	Testing	3	sa	24	72	$ 88.60	$ 6379.20	$ 2,500.00	$ 7,500.00	
17	Fluid & gas filling	3	sa	60	180	$ 88.60	$ 15948.00	$ 9,000.00	$ 27,000.00	
18	SUB CONTRACTOR X-RAY	1	L/S		0	$ 88.60	$ -	$ -	$ -	$ 28,000.00
	Total labor				8661.21		$ 785816.21		$ 64540.00	$ 28,000.00
	Materials				8565.21		$ 64540.00			
	Sub contractor						$ 28000.00			
	Total estimated job						$ 878,356.21			

Note: This estimate does not include the two vaults and does not include the control building.

Post-it™ brand fax transmittal memo 7671	# of pages ▸ 2
To BOB HEBERT	From G. Hood
Co.	Co. UTEC
Dept.	Phone # 978-887-2396
Fax # 508-991-2748	Fax # " - " -6306

Gene will CALL you IN A minute -

ITEM	TASK DESCRIPTION	QUANITY	UNIT MEASURE	UNIT HOURS	LBR-HRS EXTEN	LABOR $	LABOR $ EXTEN	MATERIAL COST	MATERIAL EXTEN	SUB CONT
	Priliminary electrical estimate				COM ELECTRIC - ACUSHNET RIVER CROSSING NEW BEDFORD PREPARED BY: UTEC CONSTRUCTORS INC. MARCH 9, 1998					
1	Brackets & suppers for 115 kv line pipe	165	ea	6	990	$ 84.60	$ 81,714.00	$ -	$ -	
2	Brackets & suppers for 15 kv fiber conduit	165	ea	6	990	$ 84.60	$ 81,714.00	$ -	$ -	
3	5" conduit installation	18200	ft	0.08	1456	$ 86.80	$ 129,001.80	$ -	$ -	
4	6 5/8" O.D. steel line pipe	2800	ft	0.4	1120	$ 84.60	$ 94,232.00	$ -	$	
5	10 3/4" O.D. steel line pipe	1400	ft	0.4	560	$ 83.60	$ 49,816.00	$ -	$ -	
6	1/c 750kcmil cu. 15kv epr cable installation	21000	cir/ft	0.015	315	$ 84.60	$ 27,909.00	$ -	$ -	
7	1250kcmil cu. 115kv pipe type cable installatio	2800	cir/ft	0.05	140	$ 83.60	$ 12,404.00	$ -	$ -	
8	350kcmil grounding conductor	2200	lin/ft	0.015	33	$ 84.60	$ 2,923.80	$ -	$ -	
9	fiber optic cable 10 fiber single mode	2200	lin/ft	0.015	33	$ 84.60	$ 2,923.80	$ -	$ -	
10	15kv straight splice kits 1/c 750 kcmil cu.	60	ea	8	480	$ 84.60	$ 42,528.00	$ -	$ -	
11	15kv transition splice kits 3/c 500kcmil-3-1/c 7	20	ea	8	160	$ 83.80	$ 14,176.00	$ -	$ -	
12	115kv pipe type cable joints	4	ea	238	1152	$ 104.60	$ 120,499.20	$ -	$ -	
13	Achushnet sub electrical labor	1	lot	430	480	$ 83.60	$ 42,528.00	$ 25000.00	$ 25,000.00	
14	Install freeze pits	1	ea	96	96	$ 83.60	$ 3,505.80	$ -	$ -	
15						$ 83.60				
16	Testing	3	ea	24	72	$ 83.60	$ 3,379.20	$ 2,500.00	$ 7,500.00	
17	Fluid & gas filling	3	ea	50	180	$ 83.60	$ 15,948.00	$ 8,000.00	$ 27,000.00	
18	SUB CONTRACTOR X-RAY	1	LS		0	$ 83.60	$ -	$ -	$ -	$ 28,000.00
	Total labor				8257		$ 750,002.20		$ 58,500.00	$ 28,000.00
	Materials				8257		$ 58,500.00			
	Sub contractor						$ 28,000.00			
	Total estimated job.						$ 837,602.20			

Note: This estimate does not include the two vaults and does not include the control building

The proposed work activities at the intersection of Belleville Road and Belleville Avenue are the result of the State's paving schedule for the area. In my discussions with the party in charge of planning the work, he indicated the State would commence paving sometime after July 1st of this year. In most cities and townships, as in New Bedford, there is a five-year cessation on redigging the roadways once this is done. Disturbing a roadway before the end of this five-year period would be unacceptable to the City unless we agreed to repave the entire intersection. Such disturbance of the paved roadway may also be undesirable to the State. Remember that the relocation of the New Bedford supply cables is scheduled to be completed in the next five years.

The intersection work is the only feasible alternative to reroute the existing cables feeding the City. Any other method reviewed has been more costly. By finishing the work by a late June target date, we avoid any conflicts which would otherwise arise. Also, paving costs incurred this Spring would be minimal since permanent paving would be done by the State after July 1st. Therefore only a temporary, less costly paving job would be required after our trenching activity. Even if at some later date permission to dig were obtained, paving costs would be substantially higher since the City would probably require the entire intersection to be resurfaced and not just where the trenching took place.

Considering all these potential problems, it behooves COM/Electric to pursue whatever course is necessary to accomplish the intersection project according to the proposed schedule. A letter of commitment from the EPA would insure that work performed would be compensated for in a timely manner, since an agreement covering the entire project is not expected to be executed prior to the commencement of construction work for this intersection.

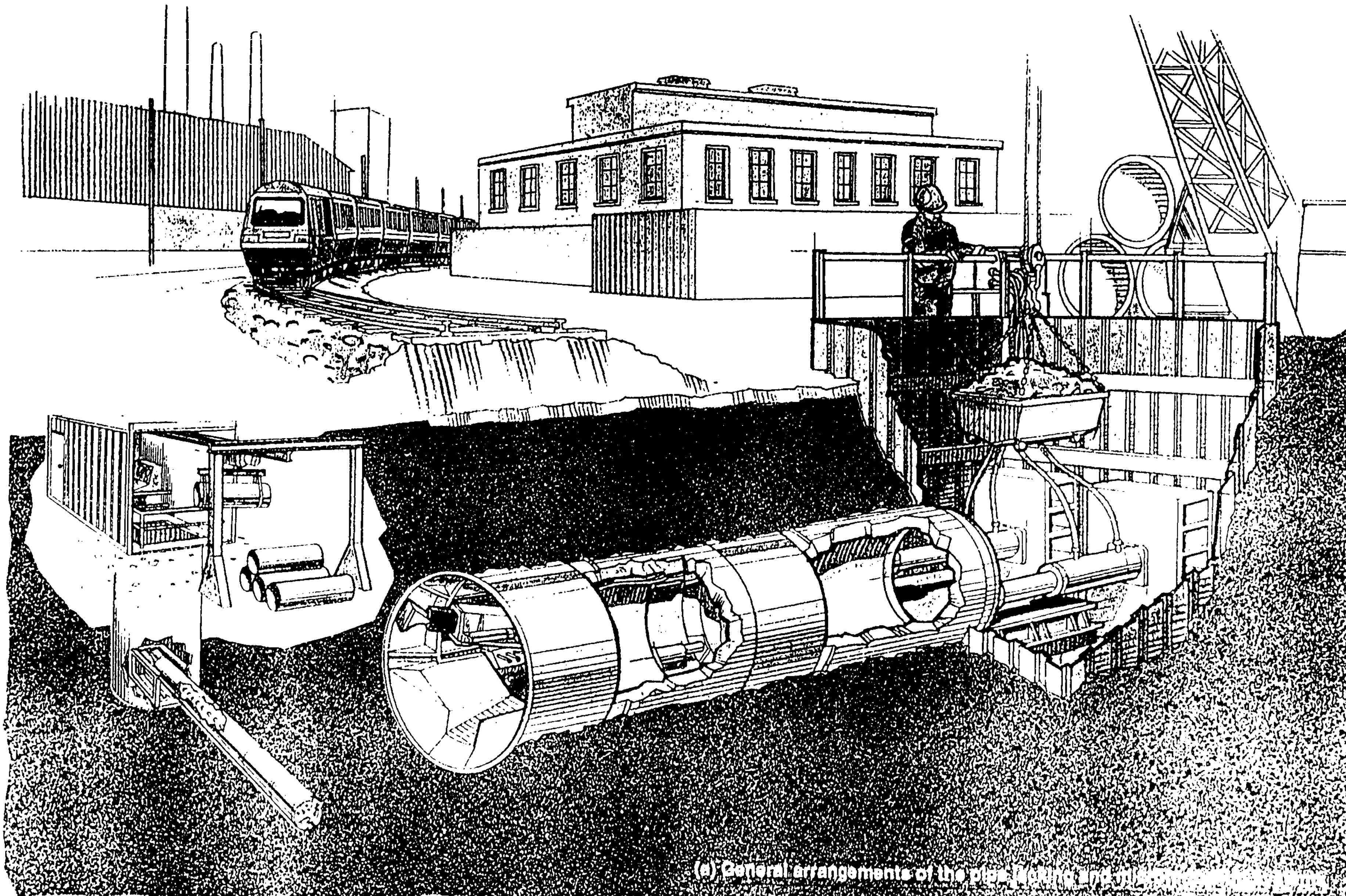
Belleville Ave. & Belleville Rd. Intersection Estimate Non--Electrical

Rebuild manholes (two)	$ 40000
New manhole on ductline	$ 20000
260ft 9duct $70/ft.	$ 18200
120ft 5duct $70/ft.	$ 8400
120ft 4duct $40/ft	$ 4800
Flowable fill $52/yd.	$ 6000
Sub TOTAL	$ 97400
15% contingency	$ 14610
TOTAL	$ 112010

NOTE: ESTIMATE EXCLUDES NEW 115KV LINE COSTS OF $35000
REVISED 3/4/98 ; SEE DRAWING COM/ELECTRIC
DRAWING NO.-- BELLINT2. FOR SPECIFIC DETAILS

9

1 the pipe jacking technique

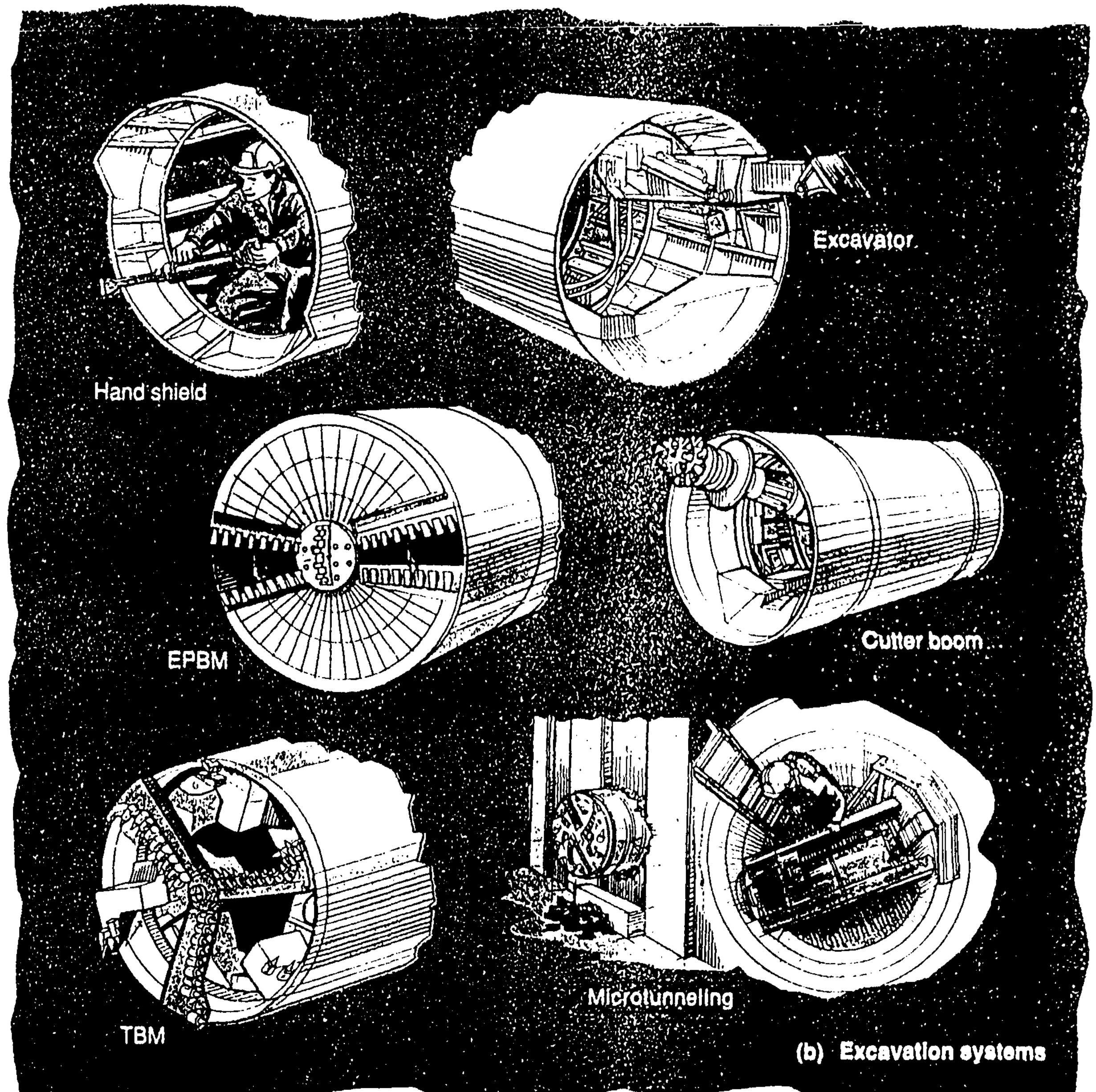


(a) General arrangements of the pipe jacking and [illegible]

Pipe jacking and microtunneling are techniques for installing underground pipelines, ducts and culverts. Powerful hydraulic jacks are used to push specially designed pipes through the ground behind a shield at the same time as excavation is taking place within the shield. The method provides a flexible, structural, watertight, finished pipeline as the tunnel is excavated.

There is no theoretical limit to the length of individual pipe jacks although practical engineering considerations and economics may impose restrictions. Drives of several hundred feet are routine. A number of excavation systems are available including manual, mechanical and remote control. Pipes in the range 150mm to 3000mm (6 in. to 118 in.) can be installed by employing the appropriate system. Construction tolerances are compatible with other tunneling methods, and the pipe jacking method generally requires less overcut than segmental tunnels, providing better ground support.

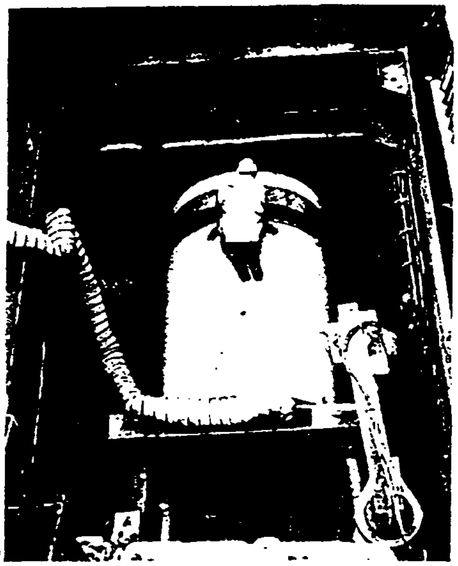
Excavation methods are similar to those employed in other forms of tunneling using either manual or mechanical excavation. Shields, excavation and face support can be provided for a wide variety of ground conditions.



(b) Excavation systems

BY PAUL FOURNIER

TBM Speeds Portland Sewer Project

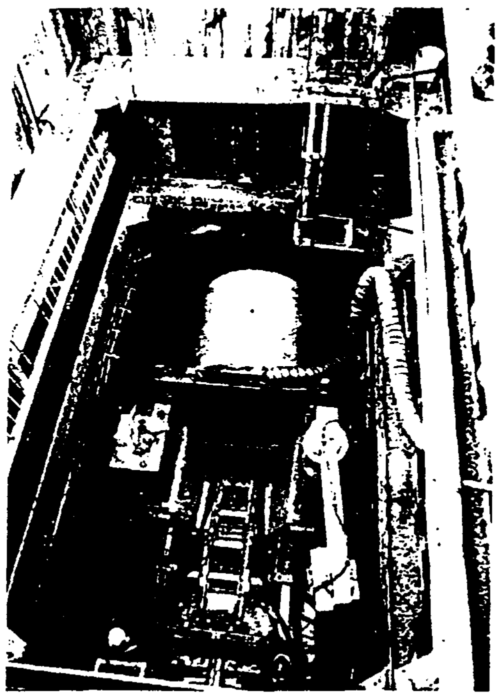


The 400-ton-capacity jacks push another length of pipe towards one in tunnel.

L.M. Bradshaw Contracting speeds installation of quarter-mile of six-foot pipe deep below streets using Akkerman Mfg. tunnel boring machine.

In spite of the predominance of sticky marine clay, a tunneling contractor achieved production rates of up to 120 feet a day on the installation of a six-foot-diameter drainage pipe deep below the streets of Portland, ME.

L.M. Bradshaw Contracting Inc. of Ellicott City, MD installed 1,390 feet of the 60-inch-diameter (inside) concrete pipe using special tunneling, hauling and pipe-jacking equipment supplied by Akkerman Manufacturing, trenchless specialists from Brownsdale, MN. Bradshaw and two Maine subcontractors, White Brothers of Portland and Callahan Brothers of Mechanics Falls, worked closely to complete the $2.25 million Libbytown Sewer Project in near record time. "This was a good team effort, especially the jacking, which was a phenomenal success," said Skip Parker, resident engineer for Dufresne-Henry of Portland, co-consultants with CH2MHill.



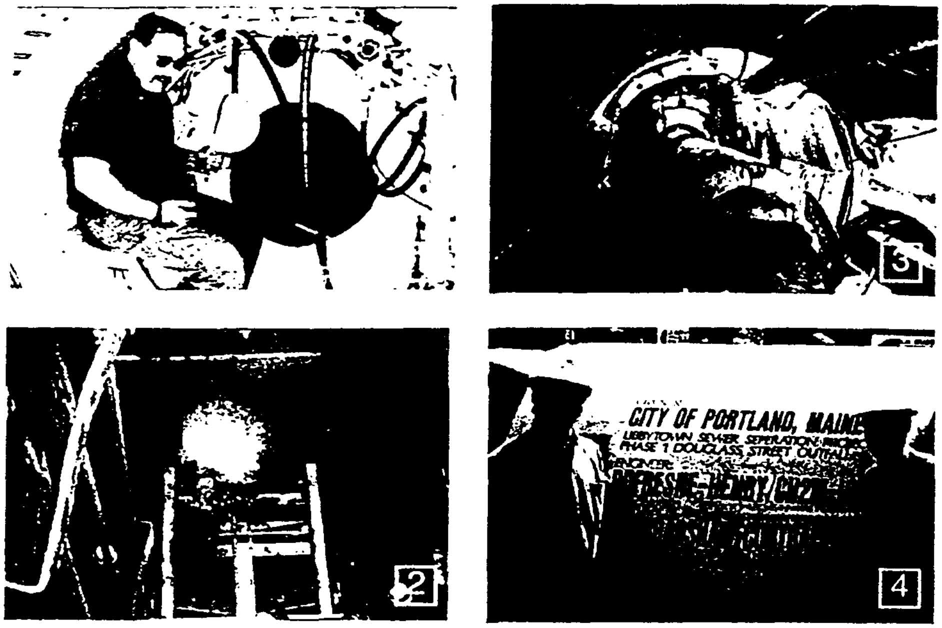
Muck cart emerges on rails inside pipe, carrying a load of clay.

City officials decided to have the pipe installed in a tunnel to avoid tearing up Douglass and Congress Streets by open excavation, which would have created horrendous traffic problems on these two major thoroughfares. The installation of the new drainage pipe is part of an effort to separate surface stormwater runoff from the city's aging brick sanitary sewers. The current project drains the Libbytown section, an area involving half a dozen streets, and is designed to carry the flow from a 500-year storm. Bruce Sherwood, project engineer for the municipal Parks and Public Works Department, represented the City in the project.

Parker said the engineers and contractors were apprehensive in the beginning because of the type of soil that lay in the path of the TBM: About 98 percent of the material is a blue-gray marine clay. In anticipation of severe friction drag from the cohesive soil, Bradshaw leased a tunnel boring machine, a 400-ton jacking system, and a railed muck-hauling system, complete with four intermediate jacking stations, from Akkerman. The contractor also asked the manufacturer of the heavily reinforced Class V concrete pipe, Hydro Conduit Co. of Connecticut (formerly Field Pipe), to apply a special friction-reducing coating to the exterior of the pipe. The seven-ton, eight-foot lengths of pipe had also been made with extra-strong joints to withstand the force of jacking.

At the onset of the job, Callahan Brothers drove 50-foot-long temporary steel sheeting to protect the excavation, then dug the 30-foot-deep pit using a 60-ton American crane with a clamshell. Crews poured a concrete mud slab on the bottom of the 12-foot by 20-foot shaft to facilitate jacking. After a worker had torched through the sheetpiling to make an entry for the TBM, a 60-ton Grove hydraulic rough-terrain crane lowered the TBM into the pit in two sections which had been bolted together for the big push.

Reprinted from – NEW ENGLAND CONSTRUCTION -- September 27, 1993



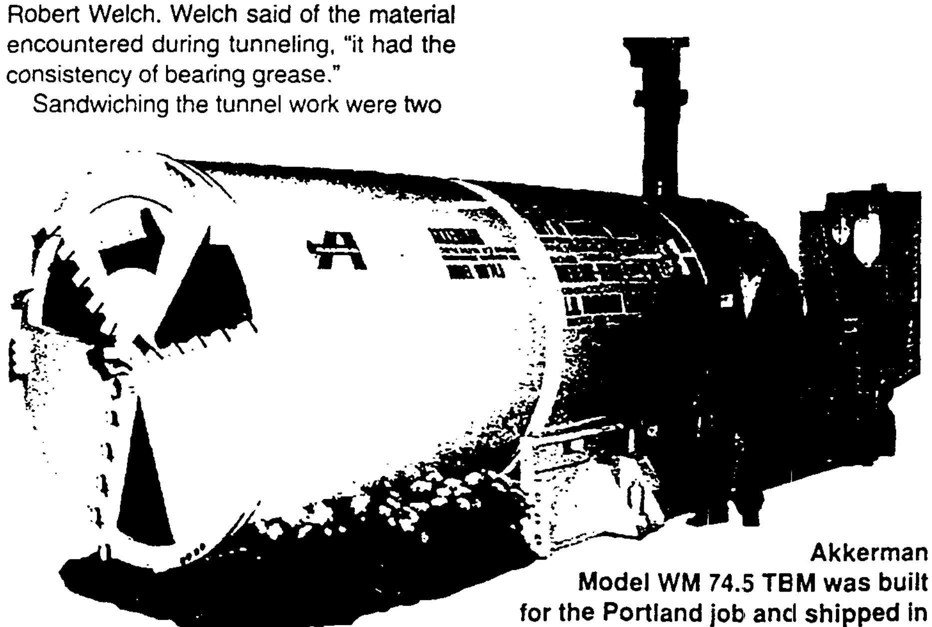
1 – Res. eng. Skip Parker sits in TBM operator's seat before placement of screw conveyor which will protrude from that hole in the middle. 2 – Worker uses torch to cut entryway through sheetpiling of shaft for tunnel boring machine. 3 – Photo looking towards front (cutting end) of TBM during operation shows enclosed screw conveyor, which is carrying muck to rail haul system at rear. 4 – Standing with Akkerman TBM before assembly in shaft are, from left, Joseph Bradshaw, vice president of Bradshaw Contracting, and Richard Michael, project manager for Dufresne-Henry.

The installation of the new drainage pipe is part of an effort to separate surface stormwater runoff from the city's aging brick sanitary sewers.

Bradshaw tunneled and jacked the pipe in two directions from a central shaft, proceeding 750 feet northward and 640 feet southward. At depths of 28 to 31 feet, the Akkerman WM 74.5 TBM proceeded easily through the clay, guided by a Spectra-Physics laser. The machine is operated by one man, who sits inside the TBM facing perpendicular to its direction of travel. It has four hydraulic motors which develop up to 80,000 ft-lbs of torque to drive the revolving, closed-face cutter head. Cuttings are carried by a screw conveyor to the haul system at the rear of the TBM. The battery-powered haul unit (or muck cart) rides a set of rails to the shaft where it is hoisted by a crane at street level and dumped into a waiting haul truck. At the peak of production, Parker said, the TBM was filling the three-cubic-yard muck cart in a minute. The total cycle—filling, hauling, dumping and returning—took less than five minutes. He noted that the 400-ton capacity jacking system never had to apply more than 100 tons of pressure, and the intermediate jacking stations were never employed.

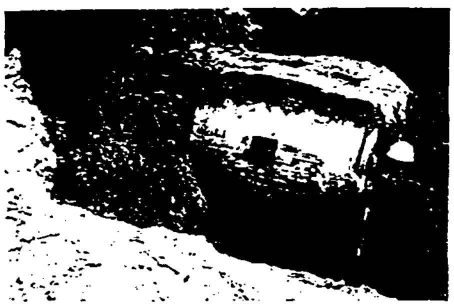
"This was to be the longest jacked pipe in the state," said Parker, "and because of the type of soil, Bradshaw expected to get about 40 feet a day in two shifts. "Instead, they averaged around 50 feet per shift with a best 12 hour shift of 120 feet". Two operators – Bradshaw employees Sammy Ricks and Eugene Phelon – spelled each other during the 12-hour shifts. Job superintendent for the Maryland contractor was Robert Welch. Welch said of the material encountered during tunneling, "it had the consistency of bearing grease."

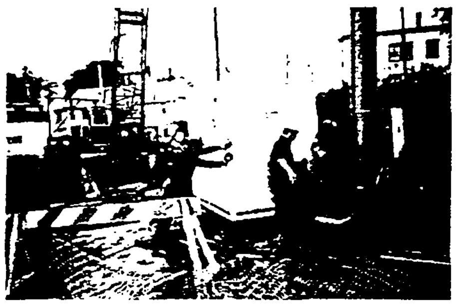
Sandwiching the tunnel work were two



Akkerman Model WM 74.5 TBM was built for the Portland job and shipped in two sections which were assembled in shaft. Note cutting teeth at left end.

Photo of end of conveyor looking towards shaft where battery-powered muck cart — loaded with marine clay — has gone.



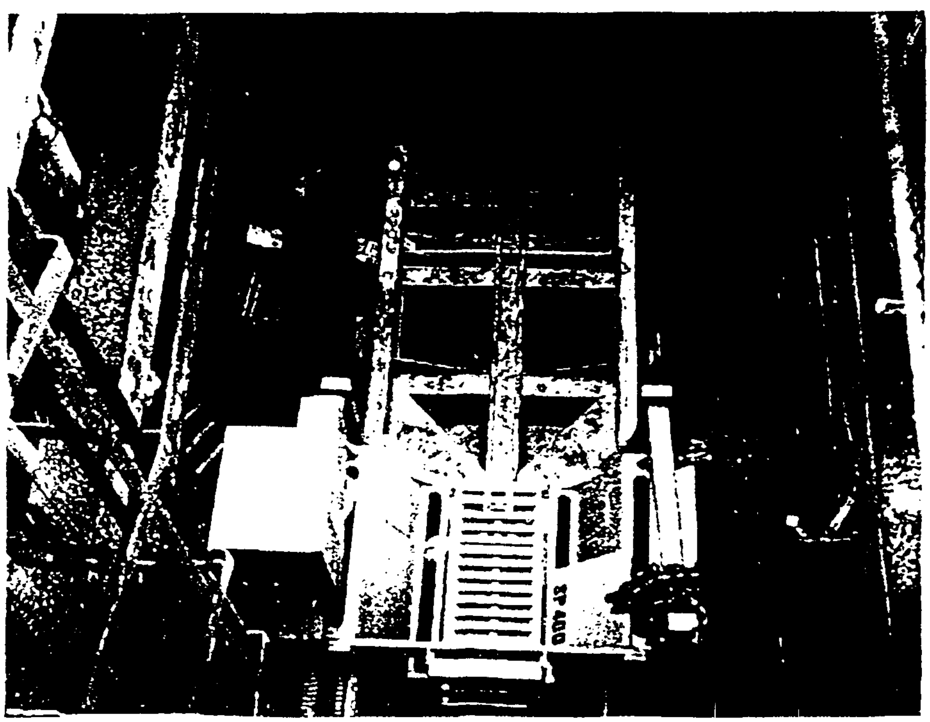


Above left: The TBM "holes through" at the open-cut end, aligned perfectly, thanks to guidance by Spectra-Physics laser. Above right: Robert Welch, Mike Bray and Romeo Morisette of Bradshaw Contracting are assisted by American 60-ton crane as they disconnect portable power unit from utility pole. Below: Cradle of Akkerman SP400 jacking system awaits lowering of pipe.

Welch said of the material encountered during tunneling, "it had the consistency of bearing grease."

sections of open-cut cross country pipe installations of 400 and 350 feet each. Excavation and pipe installation in the open-cut sections were handled by White Brothers. The Portland contractor also excavated an open drainage channel and installed riprap in a section about 175 feet long. Callahan Brothers started excavating the shaft in March 1993. By the end of August, the TBM had been removed, a precast 9-1/2-foot by 23-foot deep manhole had been installed, the hole had been backfilled and the sheeting had been pulled.

Parker said "I am very pleased with this job. This was an excellent crew." ❖



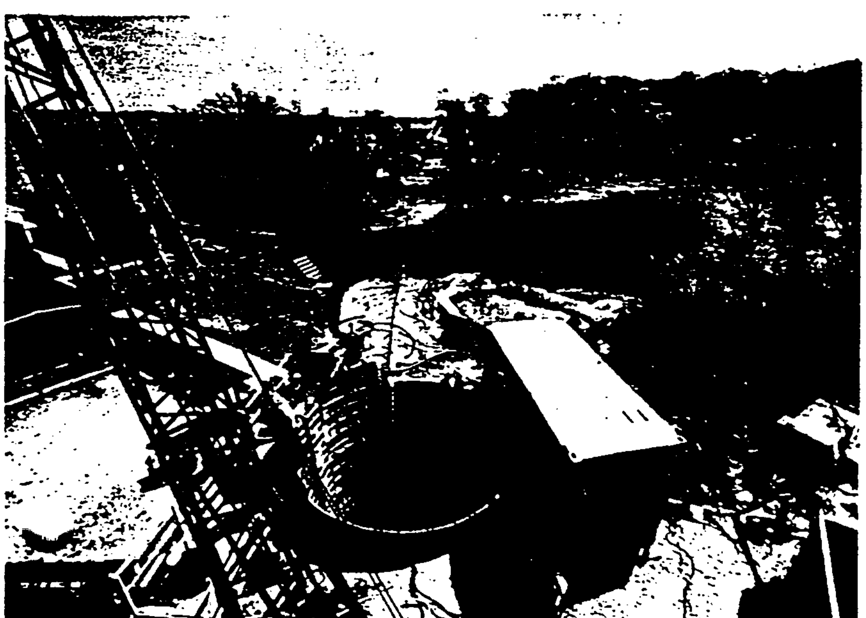
NUCA Contractors Microtunnel

by James B. Gardner, editor

This February, NUCA member Cossentino Contracting Co., Inc., of Baltimore, Md., won a sizable contract to install roughly 6,000 ft. of 8- to 12-in. DIP gravity and force-main sewer for Baltimore County, Md. This new sewer will replace septic systems for waterfront homes as part of a program to clean up the Chesapeake Bay.

Though this competitively-bid job has offered more challenge and interest than many — requiring deep cuts on a narrow right-of-way and extensive dewatering and shoring — the focus of construction activity has been around an environmentally-sensitive inlet in the Bay, which the sewer must cross. This wetlands area required the Baltimore County Department of Public Works to design a tunneled crossing beneath the inlet in order to obtain the required permits from the Maryland Department of Natural Resources and the Army Corps of Engineers.

Cossentino Contracting selected NUCA contractor L.M. Bradshaw Contracting, Inc., of Ellicott City, Md., as the tunneling subcontractor to install the 212 ft. of 30-in. steel casing pipe and 12-in. grouted DIP carrier pipe required for the crossing.



Dewatering equipment, jacking pit, sediment pond, control shed, power-generating equipment, a crane, and a [illegible] tank are prime components of this delicate microtunneling operation on the shores of the Chesapeake Bay. The far jacking pit is visible across the inlet (center of photo) just beneath the white house, and to the left of the orange fencing.

L.M. Bradshaw proposed to use the Iseki *Unclemole* microtunneling system to install the casing — its first application in the Mid-Atlantic area and the reason for all the attention. Bradshaw's proposal to microtunnel the 30-in. casing instead of using its conventional auger boring equipment or installing a 48-in. liner plate by hand under compressed air was dictated by concern for worker safety, integrity of the wetlands, soil conditions, and the need for great accuracy.

Soil Vs. Warm Pudding

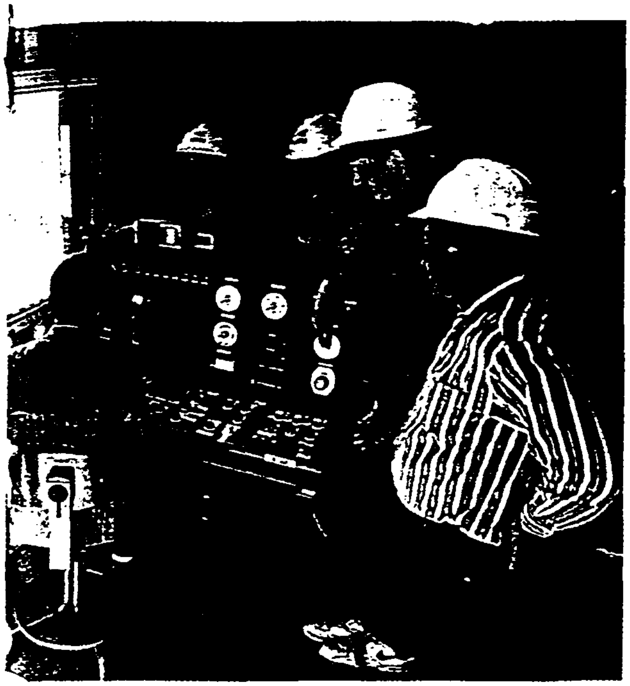
The owner's soil borings along the tunnel alignment indicated saturated clay silts with blow counts at the casing elevation of only the weight of hammer. "The soils directly under the marsh channel were considered to be about the consistency of warm chocolate pudding," Lester Bradshaw, Jr., the firm's president/owner, said.

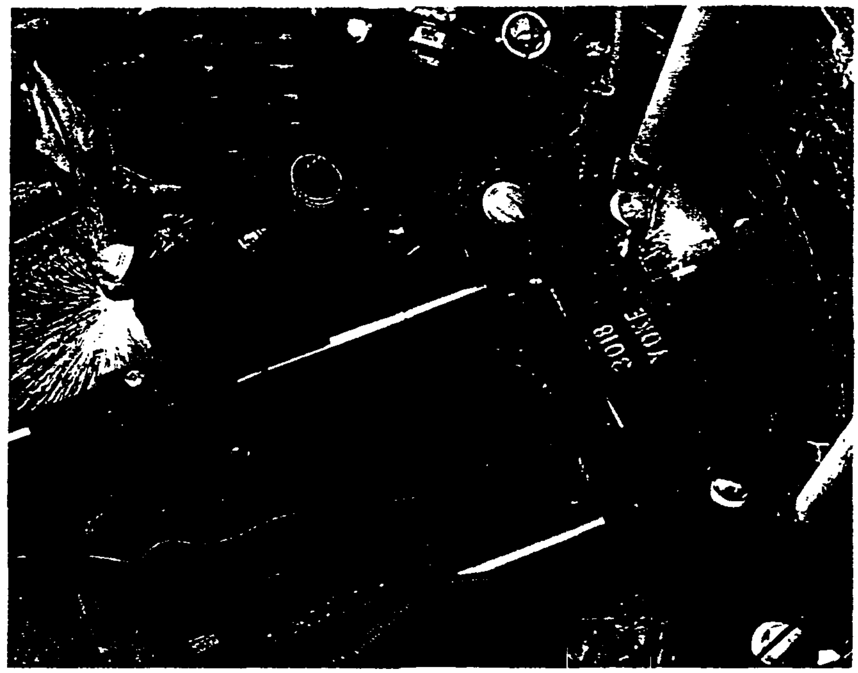
Groundwater, located just 3 ft. below the surface, was subject to 3-ft. tidal variations. The marsh channel provided only 10 ft. of tidal-muck cover to the top of the casing. There was great potential for "quick- or boiling-sand" conditions and a heading collapse along the tunnel alignment. The Iseki microtunneling system, designed to operate unmanned, would save workers from a variety of safety risks.

The Unclemole uses mechanical earth pressure combined with hydrostatic slurry pressure to balance both earth and groundwater pressures at the tunnel face. When properly balanced, the tunnel heading is prevented from collapsing or blowing out and possibly damaging the wetlands. The excavated soils are removed by the slurry system and pumped into surface settlement tanks, which facilitate spoil removal.

The extremely narrow construction site at the crossing allowed no room for a misaligned installation. A pump station, required to be located just 250 ft. downstream from the crossing, made grade tolerances critical and grade adjustments nearly impossible. Conventional cased-auger boring methods

L Chesapeake Bay Wetlands





could not guarantee installation within the required line and grade tolerances, nor could this method ensure against a heading collapse and significant disturbance to the wetlands.

Compressed-air hand-mined tunneling is laser-guided, just as the Iseki Unclemole specified for this job, but it was also judged too risky for the tunnel miners and the wetlands because of the possibility of a heading blowout.

Start-up of the job began with Cossentino workers installing extensive sediment controls, including large dewatering basins at each pit. These are very important environmental controls required by the contract permit and were subject to outside inspection by EPA. Cossentino was required to dispose of all tunnel spoils under specific review and approval of the Army Corps of Engineers.

After setting up wellpoint dewatering systems, L.M. Bradshaw excavated a 21-ft.-deep, 18-ft.-wide circular jacking pit constructed of liner plate and steel ribs. The contractors placed this pit at the up-stream manhole where there was sufficient work area for the rather large complement of support equipment required to run the Unclemole.

Workers excavated the receiving shaft at the downstream manhole to a depth of 20 ft. and lined the shaft with 12-ft.-diameter liner plates. They concreted the inverts of both shafts, installed sumps, and welded and concreted steel exit and entrance rings with rubber-gasket diaphragms into the jacking and receiving pits. A 5-ft. by 9-ft. poured-in-place concrete thrust block was constructed in the jacking pit.

Water And Then Some

During mobilization and wellpoint installation, heavy rains, a strong northeast wind, and exceptionally high tides flooded the receiving shaft area. Water crested 18 in. above the street pavement. Fortunately, the weather was more cooperative during the tunneling phase.

Iseki shipped the microtunneling equipment directly from Japan in wooden crates. Unpacking, setup, and connection of the equipment to the various electrical, hydraulic, and slurry systems took four days. After setting the jacking frame, workers installed a self-leveling laser to proper line and grade.

Above left, seated at the Iseki microtunneling control panel is Iseki training supervisor Hama Hata. Standing, (l-r) are Bob Bradshaw, Les Bradshaw, Jr., Iseki engineer Scot Bruckner, and L.M. Bradshaw general superintendent Jerry Simon. Above right, L.M. Bradshaw workers torch and weld site-designed hardware to hold the jacked casing pipe in place.

The design engineer specified steel pipe for the 30-in. casing. "We liked that choice because we felt that the rigid welded joints of the casing would keep the Unclemole from sinking if the soils proved too soft," said Les Bradshaw, Jr. "Conversely, the casing pipe would resist uplift forces caused by the pipe's buoyancy if the soils behaved more like a liquid than a solid — which proved to be the case."

The first 20 ft. of the microtunneling proceeded on line and grade with only minor delays stemming from the contractor's unfamiliarity with the system and from some required equipment modifications. On the second day of jacking, however, the Unclemole passed beyond the wellpointed section (first 35 ft. of tunnel alignment) and began to rise above the design grade and push off to the right. By the end of the second day, a total of 80 ft. of casing was in place, but the Unclemole was 1-½ in. high and 1-½ in. to the right. Jacking pressures had declined from 35 tons to 25 tons, and there was no significant earth pressure registering against the face. In order to develop earth pressures, the Iseki operator rarely opened the slurry valves to the Unclemole — and thus excavated little soil.

Over the next five workdays, the construction team tried numerous strategies to bring the Unclemole down to grade and back on line. Only 50 ft. of casing pipe was installed during this time, and it was all directly under the tidal marsh channel. Face pressures continued to be very low, and while attempts were made to correct line and grade, the Unclemole started to jackknife off the end of the casing. Iseki chief engineer Tom Kusumoto flew to the jobsite, evaluated the problems, and ordered retracting rods from Texas, which were used to pull the Unclemole back into the casing pipe. The next day, the crew installed 80 ft. of casing, with line and grade under control.

Cossentino job foreman Jimmy Kunkel, president/owner Jack Cossentino, and fellow-contractor Jay Matricciani review dewatering operations prior to making the first conventional open cut.

Nearly A Bull's-eye

The crew recovered the Unclemole in the receiving pit the following day. The casing ended up only ¼ in. high and 1 in. to the right, which was outstanding, given the exceedingly difficult soil conditions. Later surveys showed a 2-in. hump in the middle of the casing where the marsh channel was the deepest and the buoyancy forces were greatest. Iseki's Tom Kusumoto said that neither he nor his associates had ever experienced soil conditions such as these. Even when the jacks pushed the Unclemole at their maximum rate, no significant face pressure could be developed, and without the face pressure, steering was difficult at best.

Bradshaw workers completed the job by pulling the 12-in. DIP sewer pipe into the 30-in. casing and filling the void between the two pipes with lightweight concrete (80-100 pcf), which the owner specified to minimize the possibility of settlement of the casing after backfilling. Concrete this light in weight was not commercially available, so L.M. Bradshaw batched it on-site. Workers added carefully measured amounts of a foaming agent provided by Mearl Corporation, and a super-plasticizer to each ready-mix truck carrying the appropriate amount of sand and cement. This mixture was gravity-fed into the casing in one continuous three-hour backfilling operation.

Pleased In Retrospect

Looking back at the project, L.M. Bradshaw is pleased. Line and grade of the casing pipe was well within required tolerances. The wetlands were undisturbed. The project was extremely safe, with no injuries.

"Our microtunneling crew performed admirably," Les Bradshaw said. Under the direction of general superintendent Jerry Simon, and boring supervisor Dick Roknich, along with the support of dewatering supervisor Daniel Maple, L.M. Bradshaw's microtunneling crew achieved 75 percent of optimal production on the second day and 100 percent of optimal production on the last day of the crossing. In fact, 70 percent of the crossing was completed in those two days. This was quite an achievement by this crew, since there was only one relatively short tunnel on the project to learn from. "Our goal was to make this project a success for the general contractor, Cossentino Contracting, and the owner, Baltimore County, Md. We think we achieved that in the end," Bradshaw said.

Asked at the recent Kansas City No-Dig convention if he would use microtunneling again, Les Bradshaw nodded in the affirmative. "We've already bid two more projects that necessitate microtunneling to meet demanding safety and quality standards," he said. With regard to quality, L.M. Bradshaw takes great pride in Iseki chief engineer Tom Kusumoto's statement that "L.M. Bradshaw works just like a Japanese contractor — meaning that quality comes first."

Jack Cossentino and Jay Matricciani inspect a large trench box, which Cossentino Contracting employed with other shoring materials for the deep cuts required on this challenging job.

"We share that vision of quality work with Iseki," Bradshaw said. "Their microtunneling equipment will definitely figure into our future projects."

With the microtunneling phase of the job complete, the focus is back on more traditional underground utility construction operations: deep cuts, high water, horrendous soil conditions, heavy trench boxes, imported fill, demanding compaction specifications, and concerted coordination efforts — activities that Jack Cossentino's firm is well schooled in. "This has been a great job for us," said Jack Cossentino, president. "It benefits residents, the community, the Bay, and the wildlife. It keeps our employees working and our managers on top of their trade. We think this job demonstrates real progress for Baltimore, and we're very pleased to be a part of it." ■

Continued from page 19

The company's extensive safety program requires Kurth to wear several different hats, ranging from jobsite "inspector," to employee safety trainer. But it doesn't seem to bother him. He started in the business as a laborer, moved to foreman, and in 1989 was given the charge of field safety. "I think the fact that I have 21 years of field-related experience helps me to understand how the workers perceive our safety program, and also helps them to understand where I am coming from," Kurth said. "It greatly helps our communication, which we feel is a very important factor in maintaining a successful safety program."

A successful safety program consists of two-way communication between the office and the field, and the company's weekly tool-box talks are the main means of communicating safety to field personnel. The foreman discusses the tool-box talk with the crews each week, and the crews provide feedback on topics they would like discussed in the future.

The company also gives awards to crews that work up to the standards of the safety program. This selection is made by reviewing all aspects of work performed—jobsite inspections, claims and damage reports, quality of workmanship, and general attitude. "Four or five years ago, we were happy to find one crew that qualified for safety crew of the month. Now we sometimes have eight or nine a month," Kurth said.

The company's safety department is very involved in the monitoring of standards and regulations affecting the industry. Much of the credit for the company's safety progress goes to Delaine Nelson, NUCA president-elect, who developed and still directs the safety program. Mueller has long been recognized as one of the safest construction companies in the industry. Since 1981, the company has been the recipient of at least one safety award each year. ■

GENERAL INTRODUCTION

J. D. HAIR & ASSOCIATES, INC.

J. D. Hair & Associates, Inc. is a professional corporation which was established in 1987 and is based in Tulsa, Oklahoma. The firm's objective is to focus creative engineering talent on projects involving the installation of buried utilities by trenchless construction methods. In the eleven years since its founding, J. D. Hair & Associates, Inc. has been involved in over 50 miles of trenchless utility construction covering pipe diameters from four to forty-eight inches. A practical approach to the design and construction of trenchless installations is provided by the firm's principal, John Hair. This approach is an outgrowth of Mr. Hair's experience with Reading & Bates Horizontal Drilling Co., a leader in the early development of horizontal directional drilling methods. As Manager of Contracts and Engineering for Reading & Bates, Mr. Hair was responsible for new applications and project engineering on horizontally drilled pipeline projects worldwide. Significant advancements for which he provided applications engineering include the first horizontally drilled pipeline landfall and introduction of the horizontal drilling technique to the pipeline industries on the European Continent and in Asia.

J. D. Hair & Associates, Inc. is structured to provide professional engineering and construction management services. The firm's in-house capabilities include project management, engineering analysis, computer-aided design and drafting, and topographic & hydrographic surveying. Construction monitoring and operational support services are provided by project engineers working with construction supervisors drawn from a cadre of highly skilled individuals with whom J. D. Hair & Associates, Inc. has worked in the past.

Overall project management responsibility for the firm rests with John Hair. Mr. Hair brings substantial technical innovation and project management skills to the project team. His eleven years of experience in establishing and managing a successful consulting engineering practice have proven his capabilities for supervising complex, and routine, design projects. Additionally, his experience as a contractor with Reading & Bates enables him to incorporate a contractor's perspective in design. This yields benefits in terms of better defined and more constructable (less costly) designs.

The engineering services offered by the firm today include engineering support for contractors, production of preliminary and detailed engineering reports and drawings for utility owners and design firms, and construction management. The firm's clients are located throughout the United States and internationally.

PROJECT EXPERIENCE

J. D. HAIR & ASSOCIATES, INC.

J. D. Hair & Associates' specific qualifications in the area of trenchless construction are demonstrated by the numerous past projects on which the firm has provided professional engineering services. Some of the more significant of these projects are described below:

York County Wastewater Force Main, 24 inch Catawaba River Crossing

J. D. Hair & Associates provided design and consulting services relative to the installation of a 24 inch diameter sanitary sewer force main beneath the Catawaba River in York County, South Carolina. In an effort to minimize construction cost, this project was bid by both microtunneling and horizontal directional drilling contractors. Services provided include preliminary feasibility analysis; detailed cost estimates; route selection; microtunneling and horizontal directional drilling crossing designs; production of technical specifications governing crossing installation for each construction method; and construction monitoring. Preliminary engineering work began in the summer of 1995. Installation was completed in the summer of 1996.

Vermont Gas Systems, Phase 1 Looping

J. D. Hair & Associates functioned as a consultant to Vermont Gas Systems for the installation of a 16 inch natural gas pipeline beneath the Missisquoi River on this project. This involved preliminary design and feasibility analysis, preparation of design specifications, and construction management. This 1,900 foot crossing was the first horizontally directionally drilled crossing in the state of Vermont. Preliminary engineering work began in 1990 with installation completed in the fall of 1995.

Commonwealth Electric Company, 18 inch Cape Cod Canal Crossing

J. D. Hair & Associates provided total design and construction management services involved with an 18 inch natural gas pipeline crossing of the Cape Cod Canal. This involved preliminary design and feasibility analysis, consultation during the permitting phase, production of design specifications and drawings, preparation of contract documents, and construction management. This 1,400 foot crossing was the first directionally drilled installation beneath the Cape Cod Canal. Preliminary engineering began in the fall of 1993 with installation completed in the summer of 1995.

Pipeline Research Committee at the American Gas Association

Under the sponsorship of the Pipeline Research Committee at the American Gas Association, J. D. Hair & Associates produced two manuals related to horizontally drilled pipeline river crossings. The first was an applications manual focused on drilling fluids and their function in drilled crossings. The second was an overall design guide covering engineering considerations in evaluating, designing, and installing a drilled river crossing. Work began in the fall of 1993 and both publications were completed by August of 1995.

San Antonio, S. A. Consulting and Operational Support, Horizontal Drilling Spread

J. D. Hair & Associates provided consulting services relative to the purchase of a horizontal drilling rig, drilling mud system, and downhole tooling for San Antonio, S. A., an Argentine contractor located in Buenos Aires. This support consisted of on-site operational training with the equipment as well as engineering support in the United States. Initial consulting services began in 1993 with the first crossing installation completed in the fall of 1994. Engineering support is currently ongoing.

TransCanada PipeLines 42 inch Mississippi River Crossing

J. D. Hair & Associates functioned as consultant to TransCanada for the installation of a 42 inch natural gas pipeline beneath the Mississippi River (Ontario) on this project. This involved preliminary design and feasibility analysis, assistance in permitting, preparation of design specifications, and construction monitoring. The crossing is welded steel pipe with a drilled length of approximately 1,900 feet. Preliminary engineering work began in 1993 with installation completed in the fall of 1994.

Sunshine Pipeline Company Proposed 30 inch Natural Gas Pipeline

J. D. Hair & Associates provided engineering services relative to preliminary design and permitting of waterway crossings on this proposed 30 inch natural gas pipeline extending approximately 600 miles from Pascagoula, Mississippi to Tampa, Florida. Evaluations were conducted at over 40 waterways to determine the optimum crossing method. Specific tasks undertaken on this project included coordination of site surveys for drilled crossings, feasibility analysis for drilled crossings, route analysis for drilled crossings, production of drawings for permit applications, and production of plan & profile drawings describing the drilled crossings. Preliminary engineering work began in late 1993; the project is currently on hold pending market developments.

Central Hudson Gas and Electric MPR Gas Transmission Pipeline

J. D. Hair & Associates functioned as design consultant to Central Hudson for the installation of a 16 inch natural gas pipeline beneath the Hudson River on this project. This involved preliminary design and feasibility analysis, preparation of permit applications, geotechnical surveying, preparation of design specifications and drawings, and construction monitoring. The crossing is located near Poughkeepsie, New York. It is welded steel and has a total length of approximately 4,500 feet. The geology at the site required a creative design involving a combination of cut and cover and trenchless excavation. Preliminary engineering work began in early 1990 with installation complete in the spring of 1992. **The crossing was recognized in 1993 as an Outstanding Engineering Achievement by the New York State Society of Professional Engineers.**

Hampton Roads Sanitation District Gloucester Interceptor Force Main

J. D. Hair & Associates provided specialized sub consulting services relative to the design and installation of the 30 inch York River crossing on this project. This consisted of preliminary design and feasibility analysis, route selection, production of a finished plan & profile drawing describing the drilled crossing, and provision of technical specifications governing the drilled crossing installation. The crossing, part of a new sanitary sewer force main, is welded steel pipe with a drilled length of approximately 3,400 feet. Preliminary engineering work began in late 1988 with installation completed in early 1992.

Iroquois Gas Transmission System

J. D. Hair & Associates functioned as consultant to Iroquois Gas Transmission for evaluation and design of drilled segments on this 369 mile cross-country natural gas transmission system which extends from Iroquois, Ontario to South Commack, New York. Detailed drilled crossing designs, including drawings and specifications, were produced for the Hudson River, Housatonic River, Milford Shoreline, and Northport Shoreline crossings. Geologic conditions on all crossings presented state of the art challenges. Because of this, J. D. Hair & Associates recommended that the St. Lawrence River and Hudson River be installed by cut and cover construction. The shoreline crossings were installed by cut and cover construction at contractors' option. The Housatonic was installed by horizontal directional drilling. J. D. Hair & Associates provided support during contract negotiations and construction monitoring assistance on this crossing. Preliminary engineering work began on these drilled segments in mid 1990. Installation was completed on all crossings by late 1991.

Exxon Company U.S.A. Mobile Bay Development

Four drilled crossings consisting of dual drilled segments and multiple pipelines were involved in the development of this offshore oil and gas production facility. J. D. Hair & Associates provided specialized sub consulting services relative to the design and installation of these drilled crossings. This consisted of preliminary design and feasibility analysis, production of plan & profile drawings describing the drilled segments, provision of technical specifications governing installation, and contract negotiation support. The total drilled length of these segments was approximately 15,000 feet. Pipe installed was welded steel and ranged in diameter from 3 inch to 24 inch. Design began in mid 1990 with installation completed in the summer of 1991

AT&T Communications Fairview, KS to Kansas City, MO FT "A" Cable

J. D. Hair & Associates provided total design and construction management services involved with the installation of ten horizontally drilled stream crossings, including two crossings of the Missouri River, on this cross-country telecommunications system. This included topographic, hydrographic and geotechnical surveying; production and distribution of drawings and specifications; and construction monitoring. The crossings consisted of 5 inch steel drill pipe containing multiple polyethylene innerducts. Design engineering and installation were completed in 1988.

These projects represent only a partial listing of the experience of J. D. Hair & Associates. The collective experience of the practice since its inception in 1987 comprises over 50 miles of trenchless utility construction with an estimated construction contract value of well over 50 million dollars.

J.D.Hair&Associates,Inc.
Consulting Engineers

PROFESSIONAL RESUME, JOHN D. HAIR

GENERAL Twenty-four years experience in the design, specification and construction of pipeline transportation systems and hydrocarbon production facilities. Most recent position has been as a consulting engineer with emphasis on installation of pipelines and conduits by trenchless construction methods.

EDUCATION BSCE Louisiana State University, 1974

PROFESSIONAL Registered Professional Engineer in the states of Alabama, Arkansas, Florida, Kansas, Louisiana, Massachusetts, Mississippi, Missouri, Oklahoma, Texas and Virginia.

Member of the American Society of Civil Engineers, National Society of Professional Engineers, and North American Society for Trenchless Technology

EXPERIENCE

1987 - Present **President**
J. D. Hair & Associates, Inc.

Principal in a consulting firm providing specialized engineering services related to the design, construction and environmental impact of pipelines and buried utilities. Specific area of expertise involves trenchless excavation applications. Services provided include economic and technical analysis of prospective applications, detailed design of facilities, preparation of bid documents and permit applications, and construction management.

1982 - 1987 **Manager of Contracts & Engineering**
Reading & Bates Horizontal Drilling Co.

Responsible for project engineering and contract administration on company's horizontally drilled pipeline projects on a worldwide basis. Duties included project feasibility evaluation, new applications development, contract negotiations, and management of the Contracts & Engineering Group professional staff.

1982 **Assist. Manager of Contracts & Engineering, European Operations**
River Crossing Division, Reading & Bates Construction Co.

Responsible for project engineering and contract administration on company's horizontally drilled pipeline projects in Europe, Africa and the Middle East. Duties included project feasibility evaluation, contract negotiations, and coordination of field operations.

1980 - 1982 **Contracts Engineer**
River Crossing Division, Reading & Bates Construction Co.

Responsible for technical evaluation, cost estimating, and project design for prospective applications of company's horizontal drilling process.

1978 - 1980 **Senior Engineer**
International Pipeline Engineers, Inc.

Performed design, material and equipment specification, and field construction supervision for construction of a crude oil production and pipeline system in northwestern Peru. Responsibilities involved all phases of civil and mechanical design along with construction management.

1978 **Senior Engineer**
Gulf Interstate Engineering Co.

Assisted in the formulation of design criteria to be used in the mile by mile design of the Northwest Alaskan Gas Pipeline. Specific area involved was stress analysis of the pipe-soil structure when subjected to earthquake, frost heave, and high temperature differential loads.

1977 - 1978 **Terminal Operations Engineer**
Gulf Interstate Energy, Inc.

Performed design, material and equipment specification, contract coordination, and construction supervision for the renovation of a petroleum products terminal in the New York metropolitan area.

1976 - 1977 **Project Engineer**
Gulf Interstate Engineering Co.

Functioned as an advisor on pipeline technology to federal authorities monitoring construction of the Trans Alaska Pipeline System. Review of design was involved along with extensive field surveillance of construction.

1974 - 1976 **Associate Engineer**
Continental Pipe Line Company

Performed economic and technical analysis and design concerned with the transportation of crude oil and petroleum products. Also had responsibility for field construction supervision of projects involving additions to petroleum piping systems.

PUBLICATIONS

"Design and Project Management Considerations Involved with Horizontal Directional Drilling", presented at the AGA Operations Conference, Las Vegas, Nevada, May 7-10, 1995.

Installation of Pipelines by Horizontal Directional Drilling, An Engineering Design Guide, prepared under the sponsorship of the Pipeline Research Committee at the American Gas Association, April 15, 1995.

Drilling Fluids in Pipeline Installation by Horizontal Directional Drilling, A Practical Applications Manual, prepared under the sponsorship of the Pipeline Research Committee at the American Gas Association, October 31, 1994.

"Analysis of Subsurface Pressures Involved with Directionally Controlled Horizontal Drilling", presented at the ASCE "Pipeline Crossings" Conference, Denver, Colorado, March 25-27, 1991.

"Considerations in the Design and Installation of Horizontally Drilled Pipeline River Crossings", presented at the ASCE "Pipeline Infrastructure" Conference, Boston, Massachusetts, June 6-7, 1988.

"Directionally-controlled drilling for pipelines", presented at the Institute of Public Health Engineers "NO-DIG 85" Conference, London, England, April 16-18, 1985.

"Pipe Line Landfall Construction by Horizontal Drilling", presented at the ASCE "Arctic '85" Conference, San Francisco, California, March 25-27, 1985.

Joseph T. Zimnoch

Consultant
High Voltage Electrical Cables and Accessories

October 24, 1995

On May 31, 1995 I retired from The Okonite Company, after a 41 year career there in high voltage cables.

In the last 4 years of my employment, I accepted and completed a number of consulting projects, with the consent of the The Okonite Company. I am pleased to announce the continuation of my consulting services and will remain fully active in the industry.

My background and years of experience with cable systems offer many benefits, especially in this time of deregulation and change in our electric power utility companies. Attached is additional information on my credentials and more importantly, areas where my expertise can be of value to you and your company.

I will be attending the ICC fall meeting in St. Petersburg, Florida on November 5th thru the 8th. If you also plan on attending, I look forward to seeing you there.

Thank you for your time and if I can be of any service to you in the future, please don't hesitate to contact me.

Yours Truly,

Joseph T. Zimnoch

Joseph T. Zimnoch

1 Sonia Court ■ Suffern, New York 10901 ■ Tel: (914) 357-8923 ■ Fax: (914) 369-6503

Joseph T. Zimnoch

Background Profile

Employed by The Okonite Company from 1954 to May 1995 and involved with all type 5 kV to 500 kV laminated insulation high voltage cable systems including HPFF, LPP, HPGF, SCLF, LPGF and solid type PILC.

Bachelor of Science Degree (1955) and Master of Science Degree (1958) in Electrical Engineering from Newark College of Engineering (NJIT - New Jersey Institute of Technology)

<u>1954 to 1958</u>

Research and Development Engineer on new and improved types of power cables and cable components.

<u>1958 to 1968</u>

Application Engineer involved with design, coordination, installation and testing of paper cable, rubber and plastic insulated cable systems at all voltage levels up to and including 345 kV.

<u>1968</u>

Appointed Assistant Chief Engineer - Oilostatic Systems and was responsible for review, engineering, material procurement and delivery coordination of cables and accessories - including turnkey installations. Other duties included direct responsibility over staff of four Field Advisors as well as procurement, maintenance and scheduling of field rental installation equipment..

<u>1972</u> - Appointed Chief Engineer - High Voltage Systems

<u>1979</u> - Appointed Director - High Voltage Systems

<u>1987</u> - Appointed Director - Paper Cable Engineering

Overall duties included Project Engineering and direction of Okonite engineering staff handling high voltage cable system projects. Had direct responsibility for Okonite high voltage cable systems in all parts of the United States and overseas installations. Some unusual projects outside of the continental USA included:

- Five 154 kV High Pressure Fluid Filled pipe-type cable systems in Seoul, Korea
- 115 kV High Pressure Gas Filled pipe-type cable system in Saudi Arabia
- 115kV and 130 kV self-contained oil-filled installations in Chile and Yugoslavia
- 138 kV oil-filled submarine cable in Alaska

Member of National Association of Corrosion Engineers and active voting member of IEEE Insulated Conductor Committee.

Vice Chairman of ICC SC/T6 3-58 on "Remaining Life of Impregnated Paper Insulated Transmission Cable Systems"

Expert reviewer for the 1992 Edition EPRI " Underground Transmission Systems Reference Book "

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Joseph T. Zimnoch

High Voltage Electrical Cables - Consultation Services

- Examination, evaluation and recommendation for corrective action/maintenance on all type existing laminated insulation high voltage cable systems. Pipe-type cable systems are very reliable and can continue to operate trouble free if given a little timely attention. Serious and costly problems can be avoided if caught and attended to early in their formation, many times at rather small comparative cost.

- Provide experienced assistance and guidance to work along with your personnel during system disturbances such as pipe/cable/splice/termination failures. Efficient handling and repair procedures minimize system/environmental damage, keeping costs under control and resulting in earliest possible safe restoration of circuit.

- Handle or assist with arrangements for obtaining services of outside installation contractors, suppliers, or laboratory services. Have excellent relationship with these firms from many previous years of dealing with them on high voltage projects.

- Preparation of purchase specifications for new pipe-type cable systems and reconfiguration or reconductoring of existing systems. Where existing in-house specifications already exist, a review can assure these are in line with current state-of-the-art.

- Inspection of cable production tests and qualification tests at manufacturers' plants for quality assurance and purchase order compliance.

- Independent review, analysis, recommendations pro and con, of supplier bid proposals for new cable system purchases.

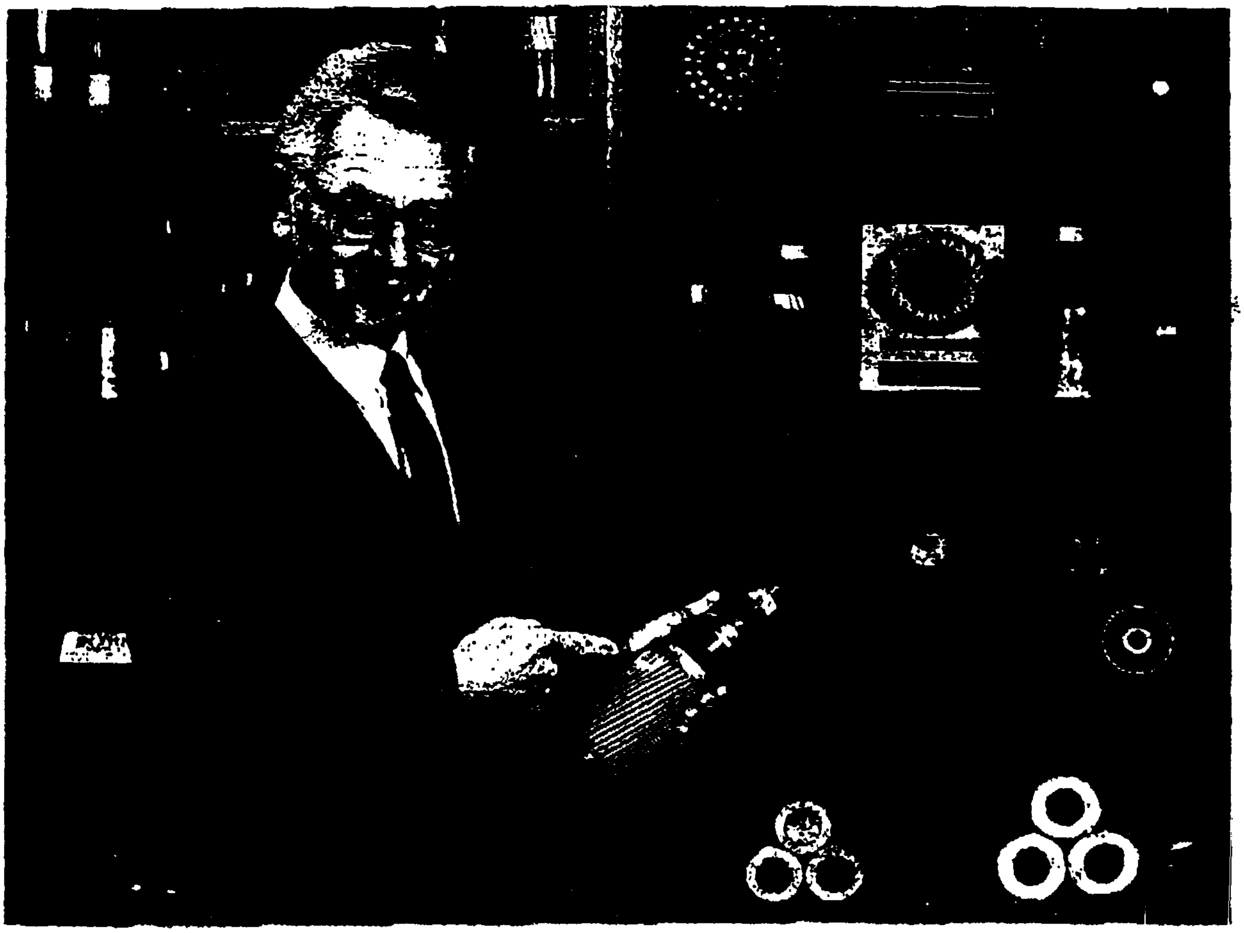
- Expert witness in litigation type situations.

- Failure examination and analysis of cables and accessories.

- Field guidance and supervision during installation of new cable systems or reworking/repair of existing systems.

1 Sonia Court ■ Suffern, New York 10901 ■ Tel: (914) 357-8923 ■ Fax: (914) 369-6503

At Okonite, Excellence in Paper Cable Engineering is a Time-Honored Tradition



Meet a Legend and a Tradition

Joe Zimnoch has devoted over 35 years to the design, manufacture and installation of laminar insulated cable systems. Since Pipe-Type cables were invented and pioneered by Okonite in the early 1930's, our cable engineers have been innovating improvements in this technology, including the most recent introduction of Oilostatic LPP® (Laminated Paper Polypropylene) cables.

With his extensive experience and electrical engineering background, Joe speaks most authoritatively on the many advantages and features of Okonite's paper cable products, systems and field engineering services—including turnkey installations. This technical expertise, in conjunction with the most modern manufacturing facility in the industry, represents engineering superiority and leadership unmatched anywhere.

Engineering excellence together with quality products and services have characterized Okonite for over 100 years. Joe Zimnoch proudly personifies these traditions.

THE OKONITE COMPANY
Ramsey, New Jersey 07446

1 Sonia Court
Suffern, New York 10901

TEL (914) 357-8923
FAX (914) 369-6503

JOSEPH T. ZIMNOCH

Consultant

High Voltage Electrical Cables and Accessories

The following list is a chronological record of previous and current clients where consulting engineering services have been provided. The 1990 through 1993 services were provided with the knowledge and consent of The Okonite Company prior to my retirement from The Okonite Company on May 31, 1995 after 41 years of service.

1990

Pirelli Cable Corporation
Florham Park, New Jersey

1992

Commonwealth Electric Company
Wareham, Massachusetts

1993

Haight, Brown & Bonesteel (Pirelli Cable Corporation)
San Francisco, California

1995

Public Service Electric & Gas Company
Newark, New Jersey

The Okonite Company
Ramsey, New Jersey

1996

Korea Electric Power Company
Seoul, Korea

Detroit Edison Company (EPRI)
Detroit, Michigan

The Okonite Company (Commonwealth Edison)
Ramsey, New Jersey

1996 - cont'd....

D. Hittle & Associates
Richland, Washington

PECO Energy Company
Philadelphia, Pennsylvania

Power Delivery Consultants, Inc.
EPRI Waltz Mill Test Facility
Ruffs Dale, Pennsylvania

Margus Company, Inc.
Edison, New Jersey

1997

Power Concepts L.L.C.
New York, New York

Virginia Electric and Power Company
Richmond, Virginia

Eastern Utilities (Newport Electric)
Newport, Rhode Island

The Okonite Company
Ramsey, New Jersey

Ontario Hydro Technologies (Con Edison)
Ontario, Canada

Commonwealth Electric Company
Wareham, Massachusetts

Black & Veatch
Overland Park, Kansas

JTZ/rtp
11/10/97