

E183 Relocation - Underground Options

01/04/2007  
DMC

	10/01/2004 Est Original Route	01/01/2007 Est Original Route	Difference 2007-2004 Original Route	Jan-2007 Original Rt IPP HDD	Jan-2007 Collier Point Route
Underground Cable	11,470	14,420	2,950	14,820	15,750
Franklin Square Transition Station	970	1,190	220	1,190	0
Manchester Street Transition Station	0	0	0	0	4,830
E Providence (Tockwotton) Transition Station	1,000	1,200	200	1,200	1,200
Overhead Line Work	1,010	1,100	90	1,100	1,100
AFUDC @ 5.22 %		1,070		1,095	1,380
<b>Total</b>	<b>14,450</b>	<b>18,980</b>	<b>3,460</b>	<b>19,405</b>	<b>24,260</b>
Existing Funded Amount	14,475	14,475		14,475	14,475
Shortfall	-25	4,505		4,930	9,785
Property Rights Needed	A	A	A	A	B

Not Included: Property Acquisition Costs, Extensive soil contamination costs (if encountered)  
Phase 1 Overhead Relocation Costs not included.

**Property Right Summary**

A: Manchester St Station (Dominion), private lot next to AlForno, India Point Park,  
Tockwotton Site (E Prov), Prov DPW Utility permit, RIDOT Utility permit, E Prov DPW Utility permit

B: Manchester St Station (Dominion), private lot at India Point HDD landfall, "Shooters" site (optional), India Point Park,  
Tockwotton Site (E Prov), Prov DPW Utility permit, RIDOT Utility permit, E Prov DPW Utility permit

**Campilii, David M.**

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**From:** Beron, David  
**Sent:** Thursday, October 19, 2006 5:32 PM  
**To:** Campilii, David M.  
**Subject:** RE: E-183 Transmission Line

Dave

I would recommend incorporating the following revised study estimates for the remaining OH portions of the work:

Remove Phase 1 Temporary Relocation:	\$200 K
Relocate and reconstruct the Phillipsdale Tap line:	\$700 K
Remove portions of the Phillipsdale Tap line	\$50 K
Remove Existing E183 line (Phase 2)	\$150 K

Thanks  
Dave

David J. Beron, P.E., P.M.P.  
Project Manager  
National Grid  
25 Research Drive  
Westborough, MA 01582  
Telephone (508) 389-2935  
Facsimile (508) 389-2890

-----Original Message-----

From: Campilii, David M.  
Sent: Thursday, October 19, 2006 11:45 AM  
To: Beron, David  
Subject: RE: E-183 Transmission Line

Dave -

Putting me to work on the overhead part of the project, I see...

Here's what went into the OH part of the \$17.3M total project estimate in 2004:

Phase 1 OH relocation:	\$1,200 K
Remove existing E183 Line (Phase 1):	\$170 K
Remove Phase 1 Temporary Relocation:	\$170 K
Relocate and reconstruct the Phillipsdale Tap line:	\$600 K
Remove portions of the Phillipsdale Tap line	\$40 K
Remove Existing E183 line (Phase 2)	\$130 K

The first two items are done (at somewhat higher cost than the numbers above).

We did apply a 25 % estimate tolerance to the total project cost once the base estimates were done.

Dave

-----Original Message-----

From: Beron, David  
Sent: Thursday, October 19, 2006 11:27 AM  
To: Campilii, David M.  
Subject: RE: E-183 Transmission Line

Dave

Can you provide me with whatever estimate info you have pertaining to the Phillipsdale Tap OH.

It may or may not need refreshing

*Original Route - Upd*

**Campilii, David M.**

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**From:** Vic Antoniello - Power Delivery Consultants, Inc. [v.antoniello@pdc-cables.com]  
**Sent:** Saturday, November 18, 2006 3:00 PM  
**To:** Campilii, David M.  
**Subject:** E183 Line Relocation - Updated Cost Estimates  
**Attachments:** E183 Updated Study-Grade Cost Estimates\_111806.doc

Dave,

Attached is the updated cost estimates including the two transition stations.

Please give me a call if you have any questions.

Regards,  
Vic

**Victor Antoniello**  
Power Delivery Consultants, Inc.  
503 Ironmine Road  
Harrisville, RI 02830  
Phone: 401-568-4638  
Fax: 866-266-5116  
Email: v.antoniello@pdc-cables.com

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11/30/2006

*The Narragansett Electric Company  
E183 Line Relocation Project  
Updated Study-Grade Cost Estimates*

DRAFT - November 18, 2006

## **Introduction**

The Narragansett Electric Company (TNEC) asked Power Delivery Consultants, Inc. (PDC) to update the study-grade cost estimates for the E183 Line 115-kV underground transmission line relocation between Franklin Square Substation in Providence and Mauran Avenue in East Providence. Cost estimates were previously provided to TNEC in PDC's March 7, 2005 memorandum.

## **Refinement of Route**

The proposed cable route has been refined slightly since the March 7 memorandum. In addition, TNEC made the decision to install a XLPE cable system and use the Tockwotton terminal site in East Providence.

The following minor changes in the cable route have been made since the March 2005 estimates and are incorporated into the new cost estimates:

- The Providence River crossing has been adjusted slightly to avoid the overhead structures near Franklin Square Substation.
- The Seekonk River crossing was shifted north to line up with Mauran Street.
- The Tockwotton cable terminal yard was reconfigured to sit on a 75' x 150' site.

The overall route length is approximately the same as the original March 7 routes at 6400 feet.

## **Cost Estimates**

Study-grade cost estimates have been developed for a double circuit 3000kcmil copper conductor 115-kV XLPE cable system that extends from the Franklin Square Substation in Providence to the Tockwotton terminal site in East Providence, a total distance of approximately 6400 feet. The cable system and terminal structure cost estimates are summarized in Table 1. J.D. Hair provided updated estimates for the HDD construction and Tech S Corp provided the terminal structure estimates.

**TABLE 1  
STUDY-GRADE COST ESTIMATES FOR A  
115-kV XLPE CABLE SYSTEM**

<b>Item</b>	<b>Cost Estimate</b>
Cable System	\$ 13,971,675
Franklin Square Terminal	\$1,190,000
Towotton Terminal	\$1,210,000
<b>Total Cost</b>	<b>\$16,371,675</b>

The cost estimates are based on the available information and was developed using information typical of some recent projects. The cable system costs include all cable costs up to the top of the terminations. The estimates include costs for consulting engineering, surveying, sales tax (7%), and construction supervision.

The following items are not included in the estimates:

- Costs associated with encountering and handling hazardous material removal or remediation or excessive monitoring requirements imposed by permit agencies.
- Costs associated with extended shutdowns due to inadvertent drilling fluid returns
- Costs associated with fill removal from the site
- Land rights, AFUDC, and G&A costs
- Fiber optic cabling between the two terminals
- Costs associated with obtaining permits or licenses
- Costs associated with administration of contracts including preparation of commercial terms, RFQs, and RFPs
- National Grid USA's project management including scheduling and budgeting tasks
- Contractor Profit and Overhead Expenses for the terminal structures - estimates are based on National Grid USA construction forces

Detailed cost estimates are included in Appendix A.

Study-grade estimates are based upon a conceptual understanding of the cable and installation requirements. They are prepared using historical cost data from similar projects. They are considered accurate within +/- 25%.

**APPENDIX A**  
**DETAIL COST ESTIMATES**

*Original Route Updated Est.*

STUDY-GRADE ESTIMATE 115-kV XLPE CABLE SYSTEM  
 Six 3000kcmil Copper Conductors, 115-kV XLPE Insulated Cables in a Ductbank System  
 E-183 Line Relocation - Providence, RI <CONFIDENTIAL FOR INTERNAL USE ONLY>

Date: 26-Oct-06  
 Eng: VDA

Total Length of Circuit (ft):	6,400	1.21 miles
Number of Cables:	6	
Conduit 1 (number and OD):	8 6.625	0.071 Volume (CY/ft)
Conduit 2 (number and OD):	4 2.375	0.005 Volume (CY/ft)
<b>Length of Open Trench Construction:</b> 4,335 (remainder is special construction such as HDD or J&B)		
% of Rock Excavation in Open Trench Area:	5.0%	
% Trench Sheathing in Open Trench Area:	50.0%	
% Non-Paved Area in Open Trench Area:	50.0%	

	Width	Depth	Volume (cu yd per trench foot)
Trench (in):	30	60	0.463
Concrete Envelope (in):	30	30	0.156
Thermal Backfill (in):	30	18	0.139
Common Backfill (in):	30	6	0.046
Pavement (in):	54	6	0.083

Description	Material Quantity	Unit Cost	Material Cost	Labor Quantity	Unit Cost	Labor Cost	Total
Mobilization	-	-	-	-	-	\$50,000	\$50,000
Sawcutting (lin. ft.)	-	-	-	4335	\$2.00	\$8,670	\$8,670
Pavement Breaking & Removal (Sq Yd)	-	-	-	1084	\$30.00	\$32,520	\$32,520
Excavate - Rock (Cu Yd)	-	-	-	100	\$250.00	\$25,090	\$25,090
Excavate - Soil (Cu Yd)	-	-	-	1907	\$100.00	\$190,660	\$190,660
Fill Disposal Costs (Cu Yd)	-	-	-	602	\$20.00	\$12,050	\$12,050
Trench Sheathing (FT)	2168	\$5.00	\$10,840	2168	\$20.00	\$43,350	\$54,190
Thermal Backfill (Cu Yd)	602	\$100	\$60,210	602	\$25.00	\$15,060	\$75,270
Common Backfill (Cu Yd)	201	\$30	\$6,020	201	\$30.00	\$6,030	\$12,050
Concrete (Cu Yd)	676	\$100	\$67,620	676	\$20.00	\$13,530	\$81,150
Special Construction A <i>Power Poles HDD</i>	-	-	-	-	-	\$2,196,252	\$2,196,252
Special Construction B <i>Subst. HDD</i>	-	-	-	-	-	\$1,754,333	\$1,754,333
Special Construction C <i>Trench &amp; Box</i>	-	-	-	-	-	\$500,000	\$500,000
PVC Conduit 1 (FT)	35026.8	\$5	\$175,130	4335	\$32.00	\$138,720	\$313,850
PVC Conduit 2 (FT)	17340	\$2	\$34,680	4335	\$0.00	\$0	\$34,680
HDPE Conduit (FT)	16520	\$10	\$165,200	16520	\$5.00	\$82,600	\$247,800
Spacers & couplings	867	\$20	\$17,340	-	-	-	\$17,340
Manholes (EA)	10	\$15,000	\$150,000	10	\$15,000.00	\$150,000	\$300,000
Comm Handholes (EA)	0	\$4,000	\$0	0	\$0.00	\$0	\$0
Comm Conduit (FT)	0	\$3	\$0	0	\$0.00	\$0	\$0
Temporary Paving (Sq Yd)	0	-	-	1084	\$25.00	\$27,100	\$27,100
Permanent Paving (Sq Yd)	-	-	-	1084	\$35.00	\$37,940	\$37,940
Non Paved Area Restoration (Sq Yd)	-	-	-	2408	\$17.00	\$40,950	\$40,950
Traffic Control	-	-	-	40	\$500.00	\$20,000	\$20,000
Cable 1 (FT)	39360	\$100	\$3,936,000	39360	\$9.00	\$354,240	\$4,290,240
Cable 2 (FT)	0	\$0	\$0	-	-	-	\$0
Cable Installation (section pulls)	-	-	-	0	\$14,000.00	\$0	\$0
Splices (EA)	30	\$10,000	\$300,000	30	\$10,000.00	\$300,000	\$600,000
Manhole Assy - clamps, supports, etc	10	\$2,500	\$25,000	10	\$1,000.00	\$10,000	\$35,000
3 Phase Link Box w/SVLs (EA)	12	\$5,000	\$60,000	12	\$1,000.00	\$12,000	\$72,000
3 Phase Grounding Link Box (EA)	12	\$3,000	\$36,000	12	\$1,000.00	\$12,000	\$48,000
Ground Conductor (FT)	13120	\$7	\$91,840	13120	\$2.00	\$26,240	\$118,080
Traffic Control	-	-	-	3	\$500.00	\$1,500	\$1,500
Terminations - Air (EA)	12	\$10,000	\$120,000	12	\$12,000.00	\$144,000	\$264,000
Terminations - GIS (EA)	0	\$0	\$0	0	\$10,000.00	\$0	\$0
Single Phase Terminal Stand (EA)	0	\$14,000	\$0	0	\$5,000.00	\$0	\$0
Three Phase Transition Structure (EA)	0	\$125,000	\$0	0	\$30,000.00	\$0	\$0
F/O Monitoring System (LOT)	0	\$0	\$0	0	\$0.00	\$0	\$0
Final Elec. Testing	0	\$0	\$0	0	\$0.00	\$0	\$0
Spare Materials (LOT)	2	\$0	\$0	2.0	\$20,000.00	\$40,000	\$40,000
Subtotal	0	\$0	\$120,000	0	\$0.00	\$0	\$0
Contingency & Profit	-	-	\$5,255,880	-	-	\$6,244,835	\$11,500,715
Sales Tax	15%	-	\$788,380	-	-	\$624,480	\$1,412,860
Subtotal	7%	-	\$423,100	10%	-	\$624,480	\$423,100
Geotech & Soil Survey (LOT)	-	-	\$6,467,360	-	-	\$6,869,315	\$13,336,675
Engineering & Survey (LOT)	-	-	-	-	-	\$85,000	\$85,000
Construction Supervision (LOT)	-	-	-	-	-	\$450,000	\$450,000
Project Management (LOT)	-	-	-	-	-	\$100,000	\$100,000
TOTAL COST	-	-	-	-	-	\$0	\$13,971,675

E183 UG - Summary of  
PDC Cable Estimates

1/10/19  
DMC

	<u>Original Route</u>		<u>Coal Yard / Revised Route</u>
Balance of Work			
UG Cable	13,972	} 14,422	15,300
	+ 450		450
Fr Sq Terminal	1,190	M/S&S	4,827
Totwotton Terminal	1,210		1,185
	<u>16,822</u>		<u>21,762</u>

OH Line Work

Remove Phase 1 Relocation	200	200
Reconstruct Phillipsdale Tap	700	700
Remove Part of Phillips Tap	50	50
Remove E183 (Phase 2)	150	150
	<u>1,100</u>	<u>3,100</u>
	17,922	22,862

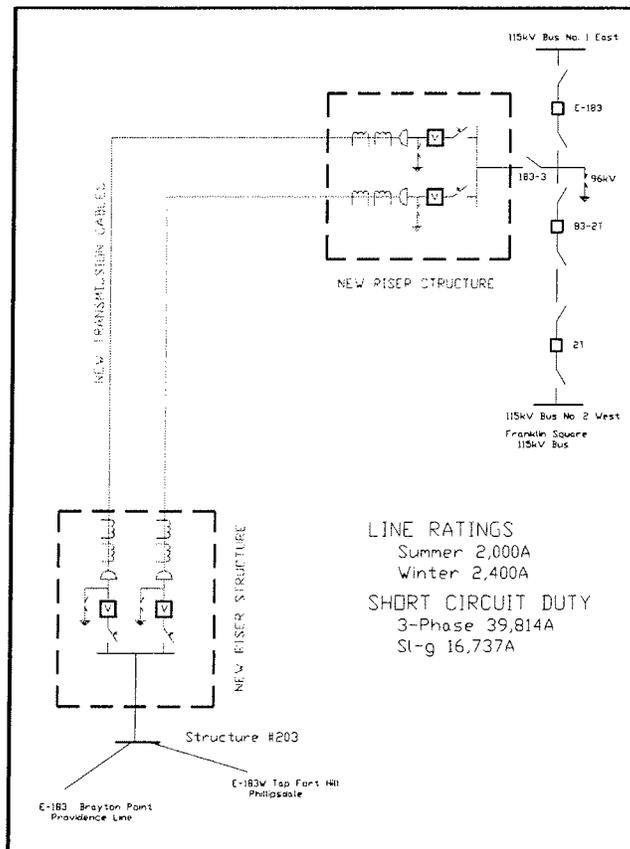
I/N Cable Eng/Design/Lic Not in PDC Est.

*Original Route  
Substation Est's*

E-183 Underground Project  
Narragansett Electric,  
Providence, Rhode Island  
Terminal Structure Design Criteria and Costs

November 8, 2006 - Revised Costs

The following narrative describes the estimated costs for two new 115kV transmission cable terminal riser structures planned for use with the E-183 underground transmission project. The first structure will be located at the Manchester Street Generation Plant/Franklin Square Substation in Providence the second structure will be positioned at in East Providence (Tockwotten site).



**Operations Description**

The above one-line diagram depicts the equipment configurations, which include circuit switchers, disconnects, lightning arresters, and the associated secondary control and protection systems. Remote circuit breakers will open in the event of line or cable fault. The circuit switchers will be used to isolate cable sections for maintenance and return cables to service.

If a cable is removed from service, one circuit switcher will be used to break the parallel load and the second circuit switcher will be used to break the remaining cable charging current. When a cable is returned to service, the reverse process will occur.

In the event of a fault, the cables will be provided with a current differential protection scheme to detect the damaged cable. Dispatch personnel using a remote SCADA system will isolate the problem cable and return the second cable to service. Motorized isolation disconnects will be used both for operations isolation and as a visible means of disconnect for maintenance purposes.

### **Scope and Cost Estimate**

At the East Providence site a control enclosure will be required to house station service power panel, dc battery & charger, local control switches, protective relay equipment, a SCADA/RTU panel, telephone and other support equipment. At the Franklin Square substation due to limited space and to help minimize the cost, the control and protective devices will be located within the existing buildings. This will necessitate longer cable runs for ac & dc power, SCADA and protective relay connections, etc.

#### *Site Preparation*

The Franklin Square substation site will require grading, concrete and asphalt removal , fence modifications and landscaping.

The exact site conditions at the other three locations have not been fully explored, however similar grading, soil removal and landscaping will be required. Dependent upon the site selected, building demolition may be necessary and subsurface structures/foundations may present a problem.

East Providence	\$58,720	
Franklin Square	\$53,020	Cost (*) \$112,000

#### *Foundations and Structures*

The transmission conductor tensions have been estimated at 20,000# each and the static line at 5,000# each. Based upon the existing transmission line intercepts, site locations and reliability, dead end "A Frame" structures were selected for the terminations. While the exact height has not been established, a minimum of 65 feet will be required to support the disconnect switches, attain the necessary electrical clearances and dependent on the East Providence site selected, allow changes in the conductor alignment.

Pending actual site borings or test pits, the dead-end foundations will be a drill design approximately 8 feet in diameter and 12 feet deep. Formed foundations will be used for the lightning arresters, circuit switchers, cable potheads, and a pad is planned for the control enclosure (East Providence)

Note: Structure steel was estimated at approximately \$ 2.80/lb. Overseas demands on US steel production may result in significant market fluctuations.

East Providence	\$490,942	
Franklin Square	\$477,683	Cost (*) \$969,000

*Primary Electrical Equipment (115kV)*

The earlier narrative described the circuit switcher and motorized disconnect operations. Lightning arresters will be used on all phases of the cables at both ends to protect from switching and lightning surges. The cable potheads will be equipped at the base with two sets per phase of slip-on current transformers.

Equipment Quantities	Circuit Switchers	4	
	Motor Operated Disconnect Switches	4	
	Lightning Arresters	12	
East Providence	\$198,002		
Franklin Square	\$198,002	Cost (*)	\$397,000

*Control Cables*

Each circuit switcher and motorized disconnect will require two cables a 12c and a 4c. Each current transformer will need one 2c cable. Cable runs at the East Providence location were estimated at 300 feet and where control panels and RTU connections will be in other buildings the Franklin Square runs were estimated at 1500 feet.

East Providence	\$46,408		
Franklin Square	\$102,800	Cost (*)	\$150,000

*East Providence Tockwotten Control Enclosure*

Station Service power, battery system, lighting, etc Cost (\*) \$67,000

*Protective Relays, RTU equipment, Switchboards*

East Providence	\$31,632		
Franklin Square	\$31,632	Cost (*)	\$64,000

*Other Hardware and Systems*

Ground grid, bus and string insulators, conduit, telephone connections, etc

East Providence	\$54,368		
Franklin Square	\$57,811	Cost (*)	\$110,000

*Supervision, Field Accounting, Mobilize/Demobilize, Safety Relay, Communications Test*

East Providence	\$50,750		
Franklin Square	\$58,598	Cost (*)	\$110,000

Notes:

(\*) Franklin Square and East Providence total installed costs for the equipment categories shown.

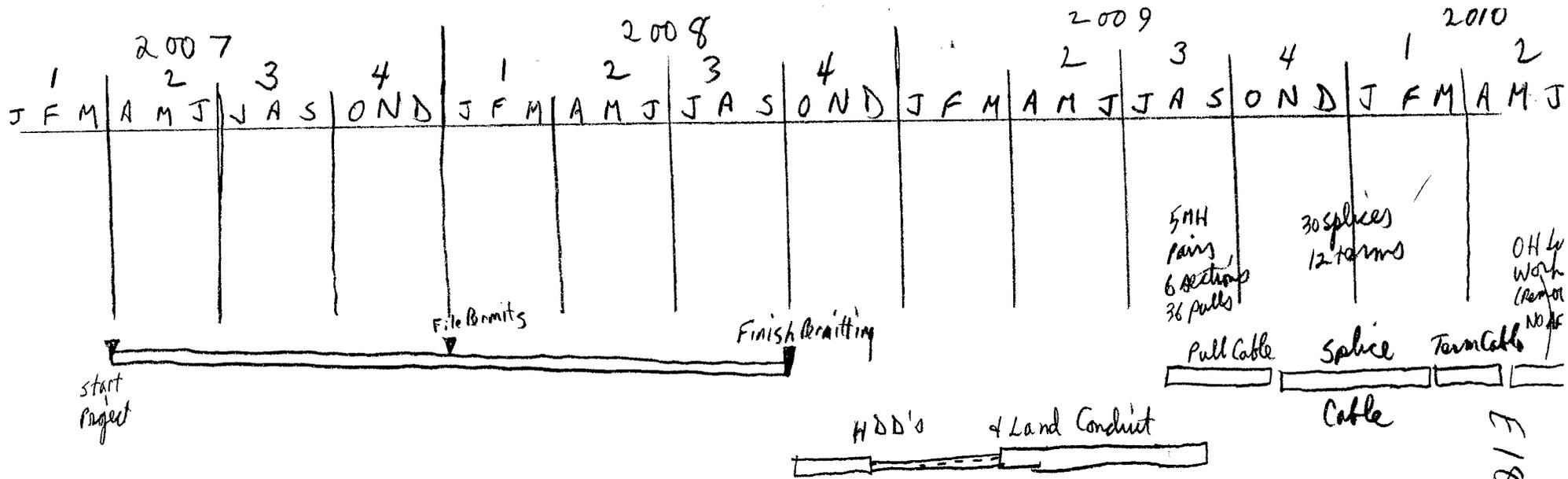
1. Engineering, Design and preliminary investigative work are not included in these totals.
2. Costs are based upon National Grid-USA construction forces. If a private contractor is used, there maybe some savings, however profit and overhead will need to be factored into the estimates.
3. There are several open design and construction issues including: the terminal structure heights, the specific East Providence location, site subsurface investigations, etc

The following is a revised cost estimate for the terminal structures including preliminary engineering, detailed design, and the construction.

	<b>Material</b>	<b>Labor</b>	<b>Company Equipment &amp; Contracts</b>	<b>Total</b>
<b>Engineering and Design</b>		\$200,000		\$200,000 ✓
<b>East Providence</b>	\$416,000	\$521,000	\$62,000	\$999,000
<b>Franklin Square</b>	\$389,000	\$535,000	\$56,000	\$980,000
Subtotal	\$805,000 ✓	\$1,256,000	\$118,000	\$2,179,000 ✓
		<i>1374</i>		
		Contingency	7.50%	\$164,000
		Sales Tax	7%	\$57,000
			<b>TOTAL</b>	<b>\$2,400,000</b>

The following items are not included in this estimate:

- Costs associated with encountering and handling hazardous material removal or remediation.
- Costs associated with fill removal from the site.
- Land Rights, AFUDC and G&A Costs
- Cost associated with obtaining permits or fees.
- Costs associated with administration of contracts incl. preparation of commercial terms, RFQs, and RFPs
- Fiber optic cabling between the two terminals.
- Contractor Profit and Overhead Expenses

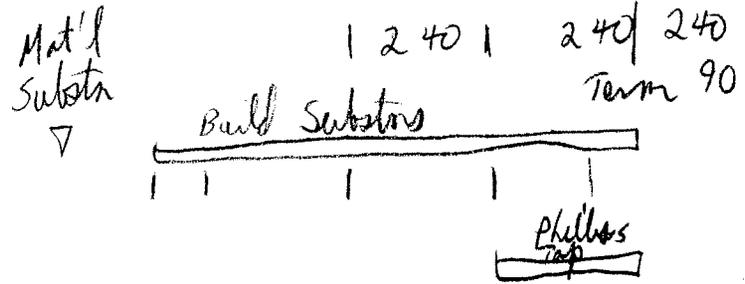


10	10	10	20	30	30	30	40	40	40	40	40
30			80			110			120		

Cable

M	690					4450				120
L		1336	1336	1336	1336					

Cable Eng'g	PDC	635K
	I/H	450
		<u>1085</u>



ORIGINAL ROUTE

Cash Flow/AFUDC  
2/1/07 DMC

E183 Line - Approximation of Cost over Time



### AFUDC CALCULATOR

Change Only Blue Cells!

E183 Jan 2007 Estimate, Original Route

AFUDC Rate		
Per Cent	Per Unit	Period
5.22	0.0522	Annual
1.305	0.01305	Quarterly

Quarter	Quarterly Spending	Cumulative Spending	Quarterly AFUDC	Cumulative AFUDC
1	30,000	30,000	196	196
2	30,000	60,000	587	783
3	85,000	145,000	1,338	2,121
4	120,000	265,000	2,675	4,796
5	130,000	395,000	4,307	9,102
6	90,000	485,000	5,742	14,844
7	949,000	1,434,000	12,521	27,366
8	1,574,000	3,008,000	28,984	56,350
9	2,500,000	5,508,000	55,567	111,917
10	7,367,000	12,875,000	119,949	231,866
11	2,155,000	15,030,000	182,080	413,946
12	1,529,000	16,559,000	206,118	620,064
13	780,000	17,339,000	221,184	841,249
14	194,000	17,533,000	227,540	1,068,788
15	10,000	17,543,000	228,871	1,297,659
16	0	17,543,000	228,936	1,526,596

End AFUDC (2/5)



### AFUDC CALCULATOR

Change Only Blue Cells!

E183 Jan 2007 Estimate, Original Route IPP HDD

AFUDC Rate		
Per Cent	Per Unit	Period
5.22	0.0522	Annual
1.305	0.01305	Quarterly

Quarter	Quarterly Spending	Cumulative Spending	Quarterly AFUDC	Cumulative AFUDC
1	30,000	30,000	196	196
2	30,000	60,000	587	783
3	85,000	145,000	1,338	2,121
4	120,000	265,000	2,675	4,796
5	130,000	395,000	4,307	9,102
6	90,000	485,000	5,742	14,844
7	949,000	1,434,000	12,521	27,366
8	1,674,000	3,108,000	29,637	57,002
9	2,600,000	5,708,000	57,524	114,527
10	7,467,000	13,175,000	123,212	237,738
11	2,255,000	15,430,000	186,648	424,386
12	1,529,000	16,959,000	211,338	635,724
13	780,000	17,739,000	226,404	862,129
14	194,000	17,933,000	232,760	1,094,888
15	10,000	17,943,000	234,091	1,328,979
16	0	17,943,000	234,156	1,563,136

← End AFUDC