

April 25, 1984

Tenneco Oil Company
P. O. Box 849
Pasadena, Texas 77501-0849

Attention: Mr. Paul R. Prokish

Reference: Cathodic Protection Survey of Pasadena Plant and Off-Site
Pipelines - Contract number 90-2945, P. O. #138653-01A

Dear Mr. Prokish:

A cathodic protection survey of the above referenced facilities was completed on March 21, 1984. This survey was conducted to determine the effectiveness of the cathodic protection system for the plants underground metallic structures and off-site pipelines.

Survey Procedures

Pipe-to-soil potentials were measured at random test points throughout the plant. The test point locations can be seen on Tenneco drawings number C-TM1-200-P-112 and C-PCI-P-01-353. These potential measurements were taken using a high impedance voltmeter in conjunction with a standard copper-copper sulphate reference electrode. The rectifiers were inspected and the voltage and amperage output was measured. Anode current output for each anode in the deep well groundbeds was recorded. Pipe-to-soil potentials and magnesium anode current output were taken at test stations for the off-site pipelines. Data pertaining to this survey can be seen on the attached data sheets.

Survey Results

One criteria for effective cathodic protection is a minimum of -0.85 volts DC. This measurement is taken between a standard copper-copper sulphate reference electrode and the pipeline. Potential measurements in the P.A. unit area were below acceptable levels. The current output for rectifiers "A" and "B" were increased to their maximum output after low potentials were discovered in this area. After the rectifiers' output was increased, potential measurements were repeated. Pipe-to-soil potentials did increase, but did not increase above the required -0.85 volts.

Rectifier "C" has an internal intermittent electrical short. During this survey the rectifier was operating satisfactorily. After the survey was

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31 486-8400

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TELEX 78-2345

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completed the rectifier was taken out of service, repaired and returned to service.

Rectifier "A" was found to have no current output at the beginning of the survey. The problem was investigated and found to be a loose connection for the positive cable in the anode junction box. This connection was repaired and the rectifier is operating correctly.

Rectifier "D" was found to have a damaged anode junction box. The rectifier and anodes are operating satisfactorily, but the box should be repaired or replaced.

Over all the pipe-to-soil potential measurements were above the -0.85 volts required for cathodic protection except in the area of the P.A. unit.

Pipe-to-soil potential measurements were taken at random test stations for the off-site acetylene, hydrogen, AOG and VCM pipelines. All potentials recorded were above the criteria for cathodic protection.

Recommendations

It is recommended that a new groundbed and rectifier be installed in the area of the P.A. unit. The system recommended would be similar to the existing systems. The groundbed would be a 8" x 200' hole with 18 Durichlor 51 type "M" anodes. Metallurgical coke breeze would be pumped around the anodes. The anode lead wires would be terminated in a junction box with current measuring shunts. A Universal 45 volts, 60 amp air cooled rectifier would be installed on a pole near the groundbed location. The AC power required for the rectifier would be 480 volts, 3 phase.

It is also recommended that the anode junction box for rectifier "D" be repaired or replaced.

Some test points shown on drawing number C-PC1-P-01-353 are located a few feet from each other. It is recommended that if two test points are located in close proximity, that one be omitted. Test point number 12 is on the dock above the water line and therefore, should be omitted.

We recommend that you continue to check the rectifiers on a monthly basis and have a complete plant survey yearly.

General Cathodic Protection Services, Inc., would be pleased to install the recommended groundbed and rectifier for a turnkey price of \$12,351.00. The AC power to the rectifier would be the responsibility of Tenneco. This price is valid for a period to 90 days.

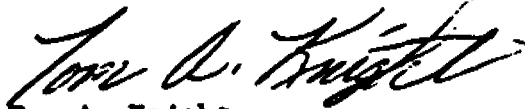
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Enclosed is our invoice number 01-TX-25037F in the amount of \$1,492.00
t cover the cost of this survey and rectifier repairs.

We appreciate this opportunity to have been of service to your company.

Very truly yours,

General Cathodic Protection Services, Inc.

A handwritten signature in cursive script, appearing to read "Tom A. Knight".

Tom A. Knight

TAK/afm

JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE PASADENA PLANT

COMPANY TENNECO OIL COMPANY

PAGE 1 DATE 3-20-84 TABULATION OF DATA

TABLE I

REF. NO.	LOCATION	PIPE-TO-SOIL POTENTIALS CU/CU SO ₄ REFERENCE			CURRENT DRAIN 8 AMPS	REMARKS
				VOLTS		
	REFERENCE DWG. TENNECO, C-TM1-200-P-112					
1				-0.995		
2				-0.928		
3				-0.929		
4				-0.887		
5				-0.864		
6				N-A		
7				-0.849		
8				-0.827		
8A	FIRE MONITOR 300' NORTH OF TEST POINT 8			-0.732		
8B	FIRE MONITOR EAST SIDE OF P.A. UNIT AT ROAD			-0.733		
8C	FIRE MONITOR 200' NORTH OF TEST POINT 8B			-0.775		
9						
10				-0.860		
11				-1.402		
12				OMIT		
13				-1.078		
14				-0.906		
15				-0.711		
16				-0.720		
17				-0.766		
18						
19				-0.696		
20				-0.892		
21				-0.762		
22				-0.960		
23				-0.641	Not Bonded to System	
23A	VALVE 100' EAST OF TEST POINT 23			-1.038		
24B	VALVE 300' EAST OF TEST POINT 23			-1.409		
25				-1.399	TEN 10/0	

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CATHODIC PROTECTION SERVICE

JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE PASADENA PLANT

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TABLE I

REF. NO.	LOCATION	PIPE-TO-SOIL POTENTIALS CU/CU SO ₂ REFERENCE			CURRENT DRAIN I AMPS	REMARKS
				VOLTS		
26				+1.051		
27				+0.716		
28				+0.867		
29				+0.756		
30				+1.241		
31				+1.469		
32				+1.161		
33				+0.943		
34				+0.875		
35				+1.009		
36				+1.053		
37				+1.082		
38				+1.049		
39				+1.215		
40				+0.926		
41				+0.940		
42				+0.865		
43				+0.945		
44				+0.954		
45				+0.883		
46				+0.959		
47				+1.013		
48				+1.134		
49				+1.151		
50				+1.083		
51				+1.093		
52				+1.097		
53				+0.862		
54				+0.882		
55				+0.872		
56				+0.823		
57				+0.915		
58				+0.930		
59				+0.910		
60				+0.926		
61				+0.885		
62				+0.932		

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JOB NO. 82015-01

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JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE PASADENA PLANT

COMPANY TENNECO OIL COMPANY

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TABLE I

REF. NO.	LOCATION	PIPE-TO-SOIL POTENTIALS CU/CU SO ₄ REFERENCE		CURRENT DRAIN I AMPS	REMARK
			VOLTS		
63			+0.906		
64			+0.907		
65			+0.890		
66			+0.904		
67			+0.909		
68			+0.900		
69			+0.897		
70			+0.896		
71			+0.910		
72			+0.926		
73			+0.926		
74			+0.970		
75			+0.914		
76			+0.923		
77			+0.916		
78			+0.915		
79			+0.853		
80			+0.930		
81			+0.927		
82			+0.927		
83			+0.951		
84			+0.935		
85			+0.923		
86			+0.956		
87			+1.008		
88			+0.992		
89			+0.998		
90			+1.005		
91			+0.988		
92			+0.932		
93			+0.919		
94			+0.908		
95			+0.942		
96			+0.827		
97			+0.834		
98			+0.895		
99			+0.846		TEN 1012

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GENERAL
CATHODIC PROTECTION SERVICE

JOB TITLE CATHODIC PROTECTION SURVEY

WORK SITE PASADENA PLANT - PVC PLANT

COMPANY TENNECO OIL COMPANY

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TABLE I

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GENERAL
CATHODIC PROTECTION SERVICE

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JOB SITE PASADENA PLANT

COMPANY TENNECO OIL COMPANY

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TABLE I

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JOB SITE PASADENA PLANT

COMPANY TENNECO OIL COMPANY

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TABLE II

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JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE PASADENA PLANT

COMPANY TENNECO OIL COMPANY

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TABLE II

REF. NO.	LOCATION	PIPE-TO-SOIL POTENTIALS CU/CU SO ₂ REFERENCE		CURRENT DRAIN		REMARKS
				NEW GROUND BED	OLD GROUND BED	
				AMPS	AMPS	
	— RECTIFIER OUTPUT —					
	RECTIFIER B					
	R10					
	SER # 51523					
	RATING 45V-60A					
	D.C. OUTPUT 7.3V					
	30.9A					
	TAPS C-1 F-3					
	— ANODE OUTPUT —					
	No. 1			0.95	0.0	
	2			1.15	0.0	
	3			1.43	0.0	
	4			1.40	0.27	
	5			1.55	0.24	
	6			2.06	0.64	
	7			1.40	1.30	6-ANODE LEA
	8			0.75	0.59	
	9			1.50	0.74	
	10			1.44	0.54	
	11			1.58	0.05	
	12			1.62	0.60	
	13			1.51	0.38	
	14			1.09		
	15			1.33		
	16			1.36		
	17			0.79		
	18			2.53		
	— DURING SURVEY RECT. —					
	INCREASED TO					
	10.4V - 49.6A					
	TAPS C-1, F-4					
						TEN 016

JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE PASADENA PLANT

COMPANY TENNECO OIL COMPANY

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TABLE II

REF. NO.	LOCATION	PIPE-TO-SOIL POTENTIALS CU/CU SO ₂ REFERENCE		CURRENT DRAIN 3 AMPS	REMARKS
		NEW GROUND BED	OLD GROUND BED		
	— RECTIFIER OUTPUT —				
	RECTIFIER C				
	RIO				
	SER#: 51516				
	RATING 45V - 60A				
	D.C. OUTPUT 9.9V				
	42.3A				
	TAPS C-1 F-4				
	— ANODE OUTPUT —				
	No 1	2.26	0		
	2	2.06	0		
	3	1.99	0		
	4	2.39	0.29		
	5	1.33	0.73		
	6	1.44	0		
	7	1.38	0.03		
	8	0.95	0		
	9	2.01	0		
	10	2.28	0.91		
	11	2.49	0		
	12	2.82	0.43		
	13	2.01	0		
	14	2.17	0		
	15	1.92	0		
	16	3.66	0.40		
	17	3.41	0.55		
	18	2.35	—		

ENGR. T. KNIGHT

JOB NO. 82015-01

GENERAL

JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE PASADENA PLANT

COMPANY TENNECO OIL COMPANY

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TABLE II

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GENERAL
CATHODIC PROTECTION SERVICE

JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE PASADENA PLANT

COMPANY TENNECO OIL COMPANY

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TABLE II

REF. NO.	LOCATION	PIPE-TO-SOIL POTENTIALS CU/CU SO ₄ REFERENCE			CURRENT DRAIN I AMPS	REMARKS
	— RECTIFIER OUTPUT —					
	RECTIFIER E					
	R10					
	SER. F 740420					
	RATING 30V - 50A					
	D.C. OUTPUT 17.3V					
	18.3A					
	TAPS C-2, F-3					
	— ANODE OUTPUT —					
	No. 1				0.0	
	2				5.84	
	3				1.88	
	4				0.0	
	5				0.0	
	6				4.70	
	7				0.0	
	8				2.37	
	9				1.30	
	10				0.01	
	11				0.25	
	12				2.08	

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GENERAL

JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE PASADENA PLANT

COMPANY TENNECO OIL COMPANY

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TABLE II

REF. NO.	LOCATION	PIPE-TO-SOIL POTENTIALS CU/CU SO ₄ REFERENCE			CURRENT DRAIN	REMARKS
					I AMPS	
	<u>- RECTIFIER OUTPUT -</u>					
	RECTIFIER F					
	RIO					
	SER.# 81162					
	RATING 30V-50A					
	D.C. OUTPUT 8.1V					
	21.3A					
	TAPS C-1, F-4					
	<u>- ANODE OUTPUT -</u>					
	No.1				1.66	
	2				1.41	
	3				1.05	
	4				1.46	
	5				1.83	
	6				0.98	
	7				0.68	
	8				1.82	
	9				1.05	
	10				1.50	
	11				1.12	
	12				0.75	
	13				2.48	
	14				2.10	
	15				1.37	

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ENGR. T. KNIGHT
JOB NO. 82015-01

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CATHODIC PROTECTION SERVICE

JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE OFF-SITE ACETYLENE PIPELINE

COMPANY TENNECO OIL COMPANY

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TABLE III

REF. NO.	LOCATION	PIPE-TO-SOIL POTENTIALS CU/CU SO ₄ REFERENCE		CURRENT DRAIN 8 AMPS	REMARKS
		PIPE VOLTS	CASING VOLTS		
	T-02 5+85	+1.024	-0.735		
	T-03 10+00	+1.080			
	A-02 13+00	+1.248		.410	
	T-04 18+45	+1.160			
	T-05 29+50	+1.172			
	6" P/L TO LIQ. AIR 38+55 INS. FLANGE				
	TENNECO SIDE	+1.184			INS. C
	LIQ. AIR SIDE	+0.814			
	T-11 91+21	+0.974			
	A-9 108+50	+1.460		.190	
	T-19 120+91	+1.337			
	T-20 123+50	+0.481			TEST LE CUT
	A-12 137+20	+1.206		.180	
	T-29 163+20	+1.182			
	A-15 168+20			.190	
	T-30 174+20	+1.120	-0.607		
	T-31 174+60	+1.104	-0.588		
	A-17 189+50	+1.267		.240	

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GENERAL
CATHODIC PROTECTION SERVICE

JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE OFF-SITE ACETYLENE PIPELINE

COMPANY TENNECO OIL COMPANY

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TABLE III

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ENGR. L. KNIGHT
JOB NO. 82015-01

GENERAL
CATHODIC PROTECTION SERV.

JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE OFF-SITE HYDROGEN PIPELINE

COMPANY TENNECO OIL COMPANY

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TABLE III

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GENERAL
CATHODIC PROTECTION SERVICE

JOB TITLE CATHODIC PROTECTION SURVEY

JOB SITE OFF-SITE AOG PIPELINE

COMPANY TENNECO OIL COMPANY

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TABLE III

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JOB NO. 82015-01

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CATHODIC PROTECTION SERVICES

JOB TITLE CATHODIC PROTECTION SURVEY

ON SITE OFF-SITE VCM PIPELINE

COMPANY TENNECO OIL COMPANY

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TABLE III

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