Pipeline Group Factual Report

ATTACHMENT 2

Volume, pressure, time of rupture

Carmichael, Mississippi
DCA 08 MP 001

EPCO, INC.

November 19, 2007

National Transportation Safety Board
Rodney I.J. Dyck, P.E.
490 L'Enfant Plaza East, S.W.
Washington, DC 20594

Dear Mr. Dyck:

This letter includes the following regarding the November 1, 2007 rupture of the Dixie pipeline near Carmichael, Mississippi:

- Calculation of the pipeline pressure at the point and time of rupture
- Discussion with regard to the time delay for recording pressure changes
- Discussion with regard to the various instruments involved in recording pressure changes
- Discussion regarding the accuracy of SCADA time stamps
- Estimated time of breach of containment
- Current estimate of volume of hydrocarbon released to atmosphere

Thank you,

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Pressure at the point of release

The release location is 2900 feet downstream of Carmichael station. The elevation at both Carmichael and the release site is approximately 320 feet above sea level and therefore elevation is not considered a factor in the following calculation.

The pressure at Carmichael station (Mile Post 425.5) at the time of the breach is recorded as 1417 psig. The pressure at Butler station (MP443.8) is recorded as 1029 psig.

1417 - 1029 = 388 psig.

443.8 - 425.5 = 18.3 miles

388 psig / 18.3 mi = 21.20 psig drop / mile

21.20 / 5280 = .004 psig drop / ft * 2900 ft. = 11.65 psig drop

1417 - 11.65 = 1405.35 psig at the point of release.

The pressure at the release location is calculated to be 1405.35 psig.

Product Loss

It is estimated that 10,253 barrels of propane were released to atmosphere in this release. (The calculation for this volume is still being refined, therefore this is not the final estimate.)

Time of release

A pressure wave travels through the pipeline at approximately 3000 ft. /second in light hydrocarbons. Therefore, it is assumed that the pressure wave arrived at the Carmichael pump station approximately one second after the breach of containment occurred.

Pressure is measured on the pipeline, at the pump station, by a Honeywell smart ST3000 pressure transmitter. The pressure transmitter is calibrated from 0 to 1600 pisg. The transmitter converts the pressure into a 4-20 ma signal with 4ma representing 0 psig and 20ma representing 1600 psig. The transmitter is directly wired to the Programmable Logic Controller (PLC) and also to a Yokagawa pressure recording device. The PLC input circuit has a 249 ohm resistor across the termination points, which converts the 4-20 ma signal into a 1 vdc-5vdc signal with 1 vdc representing 0 psig and 5 vdc representing 1600 psig. The estimated delay from the pressure transmitter to the recording device and to the PLC is approximately 155ms.

The PLC processor, model SLC 503, is the central processor for all data and controls at the pump station. The PLC has a scan rate of approximately 20 milliseconds. Scan rate is loosely defined as the amount of time it takes to read a field device, compare to logic, make a decision and act. Thus the PLC is capable of publishing a revised pressure reading approximately every 20 milliseconds.

The Arcom Director scans the PLC for new information for 5000 ms with 500ms rests in between. New data which exceeds a predetermined deadband, is published to the Arcom database. The Arcom director also contains a Report by Exception (RBE) pacing, which is configured to wake up every 2000ms and look for changes in the Arcom database, package the data and prepare the data packets to be sent over the network. Thus, new data can be sent to the SCADA system over the SCADA network once every 2000ms.

Data is transmitted from the pump station to the data center in Houston via a SCADA network comprised in part of satellite equipment and part of T1 lines. Chart A, below demonstrates that on November 1, 2007 the response time for data traveling to Carmichael station and back to the data center in Houston took from approximately 685ms to approximately 2694ms, with the average time being around 982ms. It is estimated that data transmitted from Carmichael station to Houston would take approximately 500ms to reach the SCADA system. The SCADA system then processes the data and publishes the data to a database and to a display within one to three seconds of time of arrival. Table A, below contains data received by the SCADA system immediately before, during and immediately after the pipeline rupture. The same information recorded here was displayed for the controller.

Chart A

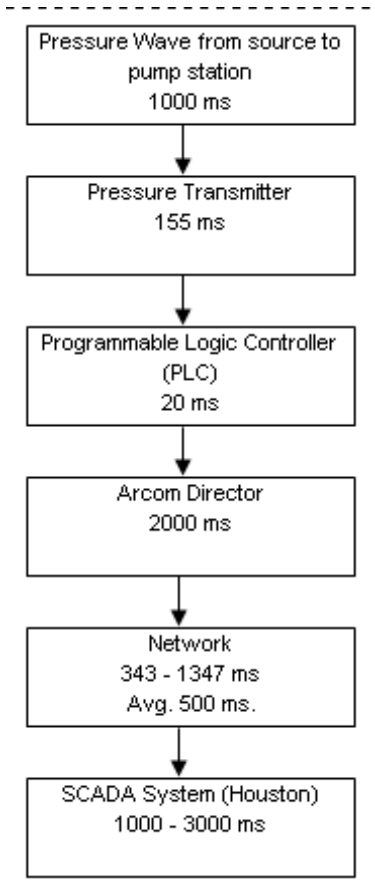
Network Speed on 11/01/2007

DX-Carmichael-2024-DII (ARCOM Device)

	AvgRTT	AvgMaxRTT	StdDev	AvgMinRTT	%Missed
11/1/2007	982	2694	82.74	685	0.00
7 Day Avg	979	2867	74.23	687	0.01

Chart B

Data Flow from Carmichael to Houston



Using the times in Chart A, if the pipeline rupture occurred at 10:35:01, an alarm could reasonably have been expected to arrive on the control display in the control center between 10:35:06 and 10:35:12. Table A below indicates a pressure change was recorded in the SCADA system at 10:35:06 on the morning of November 1, 2007. A subsequent pressure change was recorded at 10:35:13.

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Data in Table B below was extracted from the pressure recorder at the location. The recorder's time clock was found to be eight minutes and eight seconds ahead of network time. Both the actual recorder time and the corrected recorder time are recorded in the table below. The local pressure recording device is not on the corporate network. The recording device records a minimum and a maximum value for every ten second period. For the ten second period between 10:34:42 and 10:34:52 the minimum recorded value was 1414 psig and the maximum recorded value was 1417 psig. For the ten second period between 10:34:52 and 10:35:02 the minimum recorded value was 153 psig and the maximum recorded value was 1417 psig. Given that the pressure was increasing at a rate of approximately one to two psig every 10 seconds for the previous five minutes, and the previous ten seconds ended with 1417 psig., one would have expected to see a value higher than 1417 psig had the pipeline not ruptured immediately after that value was recorded at 10:35:02. Table A below represents the times the pressure changes were recorded in the SCADA system in Houston. Note that there were seven pressure changes recorded in the SCADA system in a one minute, five second time period.

Table A

SCADA system records

10:34:52 AM	1414.4
10:35:06 AM	1079.2
10:35:13 AM	154.4
10:35:17 AM	160
10:35:21 AM	163.2
10:35:31 AM	168
10:35:41 AM	164
10:35:57 AM	160.8

Table B.

Field Recording Device

Date	Time	Corrected time	Min	Max
2007/11/01	10:42:30	10:34:22	1411	1414
2007/11/01	10:42:40	10:34:32	1413	1415
2007/11/01	10:42:50	10:34:42	1414	1416
2007/11/01	10:43:00	10:34:52	1414	1417
2007/11/01	10:43:10	10:35:02	153	1417
2007/11/01	10:43:20	10:35:12	160	166
2007/11/01	10:43:30	10:35:22	165	170
2007/11/01	10:43:40	10:35:32	164	166
2007/11/01	10:43:50	10:35:42	162	164
2007/11/01	10:44:00	10:35:52	160	162

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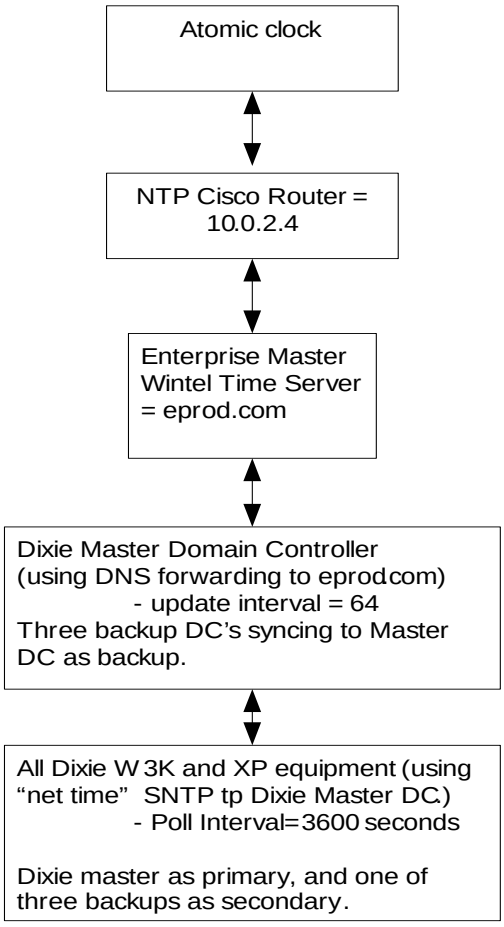
Chart C

SCADA system time clock:

Every device on the EPCO network is synchronized with the atomic clock. The Dixie system uses the EPCO time sync standards throughout the SCADA system. The local recording device is not on the EPCO network. The hierarchy from the Atomic Clock to the SCADA equipment is as follows:

Dixie Pipeline Time Sync flow



Conclusion:

Due to the number of variables in the processing speed of data sent over the network, we feel that the most accurate source of data for determining the time of the breach is data extracted from the Yokagawa chart recorder located at the Carmichael pump station. This data set indicates that the drop in pressure caused by the loss of containment was not yet recorded at the top of the ten-second period from 10:35:02 through 10:35:12, but the pressure loss was recorded very shortly thereafter. Backing off one second for the travel time of the pressure wave, we feel that the breach most likely occurred between 10:35:01 and 10:35:02 on November 1, 2007.

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