

# Detection and Assessment of Organic Compound Fugitive Emissions from Surface Installations at the Cardenas Sector

April 25 2006.

## Objectives

- ❖ **Assess organic compound emissions on surface installations at the Cardenas Pipeline Sector.**
- ❖ **Determine each piece of equipment's air-tightness on surface installations at the Cardenas Pipeline Sector.**
- ❖ **Gather specific information on location and magnitude of organic compounds fugitive emissions.**
- ❖ **Reduce operations costs on surface installations at the Cardenas Pipeline Sector.**
- ❖ **Increase equipment operation reliability.**

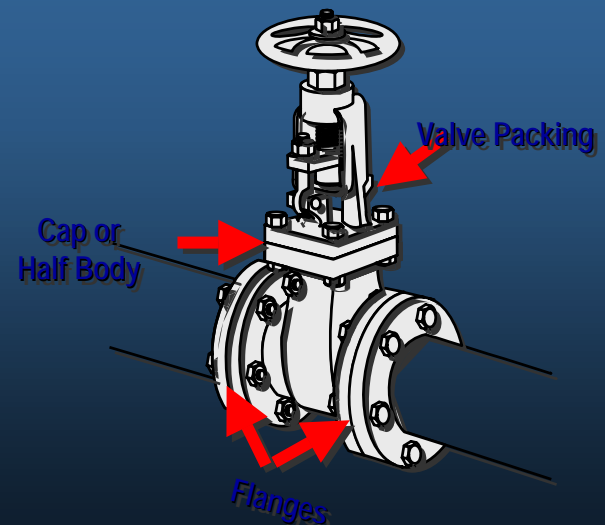
Pipeline	Section	Design Pressure (psi)	Operation Pressure (psi)	MMPCD (Million Cubic Feet per day)	MBLD (Thousand Barrels per day)
Gas 48" - 42" Ø	Cactus – San Fernando – Ramones	1,218.79	753.66	1,510	-----
Gas 36" Ø	Cactus - El Misterio	1,219.36	786.36	875	-----
Gas 36" Ø	El Misterio – Las Palomas	966.96	312.84	875	-----
Gas 30" Ø	New Pemex - Cactus	1,099.91	824.76	1,100	-----
Gas 24" Ø	Pemex City - El Misterio	1,066.50	786.36	440	-----
Gas 24" Ø	Pemex City – México	1,073.61	786.36	440	-----
L.P.G. 24" Ø	Cactus - Venta de Carpio	1,038.06	881.64	-----	112.50
L.P.G. 16" Ø	Nuevo Pemex- Cactus	1,749.06	895.86	-----	81.25
Gas 16" Ø	Pemex City- Alcalde Mayor	1,169.87	284.40	60	-----
Gas 10" Ø	Alcalde Mayor – Apasco Cements	1,862.82	284.40	40	-----
Gas 8" Ø	Pilares - Paredón		Out of Service		



- ❖ **NOM-009-SECRE-2002** Pipeline natural gas, LP gas leaks monitoring, detection and classification.
- ❖ **NOM-007-SECRE-1999** Natural Gas Transportation.
- ❖ **NOM-003-SECRE-2002** Natural Gas and Oil Liquefied Gas Pipeline Distribution.

- ❖ **Method 21, EPA** Determination of Volatile Organic Compounds Leaks
- ❖ **Rule 1173** Fugitive Emissions of Volatile Organic Compounds
- ❖ **49 FR 23513** National Emission Standard for Equipment Leaks (Fugitive Emission Sources), Subpart V
- ❖ **ASME** Gas Leakage Control Criteria. Appendix M
- ❖ **AP-42** Section 7, Factor Emissions
- ❖ **CAAA** Clean Air Act Amendment of 1990
- ❖ **SARA, Title III** Superfund Amendment and Reauthorization Act
- ❖ **NSPS** New Source Performance Standards
- ❖ **NESHAP** National Emission Standards for Hazardous Air Pollutants

- ❖ 1. Prepare logistics for fugitive emissions monitoring.
- ❖ 2. Take a census of all equipment and connectors integrating fluid transportation lines.
- ❖ 3. Labeling to identify each equipment and connector in the census.
- ❖ 4. Fugitive emissions monitoring.
- ❖ 6. Capture all field registered data.
- ❖ 7. Prepare a data base including each piece of equipment and connector monitored.
- ❖ 8. Treatment and validation of all gathered data.
- ❖ 9. Detection of components with leakage problems.
- ❖ 10. Statistical analysis of gathered data.
- ❖ 11. Identification of all equipment and connectors monitored at each printed circuit.



## ▪ Pilot Plan at the Cardenas Sector

Phase No. 1

Census, labeling, fugitive emissions monitoring and visual inspection.

Phase No. 2

Sealing of all leaks detected in installations

Phase No. 3

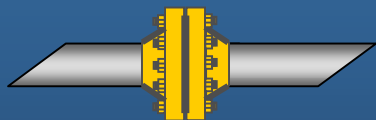
Re-monitoring of all equipment initially monitored to ensure elimination of fugitive emissions or leaks

Phase No. 4

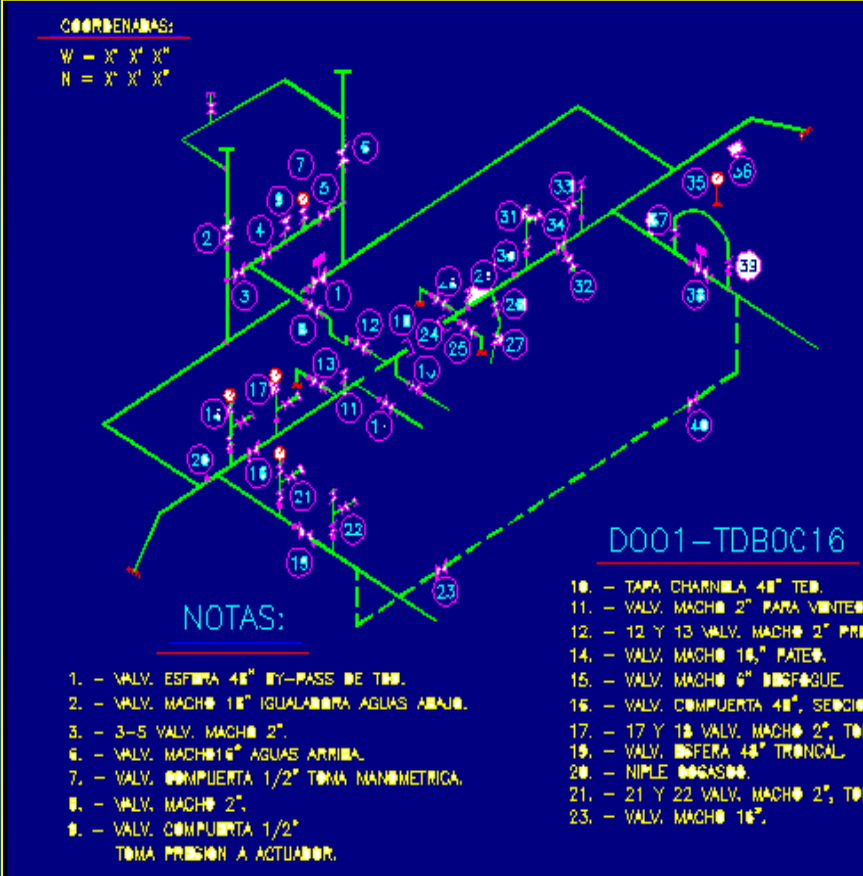
Implementation of improvement programs for surface installations' maintenance and safety

Culture in fugitive emissions and leakage prevention to eliminate environmental pollutants and risks in installations

*Fugitive Emissions  
Detection and  
Elimination on Surface  
Installations*







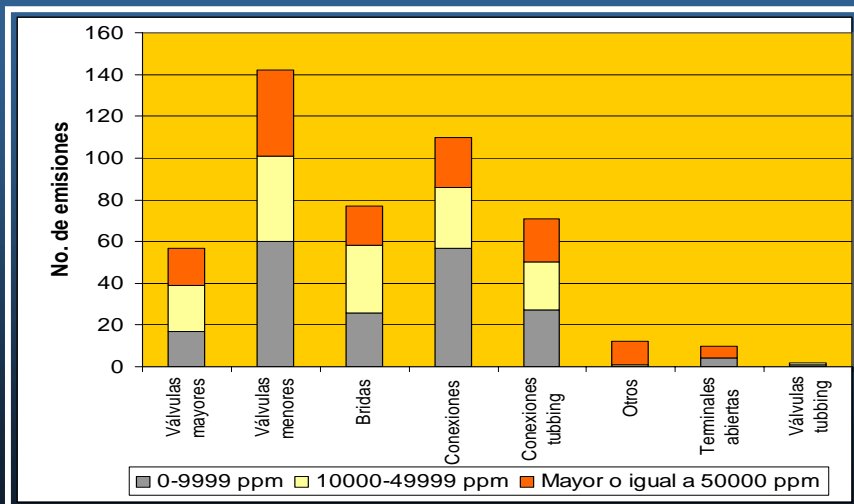
**We innovate**

**EH&S - PM** Measurement Points (ppm)

Tipo de Equipos	No. de inspecciones		No. de emisiones			Kg/año
	Componentes	Puntos	0-9999 ppm	10000-49999 ppm	Mayor o igual a 50000	
Válvulas mayores*	493	505	17	22	18	2012.77
Válvulas menores**	824	786	60	41	41	4518.59
Bridas	1648	1648	26	32	19	3157.54
Conexiones	1129	1129	57	29	24	1770.91
Conexiones tubing	1181	1181	27	23	21	1334.69
Otros	12	12	0	1	11	819.23
Terminales abiertas	45	45	4	0	6	250.88
Válvulas tubing	214	214	1	1	0	30.86
<b>TOTAL</b>	<b>5546</b>	<b>5520</b>	<b>192</b>	<b>149</b>	<b>140</b>	<b>13895.47</b>

\*Válvulas Mayores.- las de diámetro mayor o igual a 2 ½"

\*\* Válvulas menores.- las de diámetro menor a 2 ½"



- ✓ Fugitive emissions elimination work
- ✓ Component repositioning due to problem reoccurrence
- ✓ Environmental protection
- ✓ Risk elimination in installations
- ✓ Sanction prevention



Ubicación Técnica	Kg/año	Aportación (%)	Ubicación Técnica	Kg/año	Aportación (%)
D001 TDA0015	209.76	1.51	D018 VS00249	23.73	0.17
D001 TDB0016	85.40	0.61	D018 VS00250	5.19	0.04
D001 TED0000	32.32	0.23	D018 VS00253	26.17	0.19
D001 VS00005	119.30	0.86	D049 TED0438	325.98	2.35
D001 VS00007	42.10	0.30	D049 TRD0044	156.71	1.13
D001 VS00741	263.22	1.89	D049 VS00439	26.19	0.19
D007 TED0081	380.29	2.74	D049 VS00441	19.30	0.14
D007 TRD0089	129.49	0.93	D082 TRD0593	66.77	0.48
D007 VS00084	0.00	0.00	D082 TRD0595	123.73	0.89
D007 VS00086	0.00	0.00	D082 TRD0597	69.41	0.50
D008 TED0092	179.71	1.29	D082 TRD0599	127.23	0.92
D008 VS00097	5.82	0.04	D105 TED0774	267.25	1.92
D008 VS00098	65.17	0.47	D105 TRD0776	218.85	1.57
D008VS00095	119.30	0.86	D106 TED0778	13.70	0.10
D016 EM00220	113.37	0.82	D106 TRD0779	21.48	0.15
D016 EM00724	396.89	2.86	D119 TED0086	15.14	0.11
D016 EM00734	268.63	1.93	D122 TDA0905	3.47	0.02
D016 ERM0736	322.10	2.32	D122 TDB0906	3.47	0.02
D016 TDA0197	71.62	0.52	D122 TED0898	241.94	1.74
D016 TDB0198	0.00	0.00	D122 VS00900	0.00	0.00
D016 TDB0212	156.92	1.13	D122 VS00902	4.82	0.03
D016 TED0181	95.27	0.69	D122 VS00903	9.76	0.07
D016 VS00184	156.63	1.13	D122 VS00910	64.23	0.46
D016 VS00185	171.60	1.23	D122 VS01051	20.38	0.15
D016 VS00187	64.23	0.46	ECCAR	2,694.62	19.39
D016 VS00211	81.37	0.59	ECTC-1	468.47	3.37
D016 VS00213	0.00	0.00	ERM 07001	702.57	5.06
D016 VS00215	0.00	0.00	ERM 071LP	311.91	2.24
D016 VS00722	116.46	0.84	ERM 27001	62.80	0.45
D016 VS00726	0.00	0.00	ERM 27008	137.98	0.99
D016 VS00731	197.44	1.42	ERM 27009	121.58	0.87
D018 TED0233	198.79	1.43	ERM 27010	425.75	3.06
D018 TRD0256	48.86	0.35	ERM 27011	1,145.79	8.25
D018 VS00236	234.61	1.69	ERM 27012	1,350.36	9.72
D018 VS00239	57.43	0.41	ERM 27018	234.64	1.69
			<b>TOTAL</b>	<b>13,895.47</b>	<b>100</b>

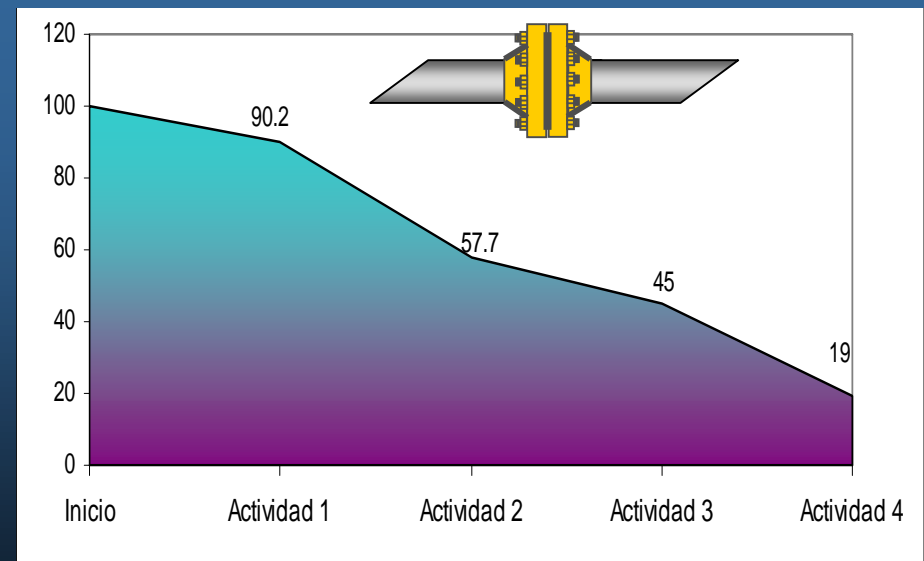
Elements for estimating natural gas losses:

- Natural Gas Density = 0.6784 Kg/m<sup>3</sup> at 60 °F
- Natural Gas Price 8.03 US\$/ MMBtu = \$84.55 per MMBtu (Source SENER Dec 2005)
- Dollar Exchange Rate = 10.53 Pesos
- Gas Heat Power = 1002 Btu/ ft<sup>3</sup>  
998 ft<sup>3</sup> = 1 MMBTU = 28.26 m<sup>3</sup>

As you can see, the economic value due to product loss is relatively low, however, eliminating fugitive emissions a potential risk of higher losses is avoided, especially in case of an accident.

Installations	Kg/Year	m <sup>3</sup> /Year	MMBTU/Year	\$/Year
Cardenas Sector	13,895.47	20,482.7	724.8	61,281

Maintenance	Emission Elimination	Cumulative Reduction to Total Emissions (%)
Activity 1	On valves and tubing connections	90.2
Activity 2	On smaller valves	57.7
Activity 3	On connections	45.0
Activity 4	On the remaining components, emissions higher or equal to 50,000 ppm	19.0



## Proposed Techniques for Corrective Maintenance

These leak sealing techniques are for lines in operation

### EXECUTION TIME

1-5 business days per installation

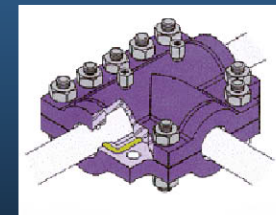
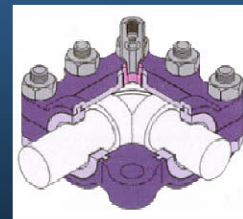
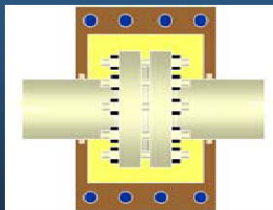
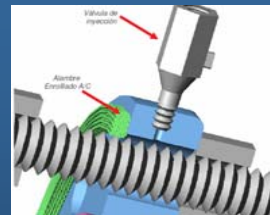
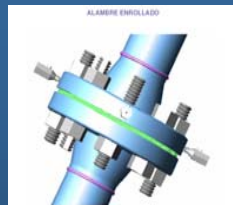
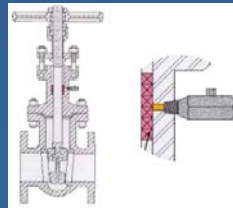
### COST

\$3, 682,500 Mexican Pesos

*Tightening with Hy-tork  
Equipment*

*Coiled Wire*

*Repacking in Valve  
Packing Box*



*Total Encapsulation of Pipeline Accessories: Tees,  
elbows, flanges, etc.*

**RANGE**

**IMPLEMENTATION, EXECUTION AND ADMINISTRATION OF A MAINTENANCE PROGRAM  
STEMMING FROM LEAK MONITORING AND CORRECTION IN THE FUGITIVE EMISSIONS  
STUDY**

**EXECUTION TIME: 60 Hours**

**COST: \$590,000 Mexican Pesos**

***RANGE***

***100 % VALIDATION OF CORRECTIVE MAINTENANCE WORK DONE ON MONITORED EQUIPMENT***

***Re-monitoring allows verification of all components in the equipment where leaks were detected and in doing so, leakage elimination is fully corroborated.***

***Re-monitoring takes 2 days per installation.***

**COST: \$ 218,334 Mexican Pesos**