Pemex Gas y Petroquímica Básica
(Pemex Gas and Basic Petrochemicals)
Division of Production

Identification and Documentation of GHG Reduction Projects in Natural Gas Processing Complexes

November 2008
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2. Collaboration of PEMEX Gas and Methane to Markets
3. Success stories in PEMEX Gas
4. Energy and GHG Emissions Diagnostics at Nuevo PEMEX and Poza Rica Gas Processing Centers
5. Next Steps
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1. Introduction

Within the framework of a sustainable development policy, the Production Division of PEMEX Gas is working to identify and document greenhouse gas (GHG) emissions reduction projects.

These activities are part of a strategic initiative called “PEMEX and Environmental Care” that promotes operational security and a better relationship with environment, under the National Climate Change Strategy promoted by President Felipe Calderón.

In close collaboration with the Methane to Markets Partnership, PEMEX has carried out on-site measurement studies in different gas processing complexes in order to identify methane and other GHG emissions reduction options, as well as energy efficiency opportunities.
SEMARNAT is the agency in charge of the M2M program in Mexico, and PEMEX co-presides the International M2M Oil and Gas Subcommittee with the Russian Federation and Canada.

PEMEX is carrying out emissions inventories and energy consumption studies to improve environmental performance and reduce industrial risks, as well as to achieve economic savings and preserve natural resources.

To take advantage of the technical support provided by M2M, M2M and the Division of Production of PEMEX Gas carried out a methane emissions measurement campaign in gas processing complexes (GPC) in the context of broader energy efficiency diagnostics, and to comply with the social responsibility of PEMEX Gas.
Why focus on methane?

- A potent greenhouse gas (GHG) with 100-year global warming potential of 23; atmospheric lifetime of ~12 years
- The 2nd most important GHG, accounting for ~16% of total climate forcing
- A primary component of natural gas and a valuable, clean-burning energy source

Global GHG Emissions in 2000
40,702 million tonnes carbon dioxide equivalent (MtCO$_2$e)
The majority of oil and gas methane emissions come from:
- Oil production
- Natural gas
  - Production
  - Processing
  - Transmission
  - Distribution

Methane emissions can be intentional or unintentional:
- Leaks
- Process venting
- System upsets
2. M2M - PEMEX Gas Collaboration

- The Methane to Markets Partnership (M2M) is an international initiative supported by the US EPA with 25 partner Governments including Mexico, and who are responsible of 70% of methane emissions in the world.

- The Methane to Markets Partnership (M2M) is an international initiative that advances in methane recovery and use as a clean energy source in four sectors:

- **Oil and Gas Systems**
- **Coal Mines**
- **Landfills**
- **Agricultural Waste**

The goals of the Partnership are to reduce global methane emissions to:

- Enhance economic growth
- Strengthen energy security
- Improve air quality and industrial safety
- Reduce emissions of greenhouse gases
2. M2M - PEMEX Gas Collaboration

How does Methane to Markets support PEMEX Gas?

- **Develop estimated methane emissions inventory**
  - The gas complex provides operational data to a consultant provided by M2M with EPA funds that is used to estimate methane emissions and to propose methane reduction opportunities.
  - Consultant delivers a report detailing economic, operational and environmental benefits from emissions reduction.
  - Helps prioritize opportunities.

- **“Desktop” project analysis**
  - Using results from estimated inventory, consultant and the gas processing complex can further evaluate priority projects with high economic and environmental potential.
  - Consultant can do further analysis to provide more specific project recommendations (detailed technical, economic, etc.).

- **On-site measurement study**
  - For gas processing complexes seriously considering implementing emission reduction project, on-site measurement studies, leak & vent detection for proposed projects are performed.
  - M2M uses methane emission identification and measurement equipment to quantify methane emissions.

- **For gas processing complexes seriously considering implementing emission reduction project, on-site measurement studies, leak & vent detection for proposed projects are performed.**

- **M2M uses methane emission identification and measurement equipment to quantify methane emissions.**
Benefits from methane recovery and use projects

**Economic benefits**
- Increased revenue by reducing losses
- Reduced maintenance and fuel costs

**Operational benefits**
- Increased energy efficiency at oil and gas facilities
- Reduced waste of a valuable fuel and energy source
- Improved industrial safety
- Potential maintenance and fuel savings
- Progress toward corporate goals

**Environmental benefits**
- Reduced greenhouse gas emissions
- Improved local air quality
List of projects performed to date under the M2M – PEMEX Gas collaboration:

- August 2006 – Ciudad PEMEX GPC. Fugitive emissions measurement from compressors with wet seals (can be used as a baseline for a CDM project)

- August 2006 – Cactus, Ciudad PEMEX and Nuevo PEMEX GPCs. Fugitive emissions identification and measurement from process.

- October 2007 – Ciudad PEMEX GPC. Post-implementation measurement from dry seals on compressors

- October 2007 – Cactus, Ciudad PEMEX y Nuevo PEMEX GPCs. Post-repair/rehabilitation measurements from valves, etc.

- October 2007 –Nuevo PEMEX GPC. Integrated methane emissions and energy diagnostic

- February 2008 – Poza Rica GPC. Integrated methane emissions and energy diagnostic
3. Success Stories at PEMEX Gas

**Wet seals replacement from compressors**

In April 2006, PEMEX Gas hosted the *International Oil and Gas Subcommittee Meeting and Technology Transfer Workshop*, where it presented the project “Shifting from wet seals to dry seals in natural gas compressors in Ciudad PEMEX GPC.” This project was selected by the International Oil and Gas Subcomittee as a *Flagship* project to promote methane recovery actions in Latin America. On October 2006, a certified measurement study to set up the project base line was sponsored by M2M.

In October 2006, the project represented Mexico in the *13Th Annual Implementation Workshop of Natural Gas*, in Houston TX, and was recognized as an example of *Best Practices* for emissions reduction.

On October 2007, the results were verified and methane emissions reductions of 99.95% (67,718 Mcf/y) were measured.

<table>
<thead>
<tr>
<th>Component Category</th>
<th>2006 Leak Survey</th>
<th>2007 Post Measurement Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of wet seals</td>
<td>Emission Factor (SCFM)</td>
</tr>
<tr>
<td>Turbine Wet Seal</td>
<td>3</td>
<td>43.11</td>
</tr>
</tbody>
</table>
Quantification of Emissions at PEMEX Gas GPCs

On August 2006, with USAID and M2M support, a methane fugitive emissions identification and measurement study was conducted in 3 GPCs: Cactus, Nuevo PEMEX and Ciudad PEMEX.

Components with the biggest impact were immediately repaired/replaced. On October 2007, a post-measurement survey was performed by Heath Consultants with the following results: 98.38% of emissions reduction, 75% from Ciudad PEMEX wet seals and 25% from other components.

### Summary results by GPC

<table>
<thead>
<tr>
<th>GPC</th>
<th>Before Rate flow, 2006 MMcf/year</th>
<th>After Rate flow, 2007 MMcf/year</th>
<th>Emissions reduction 98.38%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cactus</td>
<td>4.847</td>
<td>0.830</td>
<td></td>
</tr>
<tr>
<td>Nuevo PEMEX</td>
<td>15.336</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Ciudad PEMEX</td>
<td>70.842</td>
<td>0.641</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>91.025</td>
<td>1.471</td>
<td></td>
</tr>
</tbody>
</table>
3. Success Stories at PEMEX Gas

Quantification of Emissions at PEMEX Gas GPCs

Work in gas processing complexes included identification and tagging of leaking components. Additionally, the leak rate was measured, allowing operations staff to implement corrective actions. The successful results of this work were verified in the 2007 post-measurement survey.

The main implementation activities included:

- **A valve maintenance program was successfully implemented in Ciudad PEMEX.**
  7 leaking valves were replaced during a maintenance stop. Emissions reductions of 2.9 MMcf/year were achieved.

- **Nuevo PEMEX focused on the replacement/substitution of valves from Cryogenic Plant 2.** This effort achieved a complete elimination of emissions worth to 15.3 MMcf/year.

- **In Cactus, 7 leaks were repaired and 2 more leaks were minimized,** a total reduction in emissions of 4.0 MMcf/year was achieved.
4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostic

- On October 2007 and February 2008, measurement campaigns were conducted in Nuevo PEMEX and Poza Rica GPCs, respectively, in order to generate a GHG emissions inventory and reduction opportunities by:
  - Methane emissions control programs
  - Energy efficiency improvement

- The measurement campaign included:
  - Inventory of leaking components, process vents and flares
  - Gas process heater efficiency measurement

- Specific emissions control opportunities were identified, and an economic assessment for opportunities was prepared.

- The assessment was performed Clearstone Engineering (Canada) and PA Consulting Group (USA), with the technical support of M2M.

- These results have been integrated into action plans to implement preventive and corrective actions of energy optimization in the processes in order to reduce methane and CO₂ emissions.
## 4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostics

### Emissions reduction potential in CO$_2$e at Nuevo PEMEX GPC

<table>
<thead>
<tr>
<th>Source</th>
<th>Contribution %</th>
<th>Control Technology</th>
<th>Reduction Potential [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heaters</td>
<td>1%</td>
<td>A/F management</td>
<td>10-15</td>
</tr>
<tr>
<td>Flares</td>
<td>19%</td>
<td>Purge gas optimization and flare valve leak detection program</td>
<td>95</td>
</tr>
<tr>
<td>Fugitive Emissions</td>
<td>0.2%</td>
<td>DI&amp;M program</td>
<td>70 – 80</td>
</tr>
<tr>
<td>Compressor Venting</td>
<td>0.8%</td>
<td>Vapor recovery system</td>
<td>95</td>
</tr>
<tr>
<td>Sulphur Recovery</td>
<td>15%</td>
<td>Waste gas recovery system</td>
<td>95</td>
</tr>
<tr>
<td>Fractionation</td>
<td>5%</td>
<td>Regular inspection/tuning</td>
<td>10-15</td>
</tr>
<tr>
<td>Auxiliary Services</td>
<td>59%</td>
<td>Regular inspection/tuning</td>
<td>10-15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostics

Project opportunities\(^1\) at Nuevo PEMEX GPC

CO\(_2\) measurement results

1. These figures are based on measurements performed during the inventory on fuel consumption, volumes of vented and/or burned gas, and fugitive emissions in components and equipment.
**Total CO$_2$e emissions at Nuevo PEMEX GPC**

- **59%**: Fugitive emissions
- **19%**: Fractionation
- **15%**: Flares
- **0.2%**: Auxiliary services
- **0.8%**: Compressors vents
- **1%**: Sulphur recovery
- **1%**: Heaters

Total emissions = 2,875,000 Ton CO2e/year
## 4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostics

### Emissions reduction potential CO$_2$e at Poza Rica GPC

<table>
<thead>
<tr>
<th>Source</th>
<th>Contribution %</th>
<th>Control Technology</th>
<th>Reduction Potential [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heaters</td>
<td>4%</td>
<td>A/F management.</td>
<td>10-15</td>
</tr>
<tr>
<td>Flares</td>
<td>4%</td>
<td>Purge gas optimization and flare valve leak detection program or flare gas recovery system.</td>
<td>95</td>
</tr>
<tr>
<td>Fugitive Emissions</td>
<td>2%</td>
<td>DI&amp;M program.</td>
<td>70-80</td>
</tr>
<tr>
<td>Compressor Venting</td>
<td>17%</td>
<td>Vapor recovery system.</td>
<td>95</td>
</tr>
<tr>
<td>Sulphur Recovery</td>
<td>18%</td>
<td>Review sweetening plant</td>
<td>95</td>
</tr>
<tr>
<td>Fractionation</td>
<td>2%</td>
<td>Regular inspection/tuning.</td>
<td>10-15</td>
</tr>
<tr>
<td>Auxiliary Services</td>
<td>53%</td>
<td>Regular inspection/tuning.</td>
<td>10-15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
4. Nuevo PEMEX and Poza Rica GPCs energy diagnostic

Project opportunities\(^1\) at Poza Rica GPC

**Methane Emissions**

- 4,704 tonCH\(_4\)/year

**CO\(_2\) Measurement results**

**CO\(_2\) Emissions**

- 401,318 tonCO\(_2\)/year

\(^1\) This figures are based on measurements performed during the inventory on fuel consumption, volumes of vented and/or burned gas, and fugitive emissions in components and equipment.
4. Nuevo PEMEX and Poza Rica GPCs Energy Diagnostics

Total CO$_2$e emissions at Poza Rica GPC

Total emissions = 500,100 TonCO2e/year
5. Next Steps

Develop detailed work plans for the Nuevo PEMEX and Poza Rica GPCs, generated from energy diagnostics performed by Clearstone Engineering and PA Consulting Group

Complejo Procesador de Gas Poza Rica

Descripción: Propuesta de iniciativas para integrar proyectos de Mecanismo de Desarrollo Limpio (MDL)

<table>
<thead>
<tr>
<th>CONCEPTO</th>
<th>PROGRAMA PRELIMINAR</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>JUN</td>
<td>AGO</td>
<td>SEP</td>
<td>OCT</td>
</tr>
<tr>
<td>1.- Recepción del reporte técnico de diagnostico energético y reducción de emisiones</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2.- Presentación y difusión de los resultados</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3.- Verificación por el CT de los datos indicados en los reportes técnicos</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.- Análisis de resultados y elaboración de programas de trabajo</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONCEPTO</th>
<th>PROGRAMA DE EJECUCIÓN</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>JUN</td>
<td>AGO</td>
<td>SEP</td>
<td>OCT</td>
</tr>
<tr>
<td>Eliminar las emisiones fugitivas detectadas en equipo de proceso de TF, Gribboli y Criogénica, por orden de magnitud, considerando el reemplazo de componentes (ver nota en observaciones)</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reemplazar los componentes emisores identificados, susceptibles de reparación rentable</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mejorar la eficiencia de combustión de las calderas, mediante ajuste de la relación A/C</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reducir venteo de los sellos y de la grasera de los compresores en la planta criogénica</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ajustar la combustión de calentadores y hornos en las plantas criogénica, azufre y fraccionamiento</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implantar un programa de detección de fugas en las válvulas a QW o instalando un sistema de recuperación de gases en QW</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimizar el flujo de purga a QW’s de fosa y elevado, implementando su medición</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reducir venteos de las unidades GB-602 A/B/C</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Análisis causa-raíz de las pérdidas de metano en la planta de endulzamiento</td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Next Steps

- Replace wet seals with dry seals in 13 compressors in Nuevo PEMEX and Poza Rica GPC, replicating the Ciudad PEMEX GPC project.

- Request M2M support for an energy diagnostic for Burgos GPC to be performed in December and implement valve maintenance training at the GPCs.

- Propose feasible CDM projects and take advantage of the carbon market.

- The Production Division of PEMEX Gas will present the achievements in GHG emissions reductions on November 11 to 13, in the 15th Annual Natural Gas STAR and Methane to Markets Implementation in San Antonio, TX and will share experiences with other countries.
At PEMEX Gas we are integrating these kinds of energy diagnostic measurements into our Operational Discipline at our gas processing complexes by buying detection and measurement equipment for methane and CO$_2$ equipment and training our personnel.

These diagnostics will not only promote the development of CDM projects, but form the basis for a permanent program to sustain and replicate these actions throughout PEMEX Gas.
Production Subdivision

¡Thank-You!

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