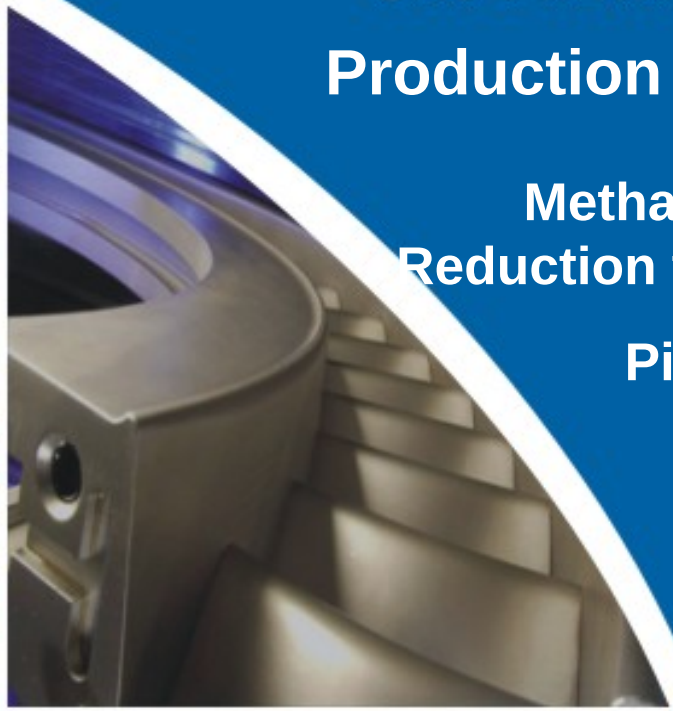


PEMEX

GAS Y PETROQUIMICA BASICA

Production Subdivision

Methane Emissions Reduction from Compressors

Pilot Project

"Technology Transfer Workshop Methane to Markets"

Villahermosa, April 25, 2006

PEMEX Organizational Structure



PEMEX operates through a Corporate Office and Four Subsidiary Entities, to wit:

Exploration and Production (PEP)

Gas Production

- Refining
- Exports

Refining (PR)

Product Refinery

- Clients
- Exports

Pemex Gas and Basic Petrochemicals (PGPB)

- Gas Sweetening
- Liquid recovery
- Fractioning

- PPQ, PEP
- Clients
- Exports

Petrochemicals (PPQ)

- Methane Derivatives
- Ethane Derivatives
- Propane Derivatives
- Aromatics and Derivatives

- Clients
- Exports

PEMEX Infrastructure and Main Results

Petróleos Mexicanos (PEMEX) operates a vast network of production, processing, storage, and distribution facilities:

With 742 finished wells and 116 perforation equipments in 12 comprehensive development assets and three regional exploration assets, in 2005, PEMEX produced:

- 3.3 million barrels of oil per day and
- 4.8 billion cubic feet of gas per day

- Its nine gas processing centers and its six refineries processed 3.88 billion cubic feet of gas per day and 1.28 million barrels of crude oil per day, respectively.

PEMEX Infrastructure and Main Results

With this processing infrastructure, the system's main oil products daily production levels were as follows:

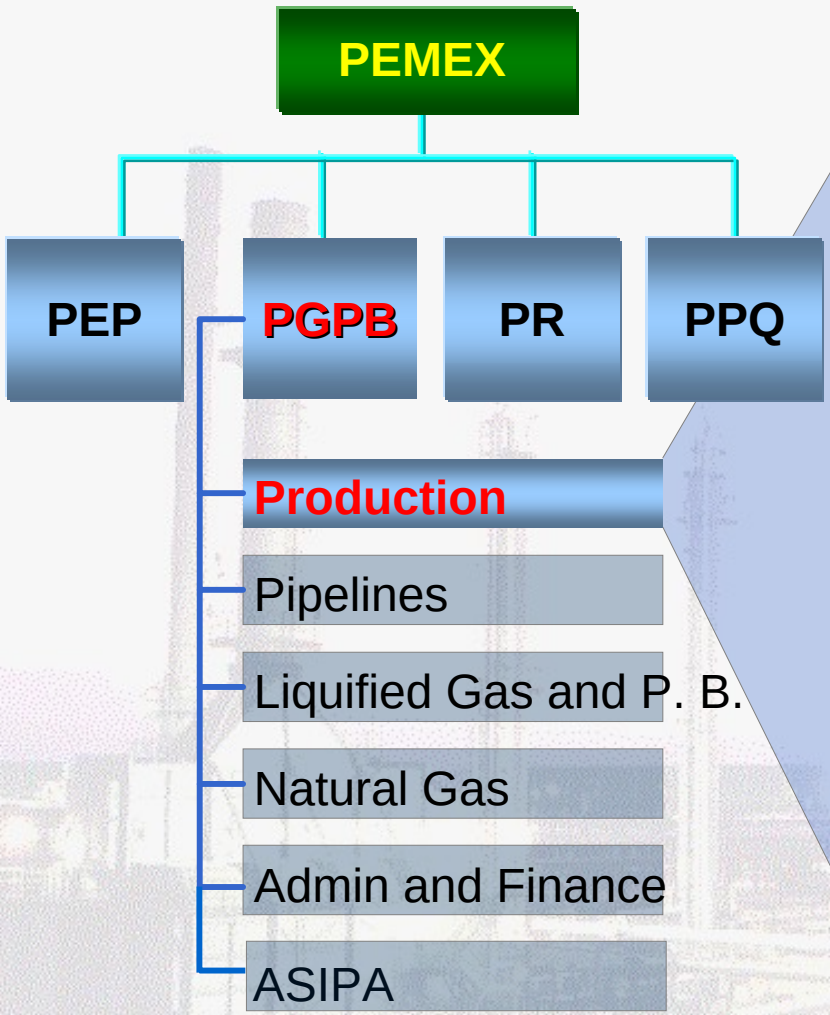
- 455 thousand barrels of gasoline
- 63 thousand barrels of turbo sine
- 318 thousand barrels of diesel
- 351 thousand barrels of fuel oil
- 246 thousand barrels of liquefied gas
- 129 thousand barrels of ethane

The system's eight petrochemical complexes produced a total of 6.2 million tons of petrochemicals during the year.

The main infrastructure for storage, distribution, and commercialization associated to these operations was as follows:

- 79 ground storage terminals
- 15 maritime terminals
- 17 liquefied gas terminals, and
- 42 thousand kilometers of transportation pipelin

Gas Processing at PGPB



Production Subdivision Mission

Processing natural gas and its liquid hydrocarbons in an efficient, clean, and safe manner to meet the requirements of our clients and related entities; to encourage team work, the incorporation of added value within a framework of transparency and accountability through the comprehensive management of quality, safety, health, and environmental protection standards.

Production Subdivision Processing Installations:

- Pemex Gas Production Subdivision's main activities are natural gas processing and liquid gas recovery.

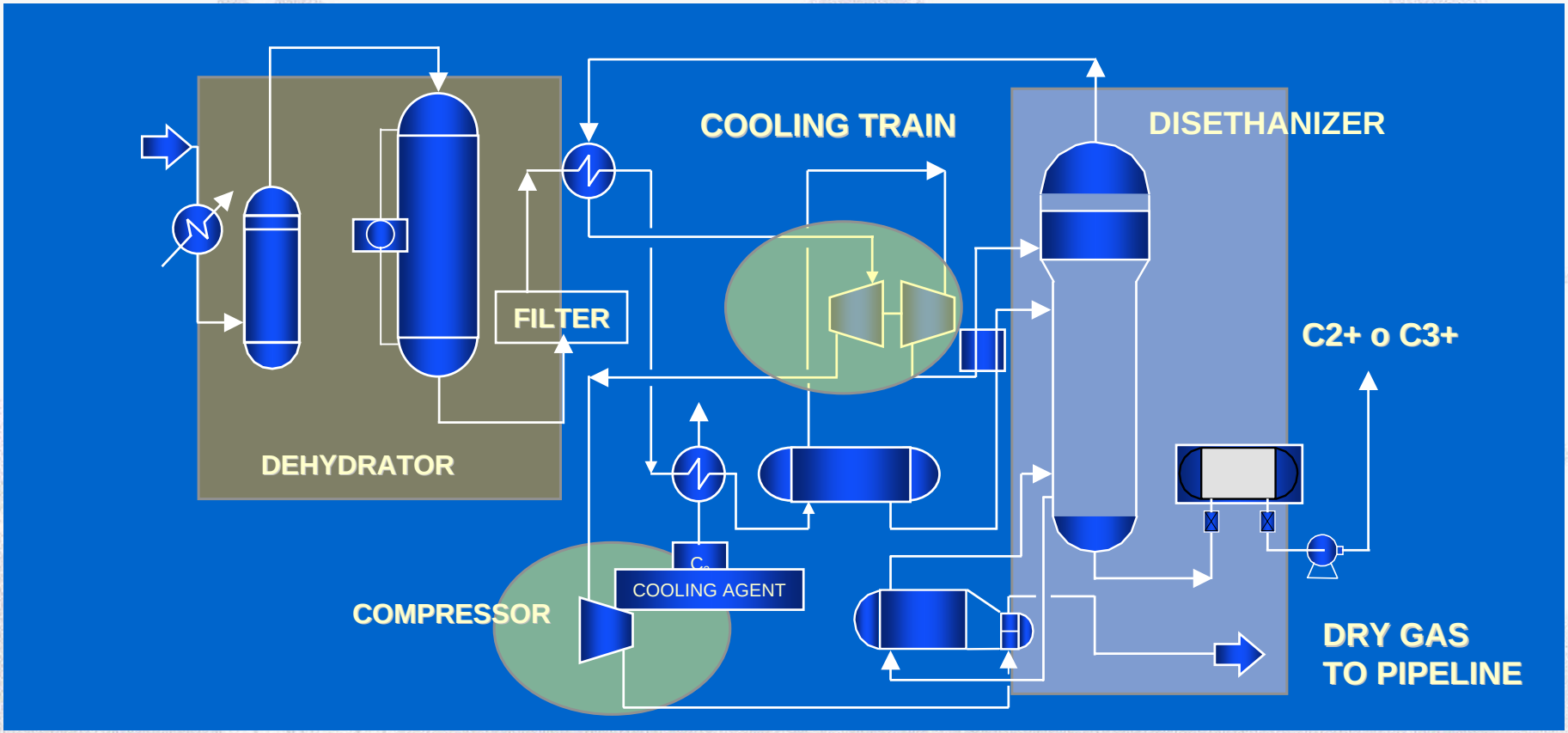
- PEMEX has 9 gas processing complexes in Mexico: 3 in the Northern Region, 1 in the Central Region and 5 in the Southeast Region.

Gas Processing Complexes

Gas Processing at PGPB

Due to the process´ nature, methane emissions can occur in different equipment and parts, such as:

- Processing lines
- Internal combustion engines
- Pumps
- Controls
- Tanks
- Natural Gas Compressors



Methane Losses from Centrifugal Compressors

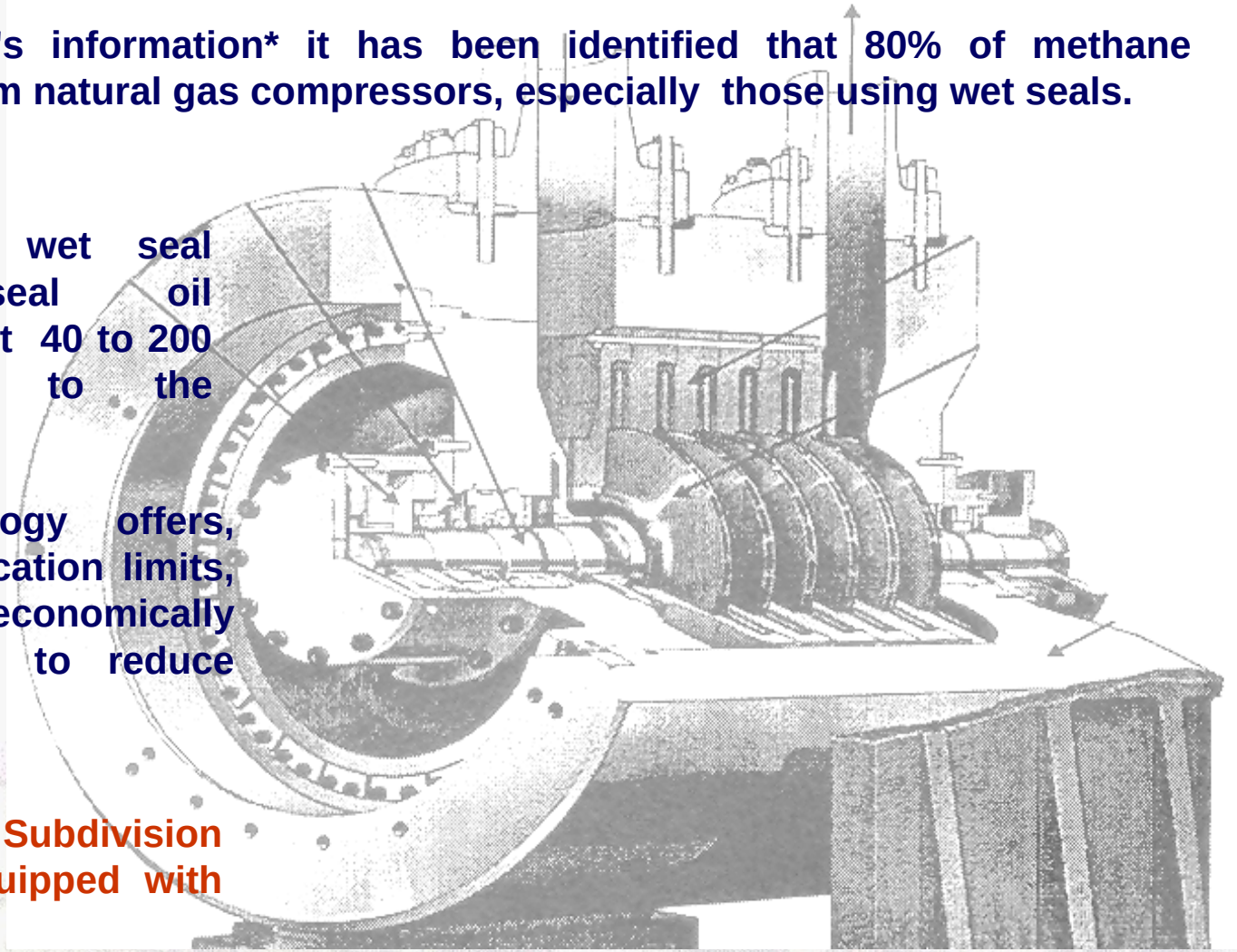


- **Based on industry's information* it has been identified that 80% of methane emissions come from natural gas compressors, especially those using wet seals.**

- **In this type of wet seal compressors, seal oil degassing may vent 40 to 200 SCFM of gas to the atmosphere.***

- **Dry seal technology offers, within certain application limits, a technical and economically feasible alternative to reduce these emissions.**

- **70% of Production Subdivision compressors are equipped with wet seals.**



* *Source: "Replacing Wet Seals with Dry Seals in Centrifugal Compressors" (EPA430-B-03-012)*

Methane Losses from Centrifugal Compressors



- Seals on rotating shafts keep high pressure natural gas from escaping from the compressor packing. Traditionally, these seals use high pressure oil as a barrier against gas leaks. It has been found that replacing these wet seals with dry seals considerably reduces operation and maintenance costs and methane emissions, and it also improves installation safety.

- Most of these emissions occur when the high pressure gas absorbed in the circulating oil is removed from the seal face.

- Because dry seals use high pressure gas to seal compressors, they have the following advantages:

  - Reduce methane emissions (7 scfm* maximum)
  - Have lower energy requirements
  - Increase compressor operational efficiency
  - Lower maintenance requirements
  - Improve installation safety

Wet Seal

* Source: *"Replacing Wet Seals with Dry Seals in Centrifugal Compressors" (EPA430-B-03-012)*

Methane Losses from Centrifugal Compressors

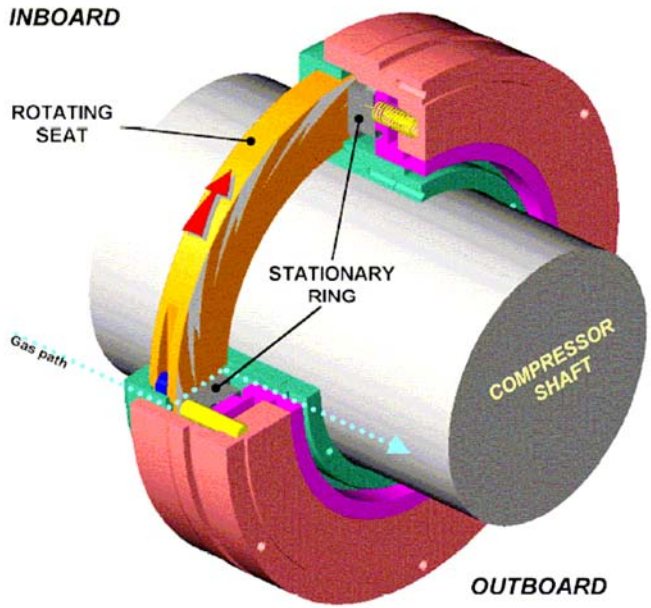


Due to the design or the pressure and temperature operational requirements, converting to dry seals may not be possible in some compressors, but it is recommended to use dry seals instead of wet seals whenever possible.

Dry Seal

Currently around 80% of new centrifugal compressors are sold with dry seals.

Dry Seal Ring



Dry Seal Components

Other dry seal benefits:

- Reduce power consumption
- Eliminate seal oil leaks

Methodology Used for the Project

Step1

- Identifyin prospects for replacing wet seals

Step 2

- Estimate savings of converting to dry seal

Step 3

- Determining the cost of converting to dry seals

Step 4

- Savings vs. Costs Comparison

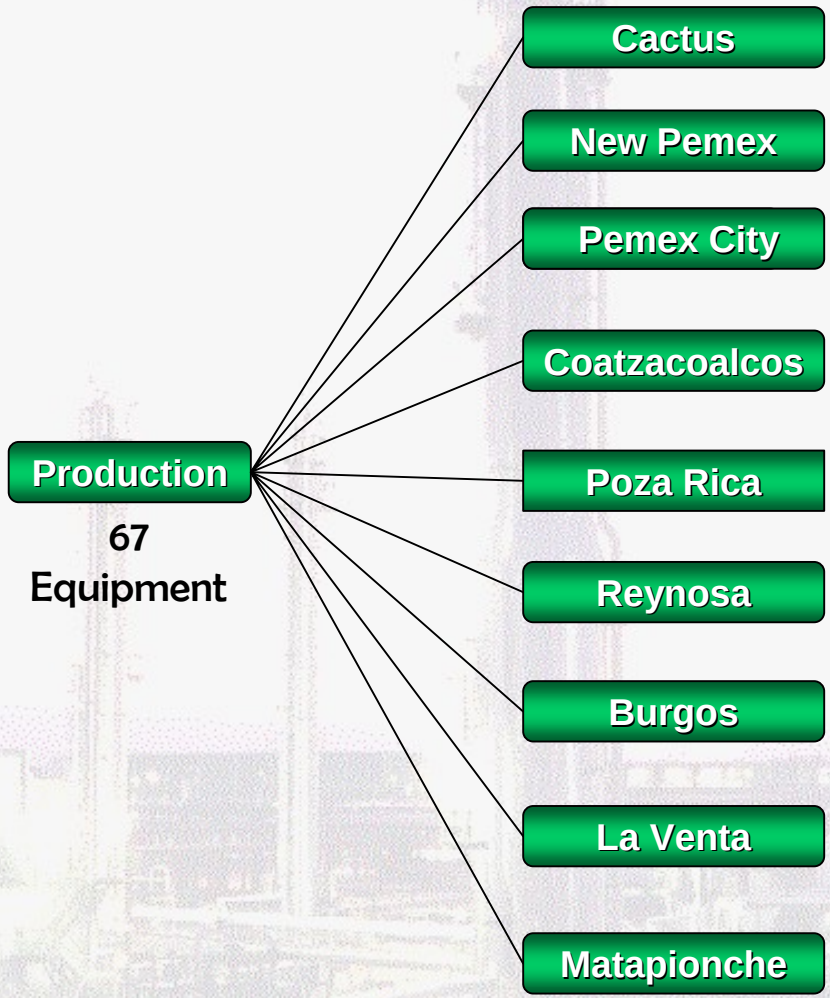
Decision Making

* *Source: Natural Gas STAR Program Best Management Practices*

Methodology Used for the Project

Step 1 – Identifying the prospect

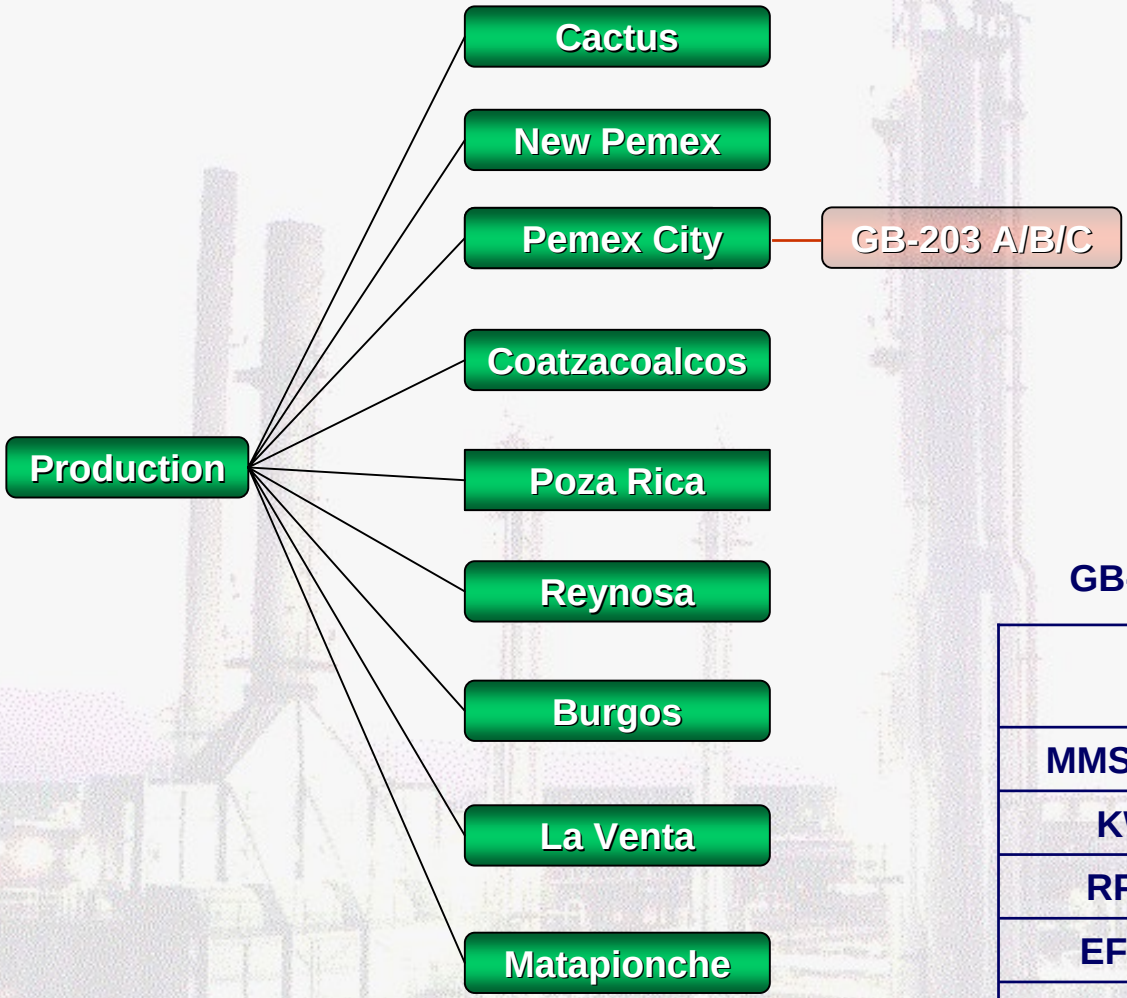
- 67 natural gas centrifugal compressors are installed at the Production Subdivision's work centers. Only 30% of them have dry seals installed, mainly at the newer installations.



	Wet Seal Compressors	Dry Seal Compressors
Cactus	15	-
New Pemex	11	-
Pemex City	3	3
Coatzacoalcos	3	-
Poza Rica	4	-
Reynosa	2	-
Burgos	0	18
La Venta	5	-
Matapionche	3	-
Total	46	21

Methodology Used for the Project

Step 1 – Identifying the prospect



Equipment was selected because it is programmed for re-powering

GB-203 A/B/C Characteristics

	Design	With Re-powering
MMSCFD	55	80
KW	3,309	4,594
RPM	10,900	10,900
EFIC.	72%	74%
Seal	***Wet***	***Dry***

Methodology Used for the Project



Step 1 – Identifying the prospect

- Currently, we are have the support from Methane to Markets for physically detecting emissions from the CPG Pemex City GB-203 A/B/C compressor seals which operate with wet seals.

- Based on statistical values and specialist opinion, it is estimated that the <u>minimum</u> expected emission from each wet seal compressor under these characteristics is 40 SCFM = 68 m3/hr.

- Based on the manufacturer's proposal data the <u>maximum</u> methane vented to the atmosphere under normal operations for each seal from a dry seal re-powered compressor will be 6.5 SCFM = 11 m3/hr.

CPG PEMEX CITY

GB-203 A/B/C

Step 2 – Estimated Savings from Converting to Dry Seals

The expected reduction in gas venting for each seal of the GB-203 compressor is 33.5 Scfm (40 Scfm – 6.5 Scfm), which is equivalent to 35 MMPC natural gas per year per compressor.

Benefits per Compressor

- Environmental: a reduction of 1,817 Ton of CO_2 equivalent per year.

- Economics:

- 2.45 MM$/year in natural gas commercial value.
- 0.15 MM$/year in carbon bonds sales.
- **2.60 MM$/year Total**

Economic benefits for operation costs (power, oil and cooling water) and maintenance are not included.

Step 3.- Determining Dry Seal Conversion Costs

- We have a cost estimate for substituting wet seals with dry seals of 5.17 MM$ (444,000 US$) for each compressor.*

** These costs include dry seal engineering, execution, installation and tests as well as the control panel.*

Methodology Used for the Project

4.- Savings vs. Costs Comparison

Evaluación Financiera

Para calcular TIR
Abril 19, 2006

NOMBRE DE LA IDEA DE MEJORA:
Evaluación Económica del Cambio de Selllos Secos en Compresores de Gas Natural

SINTESIS
Análisis Económico para evaluar la sustitución de Sellos Húmedos por Sellos Secos en los Compresores de Gas Natural GB-203 A/B/C

NOTA: NO INSERTAR FILAS A LA HOJA DE CALCULO YA QUE AFECTARÁ AL CALCULO DE LA TIR

Millones de pesos
Llenar estos datos

Tipo de proyecto M **S=seguridad. PA=Proteccion ambiental. M=Mejora**
Vida útil del Proyecto= 10 años
Tasa de Descuento (Anual)= 10%

Cálculo del flujo de efectivo

Años	0	1	2	3	4	5	6	7	8	9	10
Ingresos incrementales											
Total ingresos incrementales	0	3	3	3	3	3	3	3	3	3	3
Inversión Inicial	5										
Costos incrementales											
Costos variables											
Electricidad	0	0	0	0	0	0	0	0	0	0	0
Agua	0	0	0	0	0	0	0	0	0	0	0
Combustible	0	0	0	0	0	0	0	0	0	0	0
Catalizadores/químicos	0	0	0	0	0	0	0	0	0	0	0
Depreciacion	0	0	0	0	0	0	0	0	0	0	0
Total costos variables	0	0	0	0	0	0	0	0	0	0	0
Costos fijos											
Mano de obra	0	0	0	0	0	0	0	0	0	0	0
Mantenimiento	0	0	0	0	0	0	0	0	0	0	0
Otros (seguros, etc.)	0	0	0	0	0	0	0	0	0	0	0
Total costos fijos	0	0	0	0	0	0	0	0	0	0	0
Total costos	0	0	0	0	0	0	0	0	0	0	0
UAI	0	2	2	2	2	2	2	2	2	2	2
Impuestos	0	0	0	0	0	0	0	0	0	0	0
UDI	0	2	2	2	2	2	2	2	2	2	2
FE	-5	2	2	2	2	2	2	2	2	2	2

Valor Presente Neto

Años	0	1	2	3	4	5	6	7	8	9	10
Flujo Neto Efect	-5	2	2	2	2	2	2	2	2	2	2
Valor Presente	-5	2	2	2	2	1	1	1	1	1	1

VPN = $ 9.22

El Proyecto es Rentable

Tasa Interna de Retorno

Años	0	1	2	3	4	5	6	7	8	9	10
Flujo Neto Efect	-5	2	2	2	2	2	2	2	2	2	2
Valor Presente	-5	2	2	2	2	1	1	1	1	1	0

TIR = **44.12%**

El Proyecto es Rentable

Período de Recuperación de la Inversión

Años	0	1	2	3	4	5	6	7	8	9	10
Flujo Neto Efect	-5	2	2	2	2	2	2	2	2	2	2
Acumulado	-5	-3	0	2	4	7	9	11	14	16	18

PRI = **2 años**

El Proyecto es Rentable

This project's financial analysis shows the following results:

- A VPN of 9.22 MM$.
- The internal rate of return on the investment is 44% (including carbon bonds)
- The simple payoff period for the expected investment is 2 years.

Conclusions

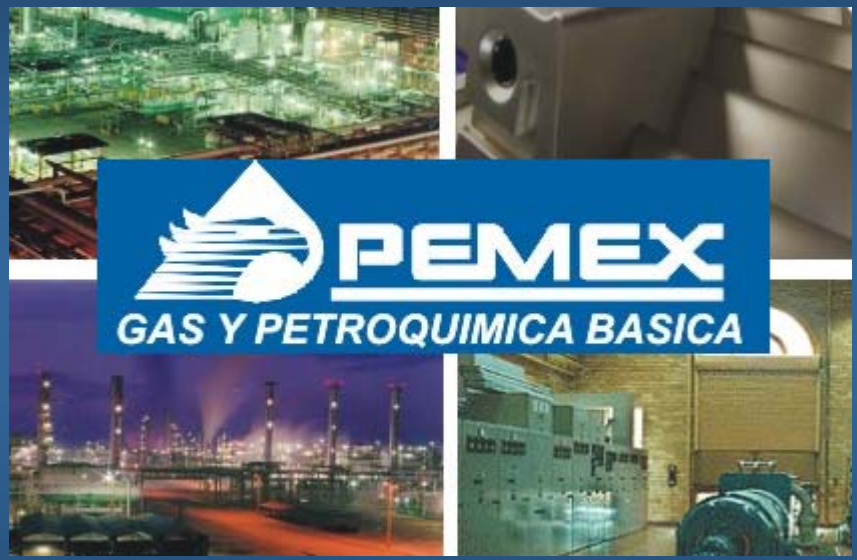
- Considering the cost-benefit ratio from methane recovery and the abatement of equivalent carbon dioxide emissions, this project justifies its profitability.

- Based on its characteristics, this project has a high replication potential in all PEMEX installations using this type of compressors.

- We need to continue getting the support of Methane to Markets through USAID/ Mexico to ratify the project's potential and its replication at all PEMEX gas compression installations.

One of the top strategic priorities of PEMEX Gas and Basic Petrochemicals Production Subdivision is the technological modernization of its installations in compliance with Quality, Safety, Health, Environmental Protection, Sustainable Development and Added Value (AVA) policies, therefore, this project meets all established premises .

Thank you!



Evaluation and Improvement Management Office

Project Administration and Innovation Assistant Management Office