# Leveraging Technology to Improve Business Performance at PEMEX Refining

VALUE NOW, VALUE OVER TIME
PI SYSTEM
POWERING THE REAL-TIME ENTERPRISE

## USER CONFERENCE 2007

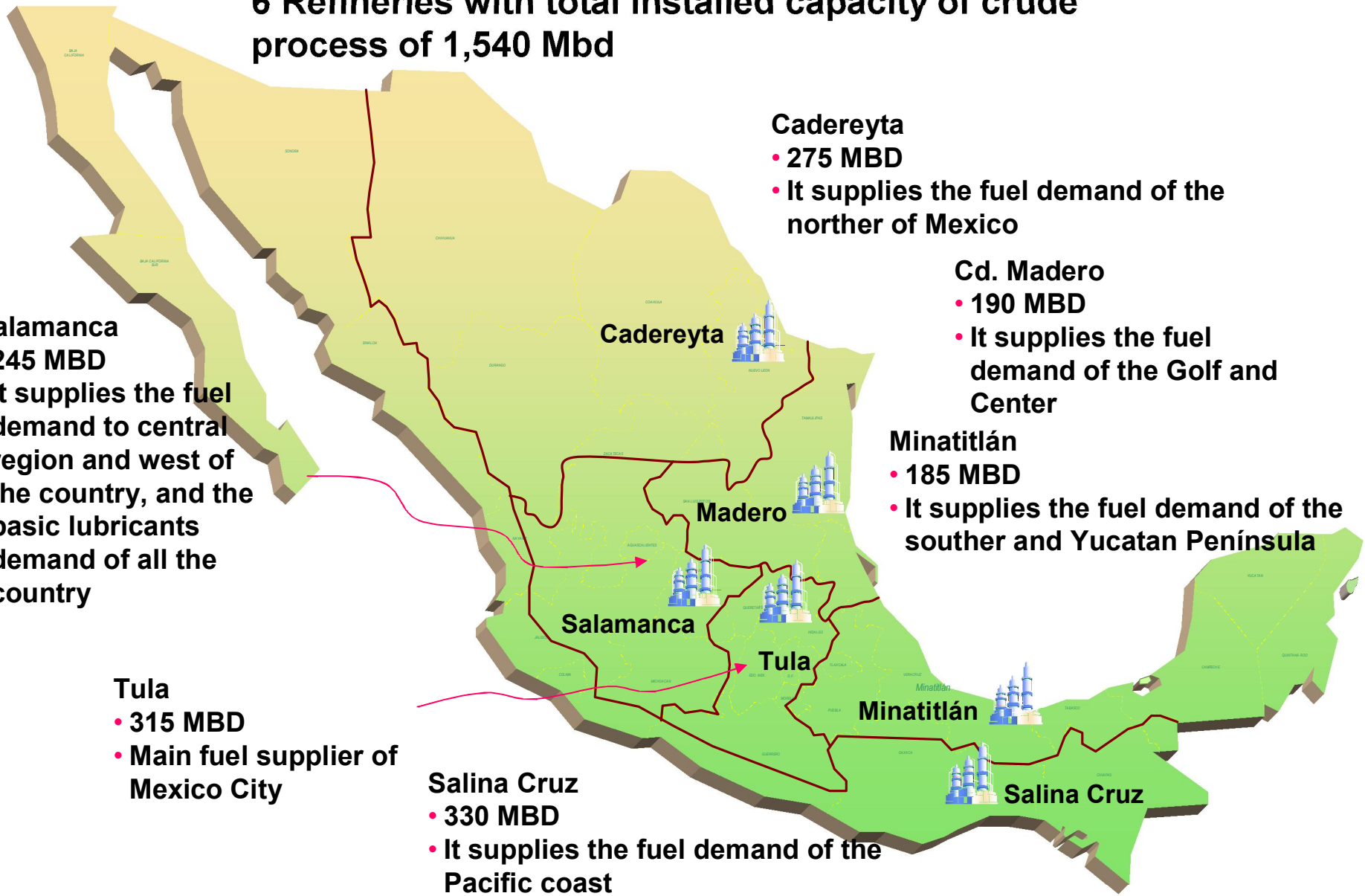
# CONTENTS



# Introduction

## PEMEX Refineries in Mexico

**6 Refineries with total installed capacity of crude process of 1,540 Mbd**




**Cadereyta**
- 275 MBD
- It supplies the fuel demand of the norther of Mexico

**Cd. Madero**
- 190 MBD
- It supplies the fuel demand of the Golf and Center

**Minatitlán**
- 185 MBD
- It supplies the fuel demand of the souther and Yucatan Península

**Salamanca**
- 245 MBD
- It supplies the fuel demand to central region and west of the country, and the basic lubricants demand of all the country

**Tula**
- 315 MBD
- Main fuel supplier of Mexico City

**Salina Cruz**
- 330 MBD
- It supplies the fuel demand of the Pacific coast

# Introduction

## Pipeline System

# Introduction



- Pemex Refining realized that a Real Time information System was imperative for monitoring their operations
- The adoption of OSISoft technology in Pemex Refining has been a key factor to achieve Pemex business strategy
- Value applications developed on top of PI have been providing a core foundation for Pemex Refining business practices
- The importance of data conversion to real time valuable information leveraged the Information Technology Department (IT) to an important position inside Pemex Refining
- Data reliability is critical for establishing credibility and trust
- The improvement in people and processes productivity is a key element for the selection of IT technology & applications

# Overview



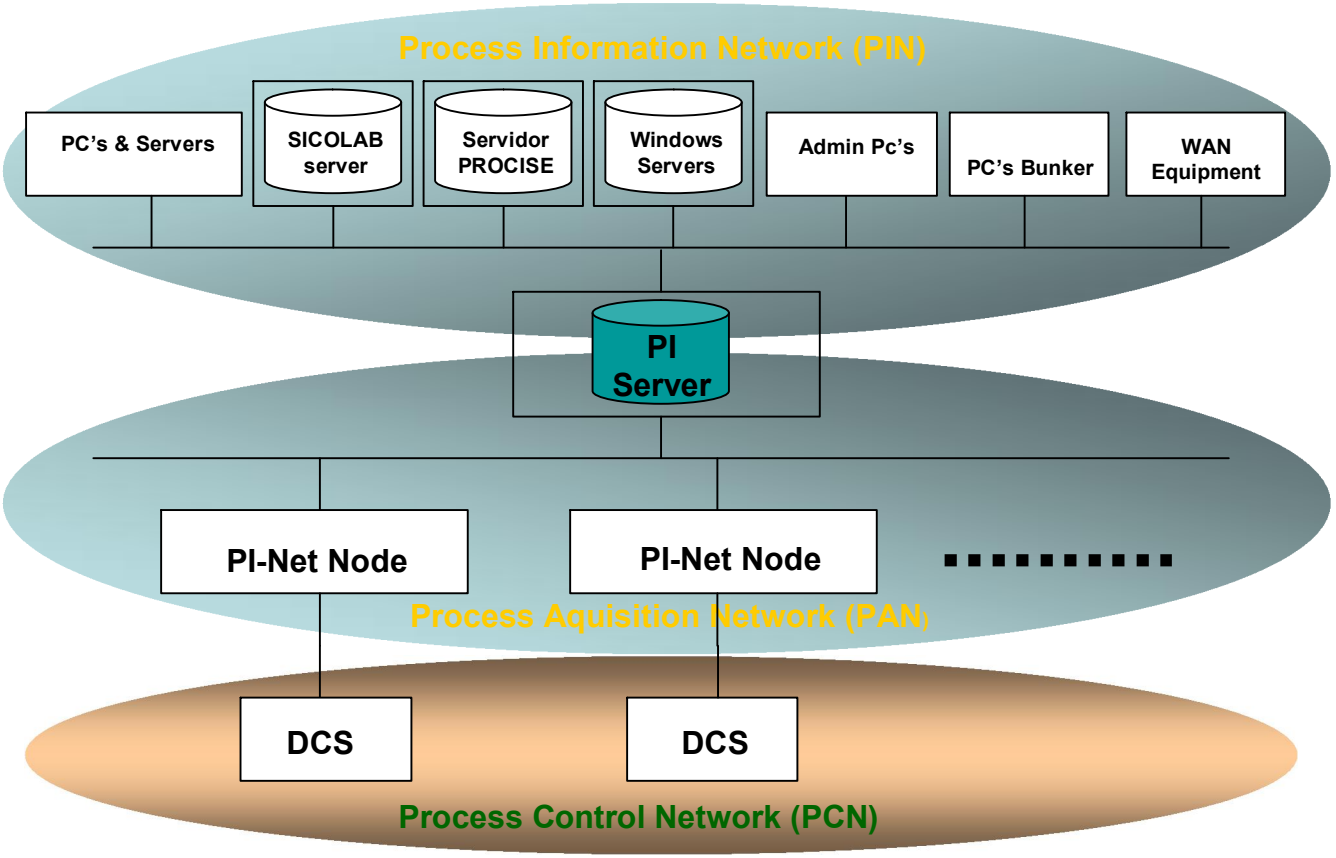
- GLOBAL
  - 10th integrated oil company
  - 3rd in crude oil producer
  - 11th in crude oil reserves
  - 13th in natural gas production
  - 13th in refining capacity
- MEXICO
  - Sole producer of: crude oil, natural gas and refined products
  - Sole producer of refined products in Mexico
  - Single most important goverment income
  - Biggest company in Latin America
  - 2nd major supplier of crude oil to the United States of America

- During the last 6 years, distilates production has increased and residuals production has decreased, due to the fact that two out of six refineries built delayed coker units in this period.
- However, these improvements have not been sufficient to meet the growing demand of gasoline, so more plant expansions will come

# Overview



- Architecture of SIIP (Production Integral Information System) (per each refinery)



# Scope



- **Corporative Goals**
  - Increase production of intermediate distilates
  - Reduce fuel oil production
  - Precess Mexican heavy & extra-heavy crude
  - Diversity transport modes & ensure sufficient storage capacity

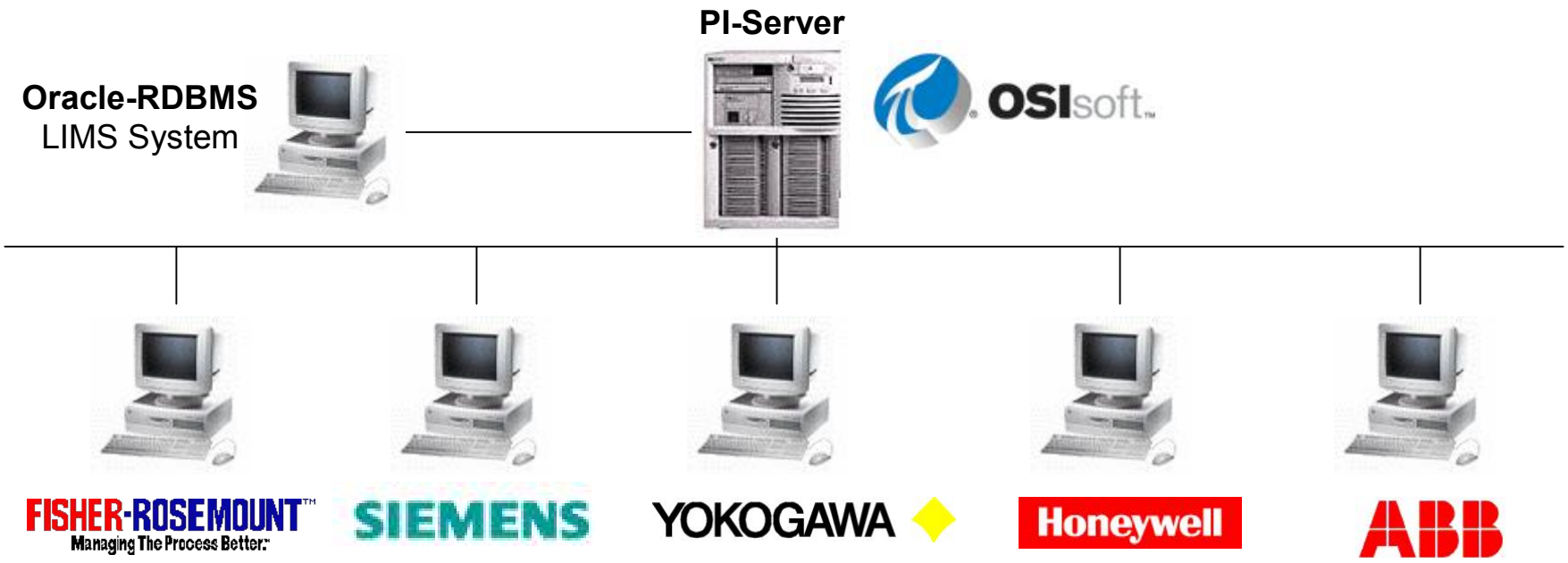
  These goals depend mostly on the succesful reconfiguration of all Pemex refineries, and on possible future capacity expansion

# Current Situation



## PI Infrastructure at the PEMEX Refining System

The PI System at each refinery is comprised of a 50,000 – 150,000 TAGS PI Enterprise Server, interfaces to: all DCS at the process units, a power plant unit and LIMS System (In-house System), Client Modules (ProcessBook, DataLink, RtPortal). Sigmafine/AF in three refineries.



# The Challange

## Islands

- ✓ Four separated business lines
  - Divisional barriers
  - Low levels of coordination
- ✓ Applications not talking to each other
  - Independent project development
  - Not sharing common infraestructure
- ✓ Value Chain suboptimized

## Monitoring

✓Supervision of operating conditions with a business vision

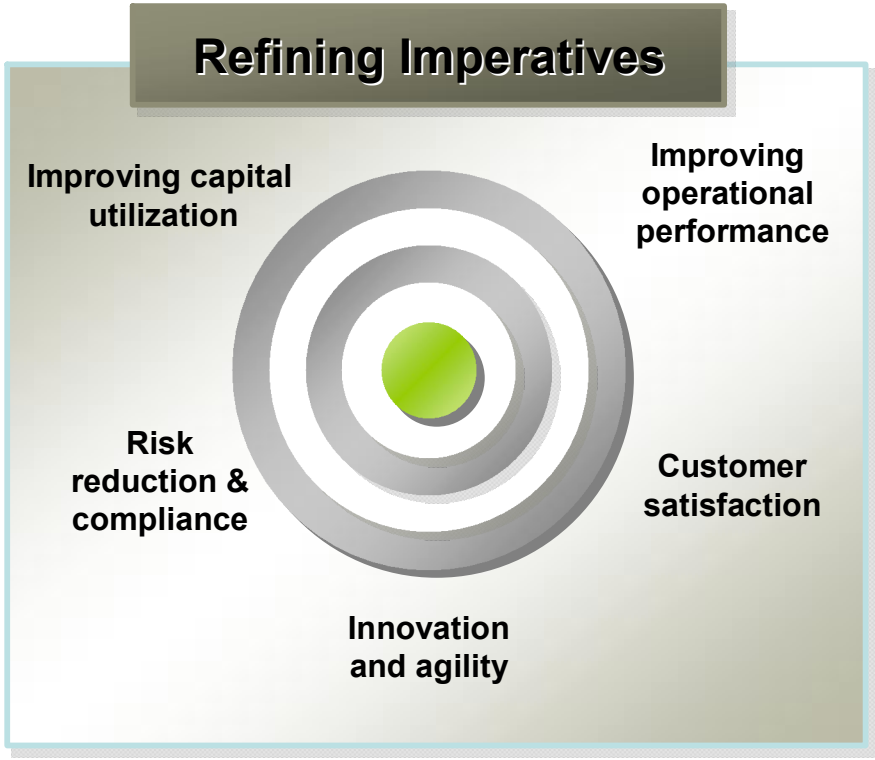
✓Evaluation operational efficiency

✓Support decisions in case of incidents and accidents.

# The Challange

When Refining Enterprise Imperatives Fail

- Limited ‘visibility’ into the refining enterprise operational performance
  - Slow time to react to market changes
- Many versions of same data
  - Lack of validated information
- Difficulty in attainment of asset views
  - Tags vs assets vs plant vs refinery
  - Single enterprise access vs multiple
- Limited communication & collaboration across refining assets and organizations
- Little capability to perform knowledge capture or management




***Resulting in compromised quality, safety and profitability–and***

***ultimately impacting the Refining Enterprise bottom line***

# The Big Picture



- A consistent, known real-time refining enterprise infrastructure
- Evolutionary migration from as-is towards to-be
- Management of the Real-Time refining infrastructure “holistically”
- Standardization critical applications across the enterprise
- Enablement - enterprise performance management
- **Improve asset reliability, availability, and capacity**
  - Condition based maintenance
  - Emissions compliance
  - Mobility and work flow integration and accessibility
- **Reduce TCO while increasing ROI**
  - Standard infrastructure reduces future project costs by providing a platform fo projects today and tomorrow
- **Improve data quality, access, and visibility**
  - Define “Official Record of Copy” data
  - Standard infrastructure makes data more easily accessible across the enterpr

# The Big Picture

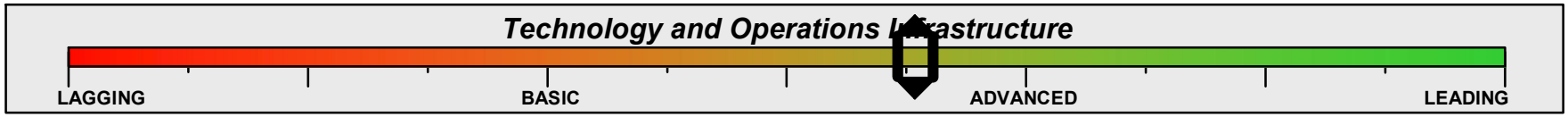


- **Improve decision making and agility**
  - The “right data” to the “right people” at the “right time”
- **Improve fleet asset management**
  - Manage “cost of carbon”
  - Fuels management/optimization
  - Improve profitability through asset optimization
- **Real-time information is important for right decisions.**
- **Right decisions represent less incidents, downtime units, safety process operations, high performance, productivity, reliability, etc…**
- **Develop people skills**
- **Have IT people supporting I&C and process people.**
- **Transparency Reporting.**
- **Management Process Standardization**

# The Big Picture

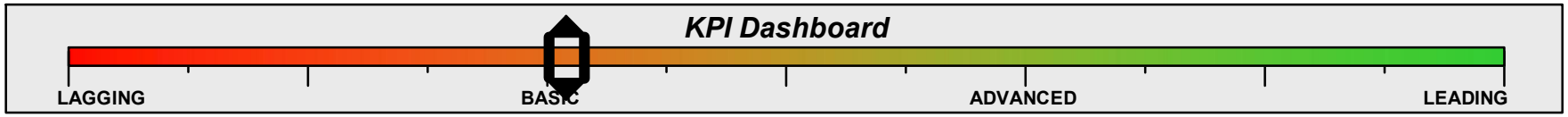


## Where are we today Across Our "Refining" Enterprise




- None
- Manually downloaded
- Partial telemetry
- Only partial data collected
- No integration of data
- Collection of all key ops data
- Automated data interfaces
- Integration of key ops data
- Centralized operations database
- Complete integration of ops data

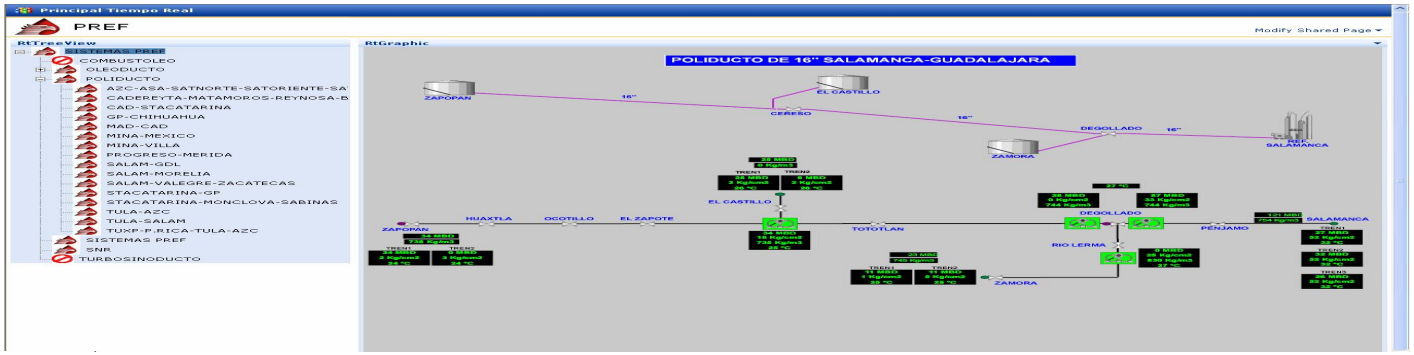

- None
- Historical trending of performance
- Condition-based monitoring
- Standardized performance calculations
- Integration of ops data w/performance apps
- Predictive, early failure detection
- Real time heat rate analysis
- Real time performance info



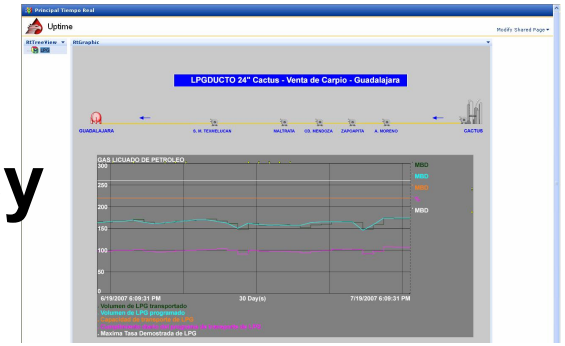

- None
- Defined
- Not well tracked/communicated
- Not used for real time decisions
- Defined
- Well tracked/communicated
- Used as measure of performance
- Available to most users
- Real time KPI's
- Available enterprise wide
- Use in real time decisions
- Key in measure of corporate performance
- Interactive wall

# Applications in PEMEX Refining System

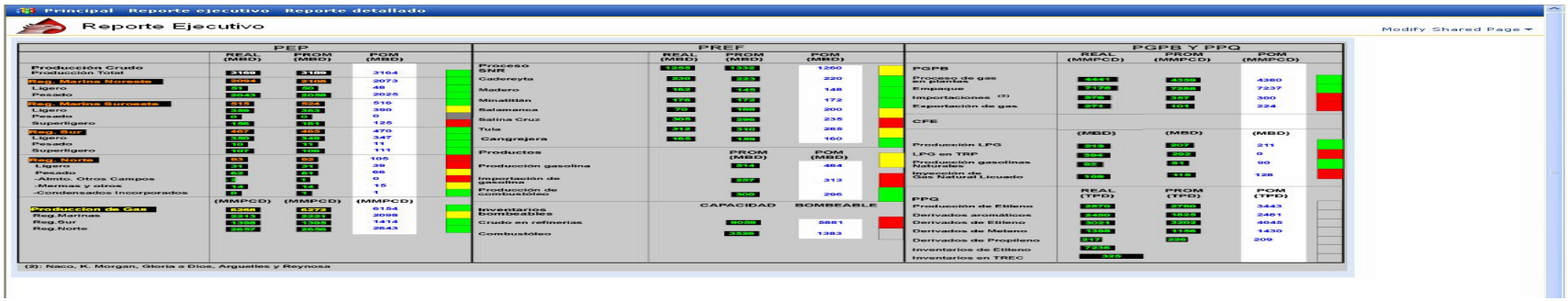
## Operating conditions




## Operational Efficiency



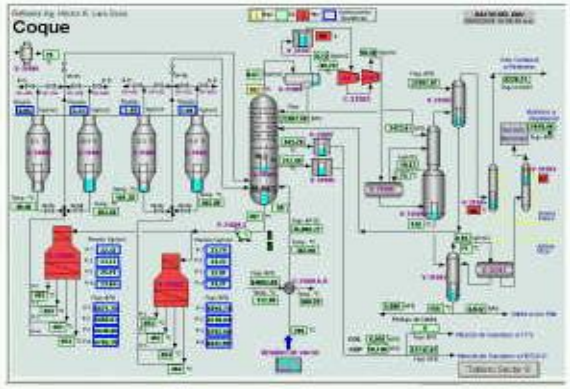

## KPI's



# Applications in PEMEX Refining System

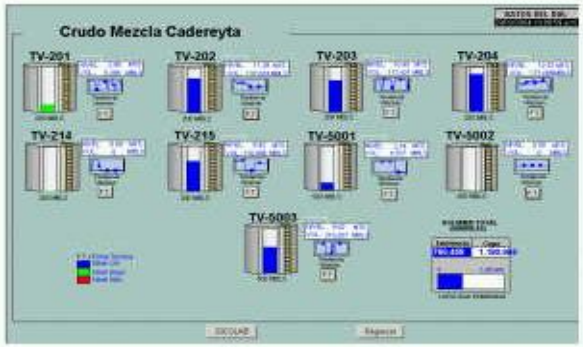
## Basic Application Package

Plot plan drawings


Consolidate Drawings of Process Units

Executives and Operatives Reports




Tanks Levels, Capacitys and Operation Conditions

Specific Applications For Process Units



Drawings and Operation Profiles

# Applications in PEMEX Refining System

**RTCO:** Real Time Operation Control Panel
Real Time Information for Real Time Decisions
Administration indicators
Prioritize process alarms on the desktop Overall of process areas

- Lights indicators -
- Where and What is the Problem ??
- Real Time Information for Real Time Decisions
- Fix the Problem

**PROCESS CONTROL - Process Conditions**
Simplified Plant Diagram, showing principal and Critical Equipments , Product Flows and Operating Conditions:
Level, Flow, Temperature, Pressure, Deltas, etc ...

All the Critical operating conditions are alarmed and they have Operating Instructions, what to do in case of a bellow or over spec. condition. Each instruction has the operating range, Tag id., description. and the specialist that executes each action.

# Applications in PEMEX Refining System

**Critical Equipment**

In addition to critical operating conditions, we must identify the critical equipment and take care of the operating parameters to avoid equipment damage. All this improves the mechanical and plant availability indicators.

**Example.-** Coke Plant with 4 critical pieces of equipment::

+ Heater H31001
+ Heater H31002
+ Charge pumps P31001 / P31002
+ Compressor C31501

The Critical Equipments will change of color depending of the alarm:

Green = OK

Yellow = Alarm Advise

Red = Critical Alarm

Operating Plant and Maintenance managers definied the alarms ranges

# Applications in PEMEX Refining System

**Critical Equipment**

When you select (click), a detail diagram is shown with all the process values of the equipment and the tags alarmed, to provide easy visability of the problem.

Here is an example of: H31001 Coke Plant Heater.

**Critical Equipment Maintenance**

The two main Maintenance scopes for Critial Equipment are:

Preventive and Predictive:

Web applications to insert information into RDB (SQL-Server):

Program Dates and Progress % in topics like : Phisical Progress, Human Resources, Material Resoruces, Tools and Equipment.

Each one has his own weight and depending of the Progress of the situation, the alarm lights are switched on. (Green=OK, Yellow=Preventive Light, Red=Alarm Condition).

# Applications in PEMEX Refining System

**Critical Equipment Maintenance**

+ Preventive...

- Each Critical Equipment in the preventive program must have a Critical Flow Chart (MS-Project) made by the Maintenance Staff of each speciality. With single click, you can browse in (PDF – acrobat mode).
- Under the Total Maintenance concept, we need to promote a Predective Maintenance Culture, Historical Data Analysis and case studies to give equipment long life, high availability, and optimal operation according the design specifitations. In this first version we are going to work with Dinamic Equipment like (Pumps , Compressors, etc...). Process Book Displays with PI Information.
- Not all the Dinamic Equipment has a signal or instrumentation into the Plant DCS´s so isn´t in PI too.
- We developed an application (Security, Catalogs, Insert and Query Data) to insert into a Oracle RDB all the Critical Pumps: vibration, pressure, and temperature conditions. New RDBMS-PI query interface with the union of LIMS-DB, Maintenance & POM DB to insert this new information into P I- RTDB

# Applications in PEMEX Refining System

**Quality Control**

Instant Laboratory Analysis

The most critical laboratory analysis are identified and the parameters to alarm out of specification situations. This for all Input & Output Products.

Alarms Criteria:

Green into Specs.

Yellow out of specs (No critical)

Red out of specs (Critical)

# PEMEX Refining System of the future

## Best Practices

- Easy visability using Lights indicators - Where and What is the Problem ??
- TOTAL Integration in one Control Panel
- Real Time Information for Real Time Decisions
- Fix and Avoid the Problem
- Training
- Improve your Process Operations
- Technology is your best friend
- All this applications were exported to the refineries of PEMEX Refinacion for standardization.
- Standard knowledge base.
- Standard information and infrastructure platform.
- Improved applications value
- Change management
- Management information transparency

# PEMEX Refining System of the future

- Pipelines & Plants
  - Integrate plant & wholesale information
  - Monitoring Productive Chain


Operating Coordination Center

To support logistics.

To coordinate events in case of out of normal operations.

To act as a quick response center in security affairs.

A highly available solution required.

# SAP PM integration

Objective:

- Help the organization to save money, by avoiding equipment failures, maintaining the assets that really need to be maintained and watching the maintenance costs.

# Expected Benefits

- Reduce maintenance costs based on performing maintenance when required
- Allow for planned maintenance, less process down time and an overall reduction of operating cost for the process.
- Improve Process Online Time performing maintenance when the condition of process dictates it can be scheduled

# Condition Based Monitoring

- Through the use of ACE, PI Alarms and PI Totalization, Pemex will monitor a wide variety of equipment and process conditions.
  - Pump Start/Stop Cycles Reaching Defined Limit
  - Temperature Reaches Upper Limit of Equipment
  - Heat Exchanger Coefficient Drops Below Limit
  - Impingement Plate Fatigue Measured with Strain Gage
  - Possibilities Only Limited to the Measurements Available
- Based on process condition changes or cycle counts plan generate PM measurement documents (first stage) and notifications (second stage).

# Condition Monitoring Configuration

- PI Tags Required
- One SAP Functional Location Required for Each Piece of Equipment Defined in RLINK
- One Measuring Point  or Calculation for Each Condition to Be Monitored.
- Multiple RLINK Alarms Can Be Defined for a Given Piece of Equipment Which Allows simultaneous Monitoring of different aspects of the same equipment.

# PEMEX Refining System of the future

## Main Steps

- 1. Download of Maintenance Program Activities necessary to fix the equipment
- 2. Download of Parts List
- 3. Calculation of % of Predictive Maintenance made to the equipments
- 4. Calculation of % of Corrective maintenance made to the equipments
- 5. Calculation and display of Maintenance KPI’s
- 6. 7. Maintenance costs
- 8. Vibration analysis
- 9. Equipment reliability calculation using ACE
- 10. CBM Indicators and graphics on RtWebparts

# PEMEX Refining System of the future

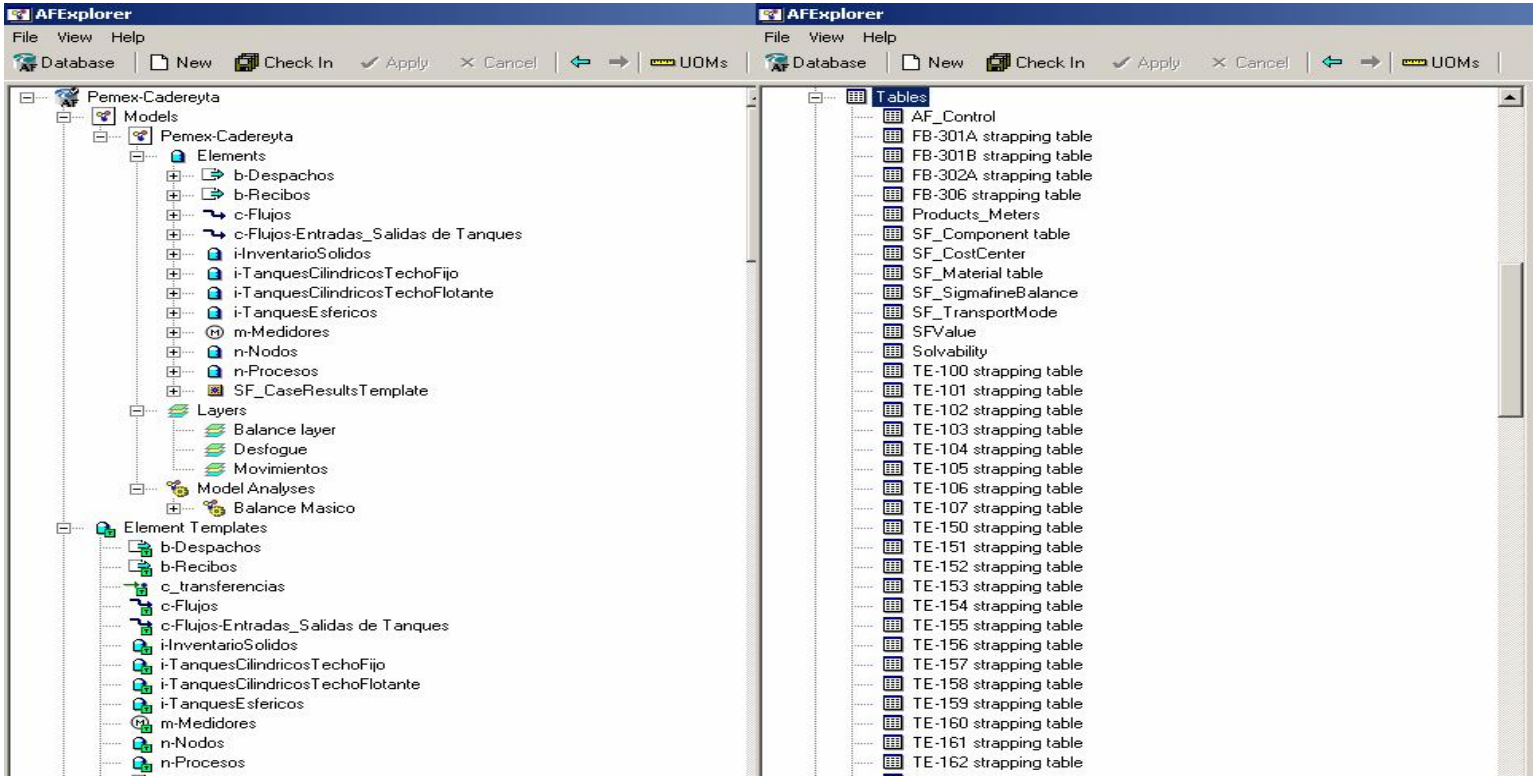
Sigmafine

## AF Explorer

The AF Explorer database was designed specially for this model.

Working on149 tables:

- 9 correspond to AF internal tables like the materials table where is located the products catalogue of PEMEX Refining System.
- 8 which corresponds to Transfer Entry System (TES)
- 132 that corresponds to location tables for the tanks of the model



# PEMEX Refining System of the future

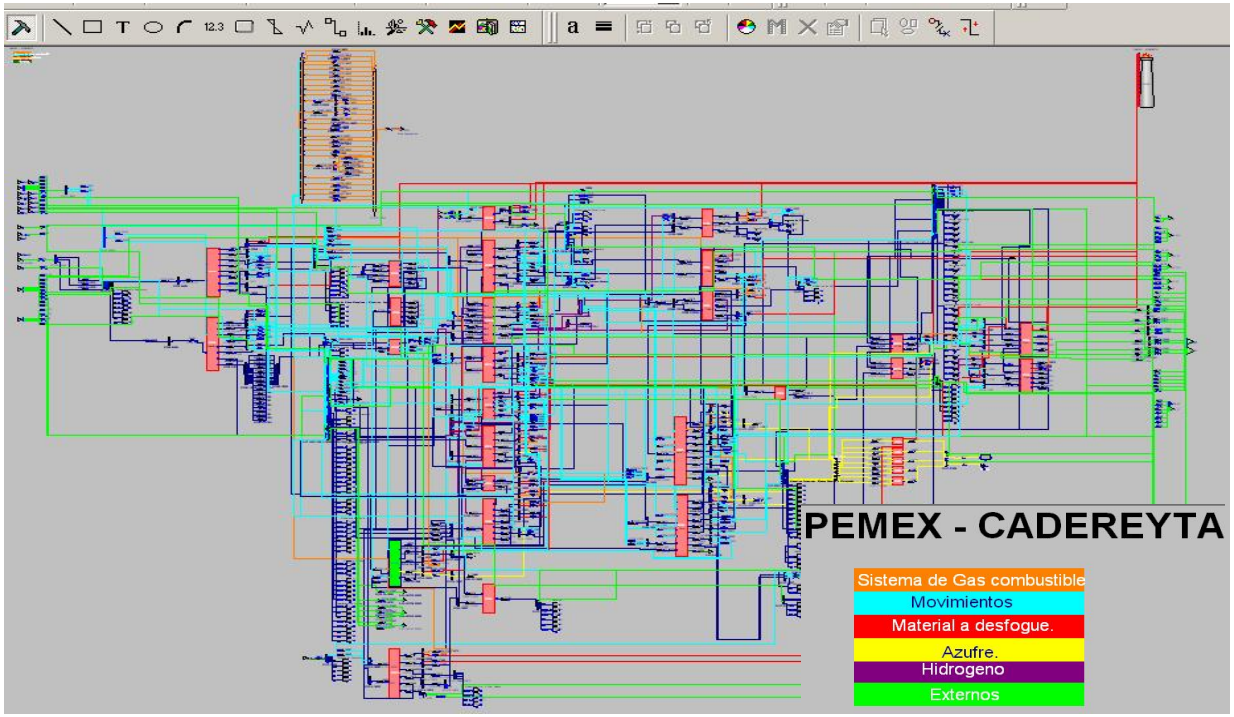
Sigmafine

## Process Book

•The model is created in Process Book with the tool Process Book Modeler Add-in. It is a complete representation of the refinery with a total of 1300 connected elements among them

•Different colors lines represent different systems that are handled at the refinery

•We are working with Layers that allow visualizing all the flows or possible connections of the refinery although by lacking of measurement do not participate in the balance directly and need to be entered through Transfer Entry System



# PEMEX Refining System of the future

Sigmafine

## Transfer Entry System

- It allows creating transferences that will be loaded to the model for their later reconciliation.
- The connections, groups, materials, etc. are totally configured by the user.
- Transference start/end date and hour are indicated, if the source and/or destiny are connected to PI we can “Read” in data, but also, we can write it

- It is possible to make a calculation to get values in Volume and Mass.
- It is added to the transferences Grid that is saved later on the database, which we are working
- TES allow bringing transferences from others data sources like an Excel spreadsheet