
REAL-TIME PERFORMANCE MANAGEMENT FOR THE ENTERPRISE
RtPM
SAN FRANCISCO PHILADELPHIA HOUSTON FRANKFURT
OSISOFT USER CONFERENCES 2005
REAL-TIME PERFORMANCE MANAGEMENT FOR THE ENTERPRISE
RtPM


# Oscar Rotava

## Process Engineer, PhD

# The corporate deployment of SIGMAFINE at PETROBRAS' 11 refineries

# Agenda

- The Company
- REPLAN/REVAP/RPBC Refineries
- Presentation objective
- Mass balance KPIs
- The way reconciled datum are used
- Conclusion

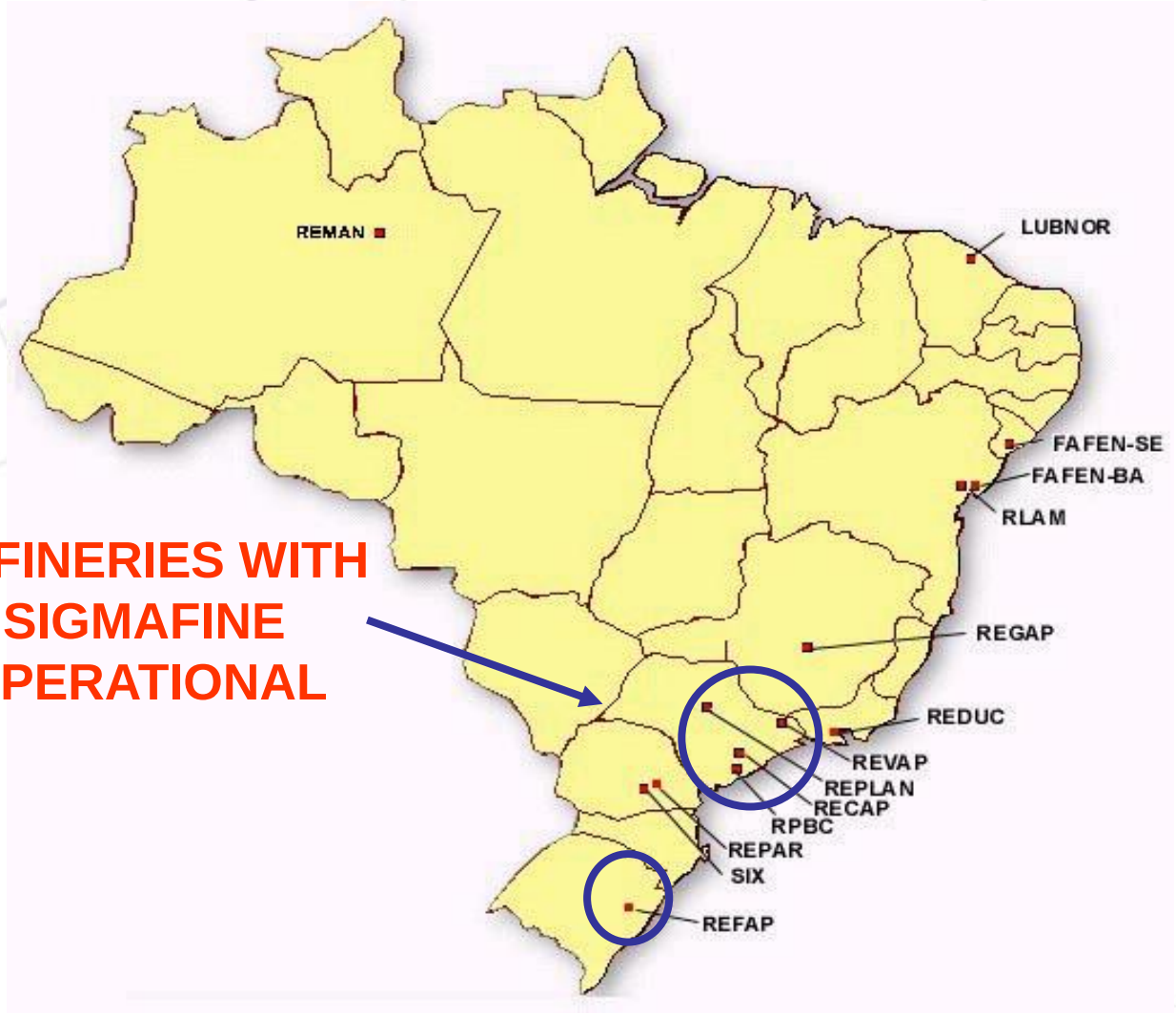
# PETROBRAS HIGHLIGHTS

- 13th petroleum company in the world
- Headquarters in Rio de Janeiro - Brazil
- US$ 43.3 billion yearly income (2004)
- US$ 7.2 billion net profit (2004)
- US$ 8.7 billion yearly investment (2004)
- 36,500 employees
- 161,000 shareholders
- 1,661,000 bpd oil production
- 1,797,000 bpd refining capacity
- 11 Refineries, 2 fertilizer plants (in Brazil)

# PETROBRAS

- 5 Refineries abroad (3 in Argentina and 2 in Bolivia)
- Unparalleled offshore technology
  (Twice honored with the deep-water oil production prize by OTC)
- Largest number of ISO-9000/14000 certificates in Brazil
- Shareholder of the 4 major petrochemical plants in Brazil

# REFINERIES IN BRAZIL




**REFINERIES WITH SIGMAFINE OPERATIONAL**

# REFINERIES WITH SIGMAFINE OPERATIONAL

- REPLAN
  - 60000 m³/day (375000 barrel/day) - 20% of Petrobras refining capacity
  - 2 Crude + Vacuum Distillation Units
  - 2 FCC Units
  - 2 COKE Units
  - 2 Diesel Hydrotreating Units
  - 3 Sulphur Recovery Units
  - 2 Hydrogen Generation Units
  - 13 Treatment Units for Naphtha, Kerosene,LPG,Fuel Gas

# REFINERIES WITH SIGMAFINE OPERATIONAL

- REVAP
  - 40000 $m^3$/day (250000 barrel/day)
  - 1 Crude + Vacuum distillation Unit
  - 1 FCC Unit
  - 1 Deasphalting Unit
  - 3 Diesel/Kerosene Hydrotreating Units
  - 1 Sulphur Recovery Unit
  - 1 MTBE
  - 1 Hydrogen Generation Unit
  - 5 Treatment Units for Naphtha, Kerosene, LPG,Fuel Gas

# REFINERIES WITH SIGMAFINE OPERATIONAL

- RPBC
  - 27000 $m^3$/day (170000 barrel/day)
  - 3 Crude + 2 Vacuum distillation Units
  - 1 FCC Unit
  - 2 COKE Units
  - 1 Alkylation Unit
  - 1 Catalytic Reform Unit
  - 1 Aromatic Recovery Unit
  - 1 Diesel Hydrotreating Unit
  - 2 Sulphur Recovery Units
  - 1 Hydrogen Generation Unit
  - 9 Treatment Units (Naphtha, Kerosene, LPG, Fuel Gas)

# SIGMAFINE IN PETROBRAS

- 2000 - Bid to buy mass balance system (won by SOTEICA – an OSI partner)
  - 6 projects turn-key
  - 5 in-house projects
  - 2-3 projects every year
- 2003 - Decision made to hire SOTEICA to operate the system at some refineries
- June 2004 – First Mass Balance Workshop
- April 2005 – Second Mass Balance Workshop

# Presentation objective

- To share some achievements due to implementation of SIGMAFINE
  - Hard work and perseverance

“There are no facts, only interpretations.”

Friedrich Nietzsche

# KPIs

- **DX** – Data quality indexes
  - DX0 – the percentage of the unchecked mass flowing through the plant (target 10~20%) (non redundant)
  - DX1 – the overall percentage of imbalance in the cross-checked measurements (target 4~10%)
  - DX2 – the overall percentage of correction applied to the individual measurements within the cross-checked balances (target 2~5%)
  - DX3 – the overall percentage of tolerances for the individual measurements within the crosschecked balances (target 2~5%)

# Utilization of reconciled data at REVAP and REPLAN

- Oil loss accounting
- Fuel consumption
- Production accounting support (financial)
- Maintenance support
- Production accounting support (mass balance)
- Test run data reconciliation
- Refinery KPIs follow-up
- Team training
- Optimization group support

# Conclusion

- Mass balance is an important tool to organize and give quality to datum
- Allows important applications to be developed
- More users to tell/share experiences

- Thank you to SOTEICA, OSIsoft and BR

- IT people developed some programs to help eliminate mistakes in the
  - Opening and closure of transactions.
  - Choice of product code (now, once the node is defined product code is assumed automatically)

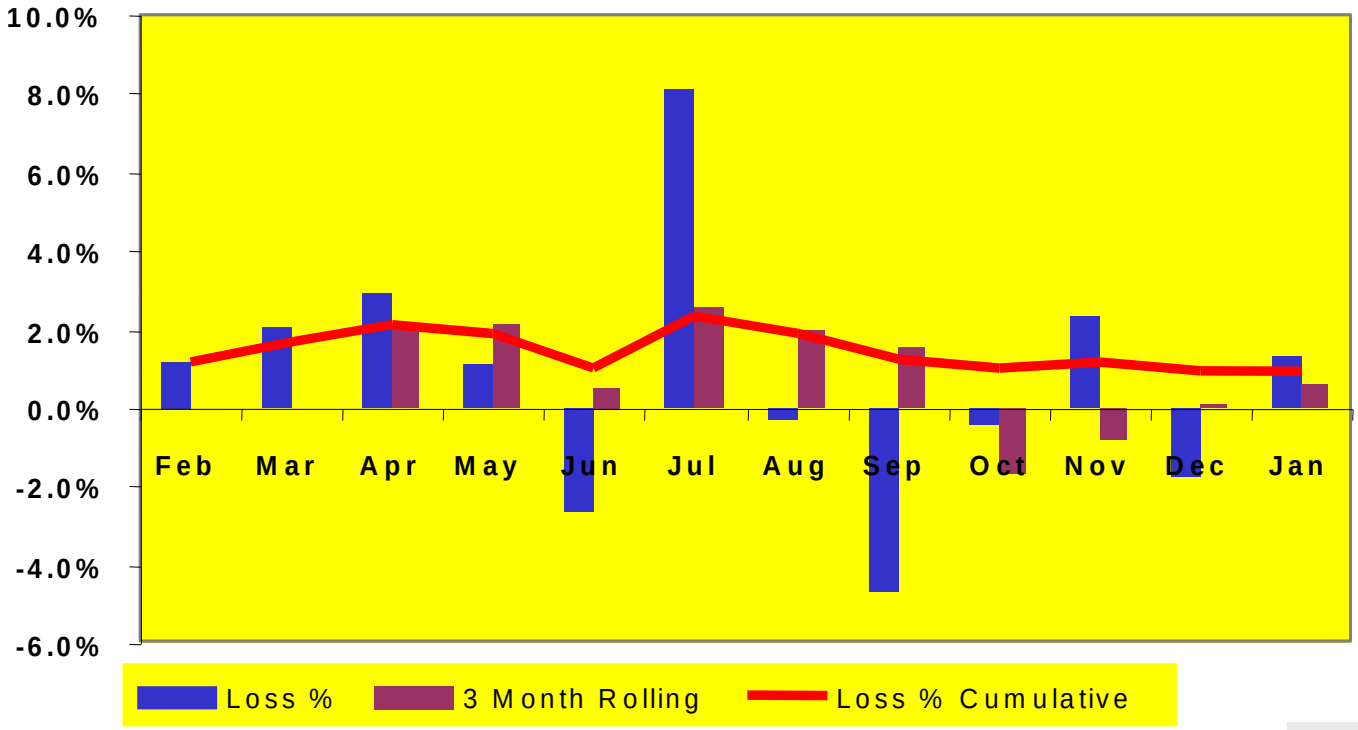
- SIGMAFINE model has few HC loss models. Project is beginning at RPBC to include the remaining models.
- Part of the loss might not be real but a result of lack of data quality: outdated densities, quantities forgotten in the mass balance. To check this feature, implies having to evaluate the HC losses.
- Corporate DB must receive measured values of custody transfer measurements and tank levels. Process flows must incorporate imbalances
- How to handle running tank operations?

# Mass Balance before Sigmafine

Loss Study - REFAP

Feb/01 - Jan/02

(Loss % Cumulative = 1.09%)



# Mass Balance before Sigmafine

**REFAP accounted Loss, Feb-01 to Jan-02**

| | tonnes | % | On Input |
|---|---|---|---|
| Crude Measurement | 0 | 0.0% | 0.00% |
| API drainage evaporation | 2,144 | 2.6% | 0.03% |
| Flares | 226 | 0.3% | 0.00% |
| Tank Evaporation | 197 | 0.2% | 0.00% |
| Flare pilots & purge | 0 | 0.0% | 0.00% |
| Crude Water Method | 10,794 | 13.1% | 0.14% |
| Inert Gas Blanket | 0 | 0.0% | 0.00% |
| Refinery Liquid Effluent | 0 | 0.0% | 0.00% |
| Process fugitives | 0 | 0.0% | 0.00% |
| Cooling towers | 0 | 0.0% | 0.00% |
| | 0 | 0.0% | 0.00% |
| | 0 | 0.0% | 0.00% |
| | 0 | 0.0% | 0.00% |
| | 0 | 0.0% | 0.00% |
| | 0 | 0.0% | 0.00% |
| | 0 | 0.0% | 0.00% |
| Accounted Loss | 13,361 | 16% | 0.18% |
| Unaccounted Loss | 68,864 | 84% | 0.91% |
| Total Loss | 82,224 | | 1.09% |

# Oil Loss figures after SIGMAFINE implementation

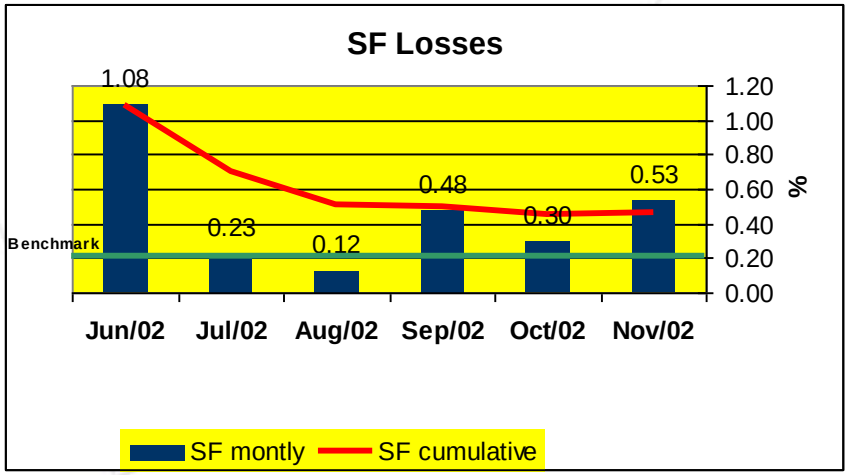
## Accounted losses - Estimates

| | Crude | Evaporation | | | Losses (ton) | | Losses (%) | |
|---|---|---|---|---|---|---|---|---|
| | Measurement | API | Tanks | Flare | Accounted | Total | Accounted | Total |
| Jun/02 | 929 | 68 | 16 | 180 | 1193 | 7,745 | 0.17 | 1.08 |
| Jul/02 | 582 | 120 | 16 | 5 | 723 | 1,294 | 0.13 | 0.23 |
| Aug/02 | 920 | 35 | 16 | 5 | 976 | 796 | 0.15 | 0.12 |
| Sep/02 | 912 | 120 | 16 | 6 | 1053 | 3,350 | 0.15 | 0.48 |
| Oct/02 | 1,007 | 100 | 16 | 260 | 1383 | 2,226 | 0.18 | 0.30 |
| Nov/02 | 793 | 60 | 16 | 35 | 904 | 3,487 | 0.14 | 0.53 |
| Total | 5,143 | 503 | 96 | 491 | 6,233 | 18,899 | 0.15 | 0.47 |

# Oil loss figures after Sigmafine implementation

## REFAP Mass Balance Follow up

| | Sigma Fine | | | | | |
|---|---|---|---|---|---|---|
| | Monthy | | | Loss % Cumulative | | |
| | Inputs | Losses | % | Inputs | Losses | % |
| Jun/02 | 715,848 | 7,745 | 1.08 | 715848 | 7745 | 1.08 |
| Jul/02 | 565,009 | 1,294 | 0.23 | 1280857 | 9040 | 0.71 |
| Aug/02 | 639,548 | 796 | 0.12 | 1920406 | 9836 | 0.51 |
| Sep/02 | 698,228 | 3,350 | 0.48 | 2618634 | 13186 | 0.50 |
| Oct/02 | 749,267 | 2,226 | 0.30 | 3367902 | 15411 | 0.46 |
| Nov/02 | 654,793 | 3,487 | 0.53 | 4022694 | 18899 | 0.47 |



- Oil loss report summary
  - Gross errors detection
  - Modeling improvement
  - Feedback for refinery and corporate production accounting
  - Oil loss KPI follow up

- Applications:
  - Daily and variable period refining margin
  - Estimation of inventory cost
  - Unit yield and gross revenue

- Priority list of flow meters requiring calibration or replacement or place/position changed
- LIC cascading to a FIC - Leak of LCO by the FIC control valve. LCO has two destinations: hydrotreater unit and LCO/diluent tank. LCO was being downgraded from diesel to fuel oil diluent - gain of US $ 6.6 million/year.

- Support the development of plant models to be used in simulators
  - Test run datum are reconciled and then used to determine the model tuning parameters
- List of flow meters requiring reevaluation of density value in their calculation

- ROCE
- APP – Production profile adequacy
- IIE – Energy consumption index
- IEA – Environmental emissions index
- IEH – Liquid effluent index
- MR – Refining margin

- Determined several flow meters requiring calibration, which affected unit yields
- Corrected coke accounting, which was made in wet bases, suffering the influence of rain regime
- Main issue: the discovery of the LCO (diesel) downgrading to fuel oil diluent