Intelligent Data Validation and Reconciliation Solutions for the Refining Industry

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Topics

• Business Performance Aspects in Refining
• Refining Case
• Production Accounting and Data Reconciliation (PADR) Requirements
• Powerful Data Reconciliation Concepts
• Customer Benefits Using Sigmafine
• Yield Accounting Management Presented by OMV Petrom
• Conclusion
Business Performance Aspects in Refining

• Operational
  o Yield, Recovery, Quality Targets
  o Production Rates
  o Process Constraints (e.g., environmental, physical limitations)

• Planning
  o Best Operational Parameters (e.g., LPs)
  o Comparison of Planned vs. Actual

• Financials
  o Material Loss
  o Cost Allocation
  o Inventory Positions
  o Taxes (e.g., domestic vs. foreign)
Market Drivers

- Environmental (GHG)
- Financial (Sarbanes Oxley Act)
- Yield Accounting Standards
  - API Standard
- Refining Margins
- Security

*The ideal platform for data validation has to comply with emerging regulations in the refining industry.*
Refining Case

• Source of Information
  o Process Historian
  o Oil Movement System (OMS)
  o Vessel Positioning System (VPS)
  o LIMS

• Business Rules
  o VCF according to API 2004
  o Ownership Tracking
  o Foreign and Domestic Tracking
  o Mass Balance
Refining Case

• Integration
  o Automatic Data Collection
  o Integration of OMS and VPS data into Production Accounting System

• Reporting
  o Excel-based for Production Accountants
  o Formal and/or Web-based for Refinery Users
  o Automatic Reporting for Measured Information
Solution Map

Data Flow for Refining Case

Historian -> Sigmafine

OMS -> Aggregation/Integration

Vessel Positioning System -> Rules

Sigmafine -> SQL Access

Report Logic -> Web-based Reports

Excel Reports
Production Accounting Solution Integration
The Bridge Between Business and Process Data

Notifications  Enterprise portal  Enterprise Reporting  ERP systems  Enterprise Service Bus  Enterprise Application Integration

Smart Clients
PI-ProcessBook
Sigmafine modeling & reconciliation procedure
Microsoft Excel
Ad-hoc reporting

Sigmafine Server
(powered by PI System technology)

Notifications  Scheduling  Data Validation

Process Data  Lab Data  Movements Records  Planning Data  Scheduling Information

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Solvability and Redundancy
Maximizing the Power of Your Measurements

Sigmafine performs flows solvability analysis.

- **R** The flow is redundant, so it is both measured and solvable.
- **NR** The flow is measured but not redundant, so the measurement must be trusted.
- **S** The flow is not measured, but it is still solvable.
- **NS** The flow is not solvable.

The more redundancy the better. This way, more values may be cross-checked to increase accuracy.
Solvability and Redundancy
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- NS The flow is not solvable.

* By adding a meter to the flow, the flow becomes redundant. As a result, other metered flows also become redundant.
Reconciliation
Finding the Best Fit for Your Model and Data

Minimize
\[ \sum_{i=1}^{N} \left( \frac{\text{Raw}_i - \text{Reconciled}_i}{\text{Absolute Tolerance}_i} \right)^2 \]

Constraints
- FL1 - FL2 - FL3 = 0
- FL4 - FL2 - FL3 = 0
Optimal Utilization of Existing Meters

Non Redundant Network

Redundant Network

Accurate Meter

Less Accurate Meter

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Error Detection
Which Network Can Detect a Measurement Error?

Non Redundant Network. There is no possibility of detection.

Redundant Network. An imbalance can be detected.

Accurate meter failure.
Meter Performance
Error Identification

Meter Error

Bias

Drift

Global Refining Summit
Rotterdam, May 18, 2011
Optimum Maintenance of Refinery Meters
Taking Action to Improve Meter Performance

Global Refining Summit
Rotterdam, May 18, 2011

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Improving the Overall Picture
Higher Confidence in Refinery Data

Overall DX1 Trend (Q4 2008 - Q1 2010)
Oil Loss Monitoring
Before and After Sigmafine

Error Elimination

Meter Improvements

Better Decisions
Oil Loss Monitoring
Before and After Sigmafine

Loss Accountability

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Sigmafine available

Global Refining Summit
Rotterdam, May 18, 2011

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Oil Loss Monitoring
Before and After Sigmafine

Mass Balance Before Sigmafine
Feb/01 - Jan/02

Oil loss (%) After Sigmafine Implementation

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Custody Transfer Error Detection
A Significant Bias Causes Financial Loss

Daily “profit/loss” in $ over one month
Accounting Fuel Consumption
Optimization of Energy Use Requires Information

Fuel Consumption, Oct 2010

Sigmafine
Legacy System

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Monitoring Refinery Performance
Validation of KPIs

Current/Shift/Running Plan
Reconciled vs. Theoretical Yields

Running Plan KPIs

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Performance Monitoring

Validating Yield Data

Reconciled Yields

Theoretical Yields
Increasing Yield Profitability
Performance Management Improvement

• Example of diesel yield improvements
  o Analyzing homogeneous data related to “sweet” crudes:
    • 2003 actual average diesel yield 37.4%
    • 2004 actual average diesel yield 39.6%
  o Average actual diesel yield increased due both to investments on plants and to performance management.
  o Historical analysis on diesel yield showed that the average increase due to performance management amount was about 0.8% in the period 2003-2004.
  o This led to a profit increase estimated in US$ 1 million per year.
Low Yield Detection After Catalyst “Improvement”
Unmasking Hidden Problems

Data Quality Improvement: Profits

Mass balance yield - FCC (Fluidized Catalytic Cracking Unit)

*Data reconciliation group identified LCO flow meter fault
*During this period it was believed that LCO yield had increased.

Flow meters maintenance required by reconciliation group

**LCO flow meter repaired
**Actual LCO yield equal to the value previously to the catalyst change

**Lower light HC and more decanted oil produced = Less profits

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Low Yield Detection After Catalyst “Improvement”
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Data Quality Improvement: Profits

Eliminated loss corresponding to US$ 23.5 million per year

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Reconciliation Coupled with Optimization
Validating Blending Optimization

Data Quality Improvement: Profits

Cost Integration with Reconciled Data

62.77 US$/m³

Optimizer Result

63.84 US$/m³

1.00 US$/m³ difference

Measurement Problem
Hydrotreated Diesel Flow

15,000 m³

15,000,00 US$/batch

x 40 batches/month

x 600,000,000 US$/month

600,000,000,000 US$/year

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Detecting Operational Errors
Finding Undetected Problems

**Data Quality Improvement: Profits**


Data reconciliation group detected rubber solvent entrainment from solvent unit to gasoline unit.
Data Quality Improvement: Profits


Potential profit depends on the difference between rubber solvent and gasoline prices ...
Detecting Operational Errors
Finding Undetected Problems

Data Quality Improvement: Profits


Total solvent entrainment: 14% of feed
Total annual losses: US$ 0.7 million
Loss of Capacity Versus Nominal Capacity

Bias Detection of a Meter

Loss of processing capacity
US$ 25.7M/year
Customer Presentation

Yield Accounting Management
by Mihaela Cristina Popescu

OMV PETROM

Yield Accounting Management

5th Annual Global Refining Summit 2011
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Conclusions
Satisfying Global Refinery Needs in the Field of PADR

- Sigmafine-based solutions deliver significant benefits to refining customers worldwide.
- Solutions have to be adaptive, keeping the customer requirements in mind.
- Sigmafine technologies are designed to satisfy current and future business requirements.

Territories

- North America: 28%
- Europe & Russia: 28%
- Asia & Pacific: 21%
- Latin America: 17%
- Middle East & Africa: 6%
Thank you!

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