Crude Unit Optimization at Refineria Isla, Curacao

A ROMeo Case Study

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Talk Outline

- Project overview/scope
- ROMeo overview
- Process MRA overview
- CD3 Crude Unit Case Study
- Conclusions

Overview: Refineria Isla

- **Refineria Isla (Curacao) S. A.**
  - Curacao, Netherland Antilles
  - Affiliate of PDVSA, Venezuela
  - Crude Distillation Unit-3 capacity : 180,000 bbls/day
  - 26-30 API; switch every 2-3 days

- **Scope of CD3 optimization model**
  - Atmospheric unit
  - Vacuum unit
  - Preheat train including furnaces
  - Gas plant

Overview: Highlights

- **Real-time Optimization: ROMeo**
  - State-of-the-art equation-based modeling/real-time optimization package
  - Enhanced usability features for faster implementation/ ease of maintenance
- **Invensys Process MRA**
  - Reliable, robust online NMR technology
  - Crude, kerosene and naphtha stream analysis for improved APC and optimizer performance
- **Project executed by refinery staff**
  - 1.5 refinery engineers
  - 0.25 Invensys engineer (consulting only)

Overview: Milestones

- MRA Analyzer
  - Test Installation Nov 2000
  - Final Installation including Crude August 2001
- ROMeo
  - Started June 2001
    - Model building/application configuration performed entirely by refinery staff; consulting from Invensys
  - Online, open-loop since Jan, 2002
    - Optimization moves reviewed before being implemented by operations staff
  - Online, closed-loop since March, 2002
    - Optimization moves transmitted to DCS and implemented automatically

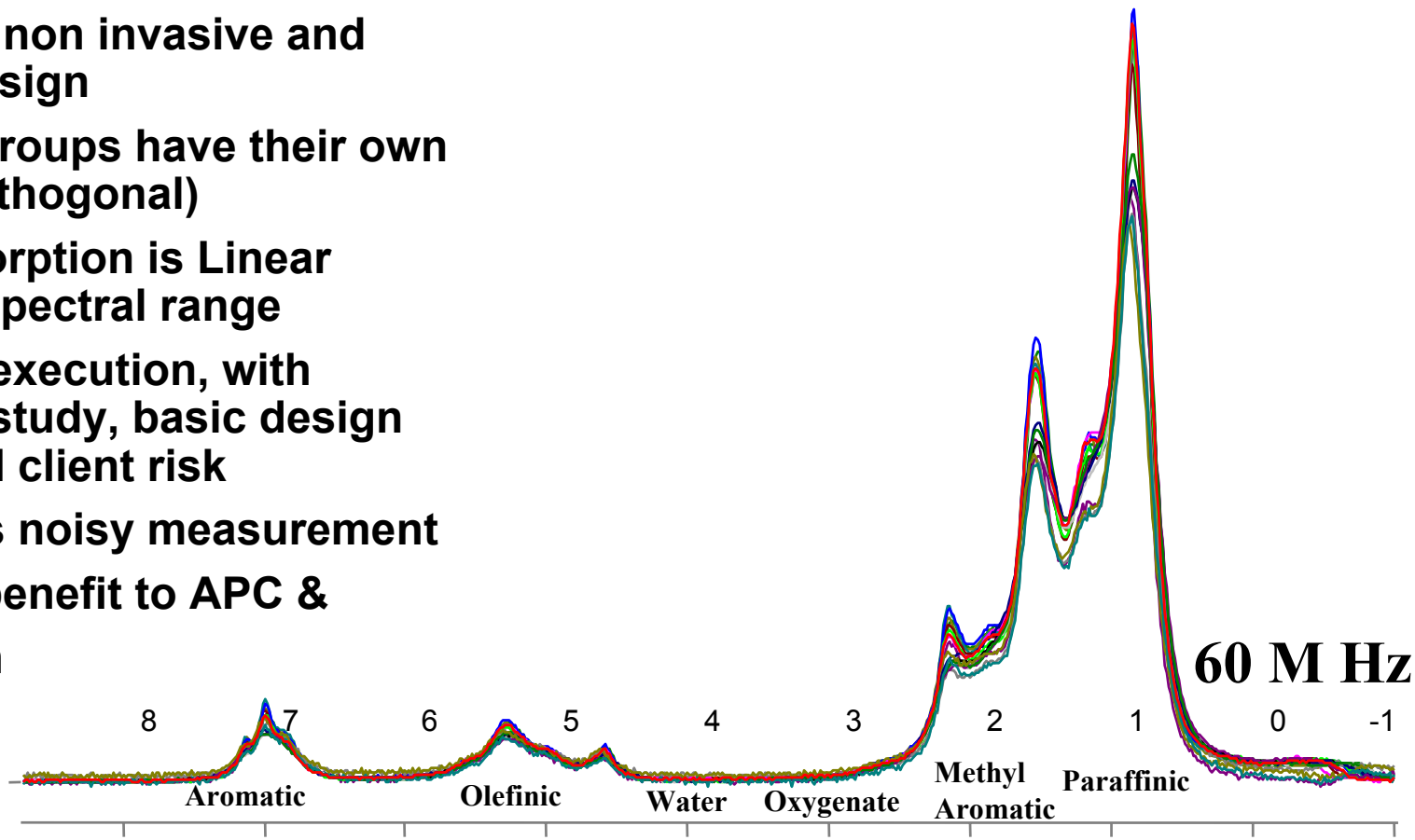
ROMeo Overview

- **ROMeo: Rigorous On-line Modeling and Equation-based Optimization**
  - **Joint development project between Invensys/SimSci and Shell U.S.A**
  - **Implemented worldwide in FCCUs, Hydrotreaters/Hydrocrackers, Crude units, Ethylene crackers**
  - **Common look/feel for all stages of model configuration, implementation, maintenance and off-line studies**
  - **Enhanced usability features cut down implementation time, improve maintainability**
  - **Refinery engineers required only three days of training to carry out most of the configuration tasks**

What are the Process MRA Features ?

- Minimum temperature and no chemical pre-conditioning
- Sampling is non invasive and simple in design
- Structural Groups have their own domains (orthogonal)
- Energy absorption is Linear across the spectral range
- Short track execution, with conceptual study, basic design and reduced client risk
- Robust, less noisy measurement

-->significant benefit to APC & Optimization



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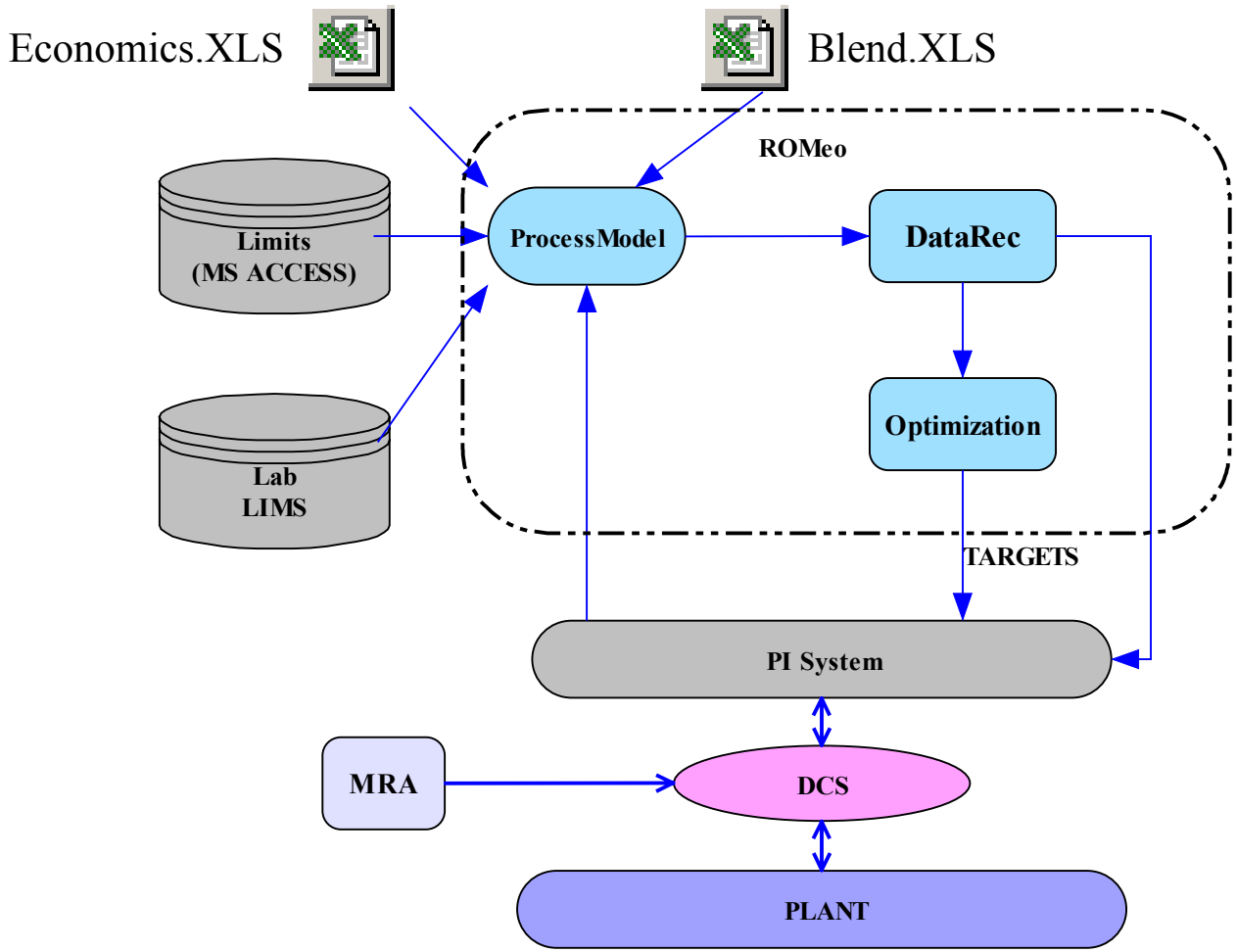
CD3 Crude Unit Case Study

Real-time Optimization Objectives

- How to maximize most valuable products like kerosene, heavy gasoil, LPG?
- How should circulating reflux flows be adjusted to maximize heat integration with the gas section?
- How to adjust the crude and vacuum furnace duties?
- Can column pressure, reboiler and reflux in gas section be adjusted to minimize fuel gas?
- Can we achieve uniform operating philosophy acceptable to all shifts?

System Overview



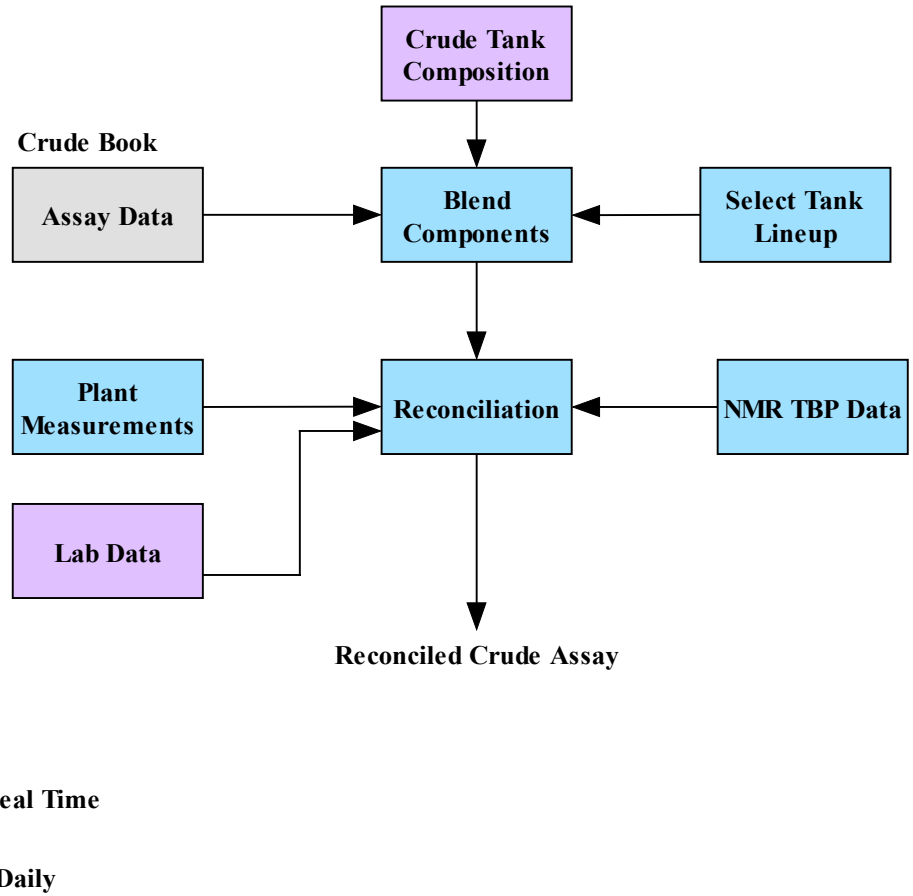
Problem Size, Platform and Performance

- Size
  - 252 Measurements
  - 26,000 Equations
  - Degrees of Freedom
    - 170 in Data Reconciliation (tuning parameters)
    - 31 in Optimization (targets to APC/DCS)
- Platform
  - Dell PC with dual 1-GHz CPUs , 2 GB RAM.
  - Windows NT Enterprise server
  - Networked to Foxboro I/A, PI, LIMS.
- Performance
  - Reconciliation: 10 minutes
  - Optimization: 5 minutes

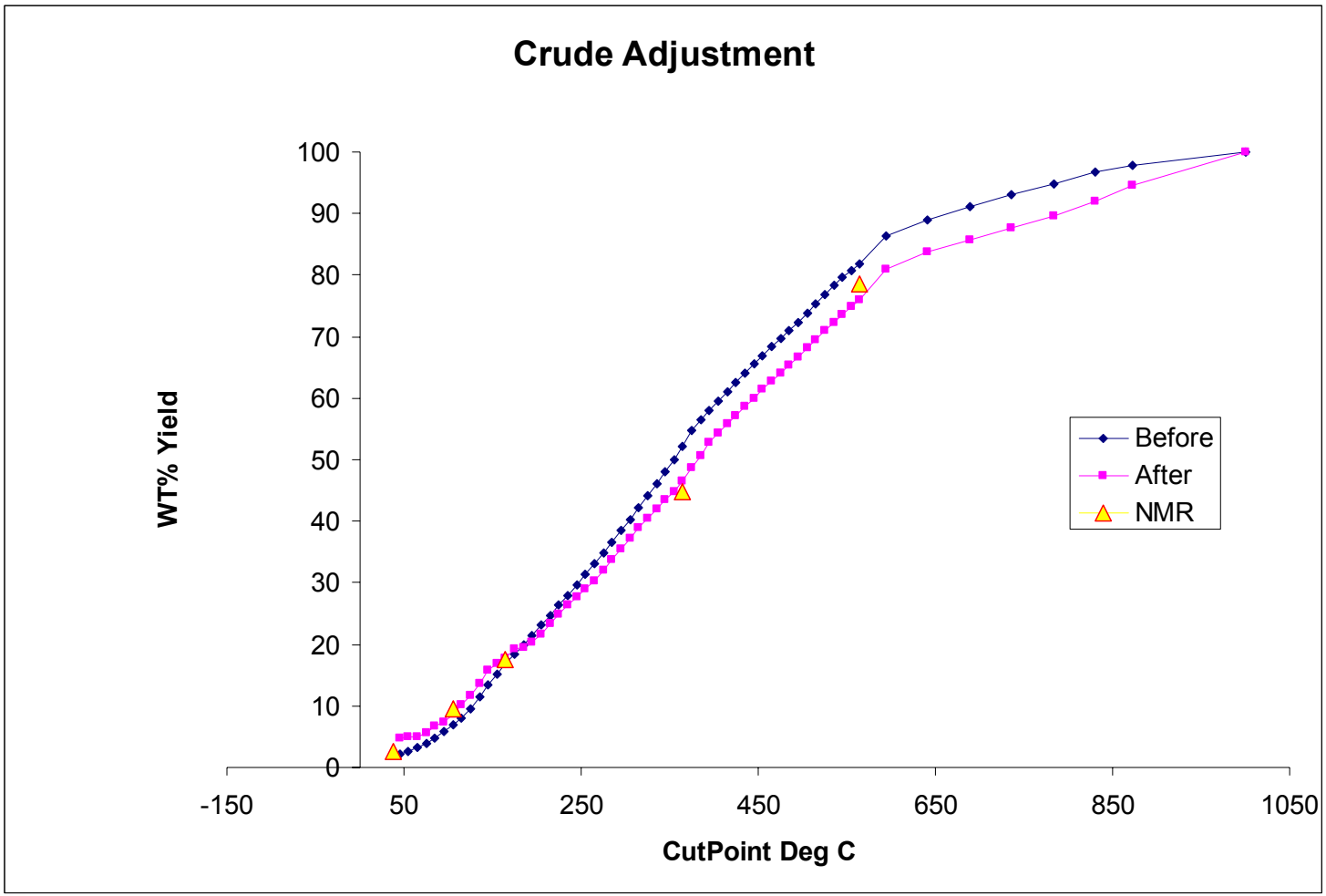
On-line MRA data

- MRA supplies real-time measurements to APC and ROMeo Optimizer
- ROMeo:
  - Crude: 5 pt TBP
  - improves feed characterization during data reconciliation
- ROMeo, APC:
  - Kero: freeze point, flash point
  - Naptha: end point
  - closer operation to constraints by APC and ROMeo → improved benefits

Feed Characterization



On-line Feed Characterization with MRA



Benefits

- **Online:**
  - Preliminary benefit estimate: 7-12 K $US/Day
  - benefits derived primarily from:
    - kero maximization
    - improved heat integration

- **Off line:**
  - Several circulating reflux flows were moved from their traditional operating levels
  - Avoided unnecessary opening of columns and exchangers during short turn around
  - Understand the impact of crude switch on downstream units

Conclusions

- The usability features of ROMeo allowed application to be configured by plant engineers on time (4 months) and within budget
- On-line optimization provides a set of operating guidelines to capture the benefit in real time instead of running the unit on preset operating guidelines that may be suboptimal
- Process MRA provides valuable real-time measurements to enhance APC and ROMeo performance