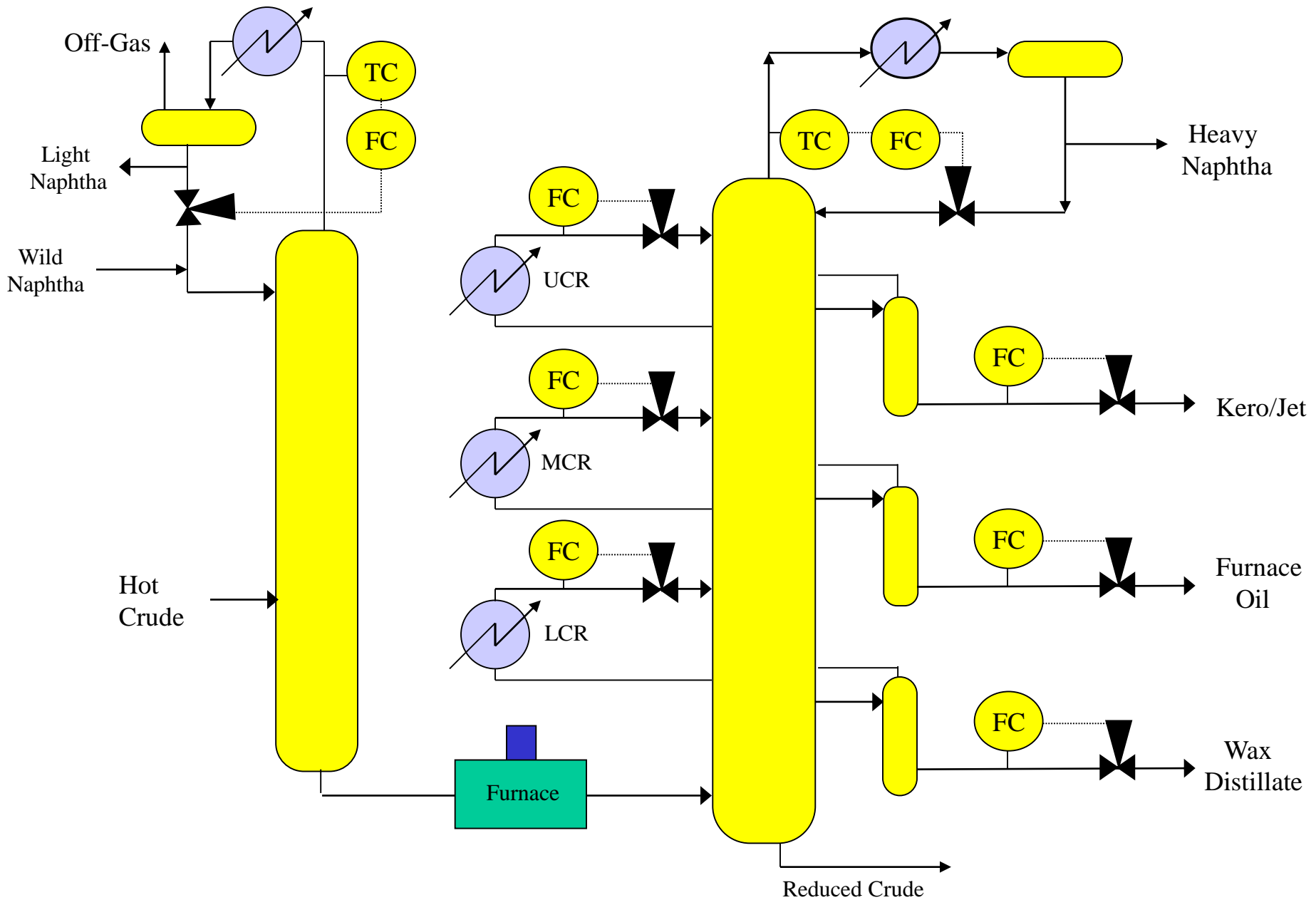


# Use Column Data To Infer and Control Crude Fractionation Product Properties

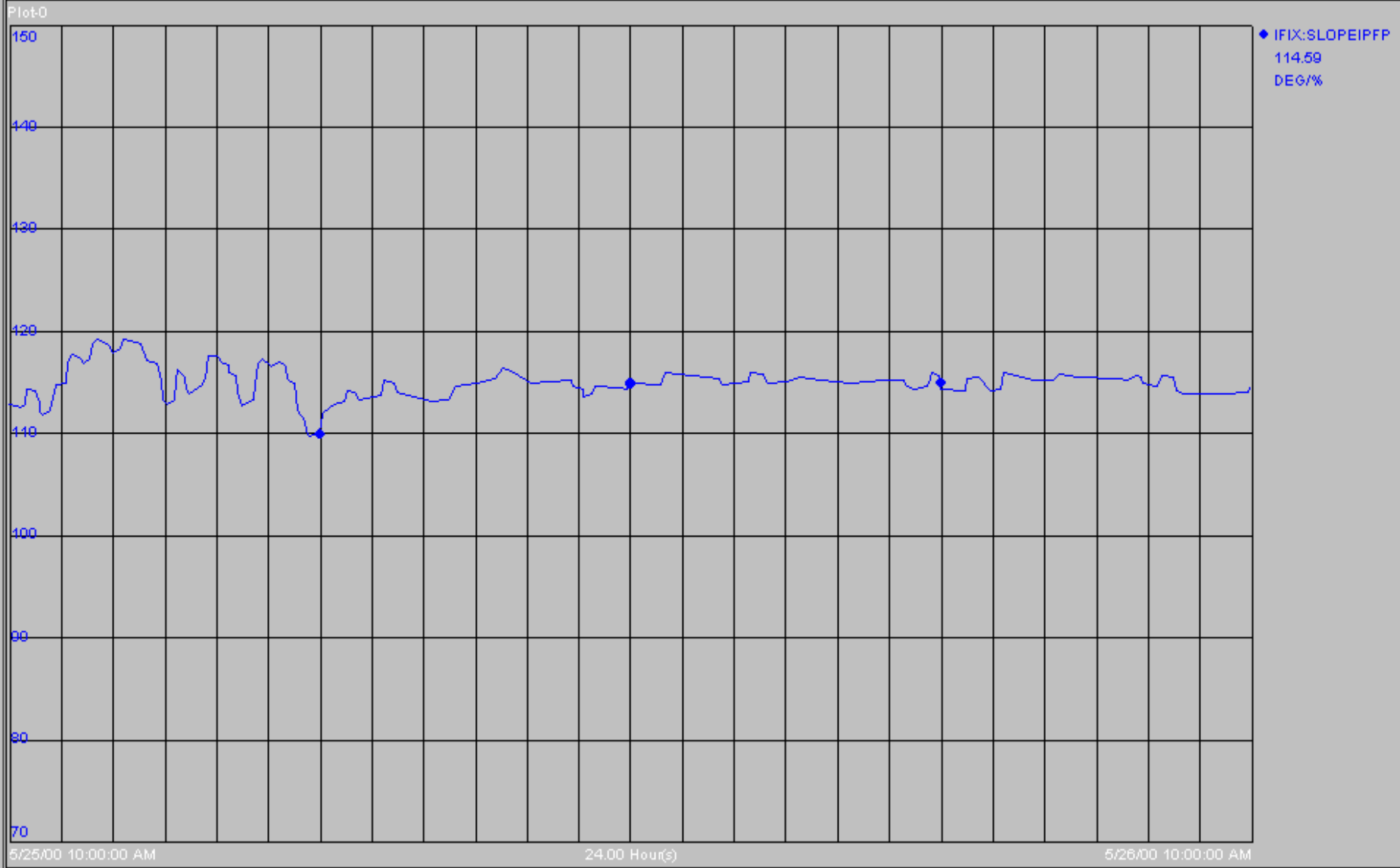
# URC Preflash And Atmospheric Columns



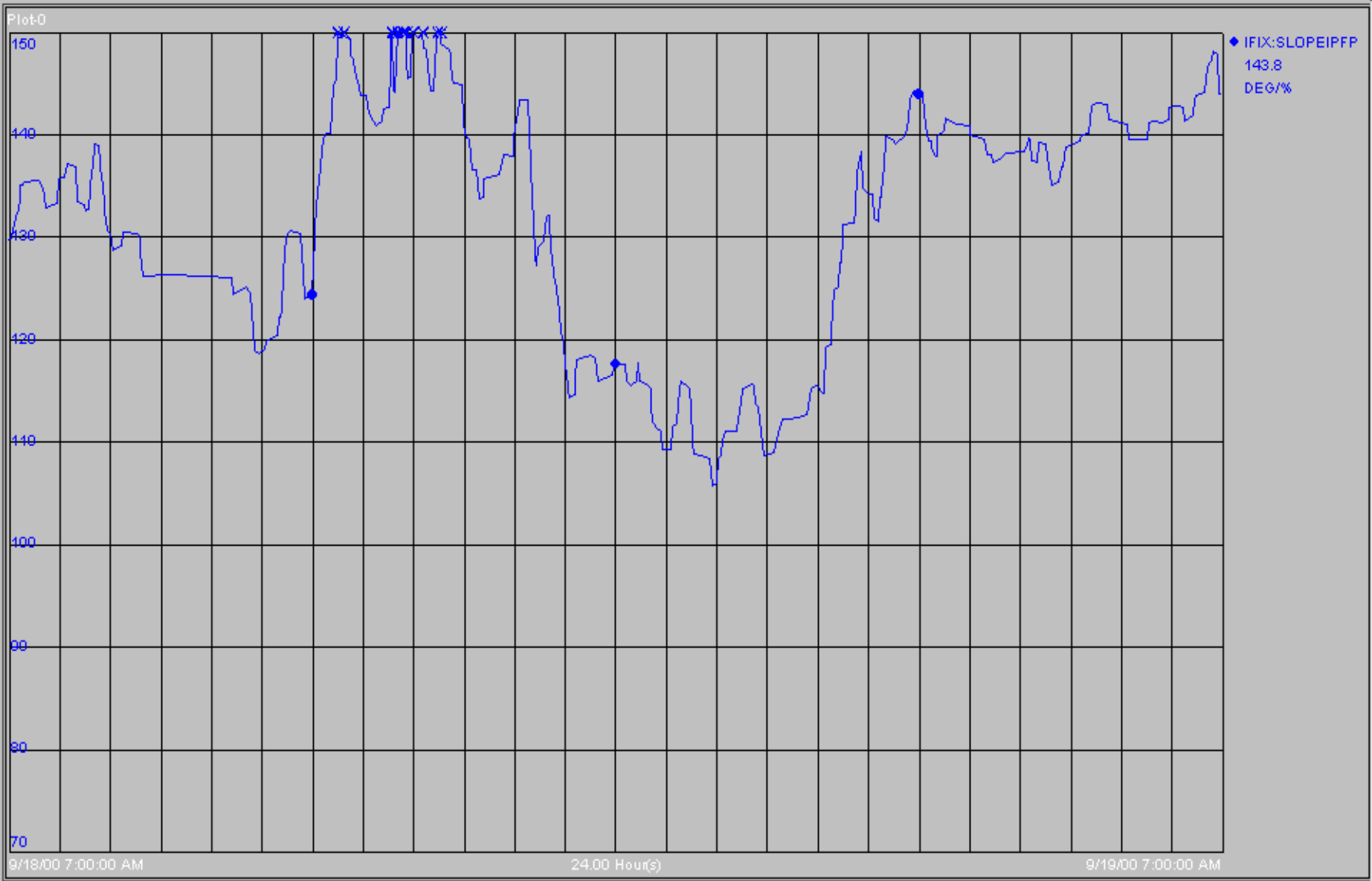
# URC Crude Unit Operations

- TBP of Crude Is Unknown and Unsteady
- Feed Switches Occur Frequently
  - *Operations Cannot Correctly Set Product Draw Rates Until Tower Is Close to Steady State*
- Lab Analysis Problems
  - *Performed Every 4 hours; Operations has difficulties interpreting results because of changing crude composition.*
- “Wild” Naphtha Recycled to Pre-flash Top Tray
- Draw Trays Often Dry Up-Tray Leakage/Weeping
- Equipment Constraints

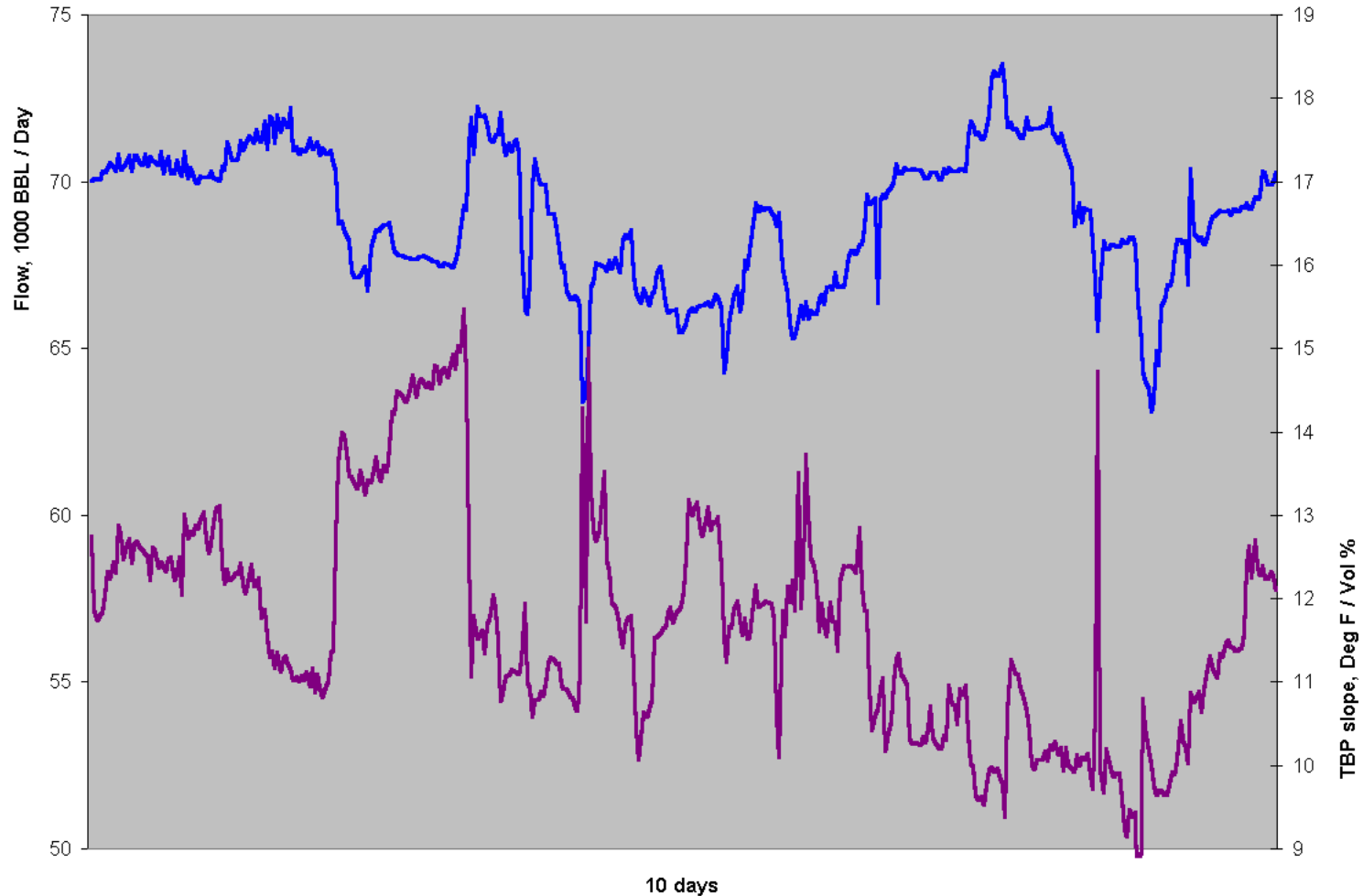
# Constant TBP Slope



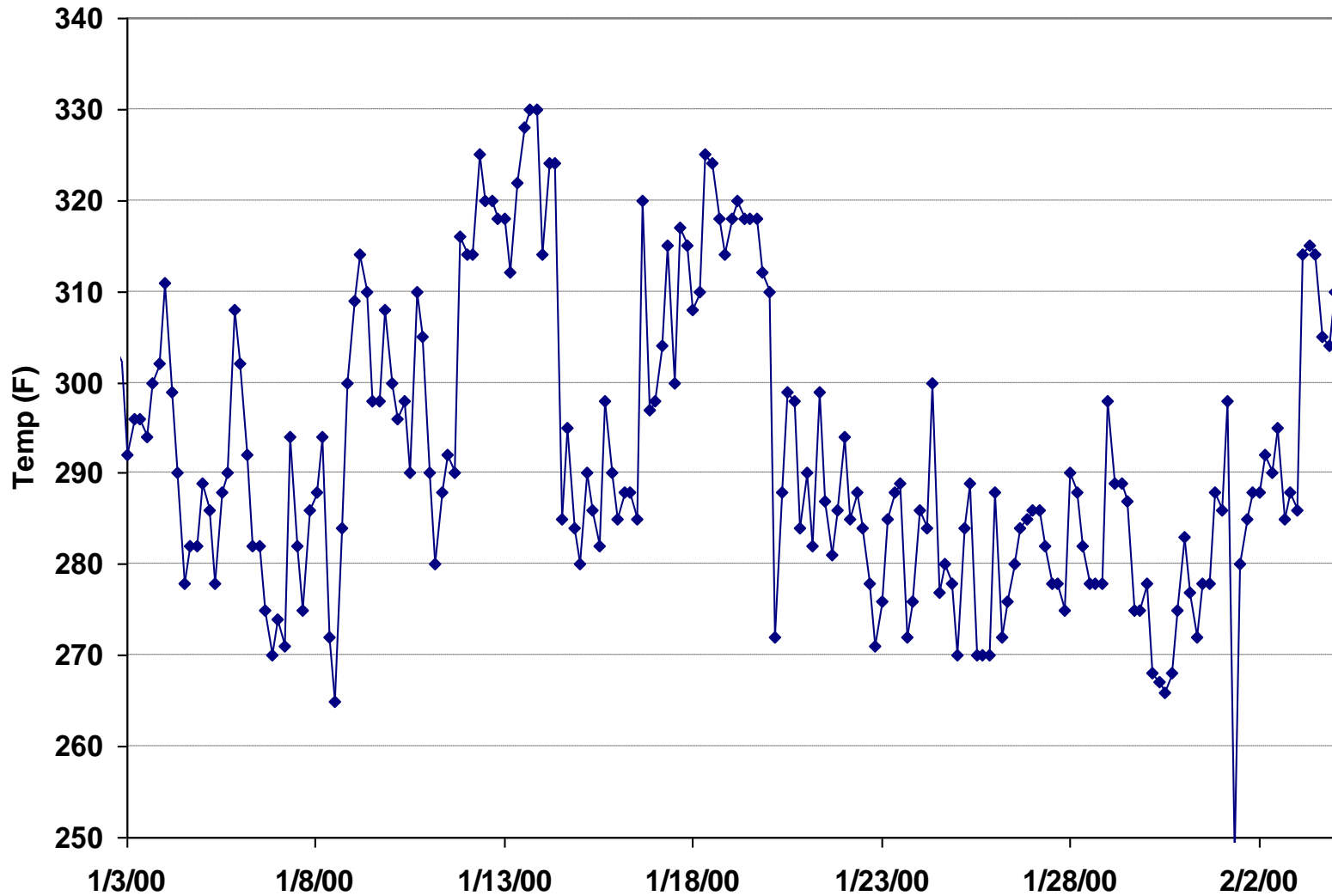
# Bad Slope Day



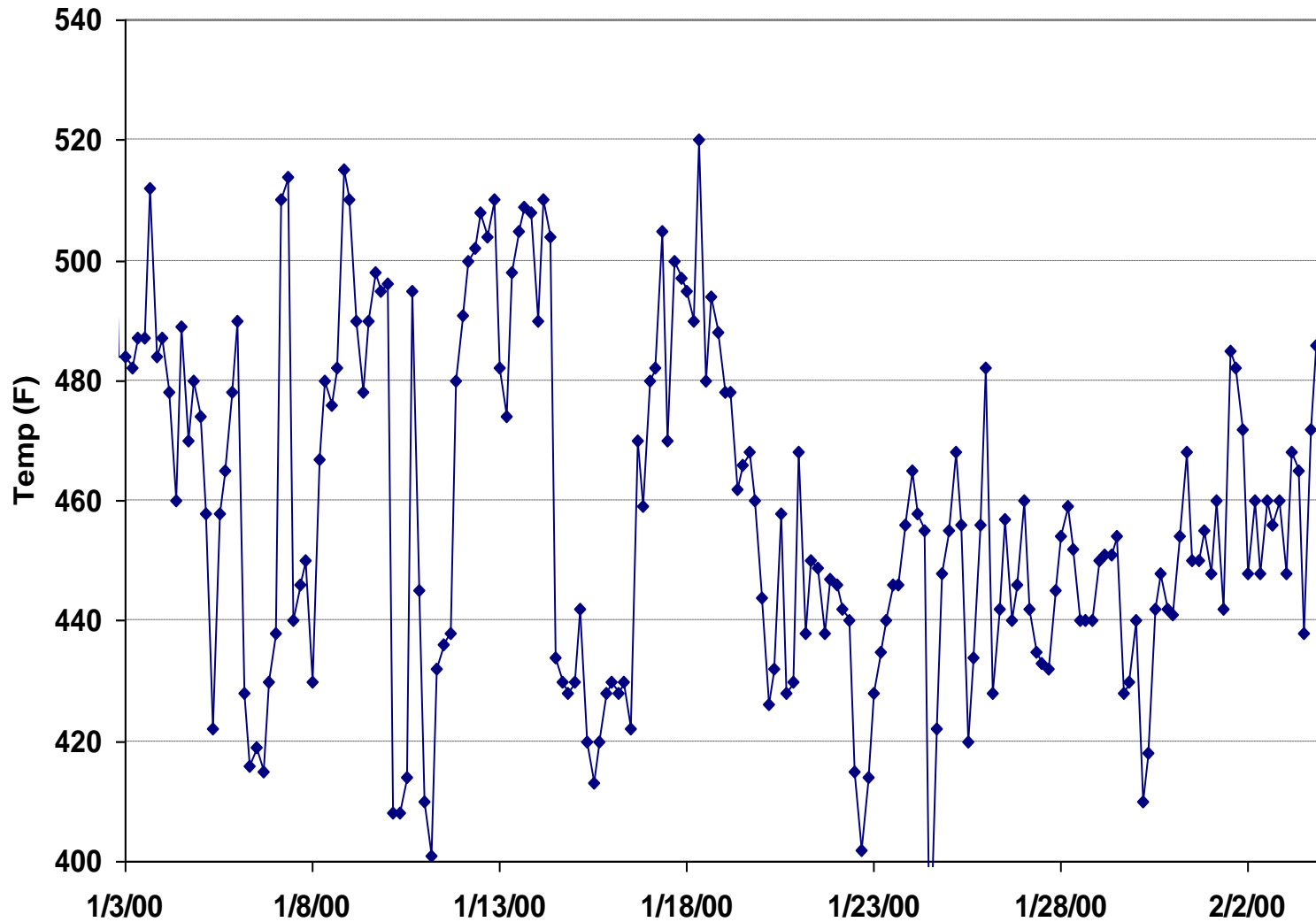
# Crude Unit Operation – Unsteady Crude



# Naphtha Product 90%-ASTM

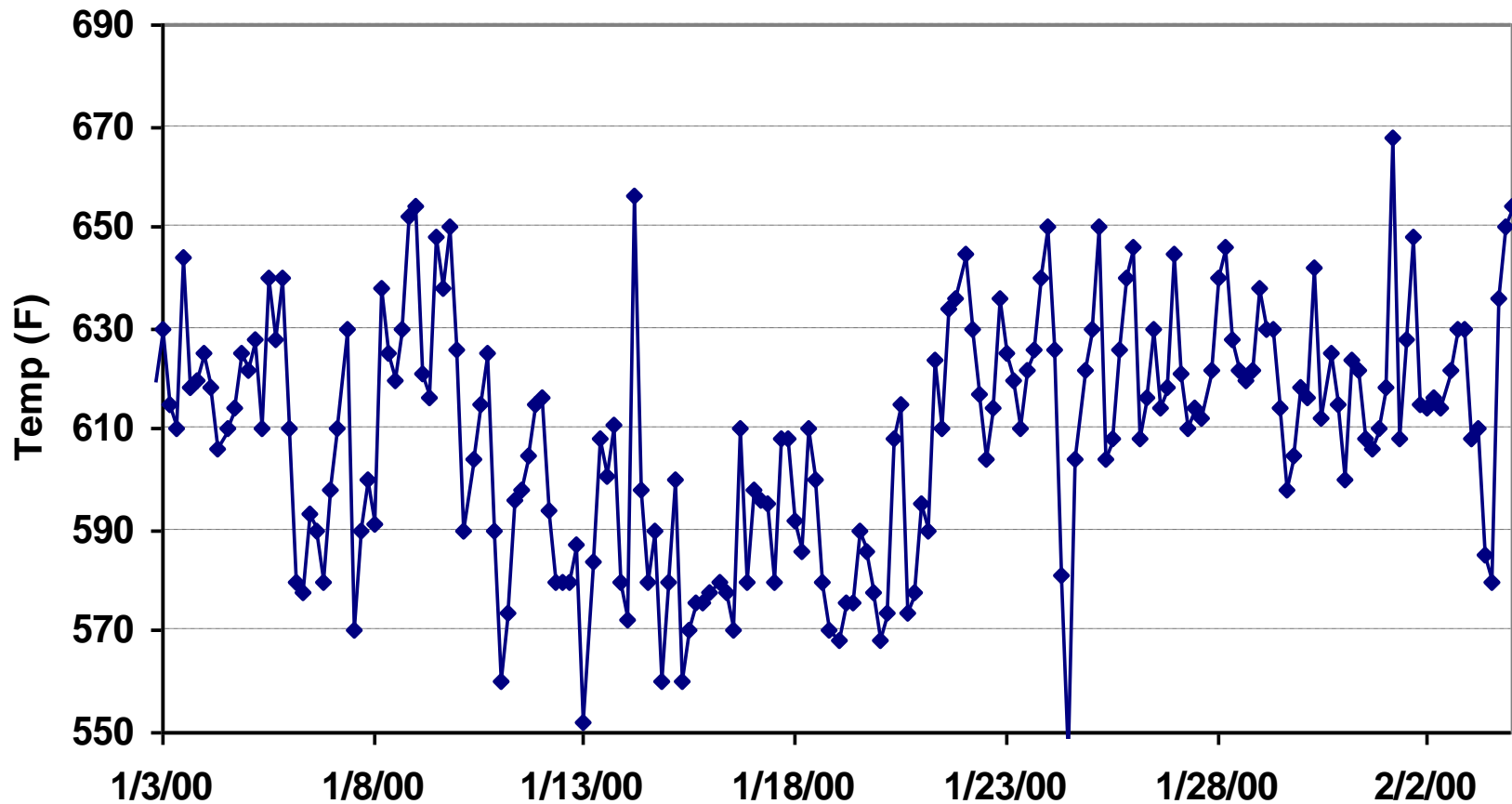


# Kerosene Product 90%-ASTM





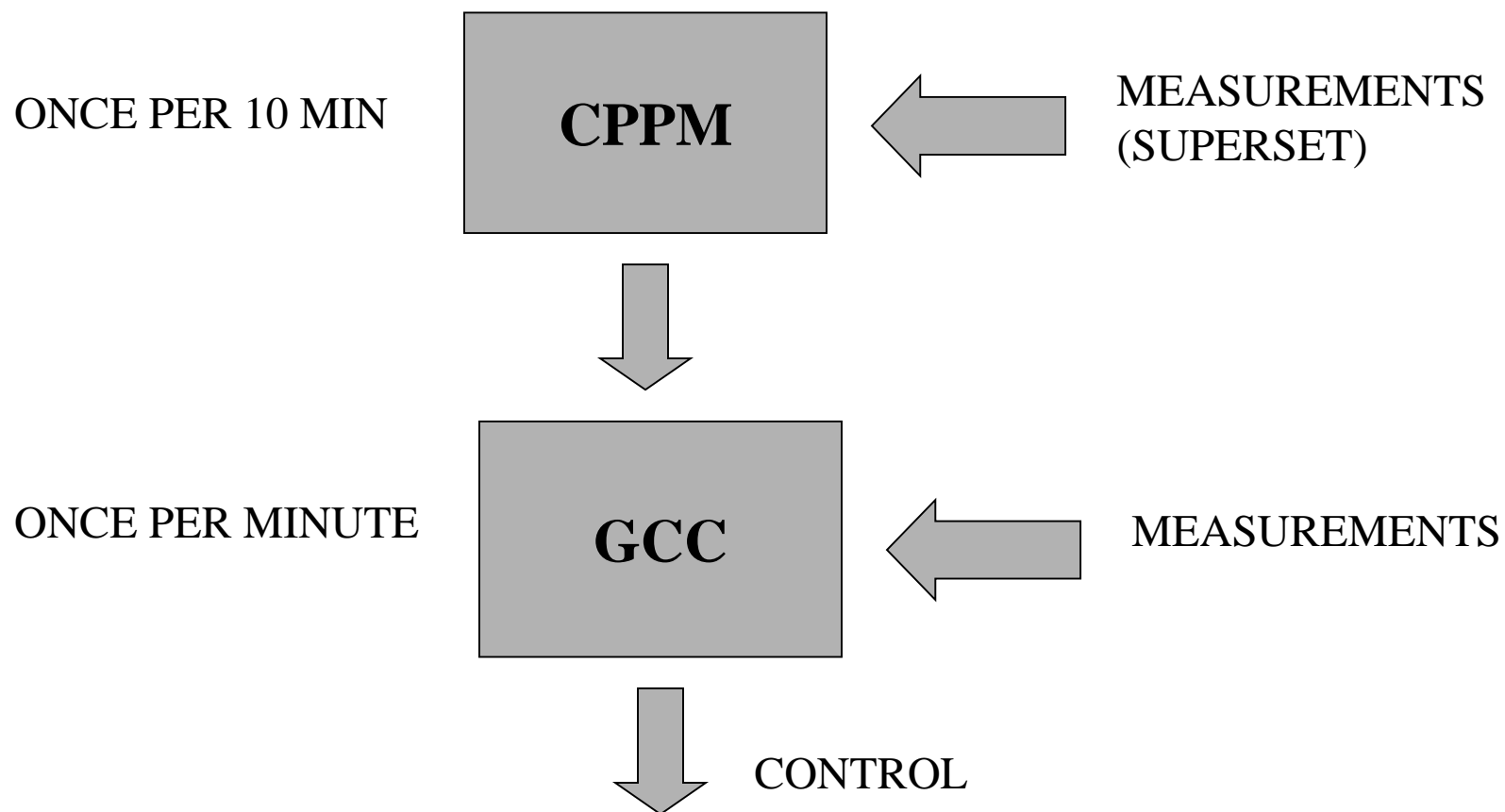
# Furnace Oil Product 90%-ASTM



# Project Objectives

- Improve/Automate Control of Product Qualities (ASTM's)
- Improve Pumparound Heat Recovery
- Shorten Transition Between Crude Switches
- Reduce Lab Testing

# Inferential Models



# Approach Used

1. Use On-Line (PI) Data of Temperature/Pressure Profiles and Selected Flows to Construct Crude TBP
  - *Simplified Approach – GCC*
  - *Rigorous (T-t-T) - CPPM*
2. Predict Product Qualities
3. Predict V/L Profiles
4. Calculate with GCC Set-Points of Product Flows and Other Manipulated Variables to Control Product Qualities and V/L Traffic; Return to Step 1 (~Once/Min)
5. Use CPPM to Adjust Key GCC Parameters/Biases; Return to Step 4 (~Every 10 Minutes)

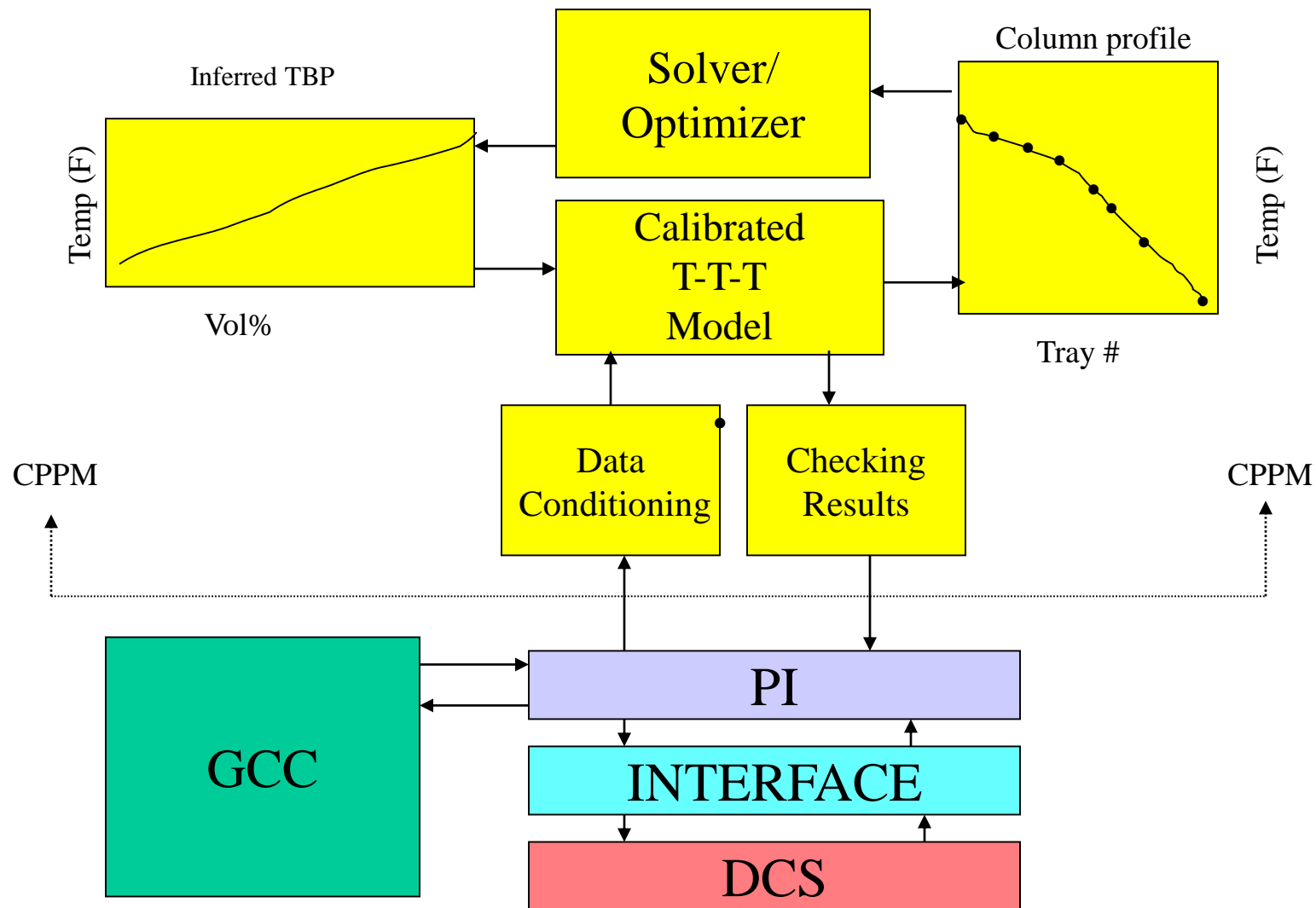
# GCC Features

- **Simplified Model Based on First Principles**
  - *Good Range of Validity*
  - *Calibration Requires 2-3 Data Sets*
  - *Easy to Understand and to Implement*
- **Responsive To Crude Switches**
  - *Thanks To Emphasis on Heat Balance*
- **Robust and Fast**
- **Compact, Integrated Package of: Constraints / Dynamics / Manipulated Variables / Inferential Models**

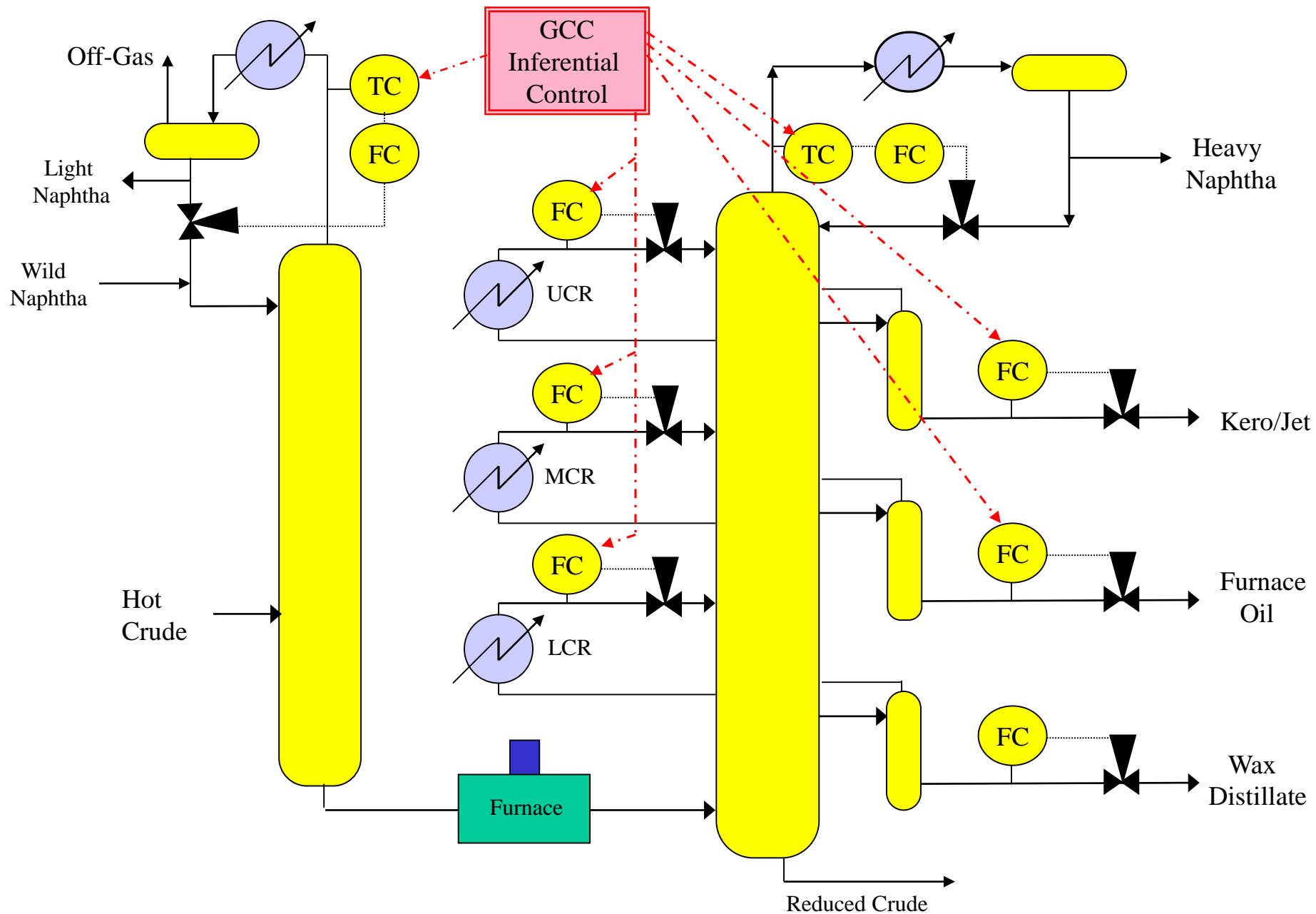
# CPPM

- Uses Rigorous Tray-to-Tray Model
  - *Simultaneous Matrix Solution (Open Equation)*
  - *Component Aggregation Reduces Matrix Size, Increases Robustness and Speed*
- Monitors Instrumentation Readings
- Adjusts Feed TBP by Minimizing Errors Between Calculated and Measured Column Profile
- Calculates Physical Properties of Products
  - *ASTM Distillation*
  - *Flash Point*
- Calculates V/L Profile
- Calculates Biases for GCC

# System Overview

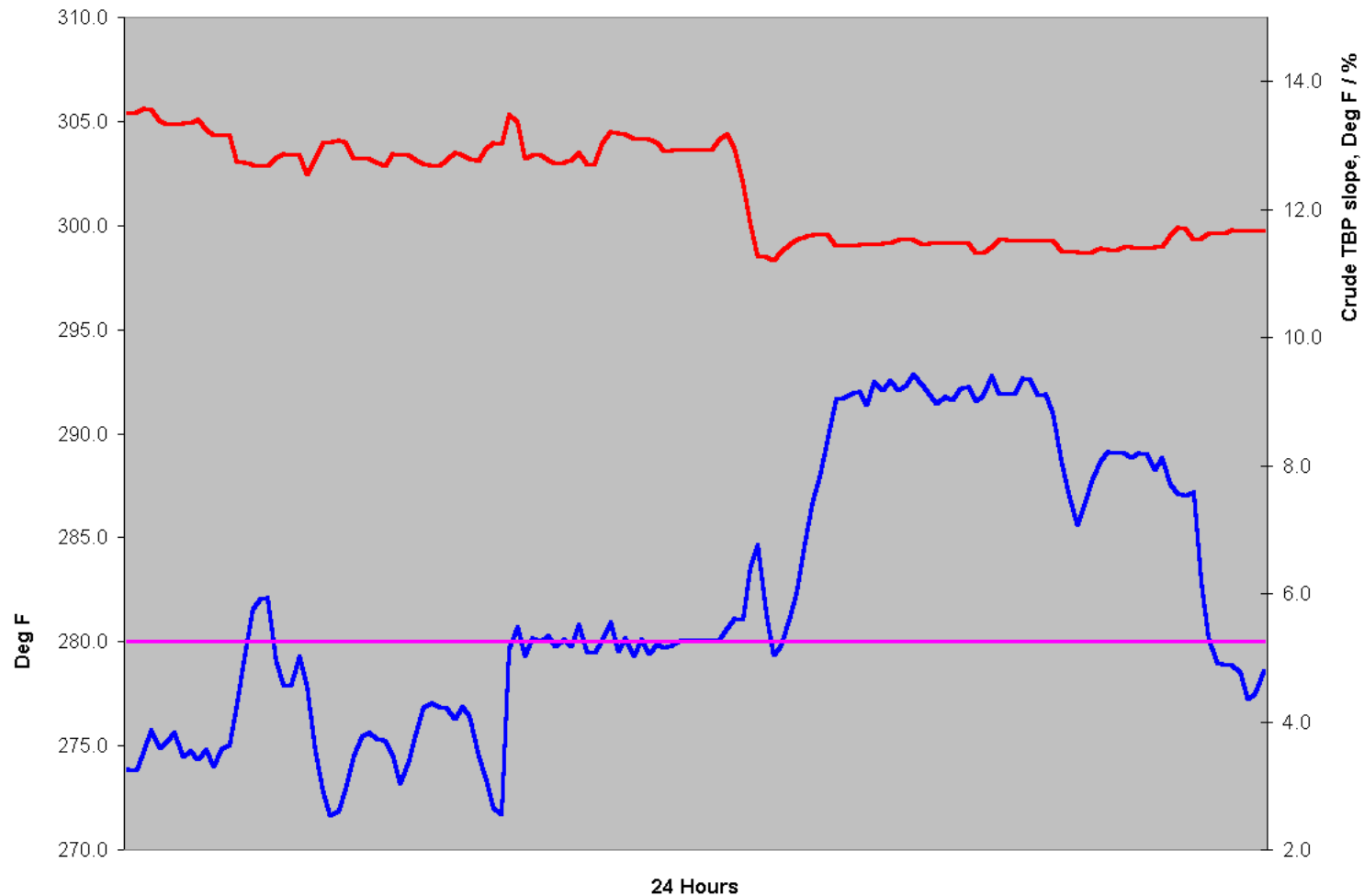


# URC Preflash And Atmospheric Columns

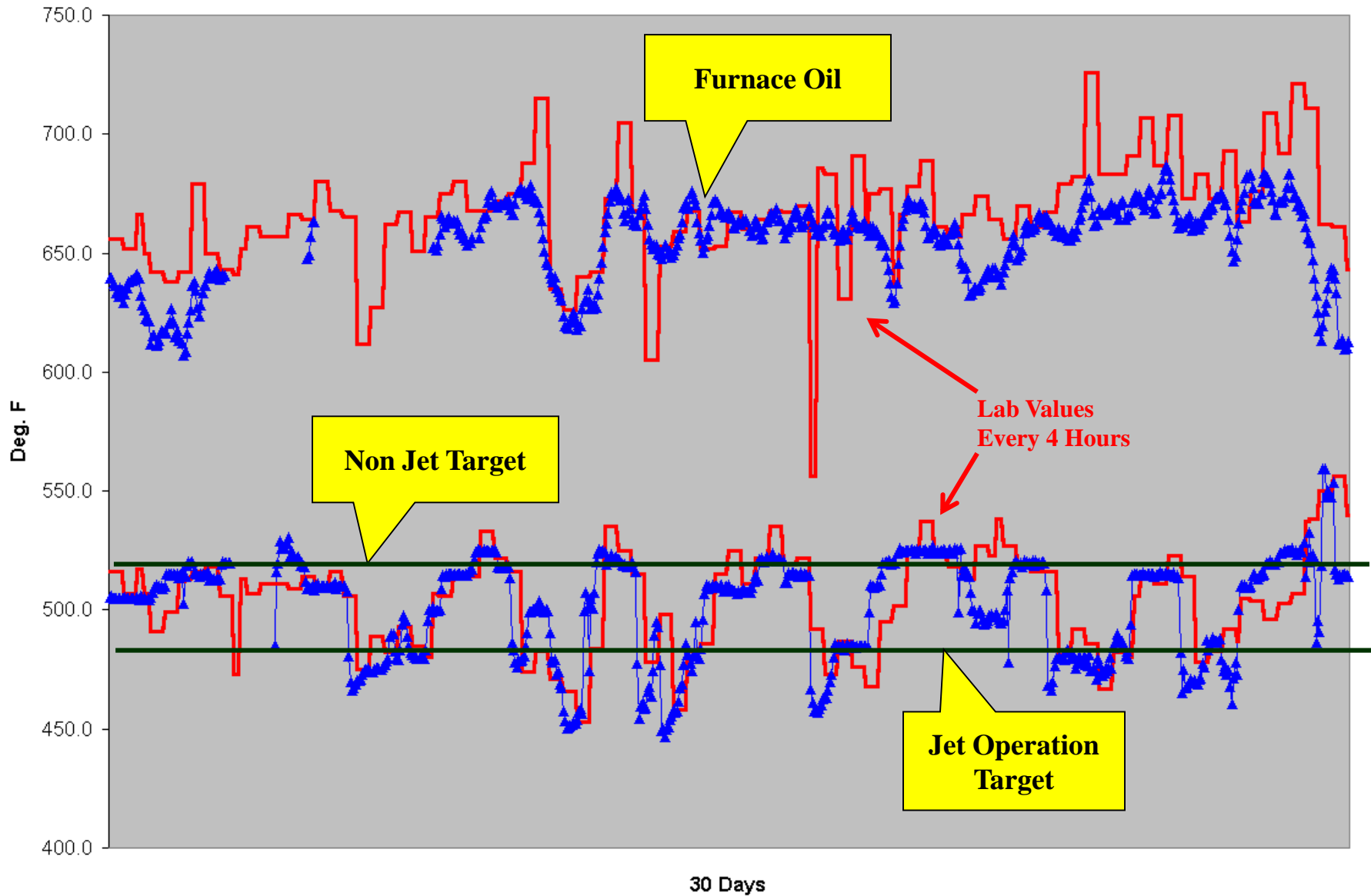




# Naphtha Cutpoint Example



# Inferred 90% vs Lab Data



# Benefits

- Improves Control of Product Specs
  - *Eliminates Effects of Analyzer Dead-Time*
  - *Reduces Quality Give-Away*
  - *Increases Yield of Valuable Products*
- Shortens Crude-Switch Time
- Pumparound Control Increases Unit Efficiency
- Reduces Side-Stripper Draw Tray Dry-Ups
- Reduces Operator & Lab Loads
- Increased Understanding of Crude Tower