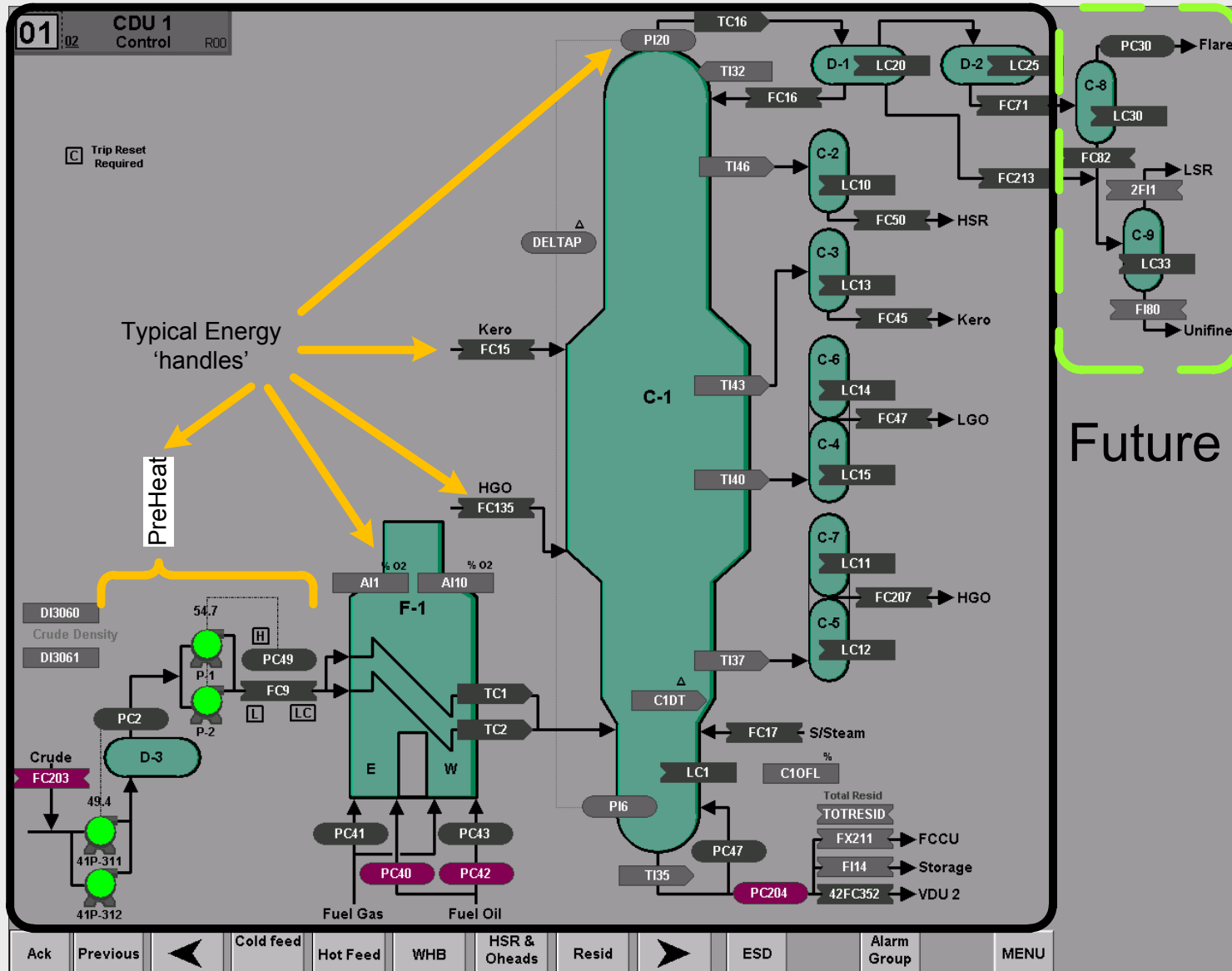# LOR Crude unit 1 APC March 2012

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Agenda

- **Process APC description and scope**
- **Multivariable predictive controller**
- **Inferential models**
- **Issues with Inferential 'trust' versus analyzer readings and Lab**
- **Energy on CDU and APC projects**

LOR CDU1 APC scope

Typical Energy 'handles'

PreHeat

Future scope

APC considerations

- **CDU is the first refinery unit and correctly splitting the crude oil at that stage is a must for a better overall refinery performance.**

- **Hence CDU APC is lucrative. It works via**
  - **<u>Inferential models</u>, estimating the many product qualities (distillation and cold properties).**
  - **<u>MVPC</u>, pushing the unit continuously against plant constraints and product specifications.**

- **Quality inferences are key to successful APC. They must perform well at all times:**
  - **Whatever the crude slate or type**
 - **Whatever the type of spec to run with**

Inferential model methodology

- **A <u>calculation</u> based on "field measurements" such as flows, pressures, temperature.**
  - **These calculations are based on thermodynamics first principles**
  - **A TBP (true boiling point) curve of the crude is estimated from column conditions**
  - **Internal reflux flows, including the most important over-flash flows are also estimated**
  - **From that information the model calculates all the different product properties (Flash, 5%, 95%, etc.)**

# Estimate the crude TBP curve
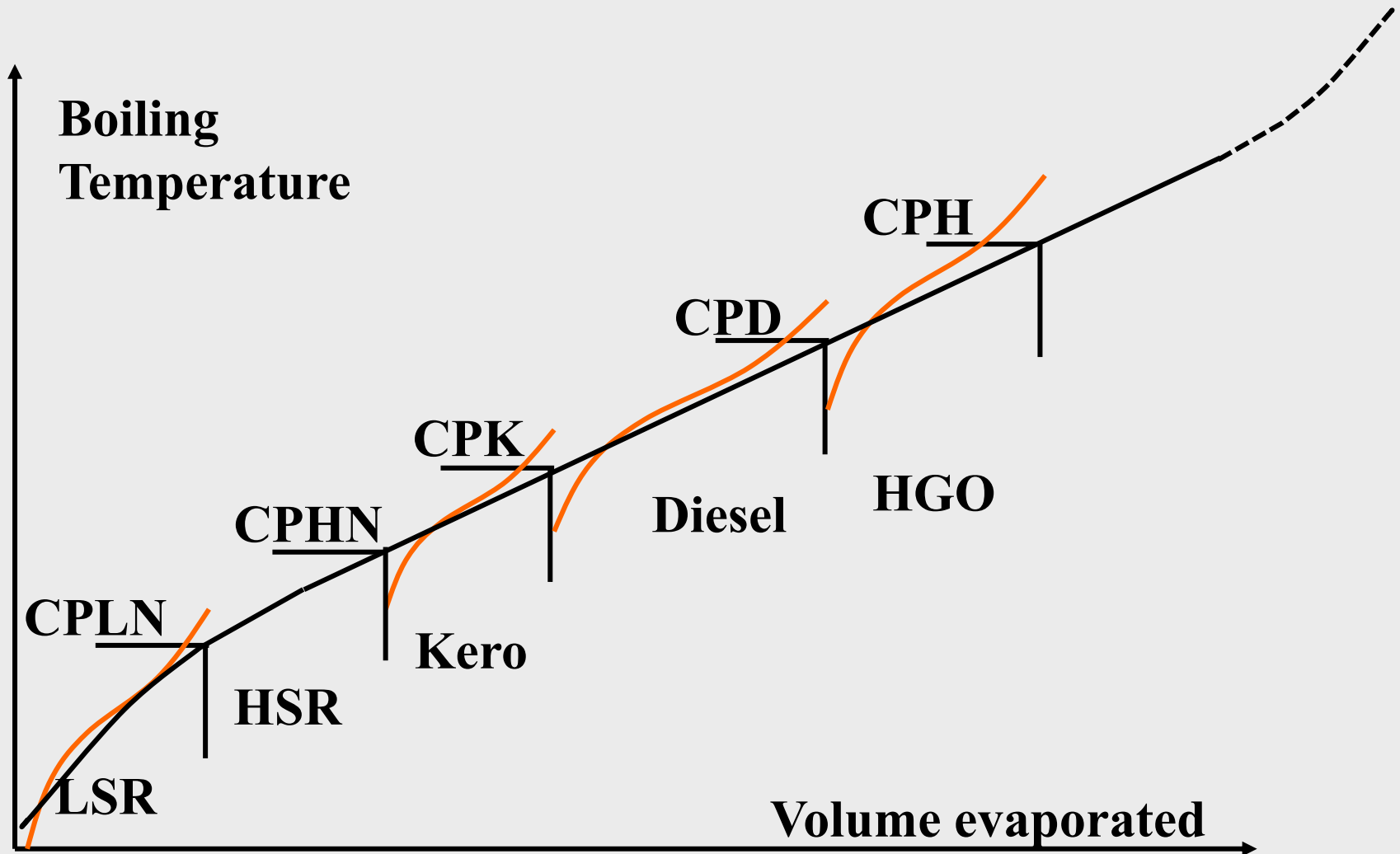
LOR inferences
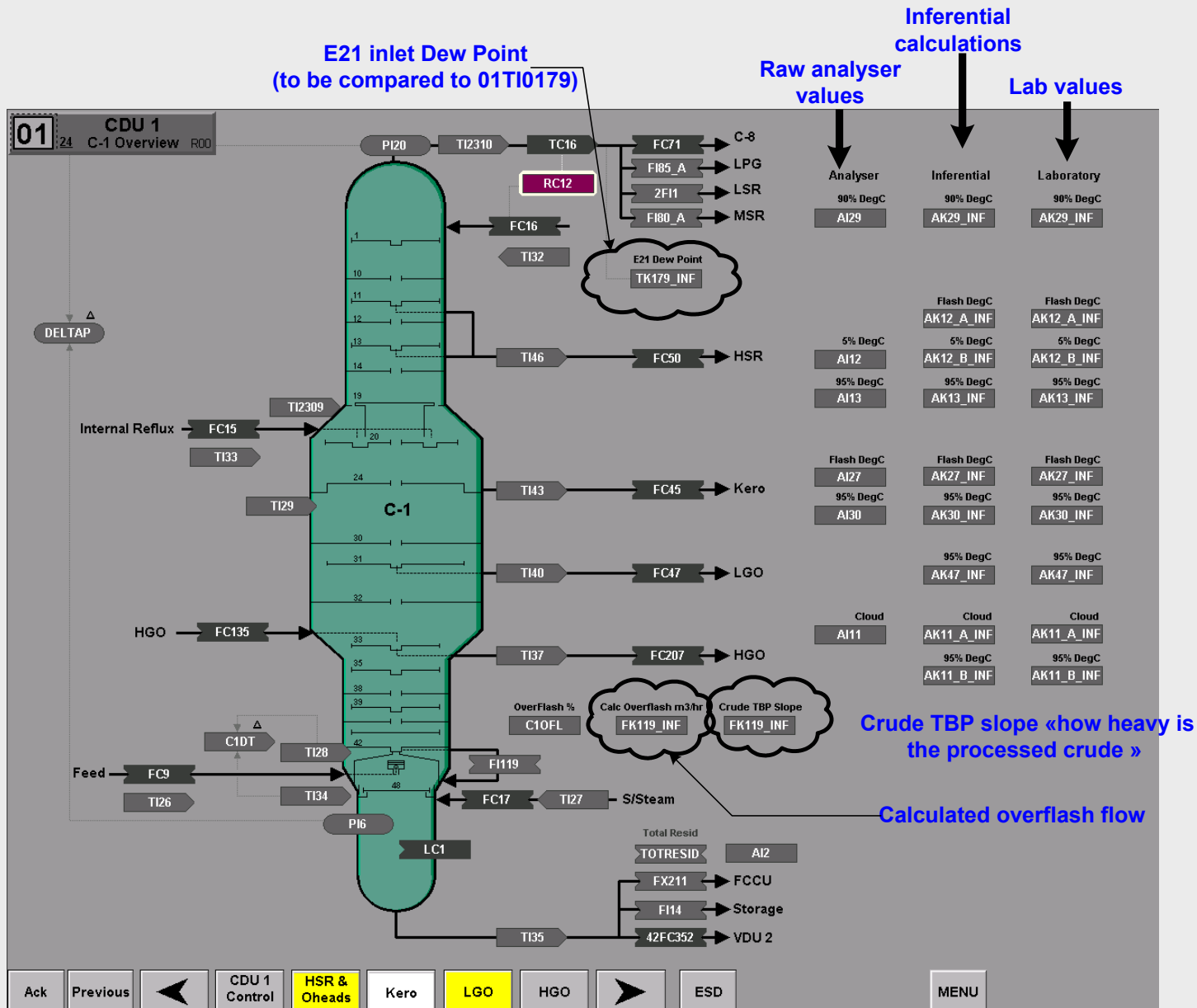
Inference versus analyzer

- **Analysers are slow by nature, not giving the right speed of results for fast control actions when needed.**

- **Also during a specification product transition, the analyzer takes time to line up to the new product.**

  - **Operators do not believe the analyser as it takes 5 hours to switch properly (change of measurement method requires a switch on the analyser)**

  - **They wait for a Lab value to come … which takes time as well …**

  - **The inferential is there at all time. If it generally agrees with the lab it becomes quite useful**

Inference versus analyzer trend 1
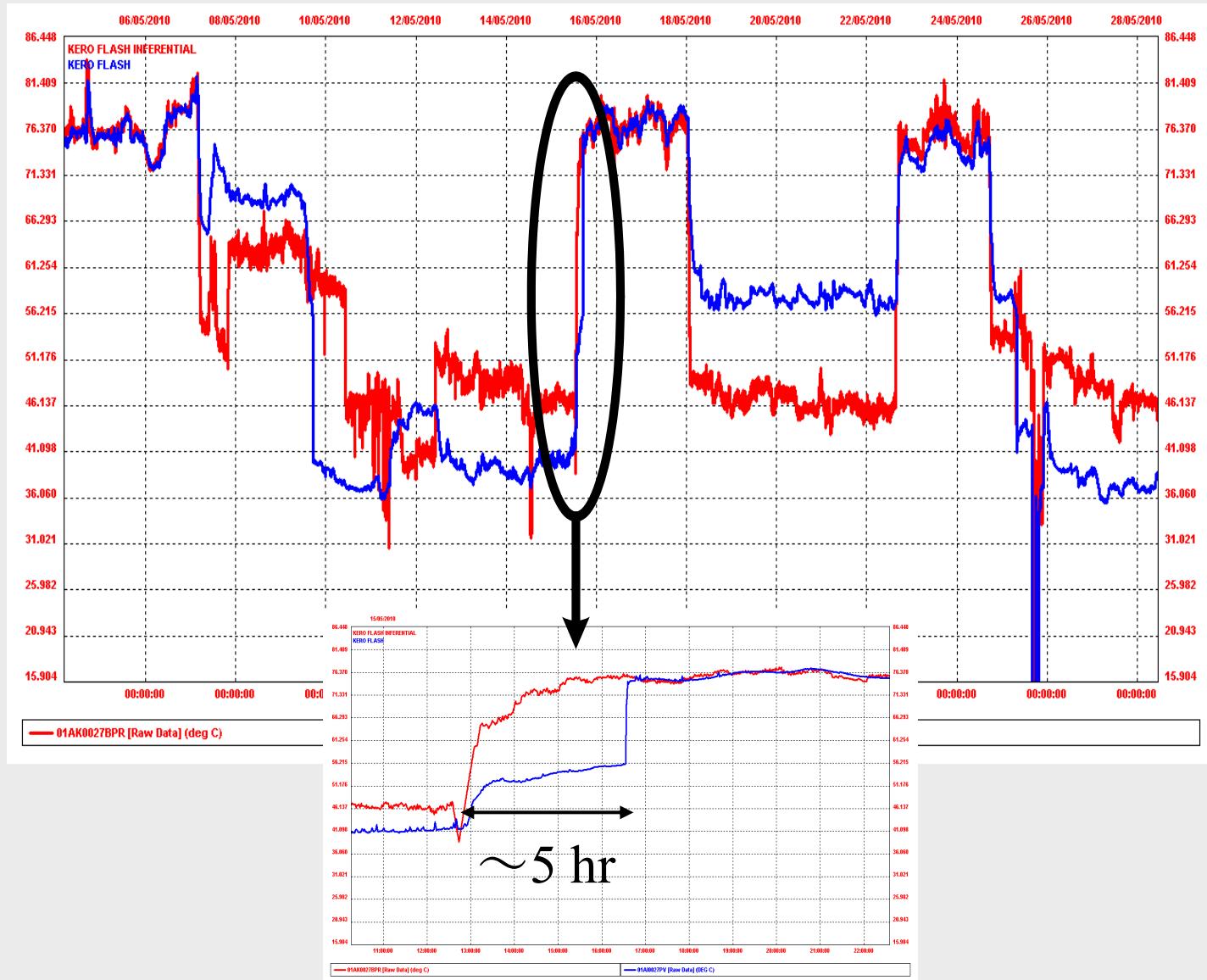
# Inference versus analyzer trend 2
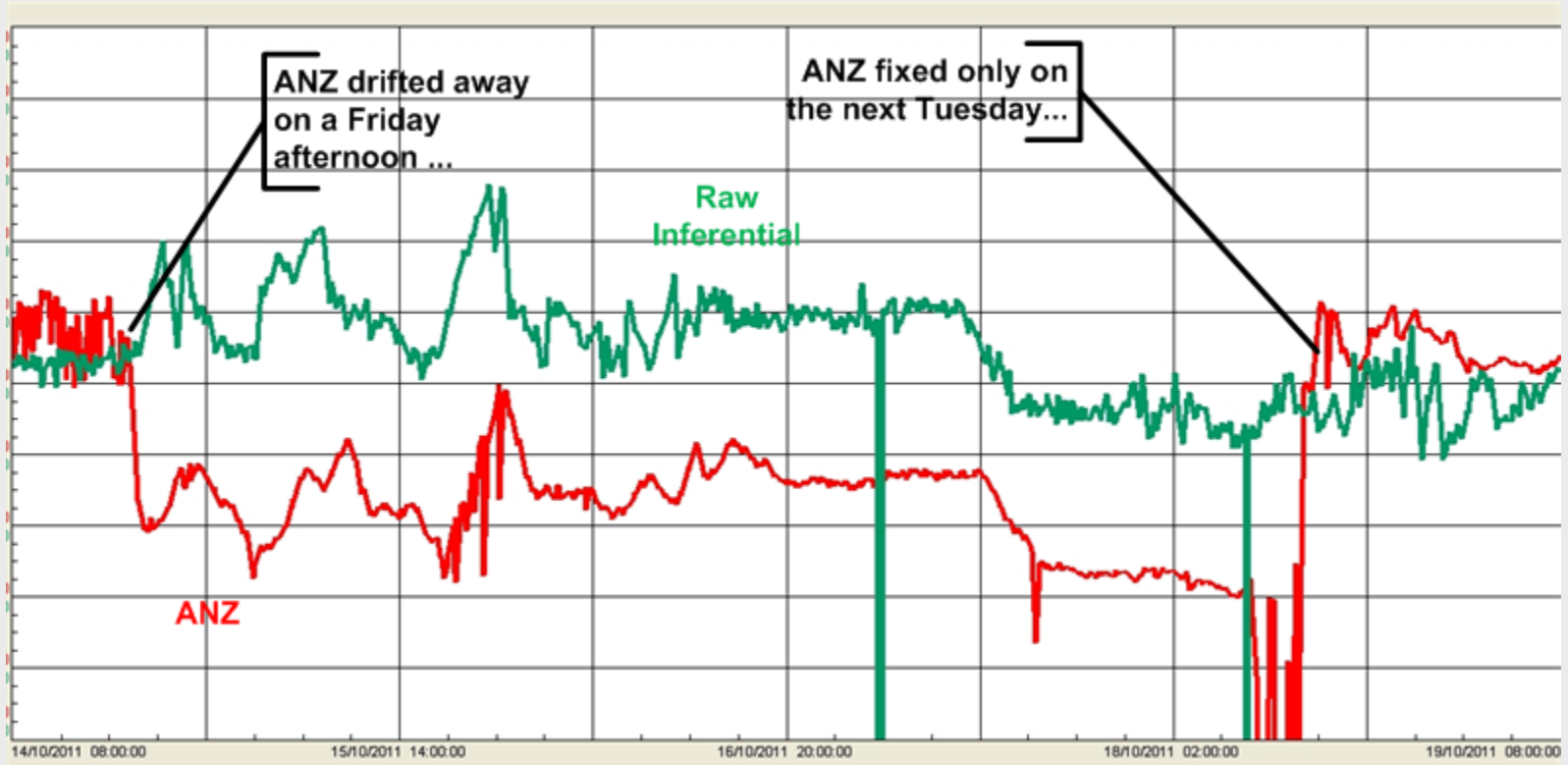
CDU APC strategy

- **Control product qualities to targets given by the planers, in order to optimally feed downstream units**

- **Push the feed rate up to:**
  - **Requested production target**
  - **Approach but do not exceed unit constraints**

- **Reduce the time of crude switches**

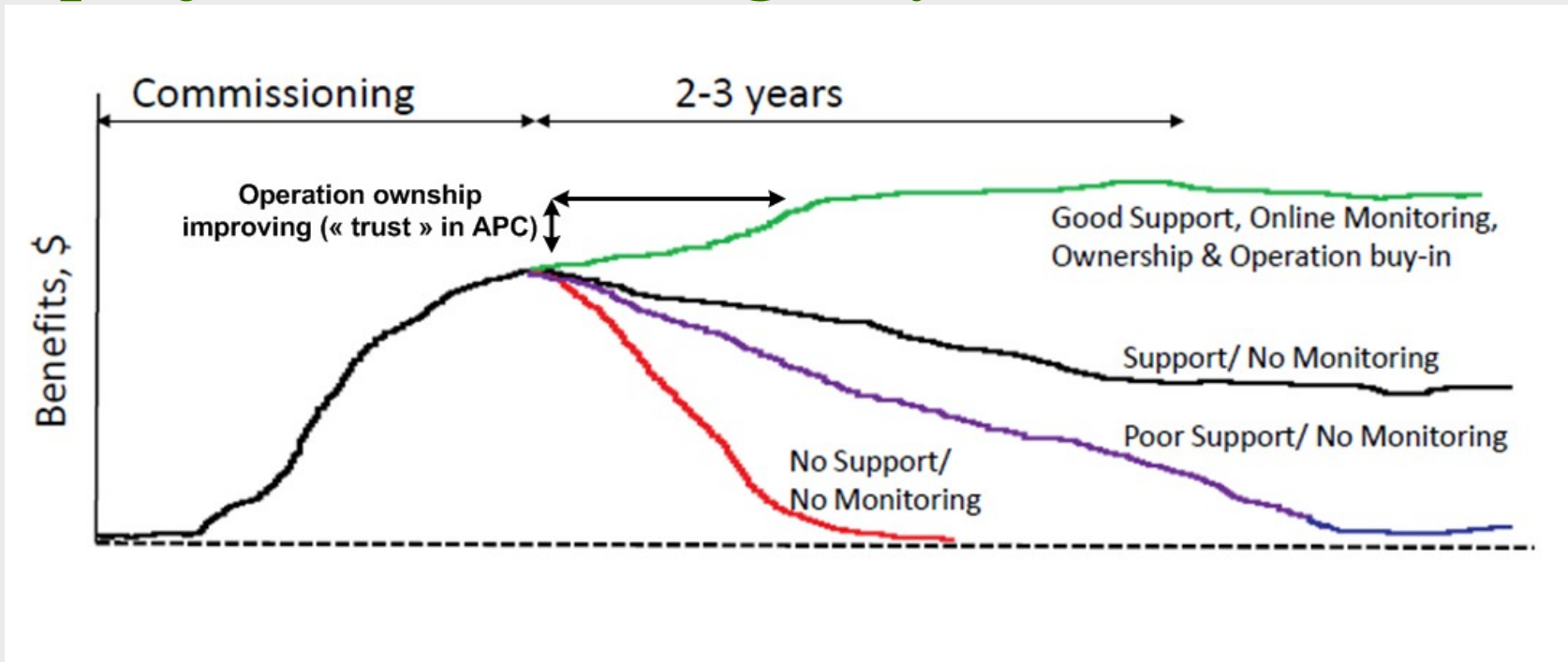- **Handle the different production modes ('specialities' for Kerosene)**

Benefits

- **First of all, <u>a high operator acceptance and trust with a typical service factor over 85%, up to 99%</u>**

- **Financial benefits > 6 M€/y (due to higher distillate recovery)**
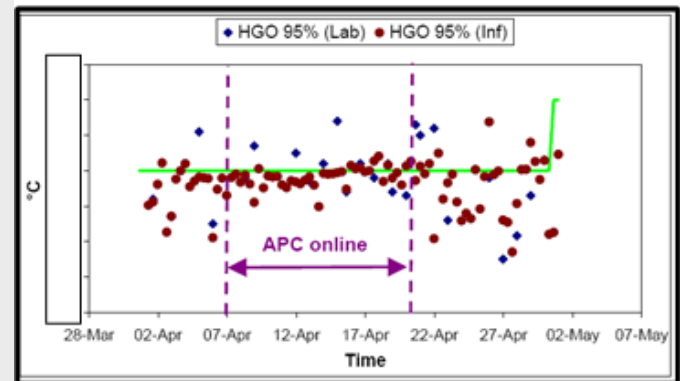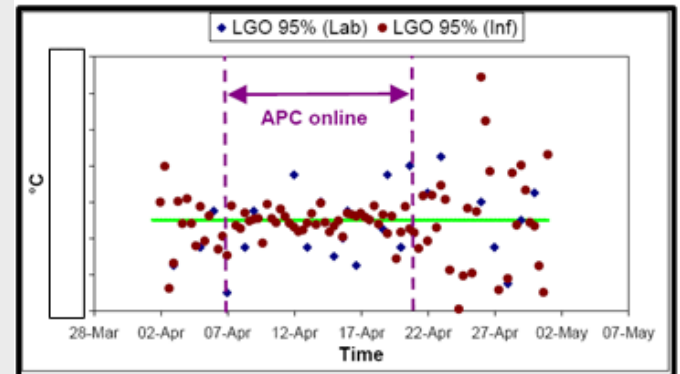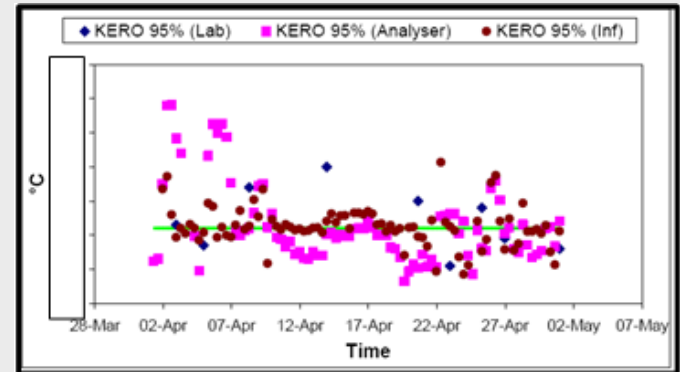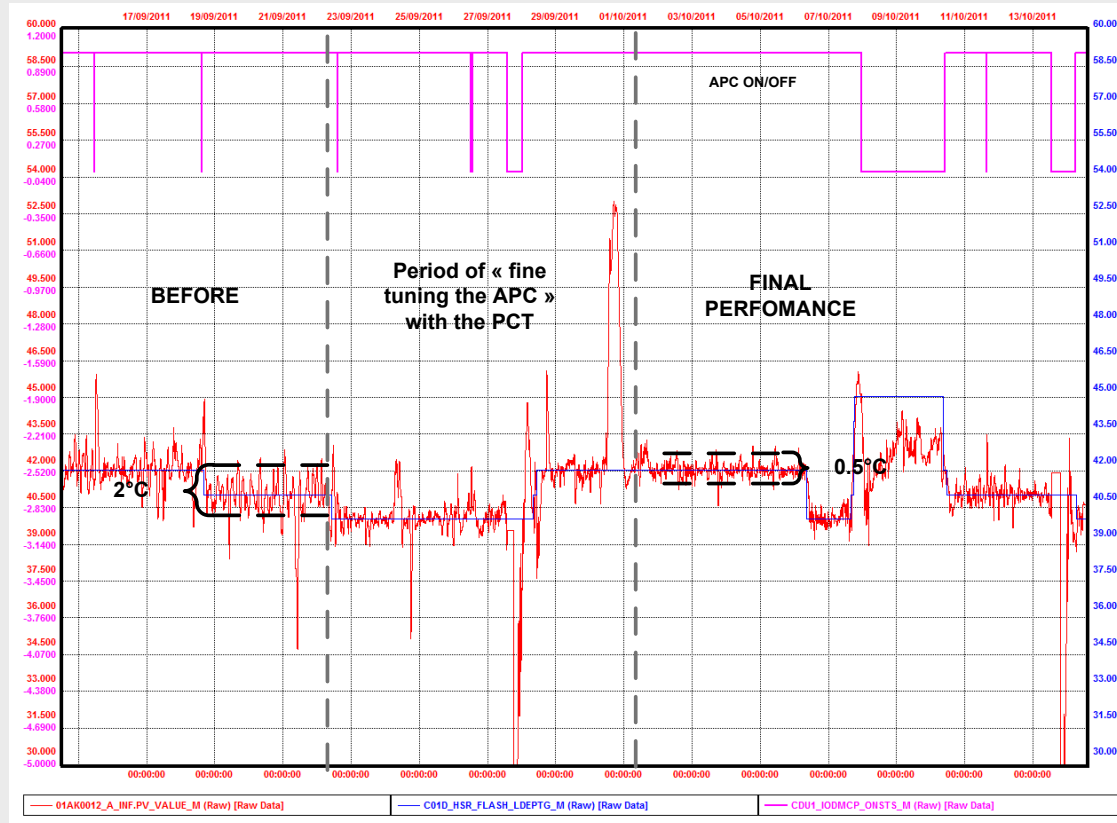
After the project

- **We often speak about successful APC project and how long they can last 'alive'…**

- **The APC project cannot capture all the APC potential benefits and continuous improvement is a must.**

After the project improvement

- **HSR Flash point control improved over time:**
  - **Standard deviation reduced by a factor of 4.**
  - **Benefits: 90k$/m**

Energy optimization

- **The trade-offs among throughput, yields and fuel consumption are studied off line to establish energy related targets**
  - **Preheat system flow splits**
  - **Pumparounds heat duty splits**
  - **Heater outlet temperature**
  - **Stripping steam ratios**
- **APC drives the plant towards these targets.**

Heater control

- **The large CDU heater must be stabilized and optimized or else entire APC objective is in jeopardy.**

- **Once that is accomplished we desire to minimize furnace excess air to environmental constraints.**

  – **Improvement of the Fuel gas network**

  – **Improvement of the Heater Outlet Temperature control**

  – **Improvement of the heater flue Gas O_2 control**

Furnace COT control

A first step of better usage of energy on the heater: stabilize heater operation (leading to better product separation)
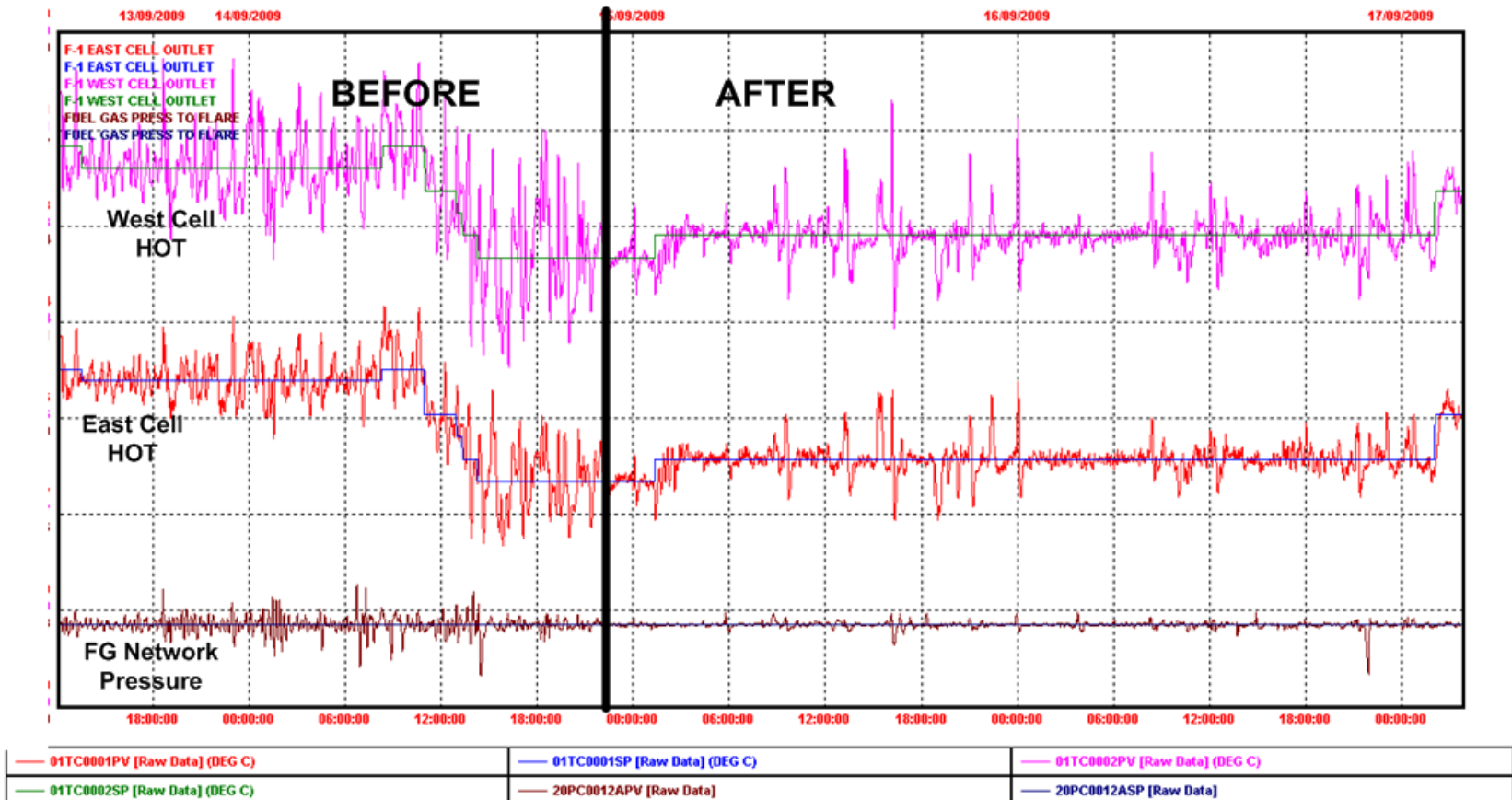
Furnace stack O2 control

The second step is to optimise the furnace efficiency using a stack O_2 control. The benefits:195k$/y.

- **Previous improvement already stabilise stack O_2 (green curve).**

- **Now the O_2 control is made available to further improvements and energy benefits.**
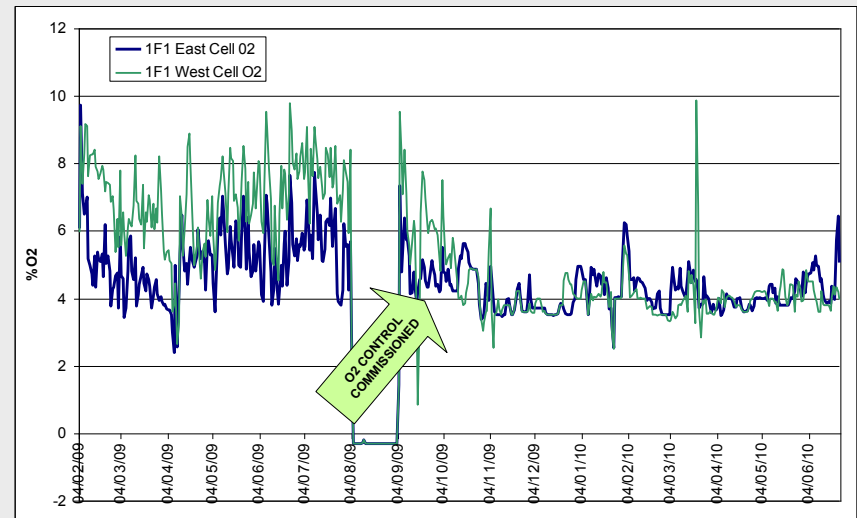
Conclusions

- **This is APC at its best**
    - **Controlling product properties at targets**
    - **Controlling internal reflux at reasonable targets**
    - **Keeping the unit within constraints and if that is not possible – cut throughput**
    - **Reducing the chance of incidents by handling crude switches smoothly**
- **TOTAL estimates the CDU APC benefits at > 6 million Euro/annum**