ZEELAND REFINERY CDU APC REVAMP PROJECT

Laurent Ferrari	Total
Zak Friedman	Petrocontrol
David HOFFMAN	AMT
Barry RUTTER	AMT
John ZIJLSTRA	Total Zeeland Refinery

ZEELAND BACKGROUND

- **Joint venture between LUKOIL and TOTAL.**
- **Located in south-west Holland in the Zeeland region.**
- **Crude capacity of 8Mt/y (160 Mbbd).**
- **The CDU had APC since 2000 but its performance had became poor. This situation was highlighted by an APC audit conducted across the entire Refinery in 2013.**
- **The APC degradation was due to debottlenecking (in a different unit), creating model mismatch between the APC model versus current plant response.**
- **Moreover, APC understanding and know how improved considerably, leading to better APC designs.**

WHAT IS APC?

- **APC stand for Advanced Process Control.**
- **It is a control application running above the DCS, optimising a full unit at a single time.**
- **The system is like a smart cruise control…**

- **Drive the unit to optimal settings**
- **Correctly predict product qualities and keep them at targets**
- **Within mechanical constraints**
- **Stable all the time**
- **Upon crude switch move smoothly to another operation**

THE TWO PARTS OF APC

- **Part 1a**

  Measure constraints

- **Part 1b**

  Predict (infer) unmeasured constraints (Usually product qualities but not always). Good inferences are important for success of APC

  Sometimes we employ analysers to measure qualities but even then it is best to obtain a redundant inference minute by minute.

- **Part 2**

  APC moves unit control handles based on a model for unit steady state and dynamic response.
  The model is established from a plant test during which each plant handle is moved to gather the plant response.

  With the help of such a model APC calculates optimal setting and moves many variables together to soft-land on the optimal conditions

HOW APC MAKES MONEY?

- APC can also be seen as a continuous processes to improve plant profitability using control technics.
- It starts by improving based control scheme and using best practices control scheme.

→ € by less alarms

→ €€ because of a more stable plant

→ €€€ because of effective controllability of the plant for the operator @ all times

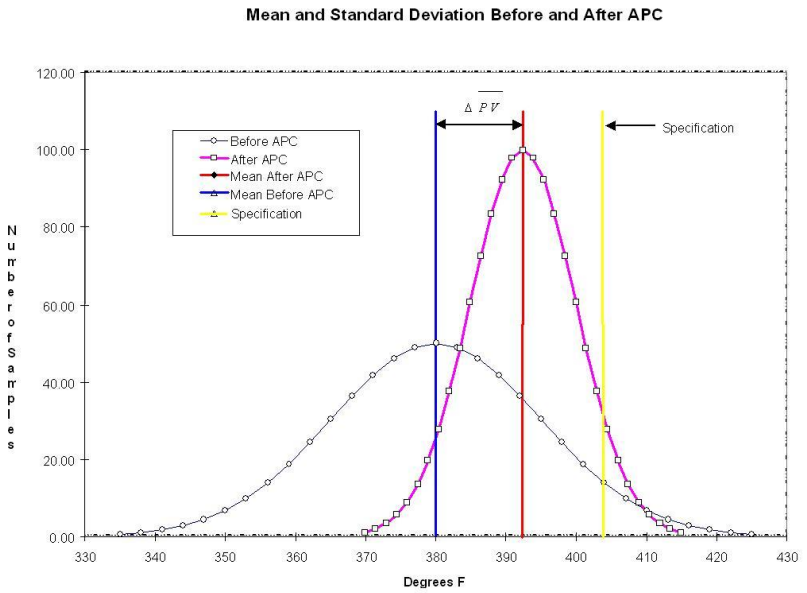
- Then the APC application can be implemented following a project methodology.

€ The APC application will push to multiple constraints simultaneously

€ Deal with energy savings

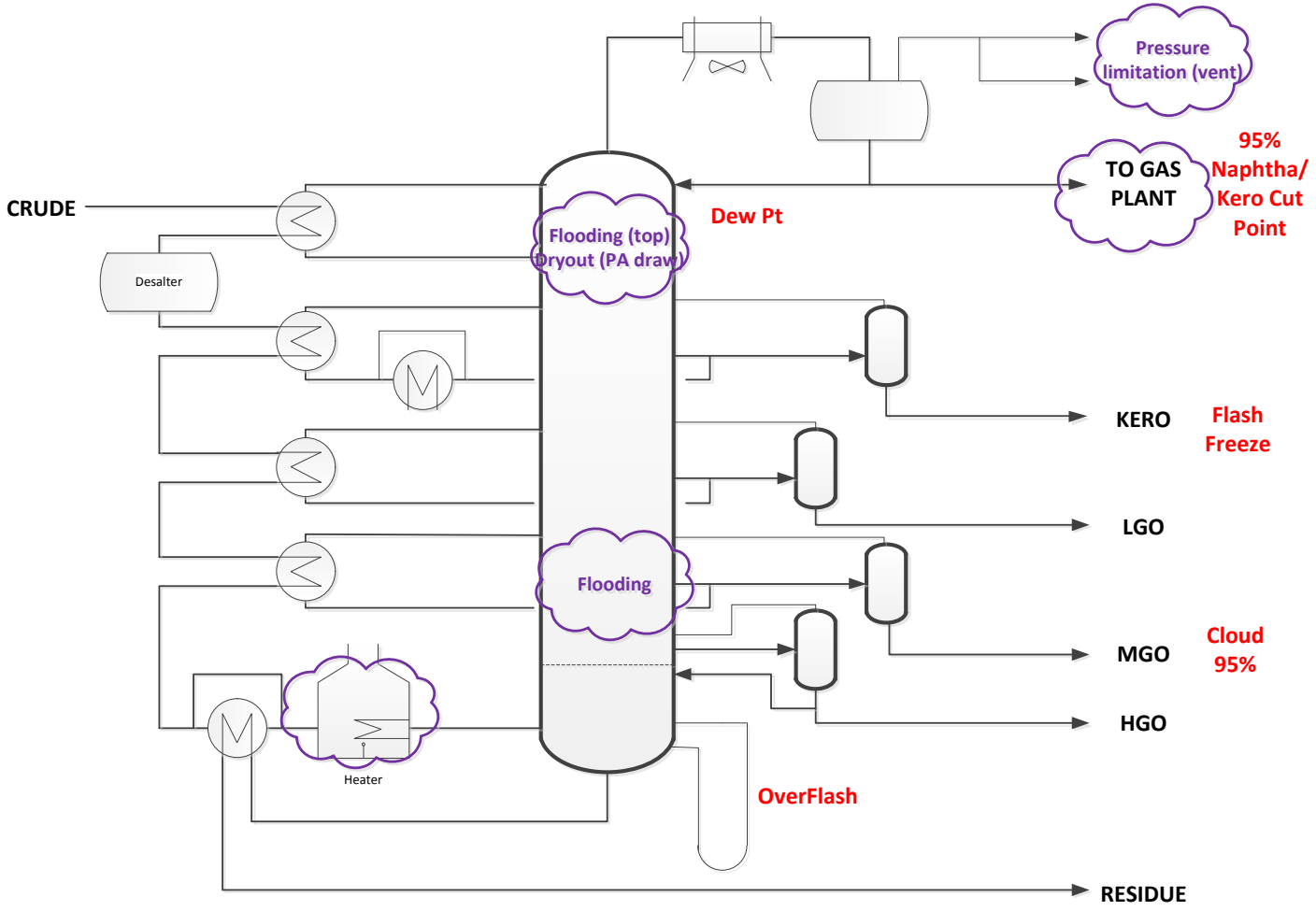
€€ Pushes to maximise more profitable products

€€ Pushes feed rate toward true plant constraints



THE CASE OF ZEELAND REFINERY CRUDE DISTIALLTION UNIT

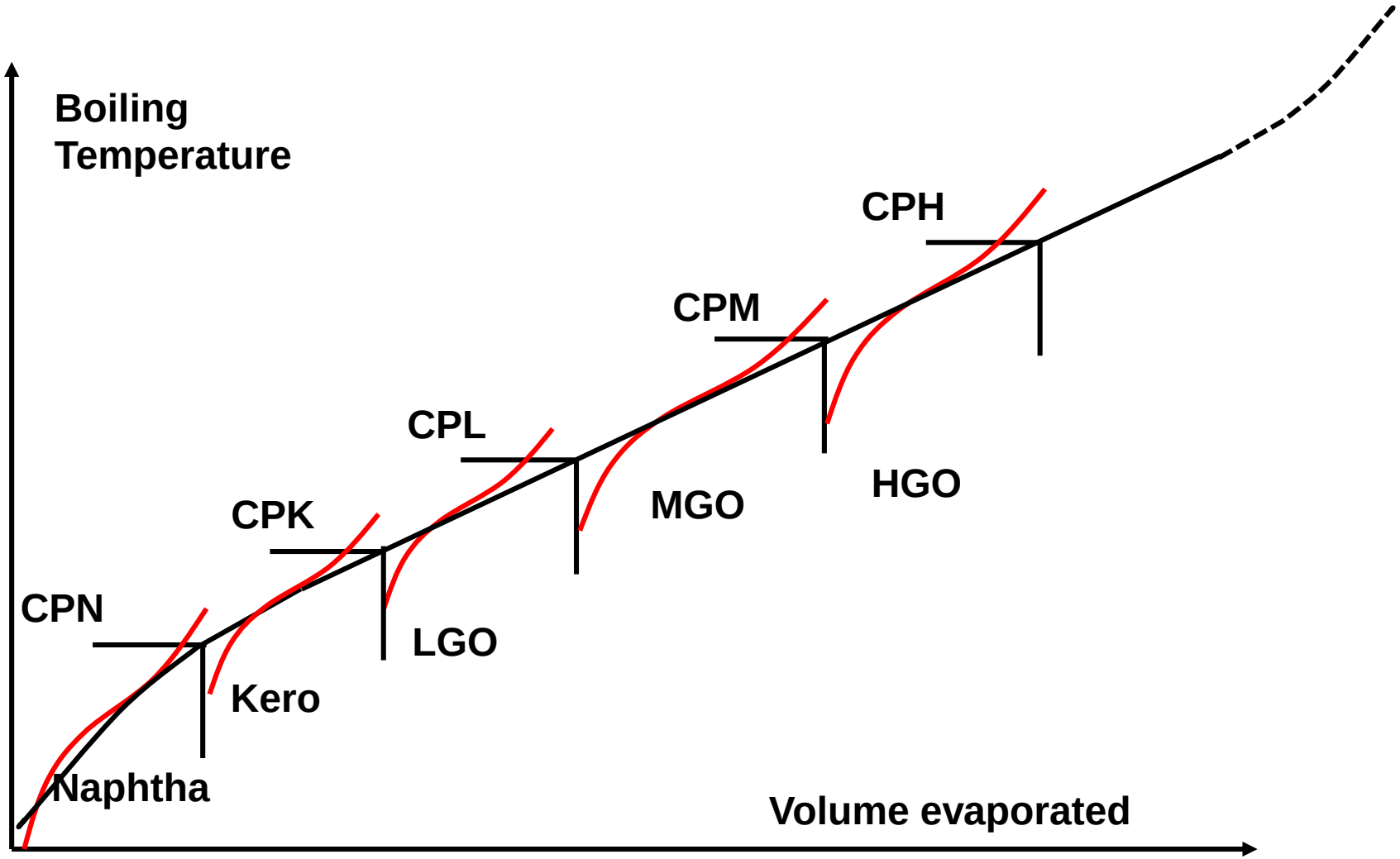
Where are the constraints?



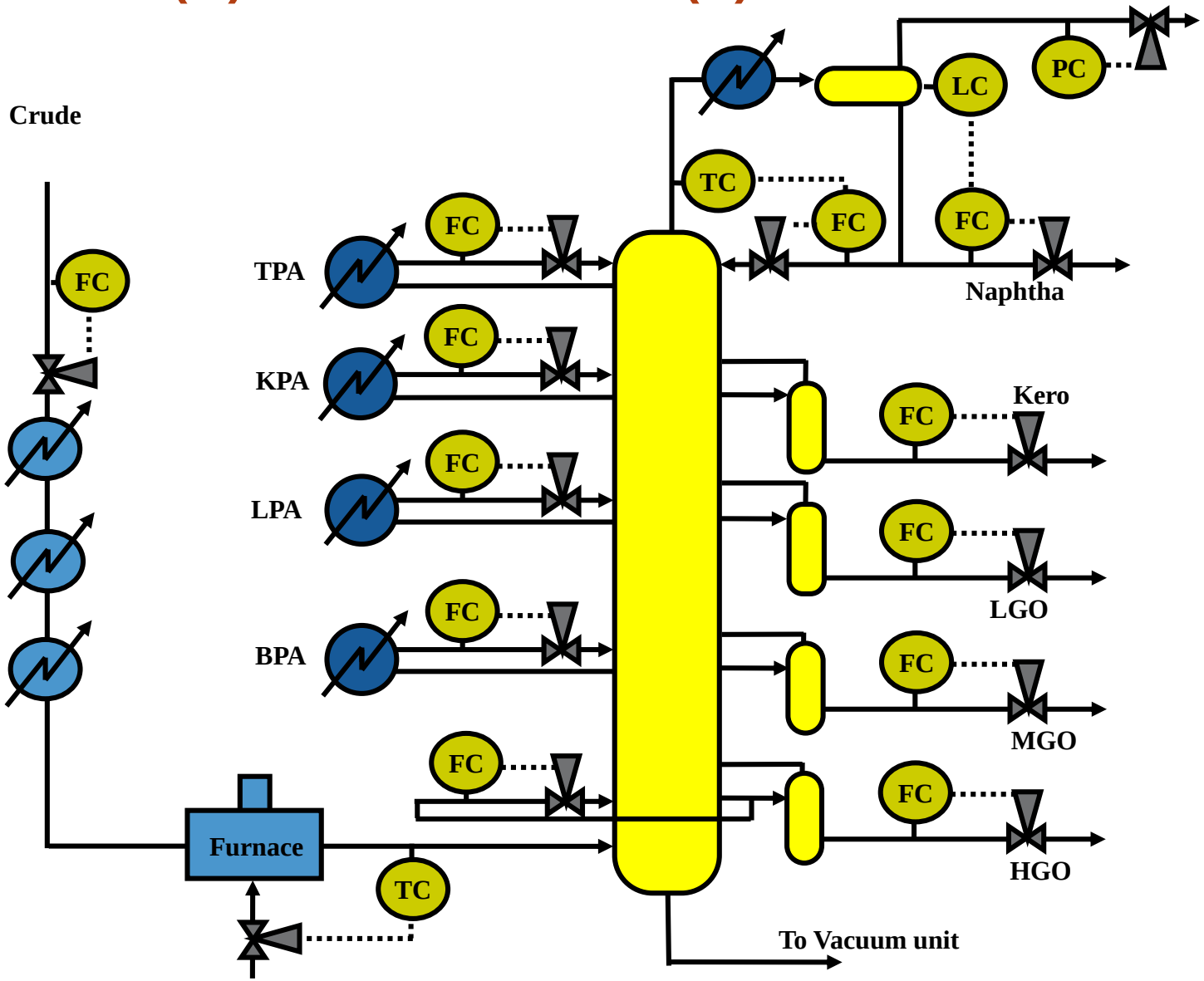
THE GCC INFERENTIAL METHOD

- **“Generalized cutpoint calculation” is a simplified simulation in reverse**
- **Measure key flows, pressures and temperatures.**
- **Come up with a TBP (true boiling point curve) that would theoretically create such a measurement pattern.**
- **calculations are based on thermodynamics first principles**
- **Calculate certain unmeasured constraints: Internal reflux flows, including the most important over-flash flows**
- **From TBP and internal reflux information calculate all product properties (Flash, 5%, 95%, etc.)**

TYPICAL CRUDE TBP CURVE



INFERENCES (M) AND ANALYSERS (A)



LPG in naph M

Top dewpoint M
Naphtha 95% M

Internal reflux M
Kero flash M & A
Kero 5% M & A
Kero 95% M & A
Kero freeze M & A
Internal reflux M

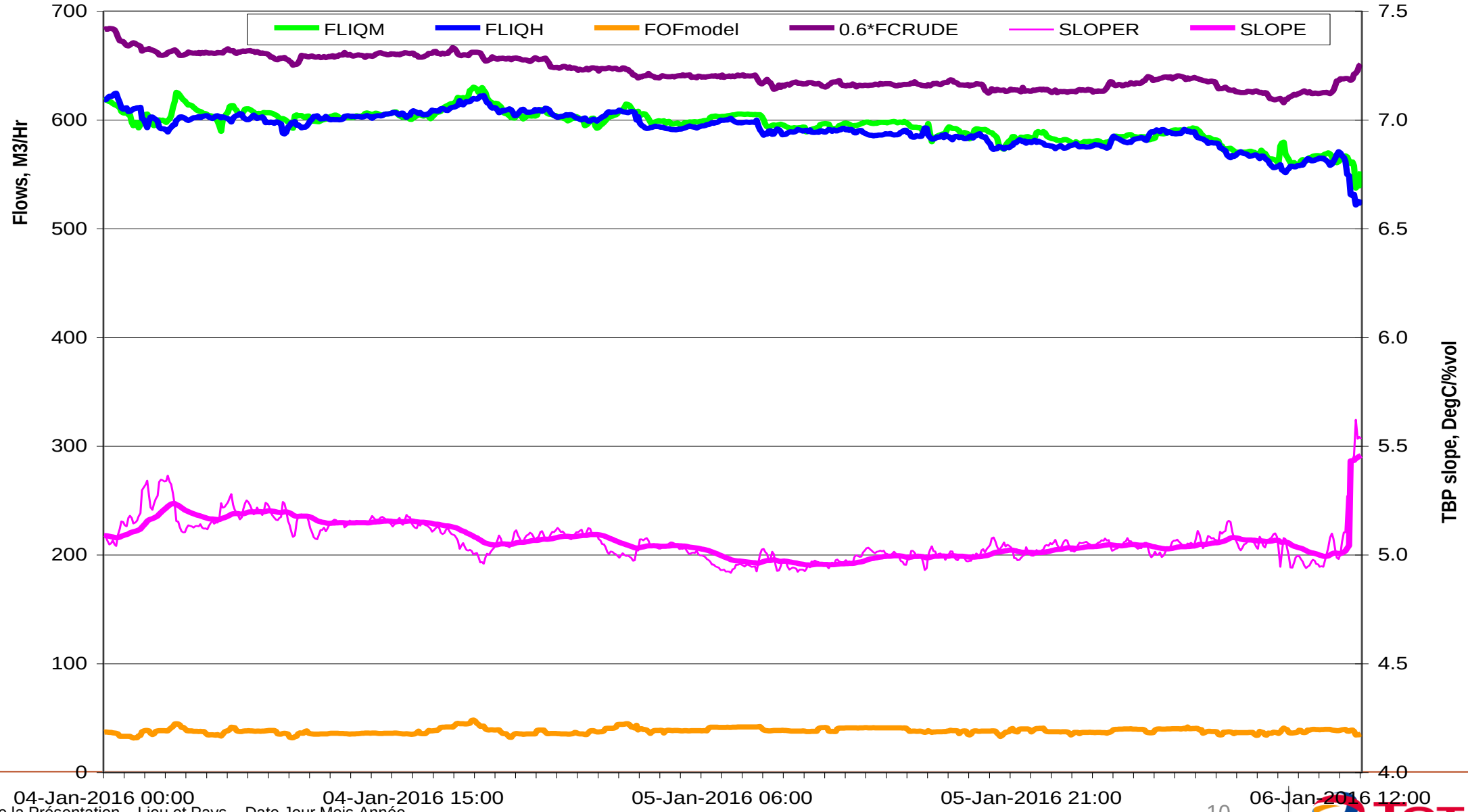
LGO 95% M

Internal reflux M

MGO 95% M
MGO cloud M & A
Internal reflux

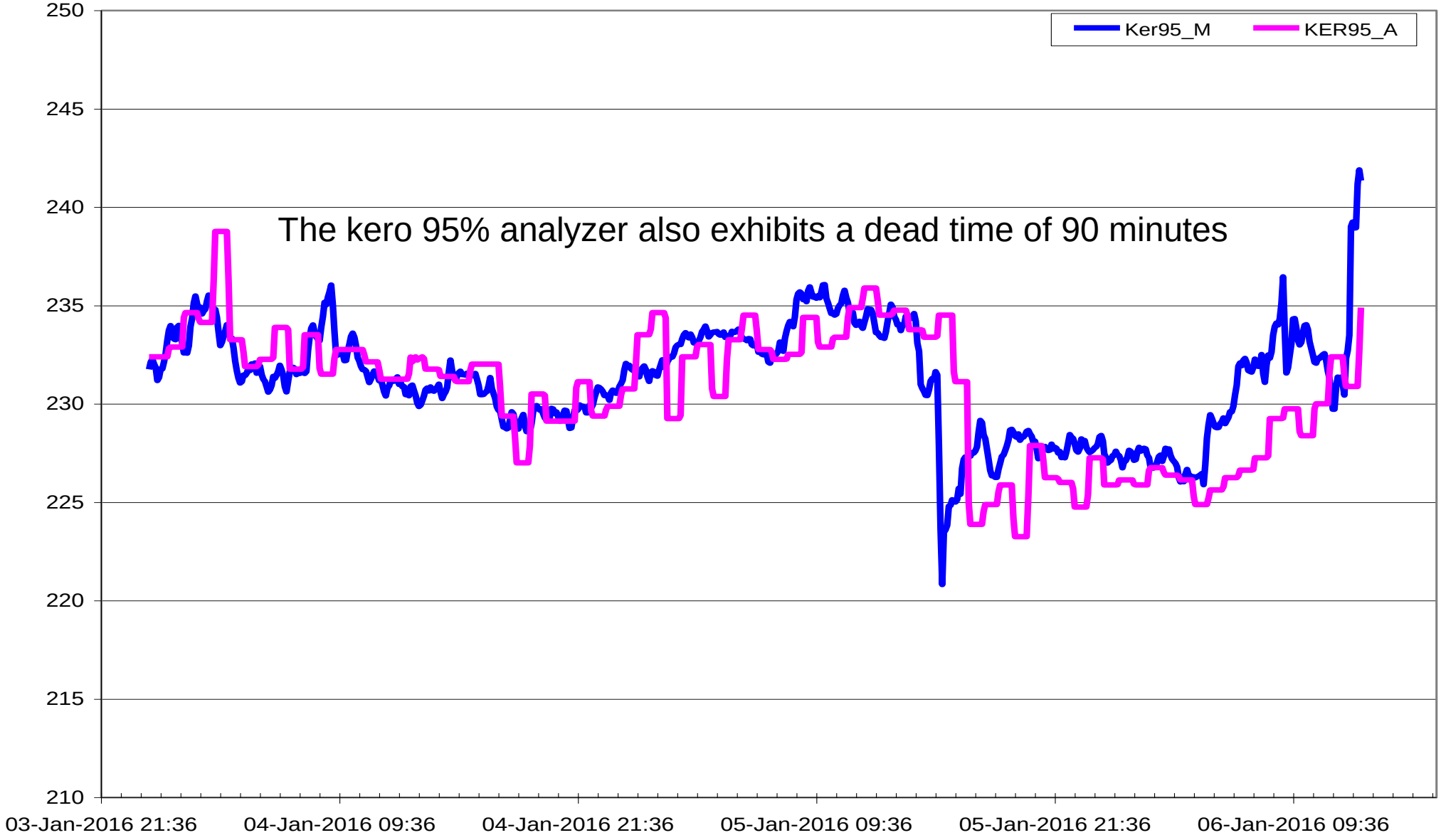
HGO 95% M
Overflash M

EXAMPLE TBP SLOPE IDENTIFICATION, 2.5 DAYS TREND

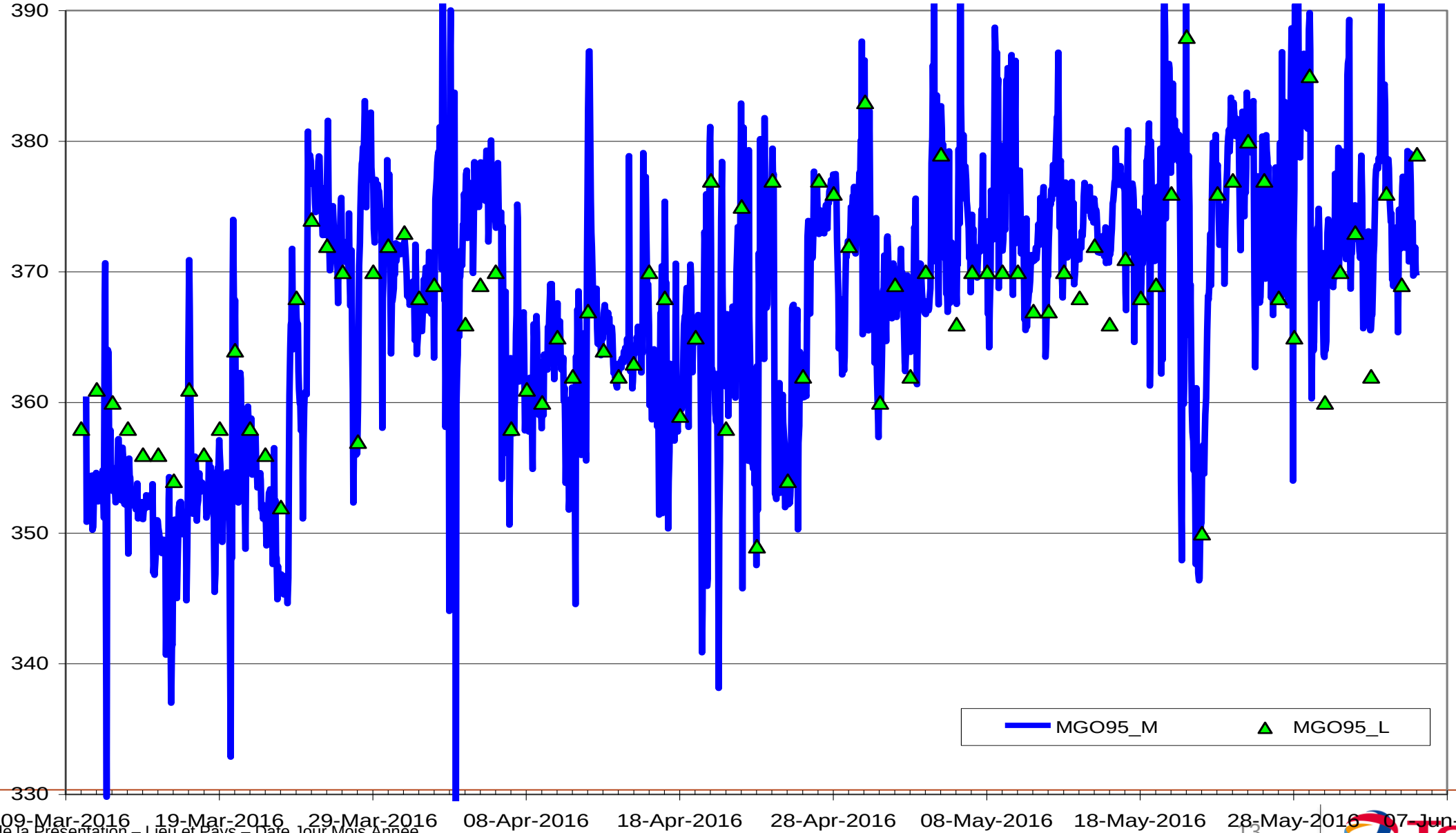


EXAMPLE CLOUD MODEL VS. ANALYSER DYNAMICS, 2.5 DAYS TREND

EXAMPLE KERO 95% MODEL VS. ANALYSER DYNAMICS, 2.5 DAYS TREND

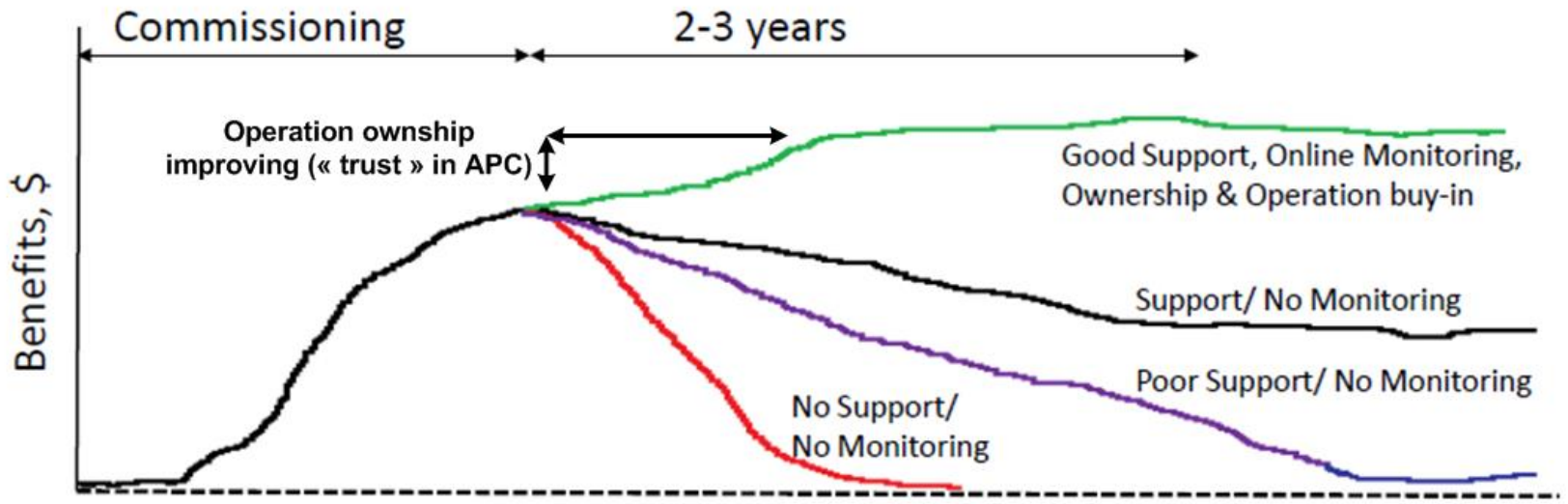


INFERENCES VS. LAB EXAMPLE, 3 MONTH TREND



WHAT HAPPENS AFTER APC COMMISSIONING

- APC is based on an empirical model, therefore across the years its performance will struggle has plant get changed.

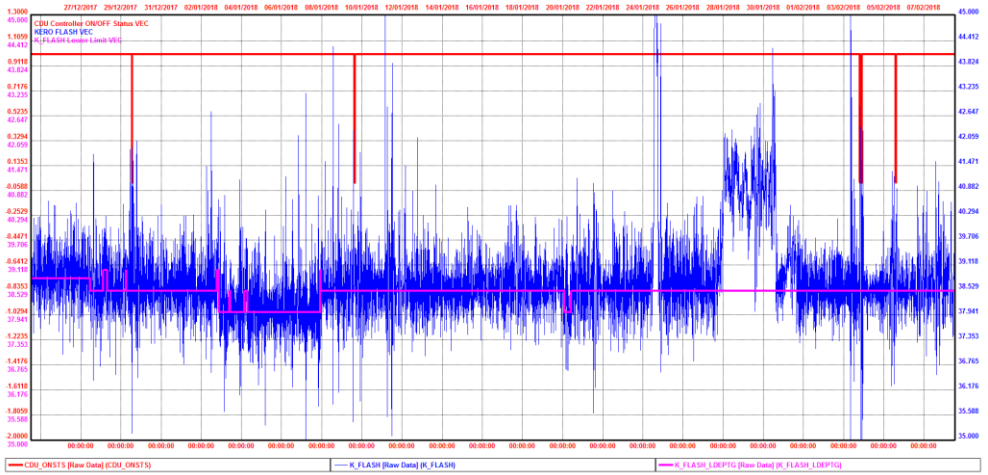


AN APC REVAMP… BETTER CONTROL, MORE MONEY

CASE OF THE KERO FLASH

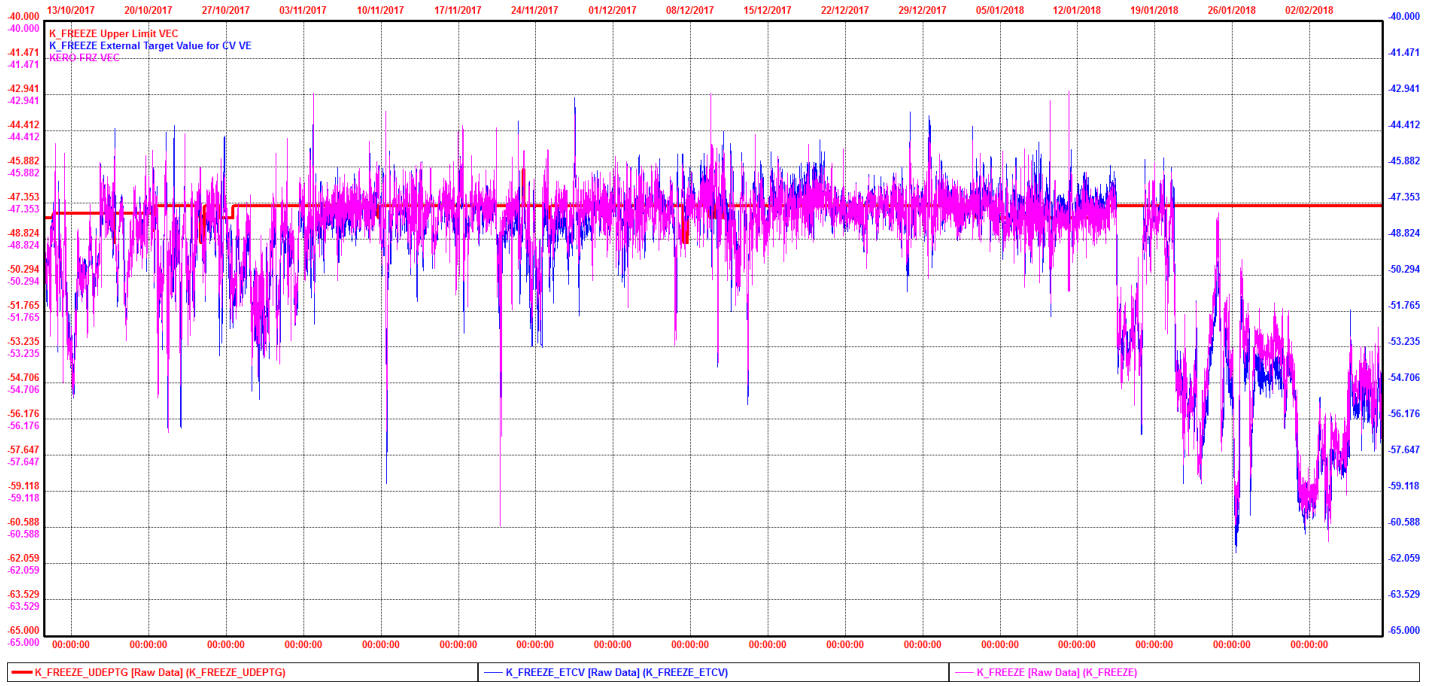
Before … Flash control was “average”

After… Flash is almost continuously at target … leading to an extra +0.5M$ alone



AN APC REVAMP… BETTER CONTROL, MORE MONEY

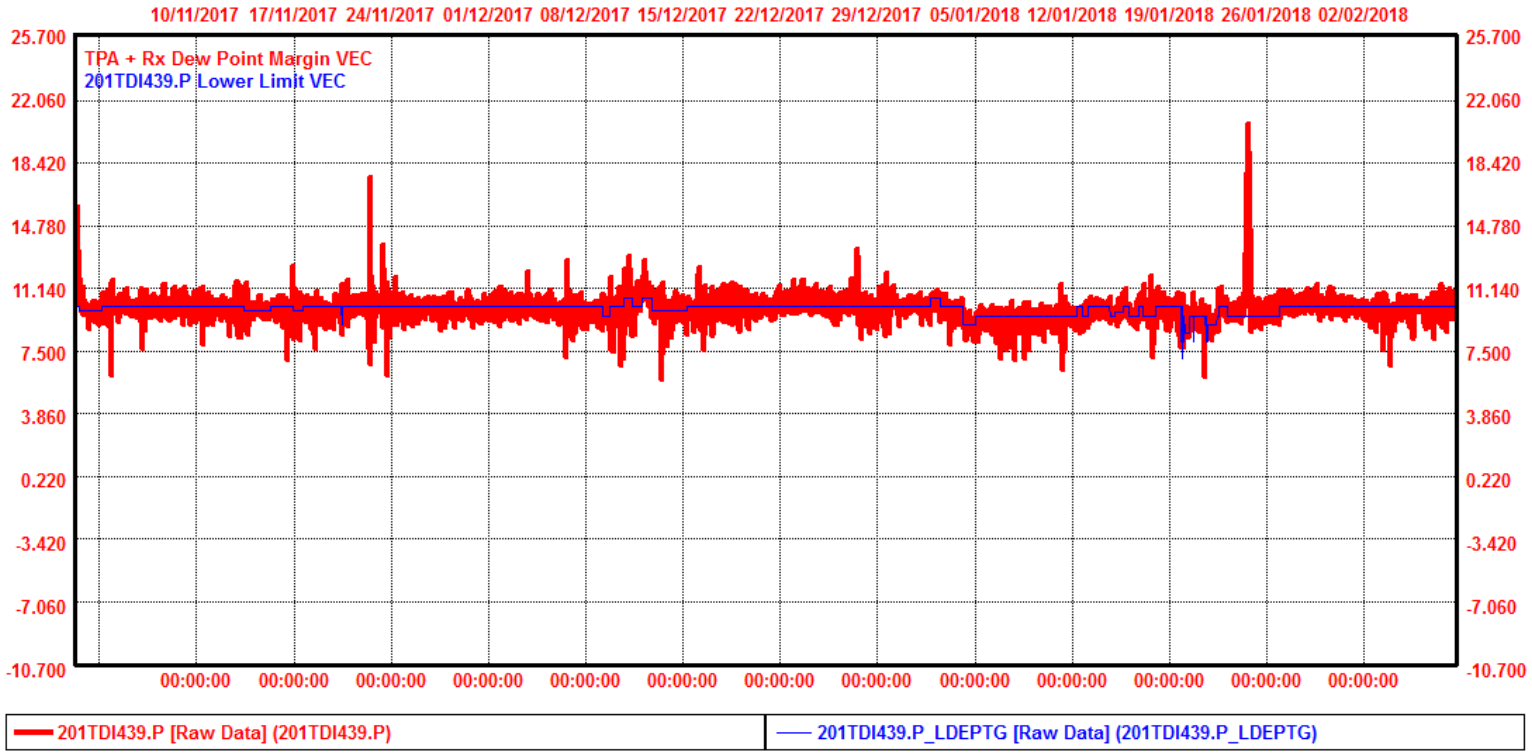
- Another key Crude unit quality is Kero Freeze point. Honouring Kero Freeze target is a must and help to maximise crude distillation unit profits.
- The revamped APC application and its inferential have made a significant set up



AN APC REVAMP… BETTER CONTROL, MORE MONEY

- Dew Point constraint Control : a must for Availability.

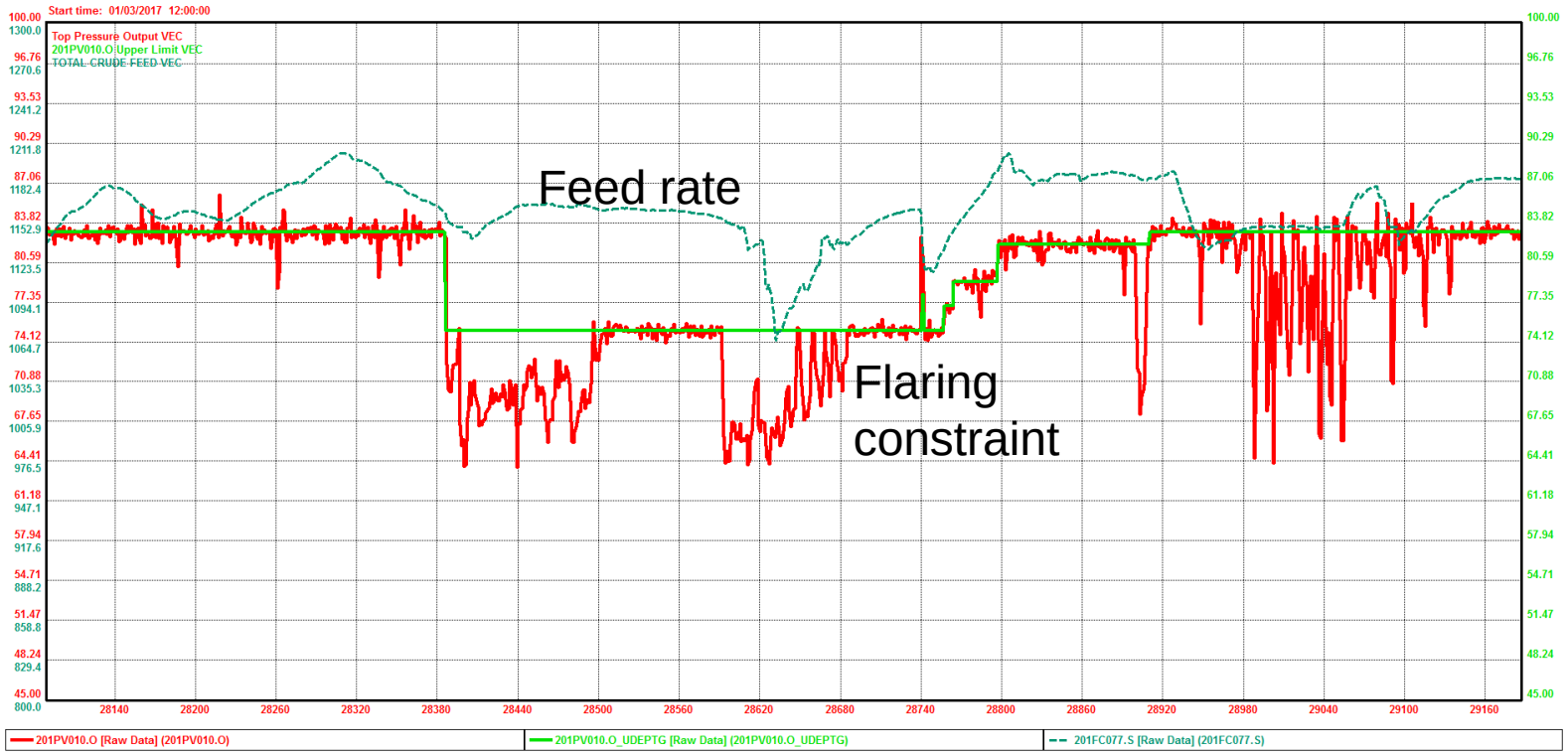
This specific constraints are now perfectly on control and contribute to improve plant availability on the long term.



AN APC REVAMP… BETTER CONTROL, MORE MONEY

- Feed pushing to constraint : case of vent to flare.

Vent to flare is one of many feed constraints. APC will avoid flaring, targeting the constraint.



HOW DO YOU KNOW YOU HAVE DONE A GOOD JOB

- As a reward you start getting phone calls at 03:00 to come ASAP to the control room to help fix a problem

- And that is a good case scenario