Implementation of APC on CDU1 and CDU3 at the Sinopec GaoQiao (Shanghai) refinery

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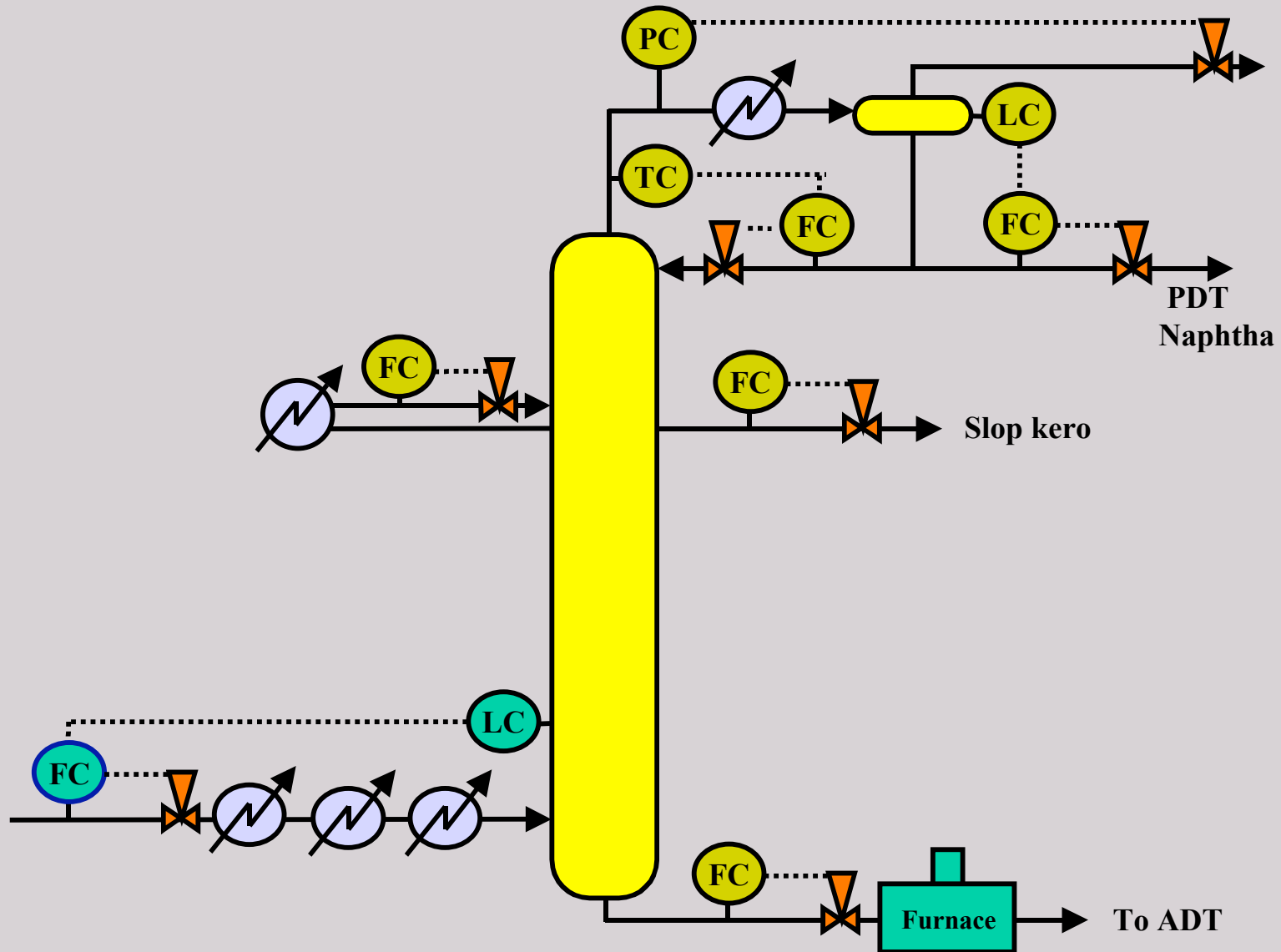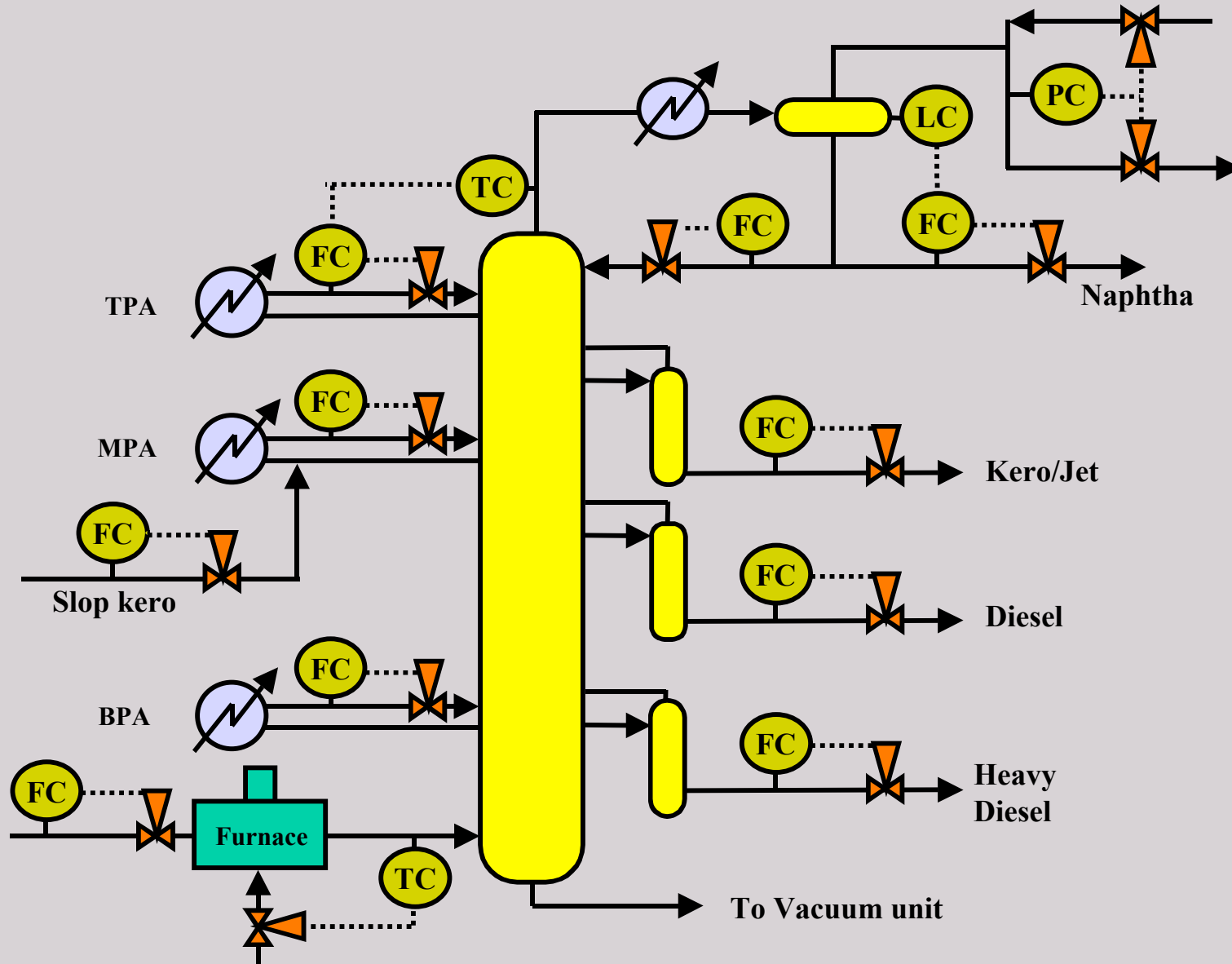
Honeywell

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Project highlights

- **CDU 1 and 3 computing equipment**
  - **I/A DCS**
  - **RMPCT multi-variable controller**
  - **PHD for historization and monitoring**
  - **Inferential model coded in C++ in PHD**
  - **Petrocontrol GCC inferential model**
- **Project execution**
  - **Turnkey projects by Honeywell**
  - **Petrocontrol was subcontracted for GCC**
  - **Participation by Sinopec engineers**
  - **Current maintenance by Sinopec engineers**

CDU PDT

PC

TC

FC

LC

FC

PDT Naphtha

FC

Slop kero

LC

FC

FC

Furnace

To ADT

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CDU ADT

TPA

MPA

Slop kero

BPA

Furnace

Naphtha

Kero/Jet

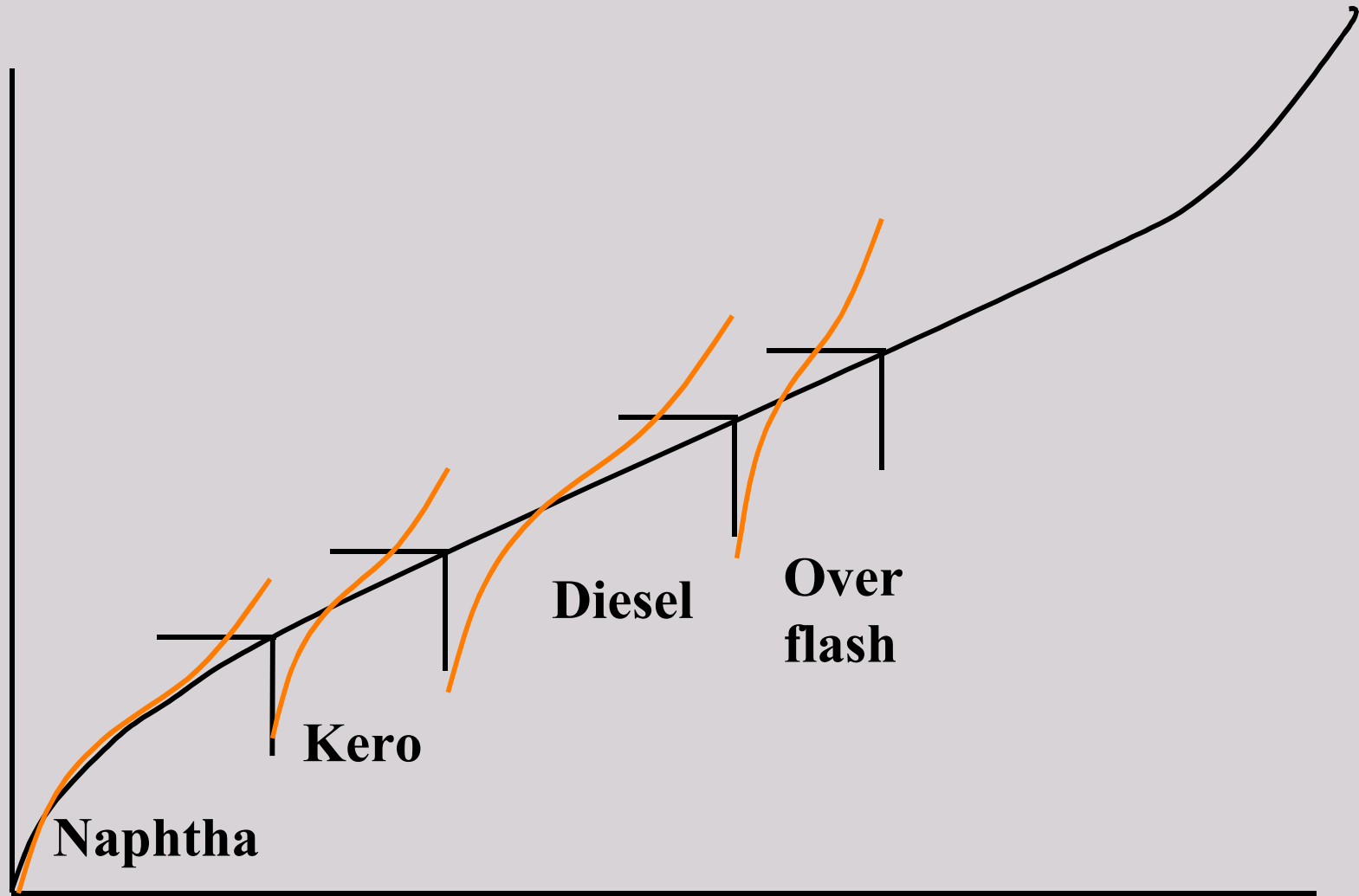Diesel

Heavy Diesel

To Vacuum unit

GCC (Generalized cutpoint calculation)

- **Established inferential package (about 50 crude units)**
- **Able to work during crude switches**
- **Several years ago Chinese refineries worked on steady crude diets**
- **Today there are many import crudes and frequency of crude switching have gone up to once every several days**
- **Refineries need a robust inferential tool to work through crude switches**

GCC concepts

- **GCC estimates crude TBP curve from unit conditions**
- **Then estimate product qualities:**
  - **ASTMX% = f (cutpoints, internal reflux)**
  - **Flash = f (cutpoints, steam)**
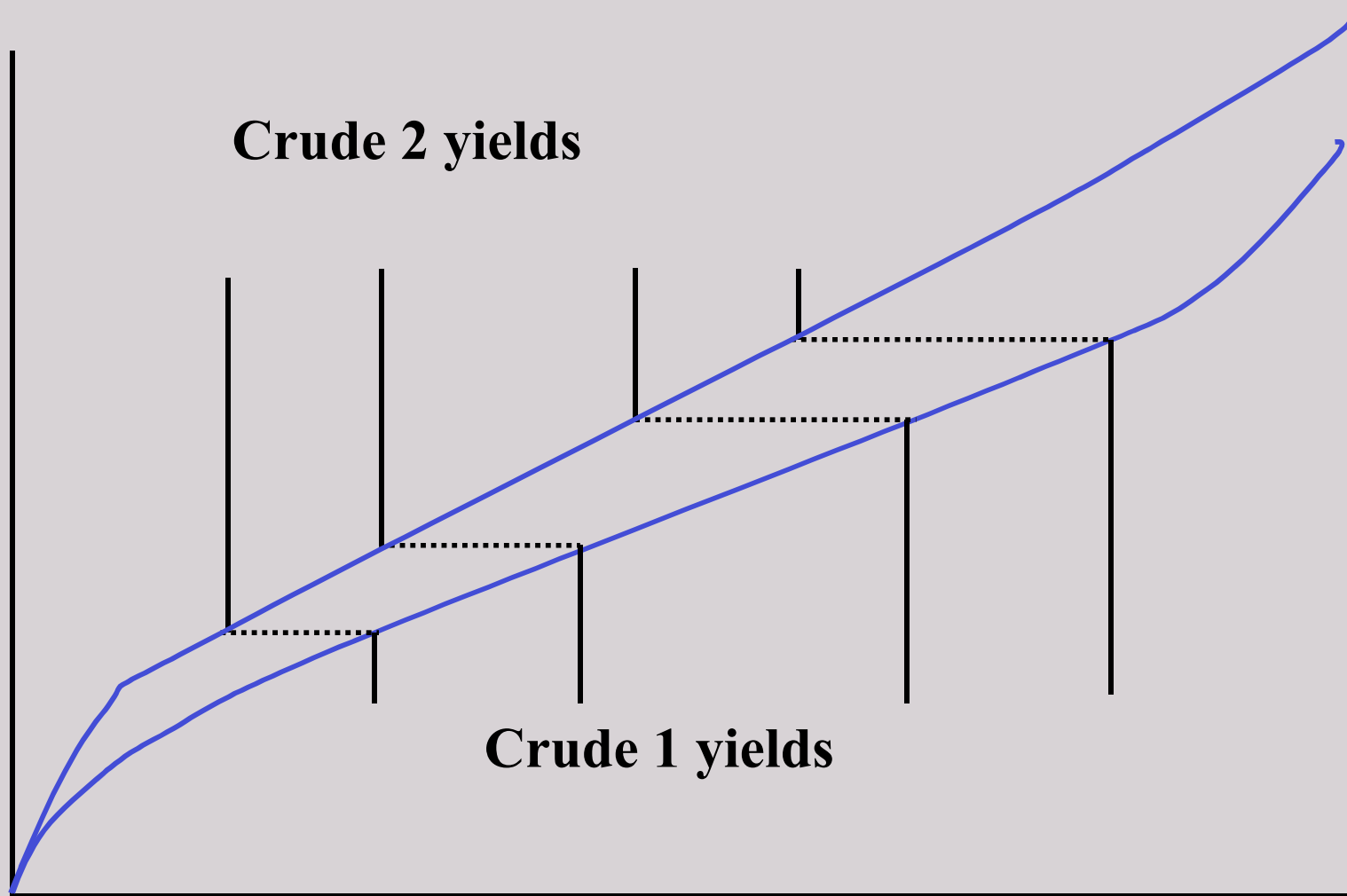 - **Freeze = f (cutpoints, Kw)**
- **No operator inputs are required**

Crude TBP curve

Over flash

Diesel

Kero

Naphtha

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GCC makes use of heat balance

- **Heat balance**
  - During major disturbance the unit can operate off mass balance
  - But it is always in heat balance
  - Fractionator cooling load changes with crude
- **Quickly detects crude TBP curve changes**
  - Corrects the yields to keep cutpoints at targets

How GCC handles crude switches

Crude 2 yields

Crude 1 yields

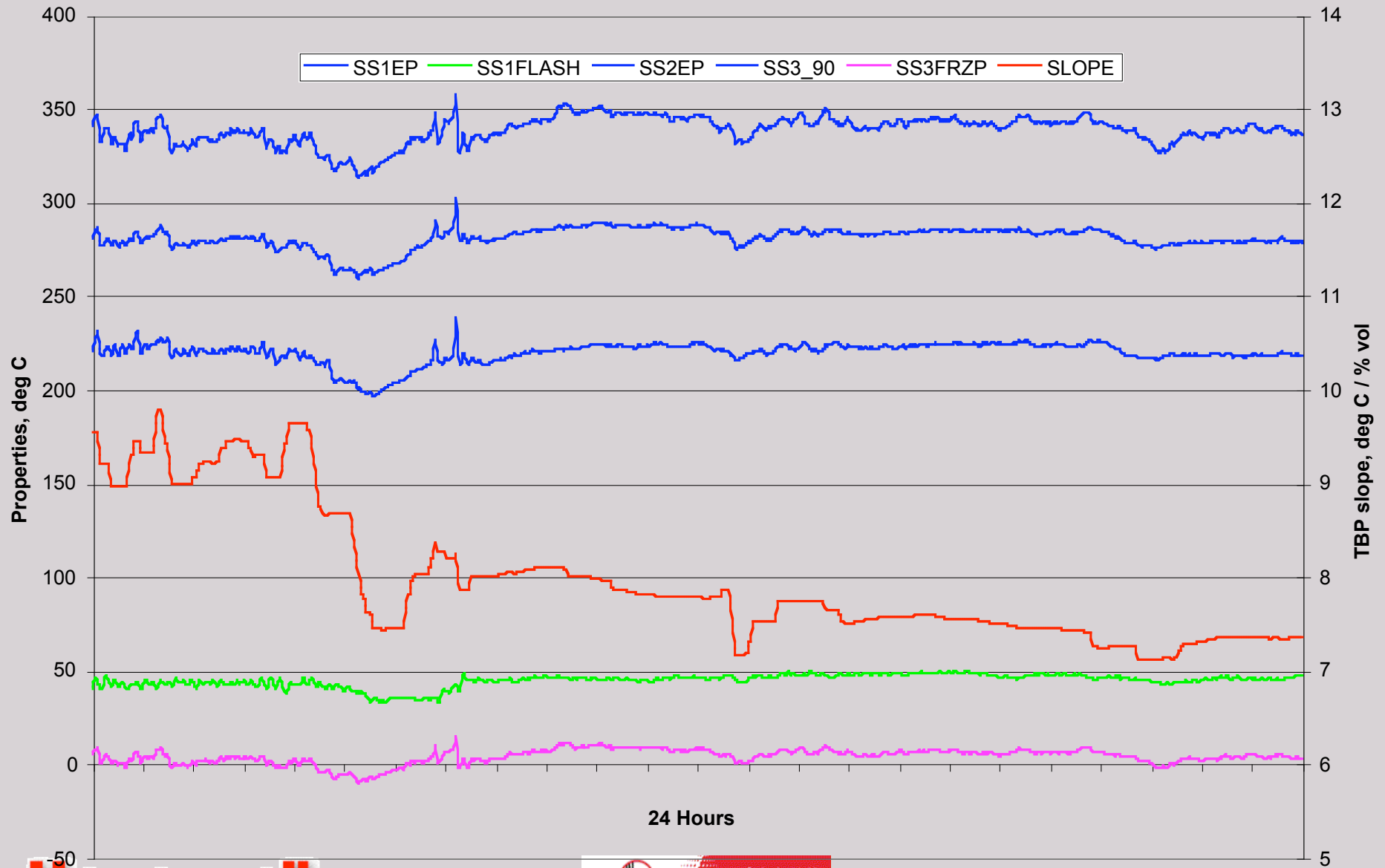SINOPEC 中国石化 SINOPEC CORP.

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Internal reflux control

- **Internal reflux model**
  - Permits precise pumparound control
  - Improvement of fuel efficiency or product distillation gap
  - Eliminates tray dry-out events

- **Overflash model**
  - Eliminates carry-over contamination

- **These features are key to a smooth crude switch handling**

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Typical crude switch trends

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CDU1, Feb 14ᵗʰ, 2006 crude switch

CDU1, Feb 16th, 2006 crude switch

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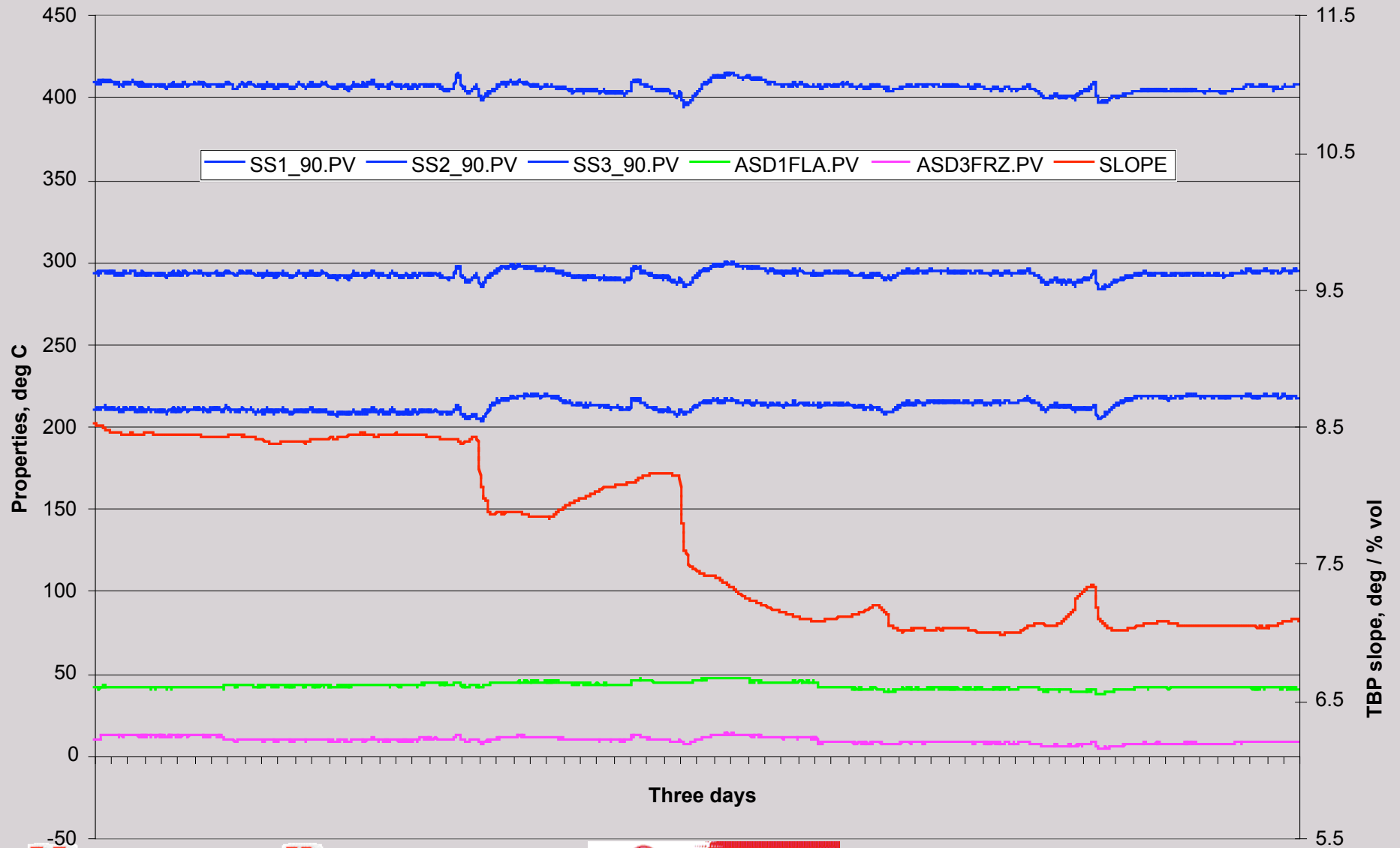*Petrocontrol*

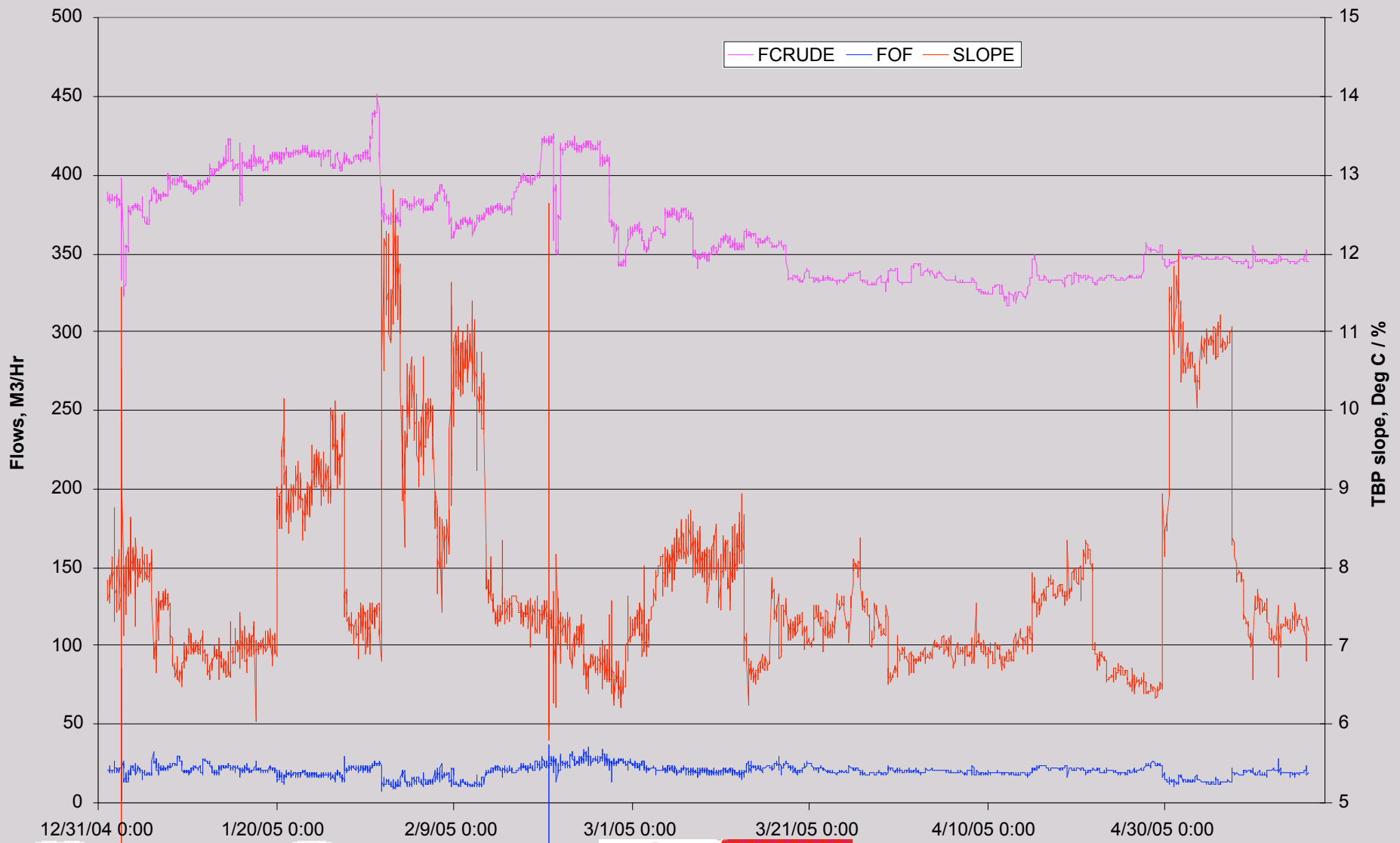# CDU3, Nov 9th, 2005 crude switch

CDU3, Jan 5th, 2006 crude switch

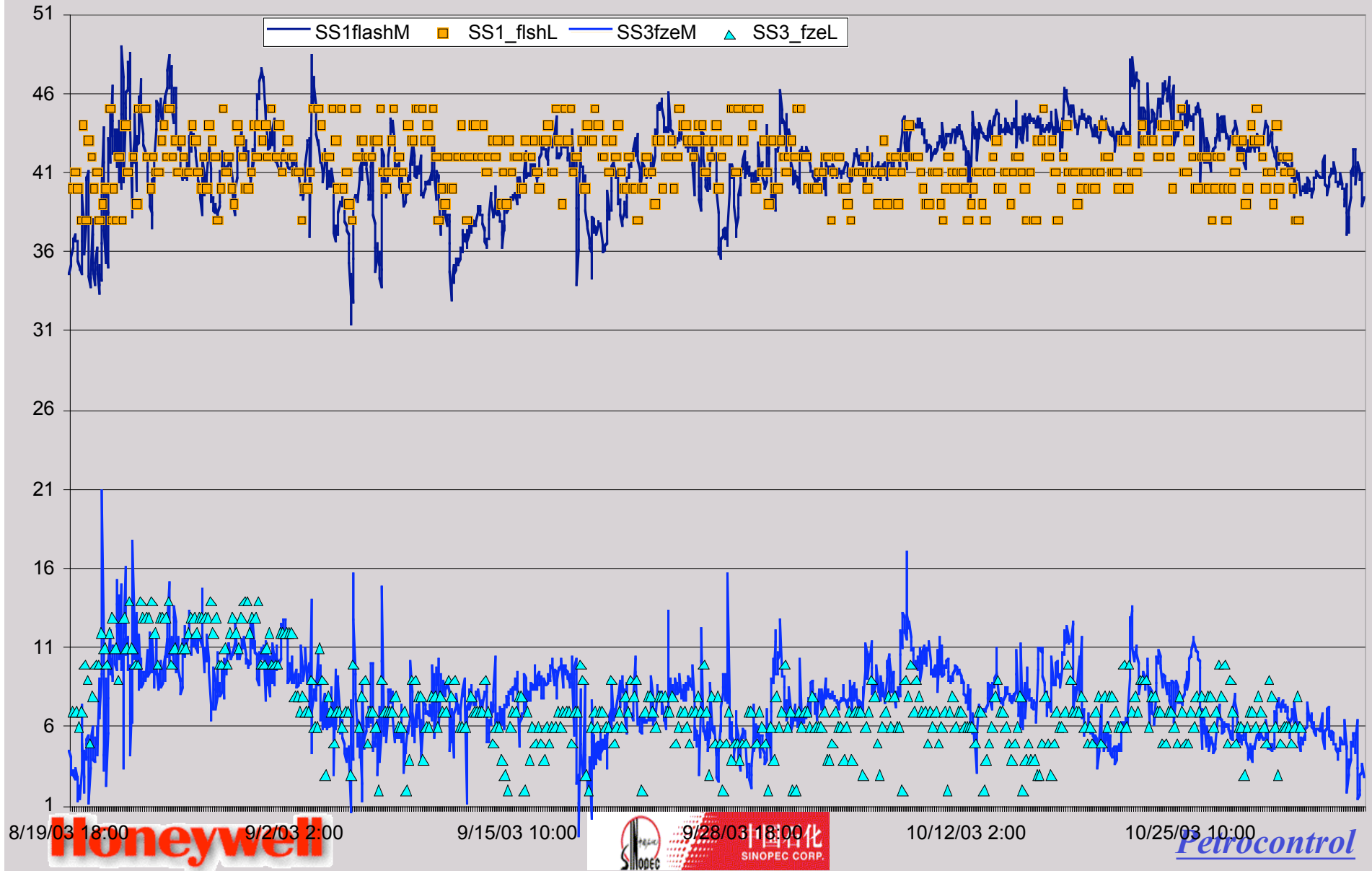# Example
Inference versus lab trends

CDU1 TBP slope and overflash – 4 months

CDU1 heavy naphtha and LGO trends

Kero flash and HGO freeze trends

Conclusions

- **GCC is establishing a position in China**
  - **Two CDUs done**
  - **Two more now being implemented**
- **That is in response to the changing refinery crude cocktail**
- **An inferential package that works during crude switches permits**
  - **Product property control during switches**
  - **Throughput maximization during switches**