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HYDROCARBON PROCESSING®

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Implementation of APC on a Mild HydroCracking Unit at BAYERNOIL's Neustadt Refinery

by

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BAYERNOIL History

1965
ERIAG
ERDÖLRAFFINERIE
Ingolstadt

1967
BP Raffinerie Bayern
Vohburg

→ 1989
RVI
Raffineriegesellschaft
Vohburg/Ingolstadt

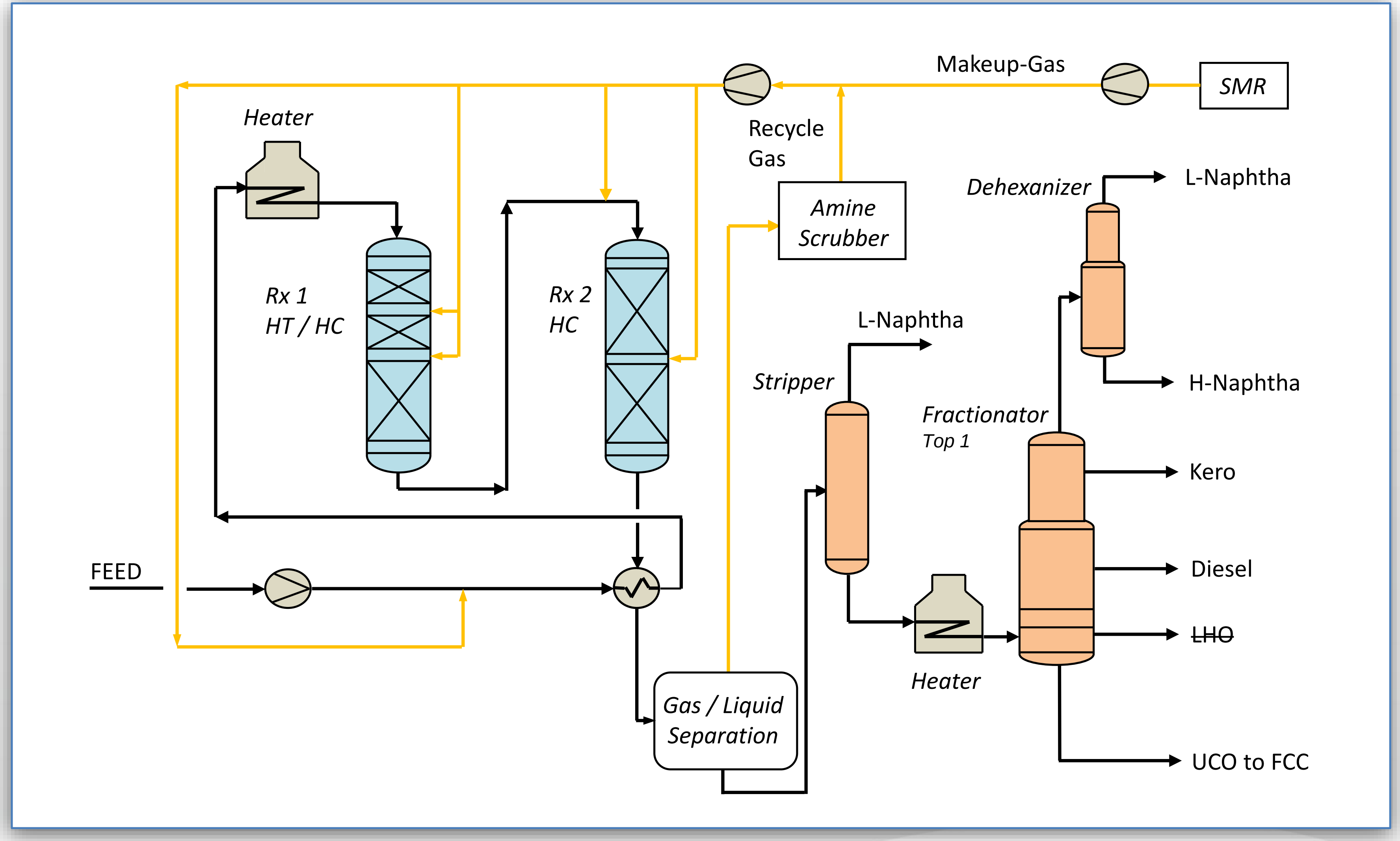
1964
ERN
ERDOEL-RAFFINERIE
Neustadt

→ 1998
BAYERNOIL

bayernoil
Gemeinsam erfolgreich

VARO Energy	45 %
eni deutschland	20 %
bp	10 %
ROSNEFT / bp – RUHR OEL GMBH	25 % of which: 50 % BP, 50 % Rosneft

MHC – Process flow diagram



Overview

- The MHC converts 70% of feed to distillates
- The application covers the reaction and separation sections
  - 6 Subcontroller
  - 50 MV
  - 127 CV
- This presentation is focused on control of the separation section

MHC APC Application Implementation

- The MHC APC Application was developed using the following technologies:
  - AMT/Petrocontrol's **G**eneralized **C**utpoint **C**alculation (**GCC**) for the inferential product quality models
  - Aspen's DMCplus for APC software
  - Aspen's IQ on-line technology for real time execution of the GCC model
- Design and Implementation of the application was done by AMT supported by Petrocontrol

MHC APC Application Key Objectives

- The combined APC application maximizes product yields
  - The **NAPHTHA** product rate is minimized to:
    - The lower limit for the **KERO FLASH** or the **NAPHTHA 95% point**
  - The **KEROSENE** draw flow is maximized up to:
    - The upper limit for the **KERO 95% point**
    - The upper limit for the KERO stripper level valve
  - The **DIESEL** draw flow is normally maximized up to:
    - The upper limit of the **DIESEL CLOUD**, or **DIESEL 90% point**
    - The upper limit of the DIESEL stripper level valve or
    - The lower limit for the overflash flow or level valve

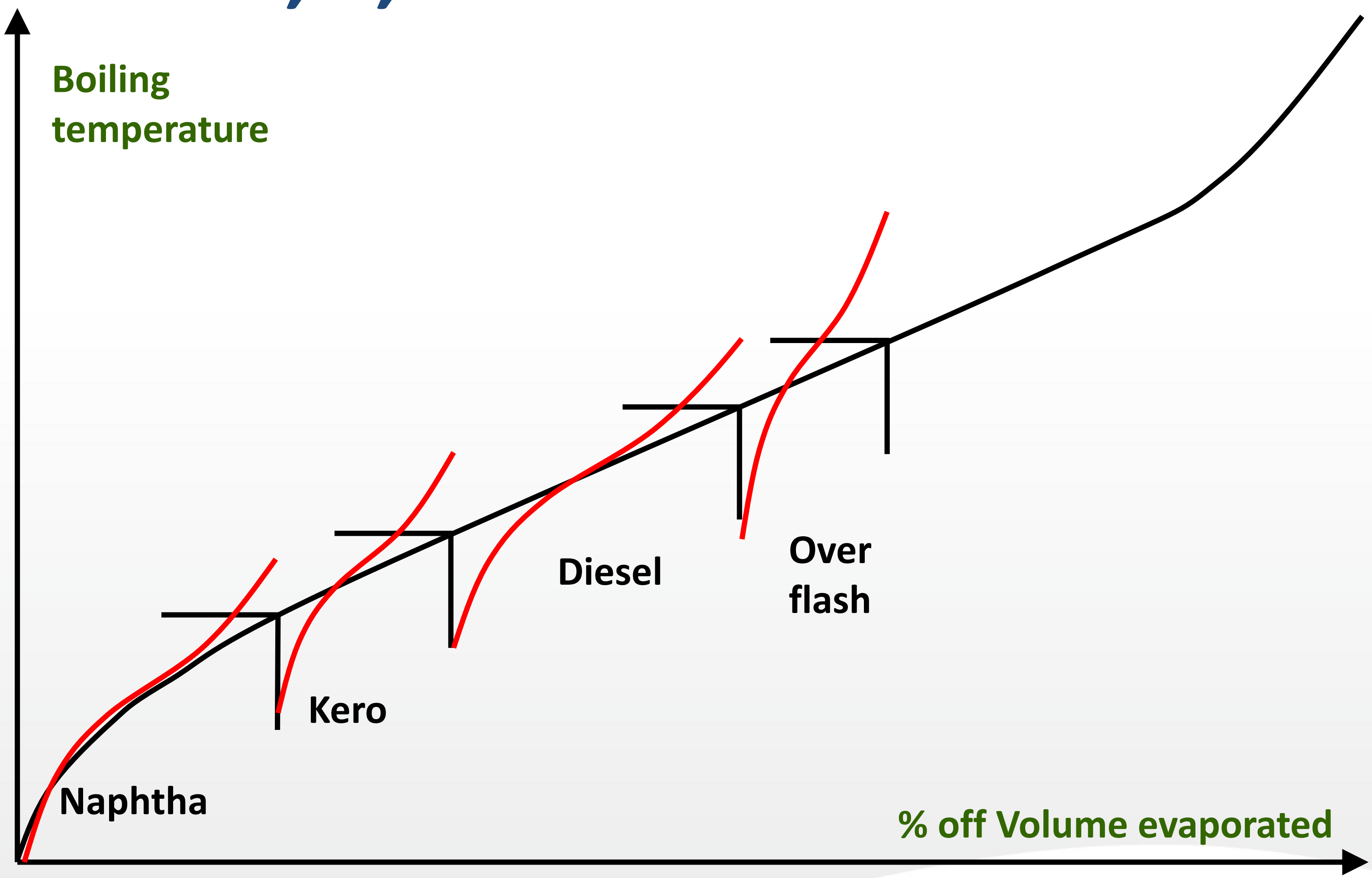
MHC Fractionator Inferences

- The GCC inferential quality models are used to control product properties
  - Naphtha, kerosene and diesel inferences used for control of those key qualities
  - Analyzers are available for all key properties and are used as a backup to the inferences

- GCC calculates overflash and internal refluxes
  - GCC generated "overflash" or diesel internal Reflux are used to constrain the Diesel draw and heat balance when necessary

GCC Model and Inferential Concepts

Predict TBP curve from F, T, P measurements



GCC Concepts

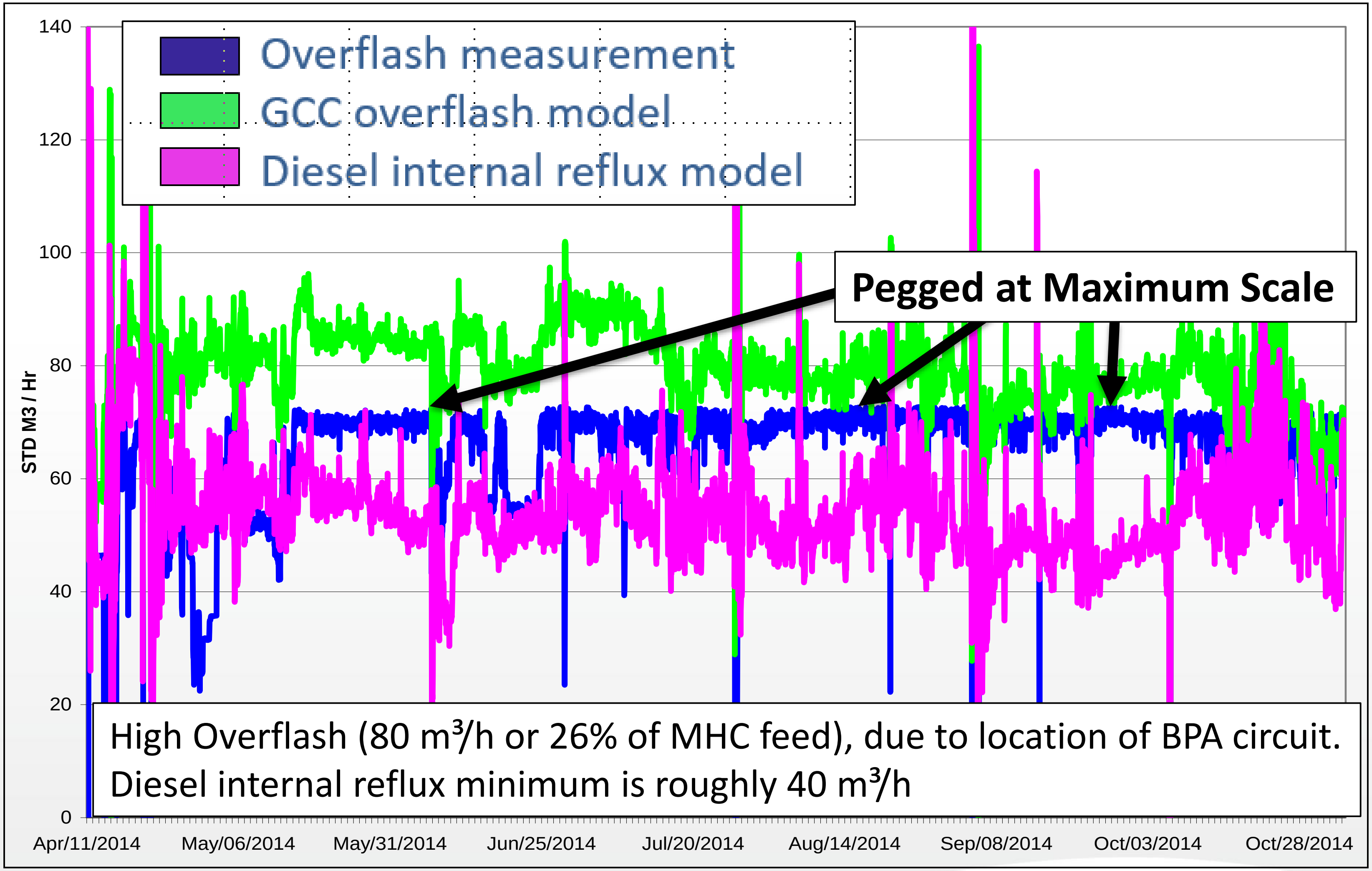
- **Property Predictions**
  - A function of cuts, internal reflux, others
  - Example:

    DK 90% = K1*CPK+K2*CPD+K3*[FDK/(FDK+FIntRef)]+Bias

- **Overflash Model**
  - Predict column temperatures in the wash zone
    - A function of overflash
  - Calculate overflash flow so the predicted temperature equals the measured temperatures

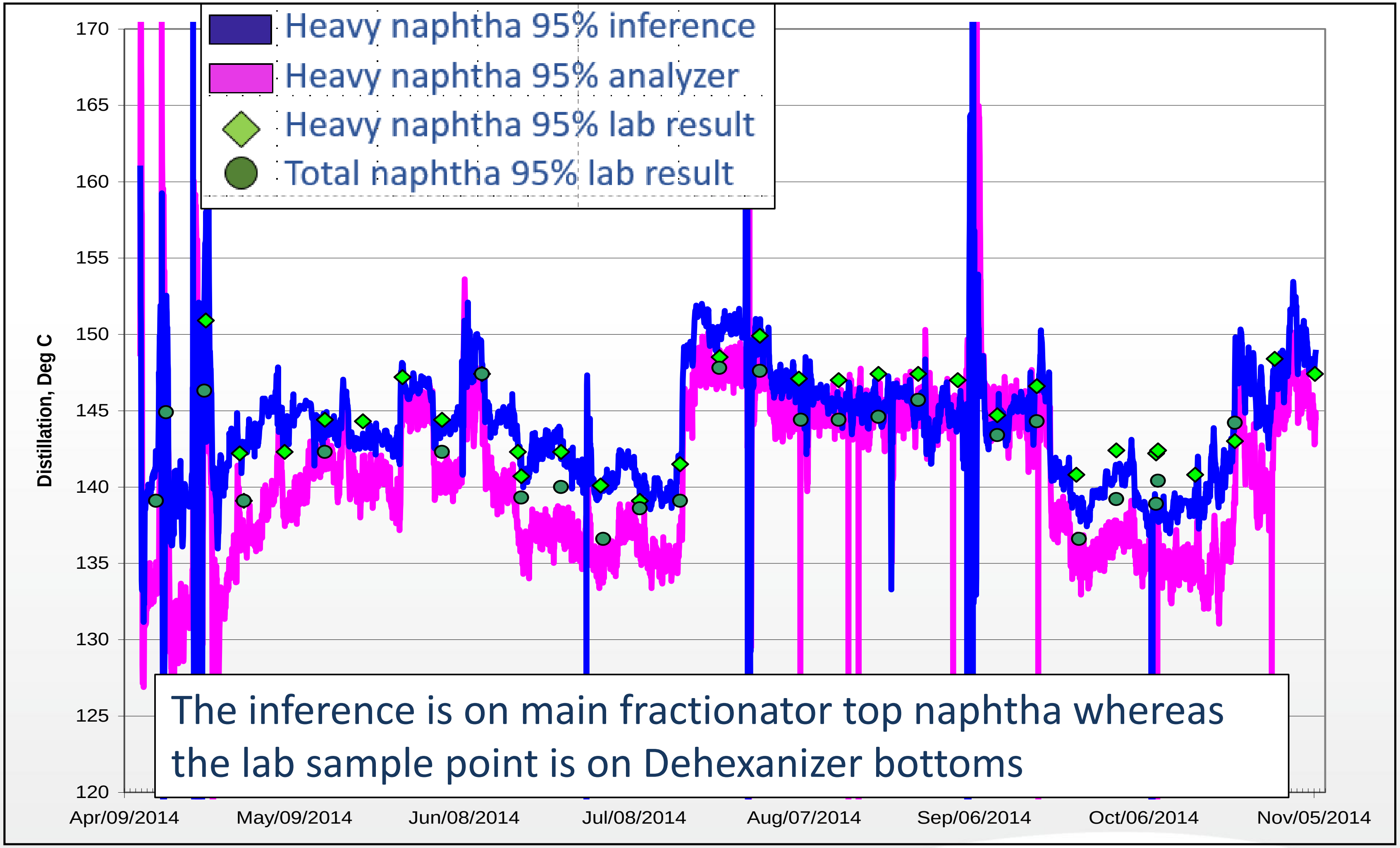
GCC
Inferential results

Overflash & Diesel IR – 7 Months

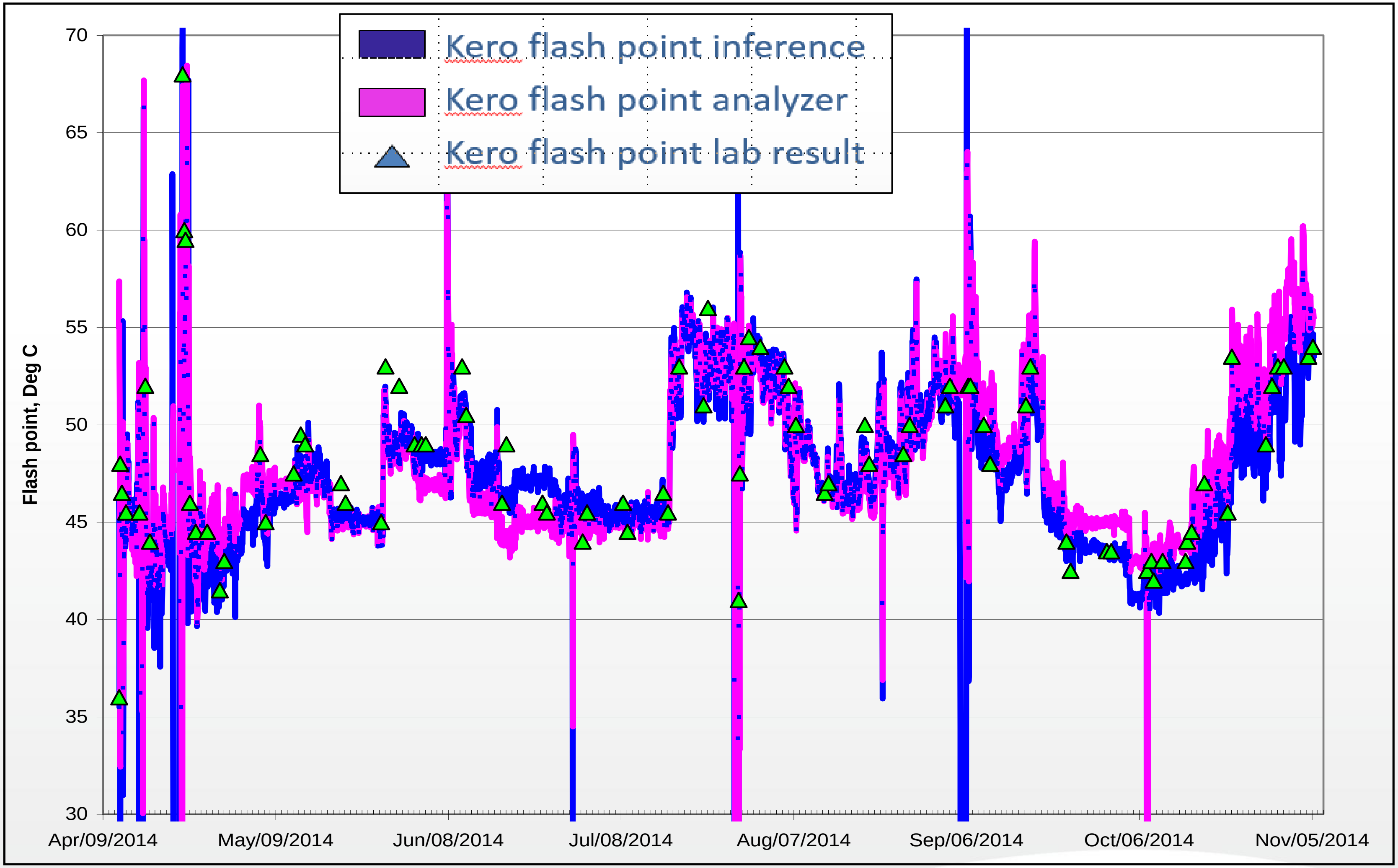


High Overflash (80 m³/h or 26% of MHC feed), due to location of BPA circuit. Diesel internal reflux minimum is roughly 40 m³/h

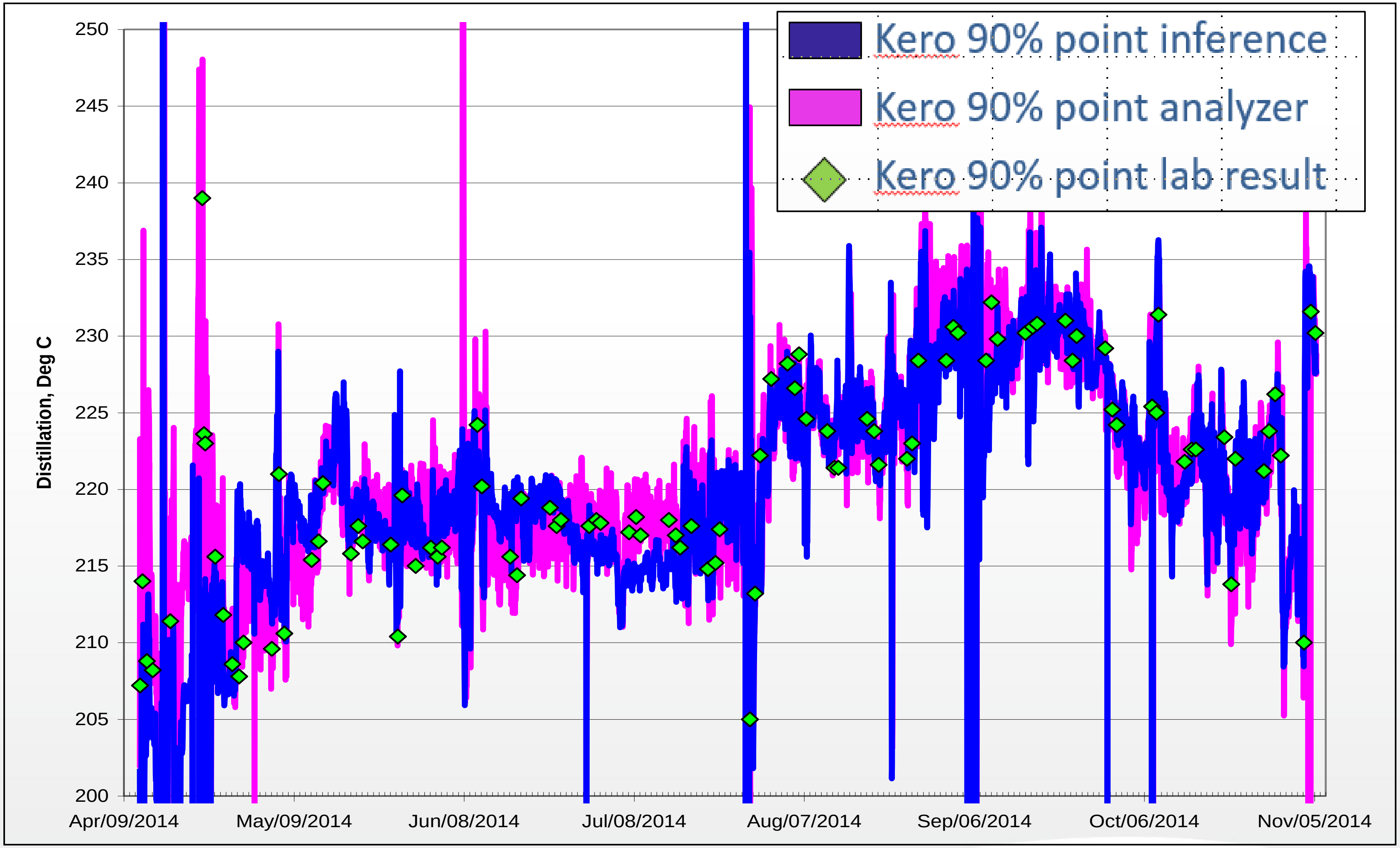
H-Naphtha 95% Point – 7 Months



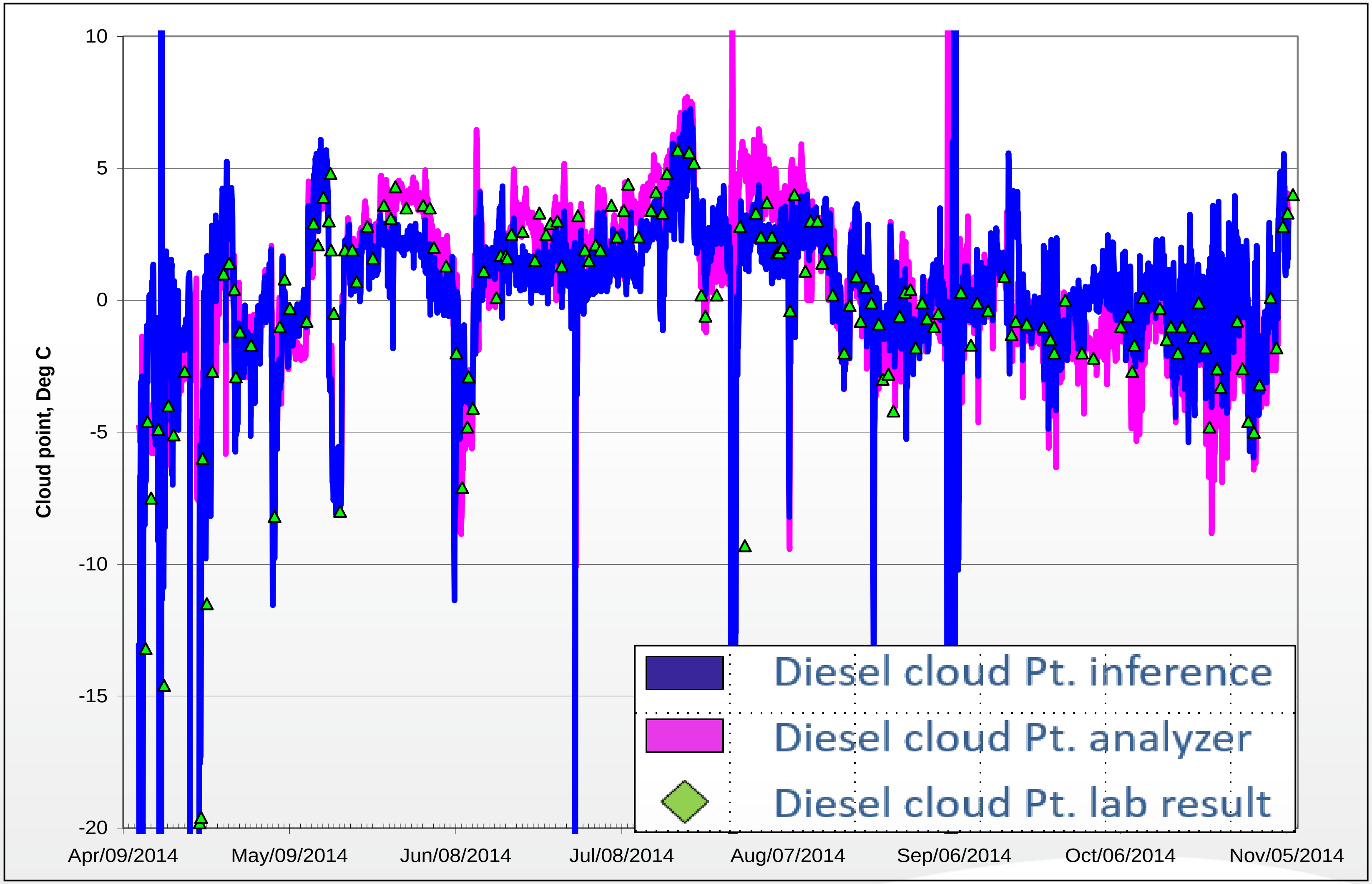
Kerosene Flash Point - 7 Months



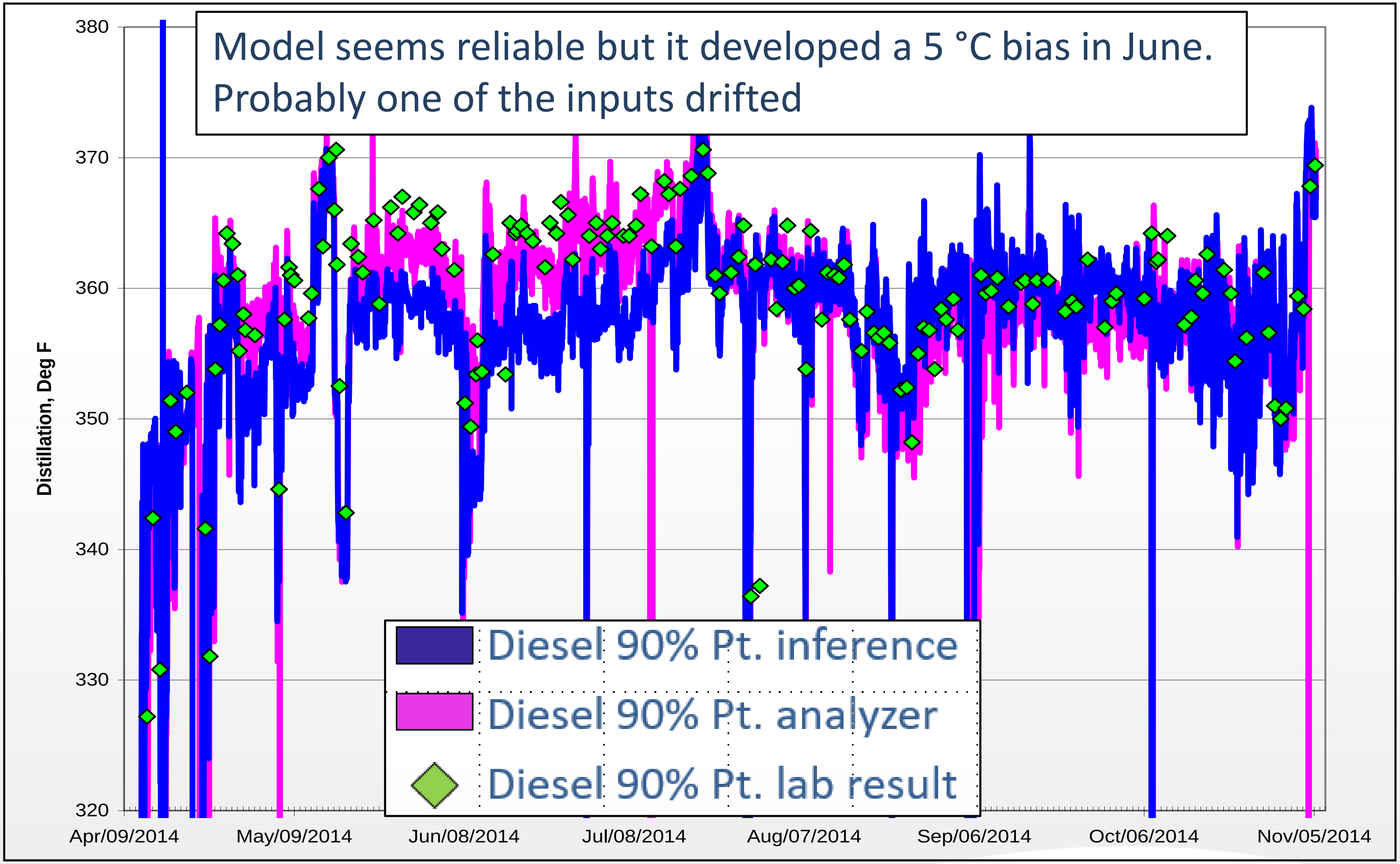
Kerosene 90% Point – 7 Months



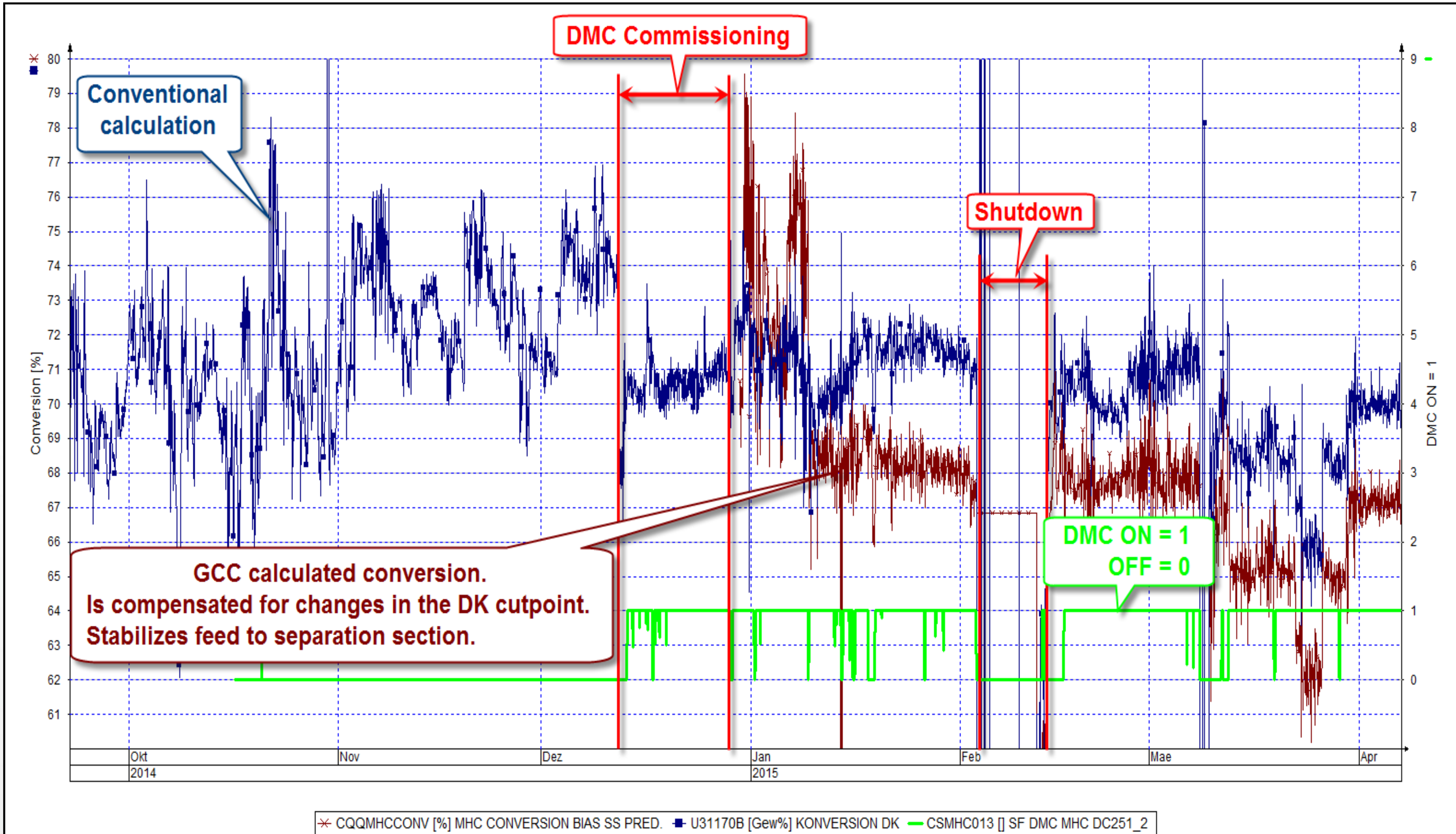
Diesel Cloud Point – 7 Months



Diesel 90% Point - 7 Months



GCC Calculated Conversion



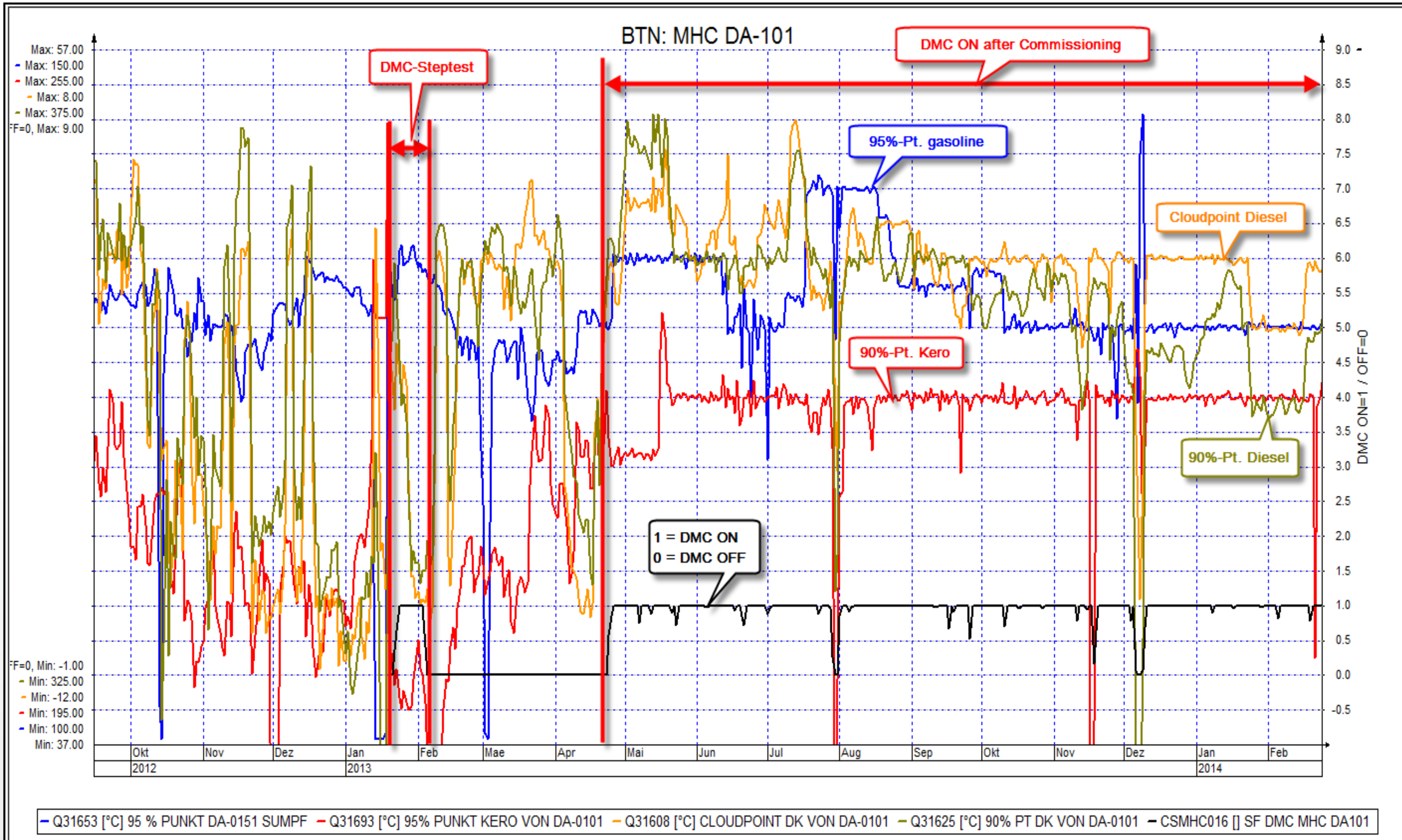
APC Application Performance

MHC-DMC	Commissioning	AMT Weeks on Site	Project Duration
Part 1: Fractionation	April 2013	< 4	< 6 month
Part 2: Reactor	December 2014	< 5	< 4 month

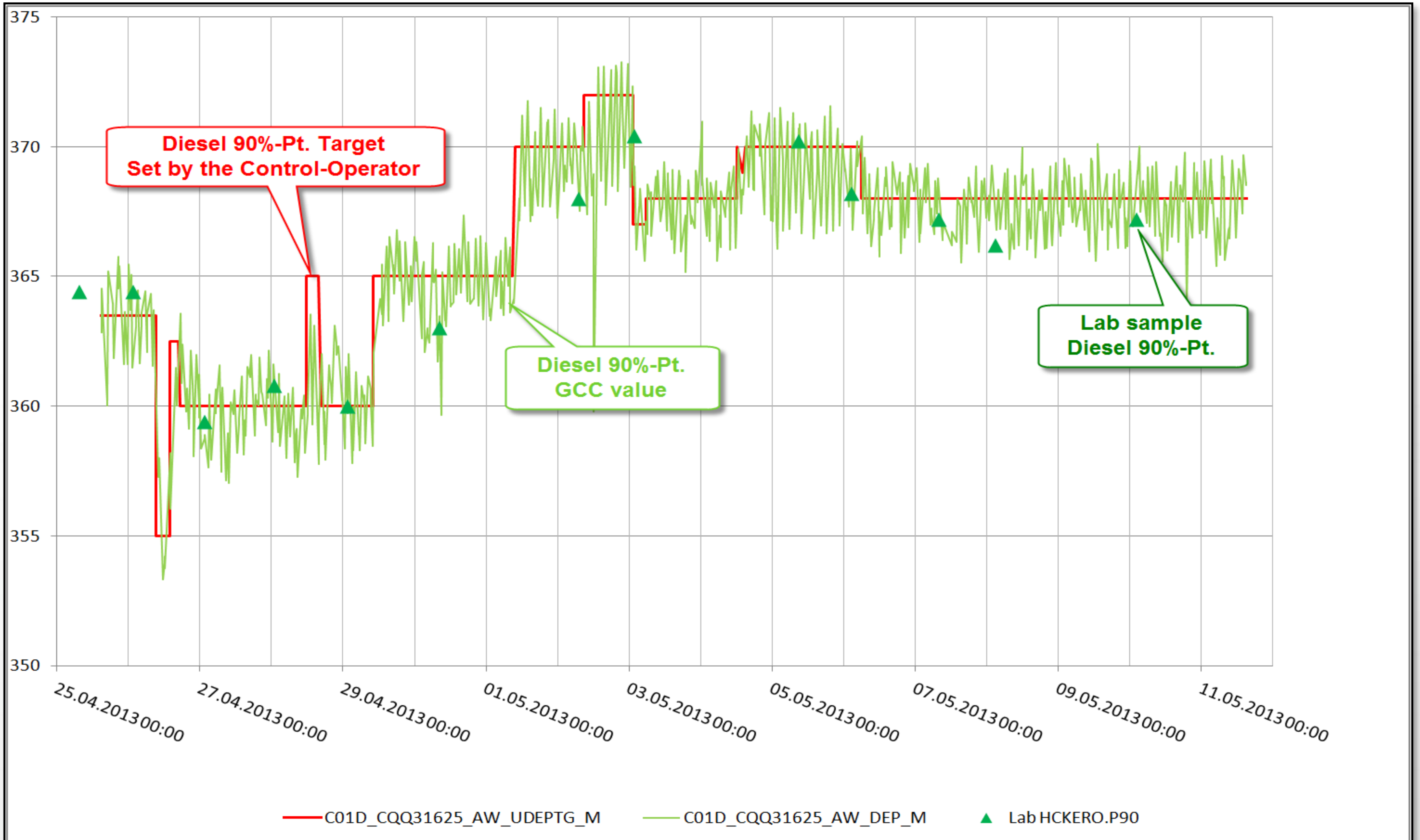
- Acceptance from operations is very high
  - For inferentials
  - For control application

=> **Service factor > 95%**

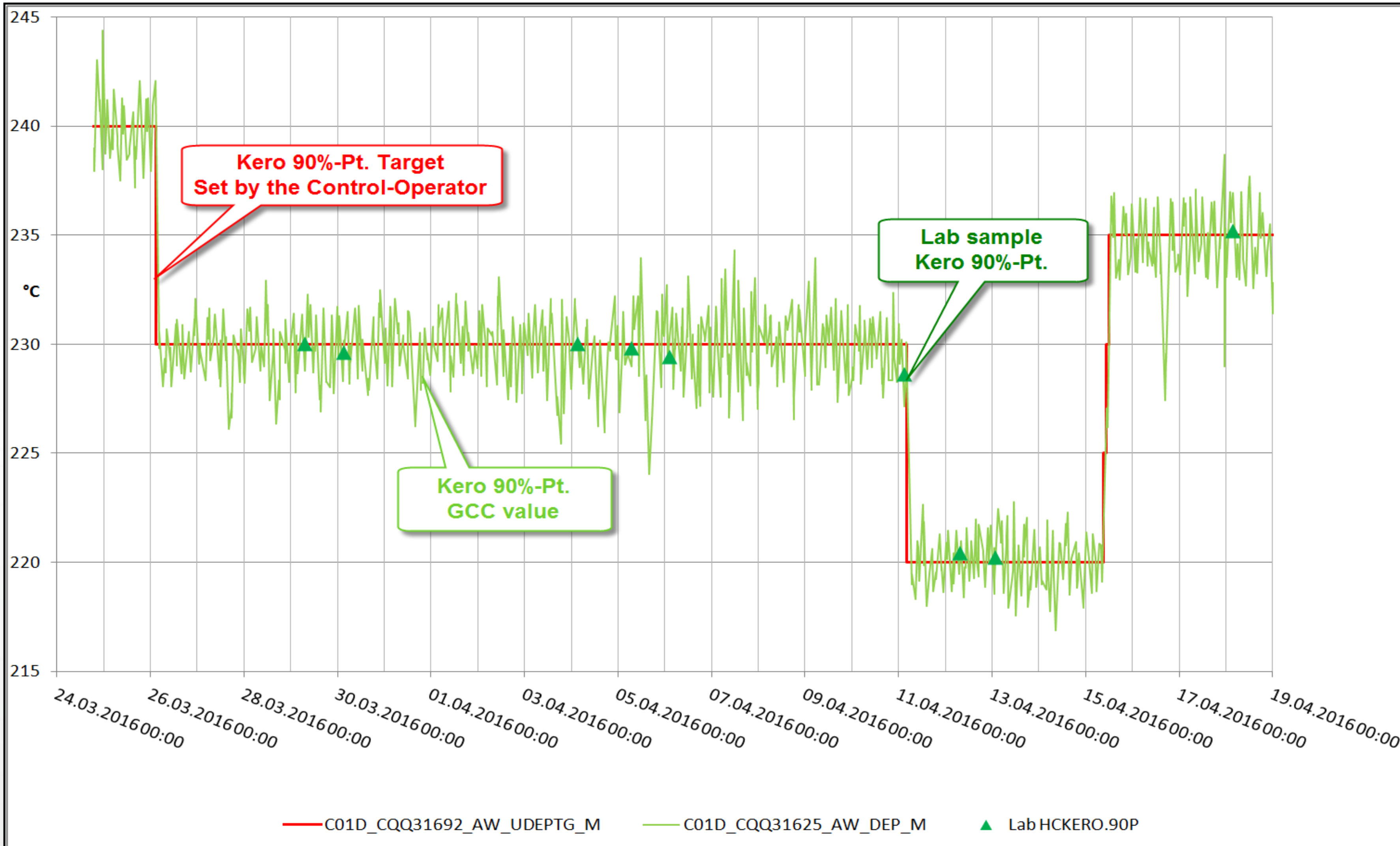
APC with DMCplus and GCC



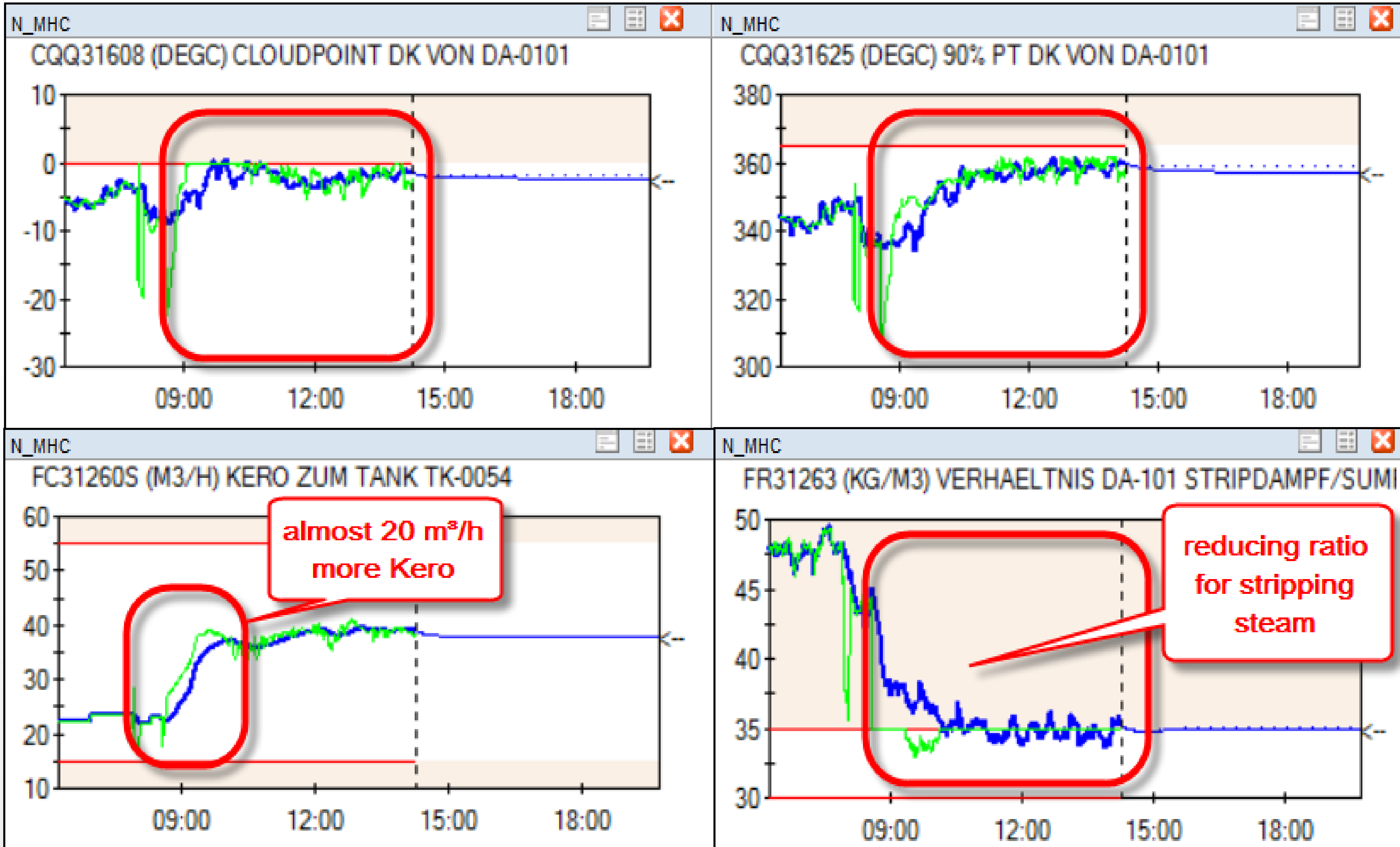
Diesel 90%-Pt Target – 16 Days



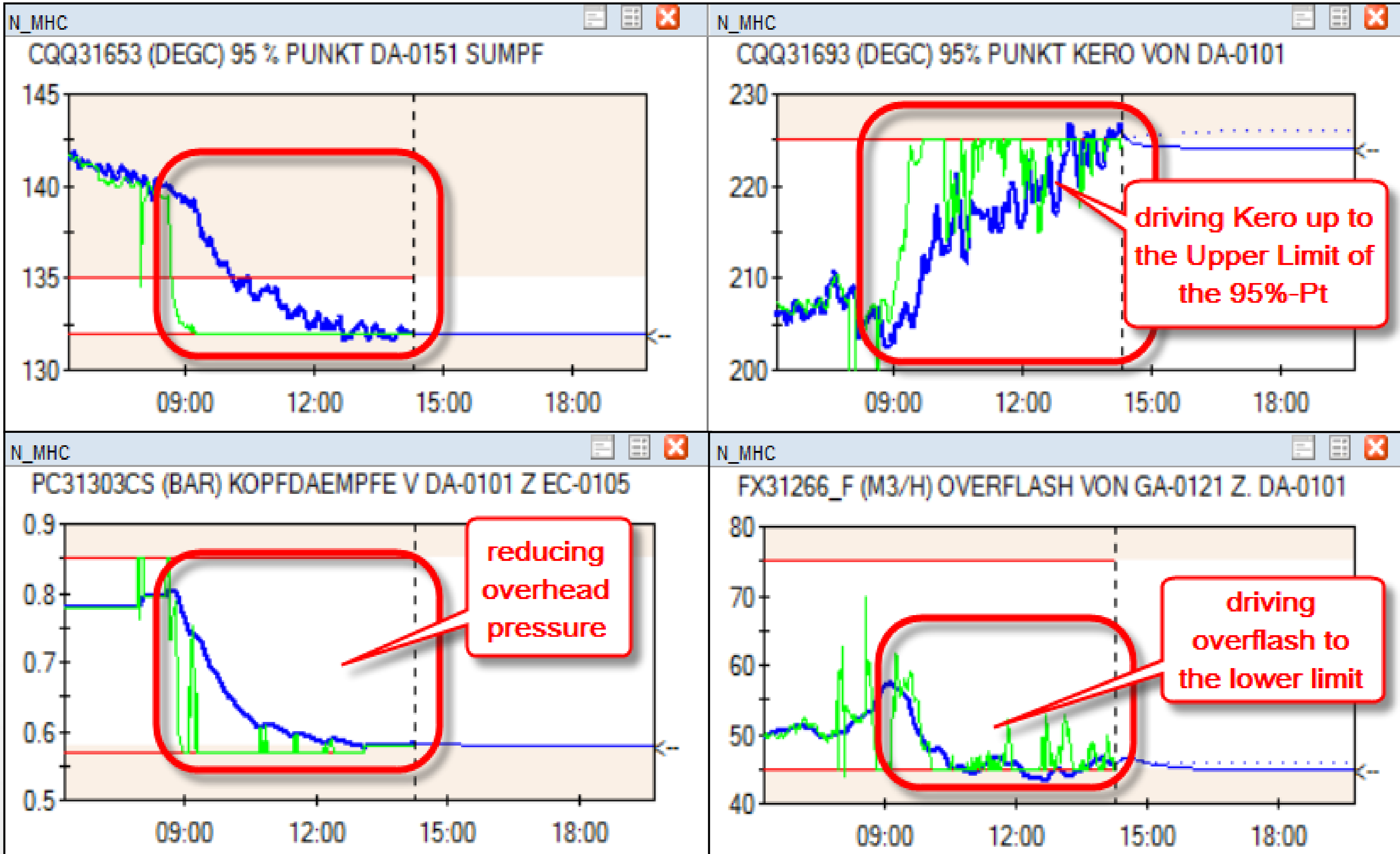
Kero 90%-Pt Target – 26 days



Performance After Start-Up

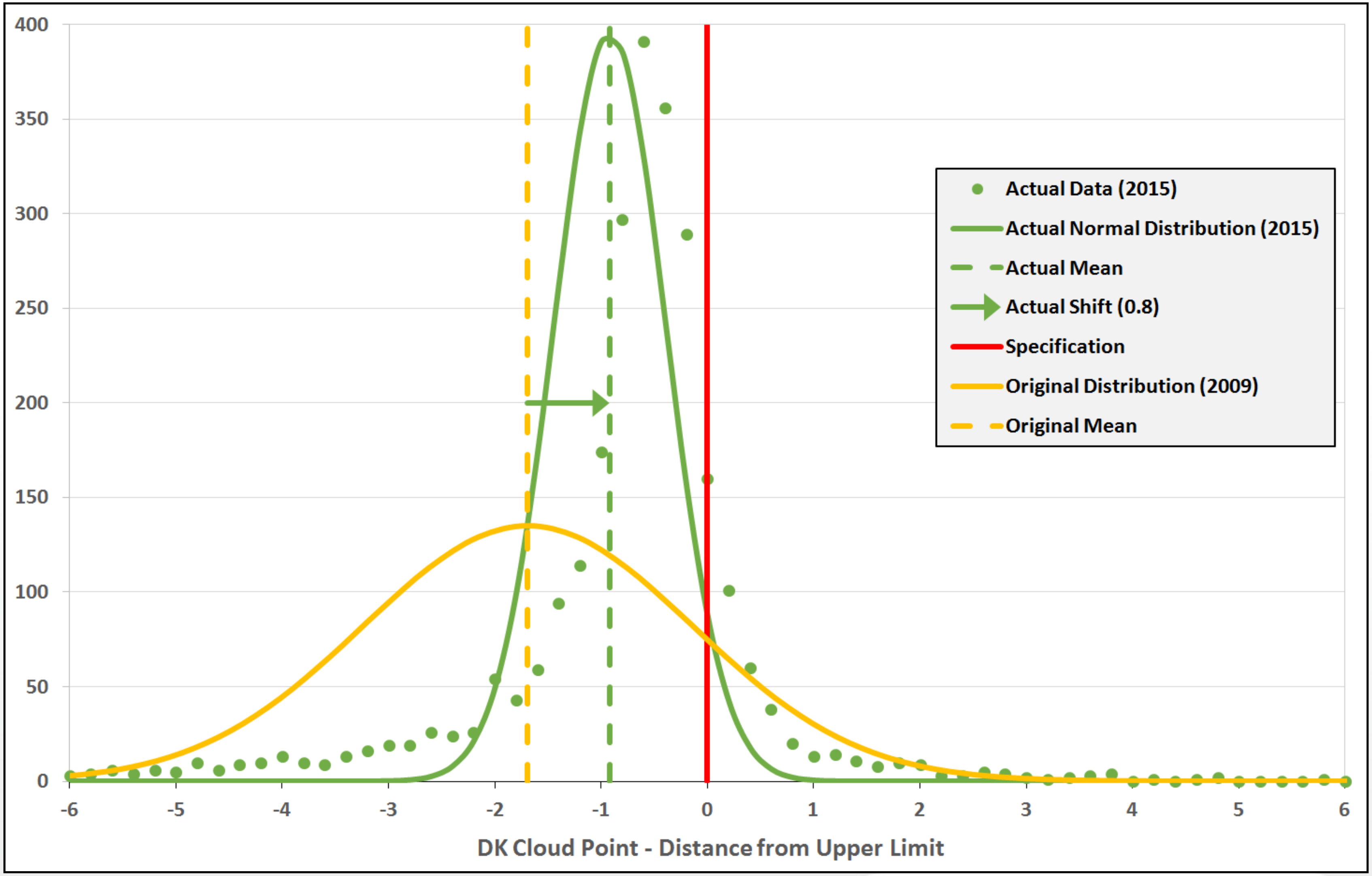


Performance After Start-Up

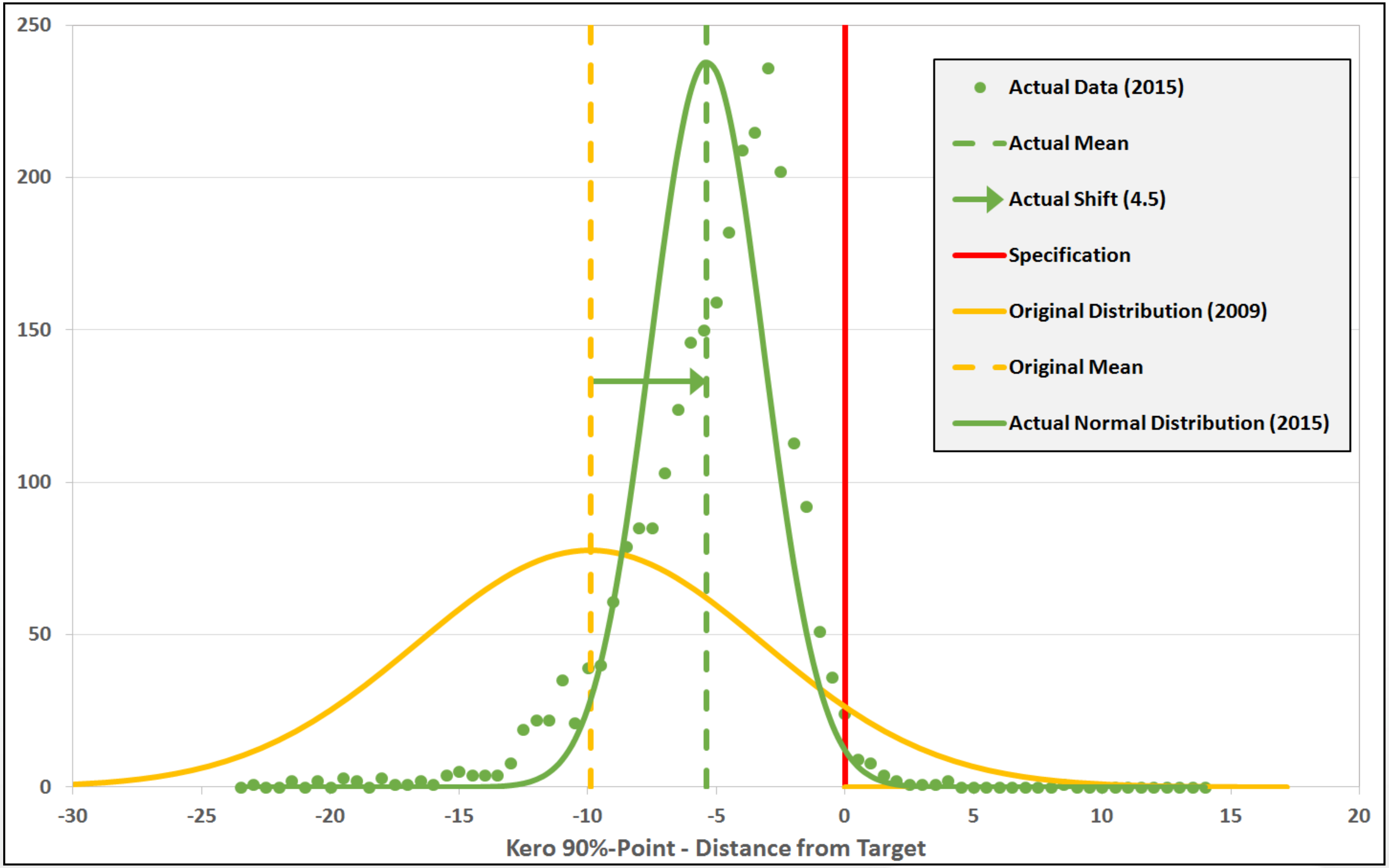


Benefits

APC Benefits Diesel Cloudpoint



APC Benefits Kero 90%-Point



APC Application Benefits

Product	Mass Balance Shifts m³/h	t/h	Benefits Realized [€/h]
Bottoms UCO	0,4	0,3	139
Kerosene	4,8	3,9	2.372
Diesel	-2,2	-1,9	- 952
Overhead Naphtha	-3,1	-2,3	- 1.032
Hourly Yield Benefit			527 €/h
Annual Yield Benefit			> 4.200.000 €/a

Conclusions

Conclusions APC performance

- Sustaining APC performance is the most important factor in realizing the benefits for this application
  - The design and development of the MHC application has delivered on the long term benefits case
- The MHC application has a high service factor because
  - The major and difficult operating constraints are addressed
  - Accurate, high quality property predictions were developed
- The application has less than a 6 month simple pay-back period

Thank you!

Comments/ Questions?