REMOTE SENSING TECHNOLOGY
A NOVEL SOLUTION IN SAFE REFINERY
PROCESS CONTROL

by
MODCON SYSTEMS Ltd.

PEFTEC

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Refinery Challenges

Challenge:

    Manufacturing of **on-specification products at an minimum cost** and **optimal environmental burden**

Refineries must be flexible to immediately respond to:

- **Changing crude cost and quality**
- **Changing Regulation/Standards on Fuel Qualities**
- **Changes in Fuel demands/consumption**
- **Stringent Safety requirements**

Requirement to achieve these goals:

- **Frequent process adjustments**
- **Stringent monitoring of process streams, whereas laboratory tests are too time consuming**

Solution:

*ON-LINE PROCESS ANALYSERS*

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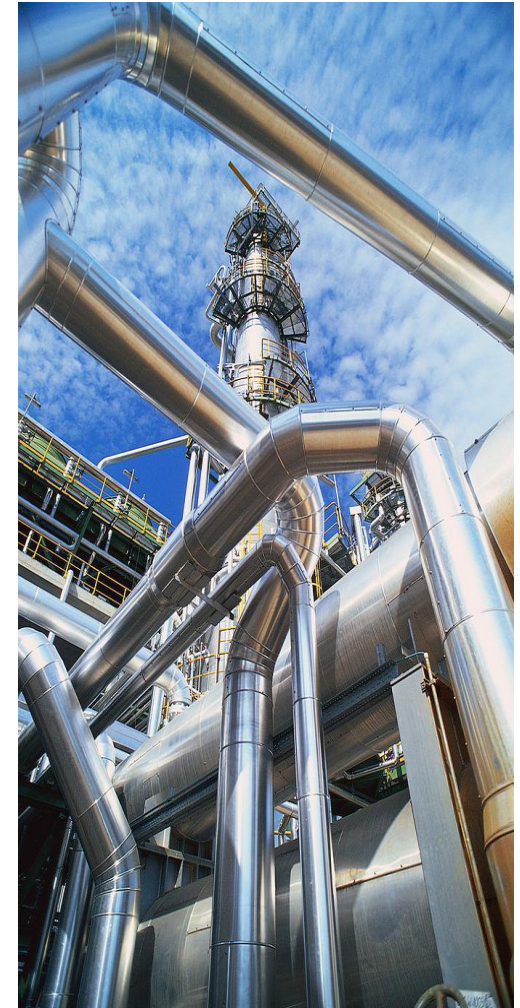
Benefits of on-line process analyzers

- Product always in-spec!

- No giveaways

- Reduces reprocessing

- Less tank occupation

- Increases production capacity of required products

- Reduces time consuming laboratory analyses

- Prevents lag time between laboratory results & real time conditions

- Allows real time process optimization

- Less exposure to hazardous materials during sampling and handling of the samples

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The New Generation of Process Analyzers
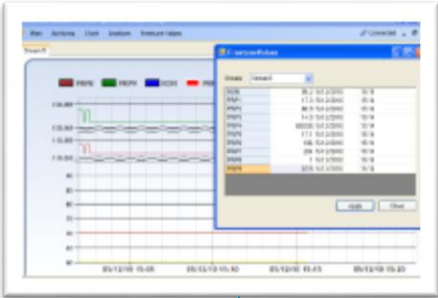
ANACON Software
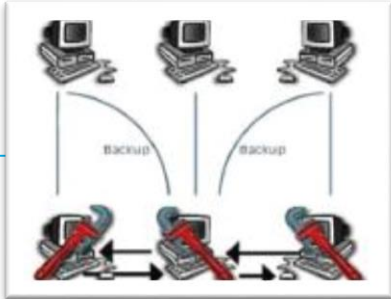
MARS - Remote Support

MOD-8000
Process NMR Analyzer

Beacon-3000
Process NIR Analyzer

MOD-6400
Sulphur Analyzer

MOD-4100
Crude Oil Analyzer

MOD-1004
Gas Analyzer

MOD-1100
Oil in Water Analyzer

CATALYTIC · INFRARED · PHOTO IONIZATION · METAL DIOXIDE · ELECTROCHE
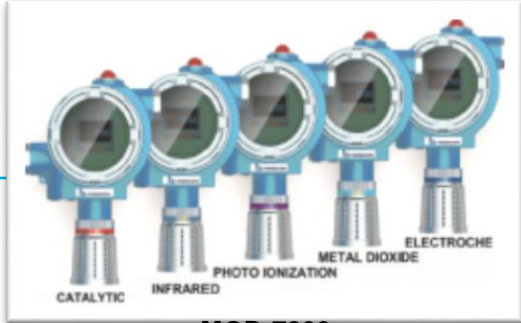
MOD-7200
Gas Detectors
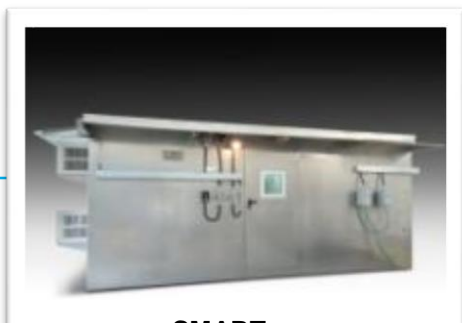
SMART
Analyzer Houses

MOD-1200
Recovery System


Sample Conditioning
Systems

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On-line Process Analyzers

ASTM-based discrete analyzers

- Best correlation with the laboratory
- Long response time
- One analyser for each physical property
- Extensive maintenance

Correlative Analyzers (NIR/FTIR, NMR)

- Correlation between spectroscopic data and quantified physical properties
- Multi-property analysis
- Fast response time
- Minimal maintenance

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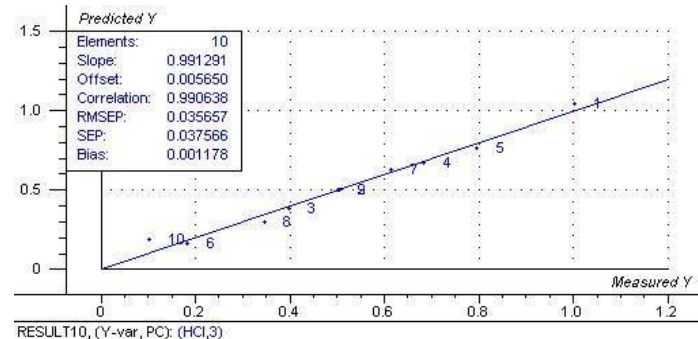
Factors to be considered

- Installation in Ex Zone – requires expensive ATEX enclosures and analyser houses conforming to IEC 61285 and IEC 60079

- The location of analyzer houses reduces the "empty space" in the process unit

- Hazardous situations may occur inside the analyzer, accidental or during maintenance

- Frequent maintenance operation in hazardous areas, includes opening and closing of the enclosure, connecting and disconnecting the analyser parts, tubing, valves etc.

Solution:

REMOTE SENSING TECHNOLOGY

Remote Sensing

- Remote sensing is based on the analyses of data required by a device, without being in direct contact with the object being analyzed.

- Remote sensing – enables measurements at far distances.

- Enables measuring in hazardous areas, such as in refineries, tank farms, blending stations without being present at the spot.

- Analyzers are now installed in safe area and therefore:

❑ eliminate need for IEC 60079 and IEC 61285 based analyzer houses/enclosures

❑ reduce occupied space

❑ Increase Safety by less maintenance in the hazardous environment

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How does Remote Sensing Increases Safety?

- No need for electric devices inside the Ex Zone

- Analyzer is installed in safe area

- Minimizes maintenance of the analyzer inside the EX Zone – normally provided in the control room

- Analyzer are far away from the unsafe area

How is this achieved?

**FIBER OPTICS BASED REMOTE NIR TECHNOLOGY**

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Advantage of NIR Remote Sensing Analyzers

- **Real time**, continuous **flow-through** stream analysis.

- Short **response time** as compared to Lab analyses allows tighter process control.

- **Multi-properties analysis** reduce conventional analyzers and provide faster result.

- Provides **high accuracy** data for precise control.

- **Minimal maintenance** required, no moving parts in sensor.

- No need for **large quantity** of different **spare parts**

- No need for ATEX enclosure/shelters

- **Low Cost** of Ownership.

NIR Remote Sensing Analyzers User Benefits

- **Optical multiplexing** for multiple streams
  - No Valves; Easy to Expand; Reliability

- Field Units are **Maintenance Free**
  Does not required **any electricity** (enhanced safe)

- Use **standard communication** fiber-optics
  - Economical; Not sensitive to temperature

- Up to **3 Kilometer** from the analyzer
  - Located close to the desired sampling point,
  - No lag time of the measurements

- **Maximizes Safety** for operators and maintenance personnel
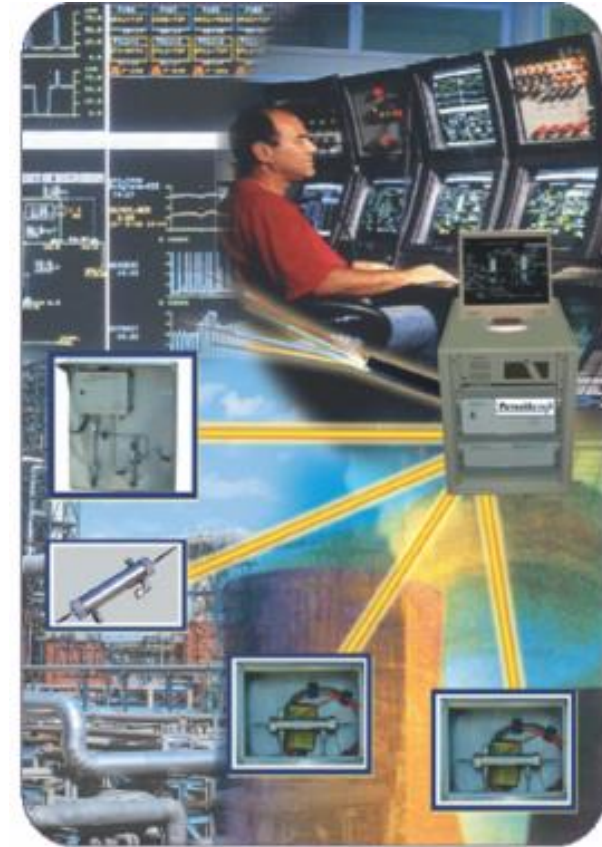
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Field Unit Operation Conditions

- Haze free
- Max. Pressure -   550 psi (40 bar)
- Flow rate -   1 l/min to 3 l/min
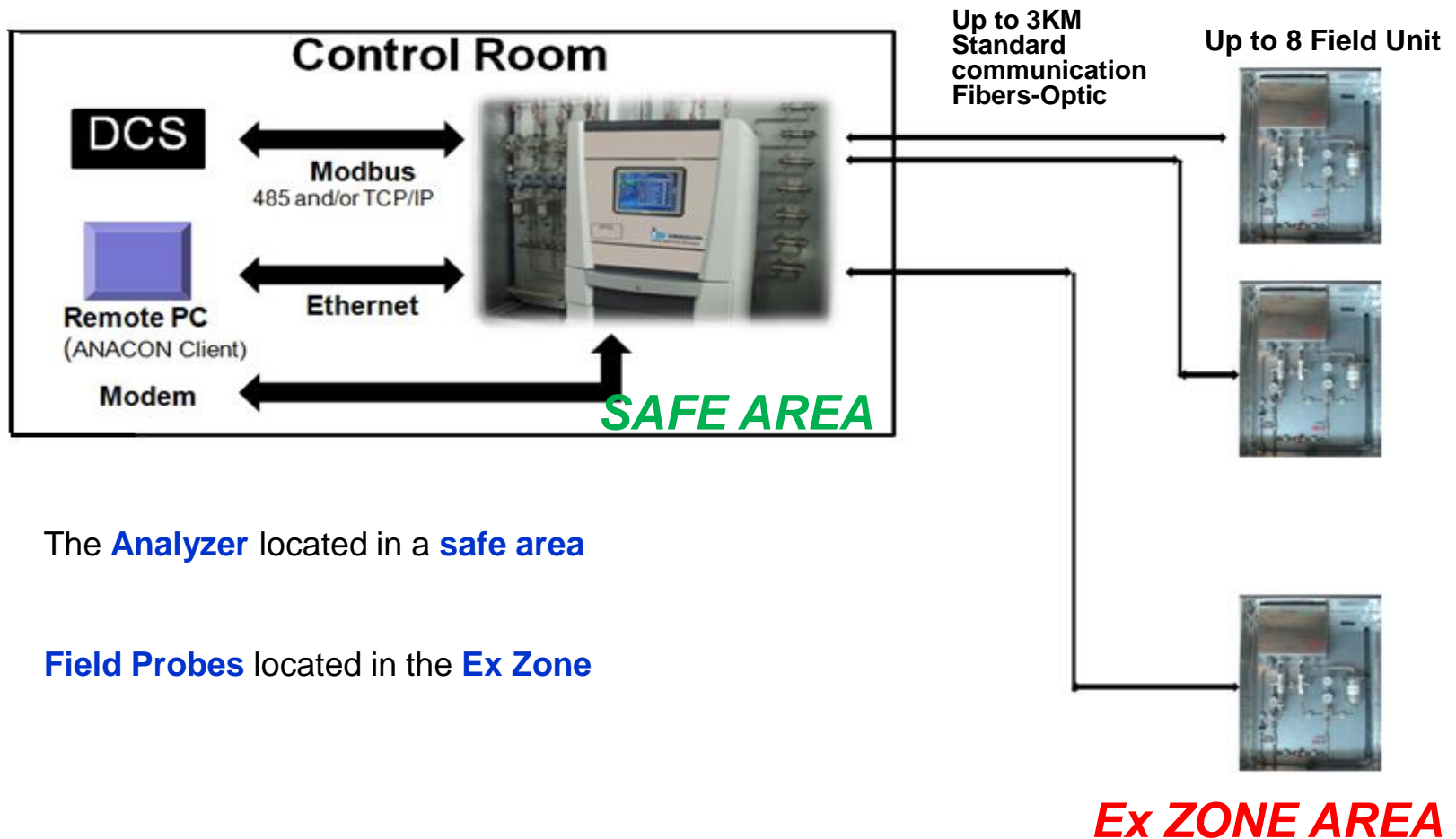- Temperature -   Above Cloud point to +160°C (300°F)

Field Unit

## Sample Cell

Probe

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Key Advantage and User Benefits

Control Room

DCS ⟷ Modbus 485 and/or TCP/IP

Remote PC (ANACON Client) ⟷ Ethernet

Modem

SAFE AREA

Up to 3KM Standard communication Fibers-Optic

Up to 8 Field Unit

Ex ZONE AREA

The **Analyzer** located in a **safe area**

Field Probes located in the **Ex Zone**

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From Spectrum to Analyses

- Chemo-metrics correlates between spectral data, provided by the NIR process analyzer, with quantified values of physical properties.

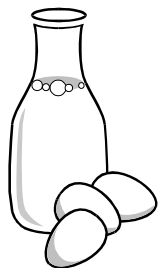- Multiple chemical and physical properties can be determined by one single measurement.
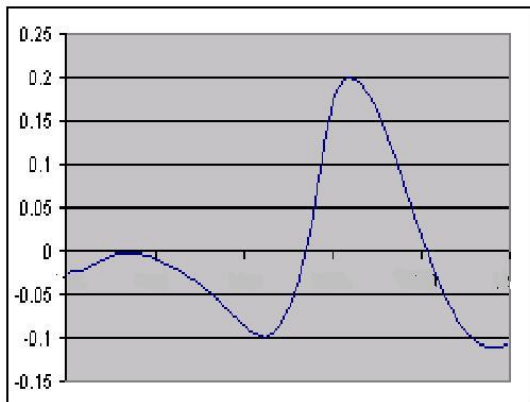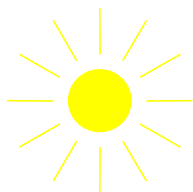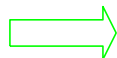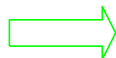

CHEMOMETRICS

RON
MON
RVP
DENSITY
Etc.

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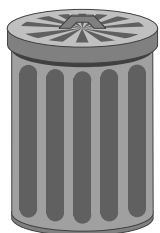# Recipe to Successful Chemometric Model Building
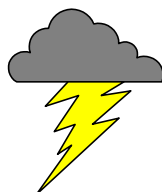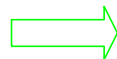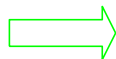
Good Lab data and on Time

Good Model

Good prediction

Bad Lab data non conforming with sample time

GIGO Bad Model

Bad prediction

gifbin.com

Importance of "Time Matching"
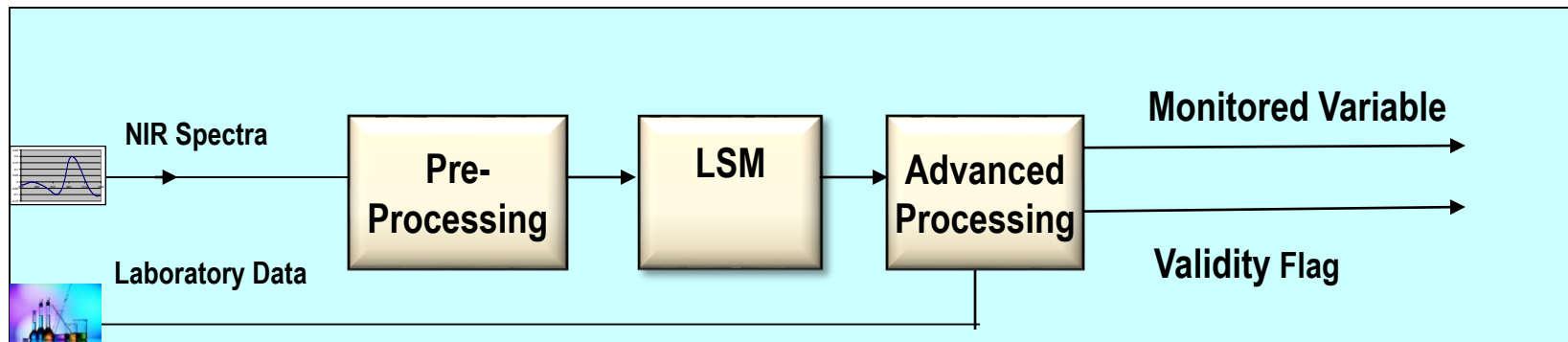
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FREE-TUNE Software

- Is a proprietary software package to guarantee highest accuracy and reliability at any time. It surpasses other techniques by accurately quantifying properties without the need for model maintenance and fine-tuning.

- Validates NIR measured analytical results with laboratory analytical results, or with analyses of calibrated discrete ASTM analyzer.

- Includes guarding and correcting mechanisms to maintain the long and short-term accuracy required for confident close-loop process control.

- Continuous calibration
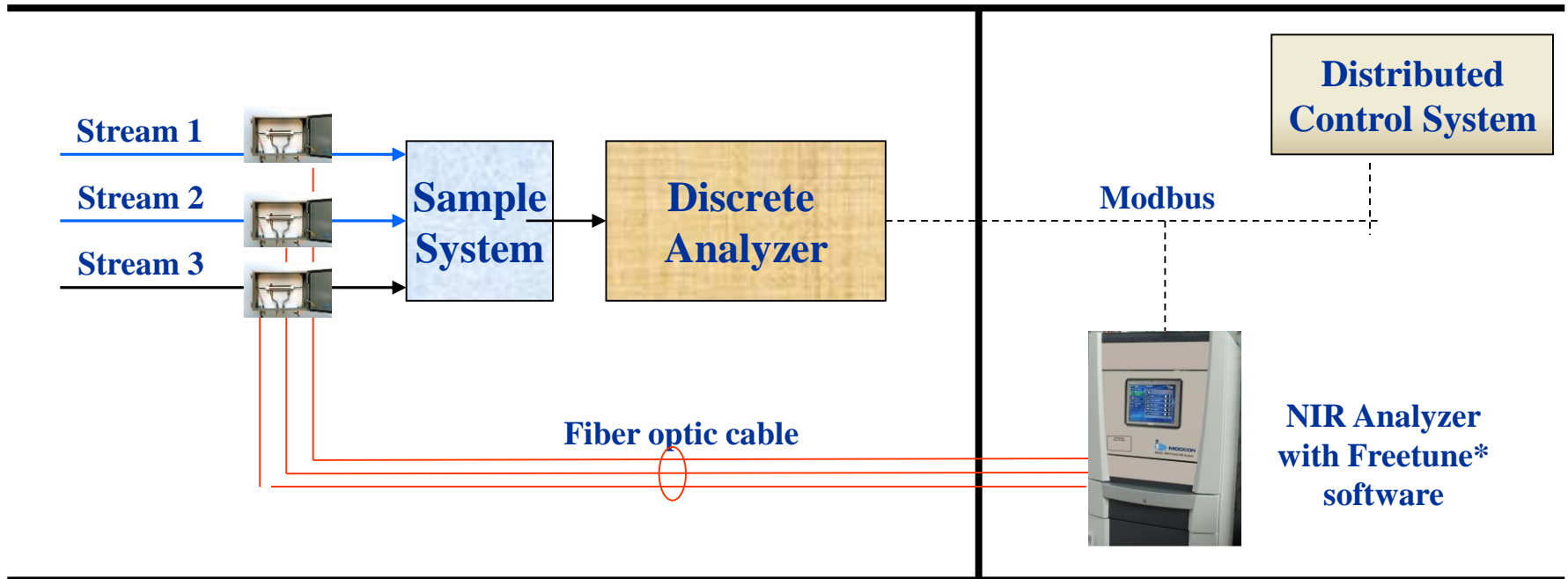
- Quick start up calibration, no need for model update

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Principles of FREE-TUNE Software

This **FREE-TUNE** software program is composed of two sequential blocks:

I. PLS regression is used to build a localized sensitive model (LSM) based on a small quantity of samples. One characteristic of this model is its sensitivity to short term (hours) process variations. Since it is localized, the model can be quickly built and validated. This procedure takes up to one week and can be performed prior to startup.

II. A proprietary software program processes the model, together with the specified plant data, to accurately quantify the properties. This part deals with predicting the long-term product variability. The inputs are measured NIR spectra. The outputs are the monitored variables and the validity flag. Each variable has a corresponding validity flag.

Fusion Solutions

Stream 1

Stream 2

Stream 3

Sample System

Discrete Analyzer

Modbus

Distributed Control System

Fiber optic cable

NIR Analyzer with Freetune* software

Response time: 5-10 min
Accuracy: according to ASTM
Availability: above 98% (full-redundant system)

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Refinery Applications

- Gasoline and Diesel **On-line blending**

- **Crude distillation** unit optimization

- **Solvents extraction** complex on-line analysis

- **Catalytic cracking** unit optimization

- **Reformer** streams on-line analysis

- **HF Alkylation** acid analysis

Measured Properties:
- Motor Octane
- Research Octane
- Total Aromatics
- Total Olefins %
- Ortho Xylene
- Distillation Points
- Oxygenates
- Cloud Point
- Viscosity
- Flash Point
- Pour Point
- Cetane index
- Reid Vapor Pressure
- % para Xylene
- PIONA
- Chemical Composition%
- Benzene
- % meta Xylene
- % MTBE and more

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Typical NIR in Refinery
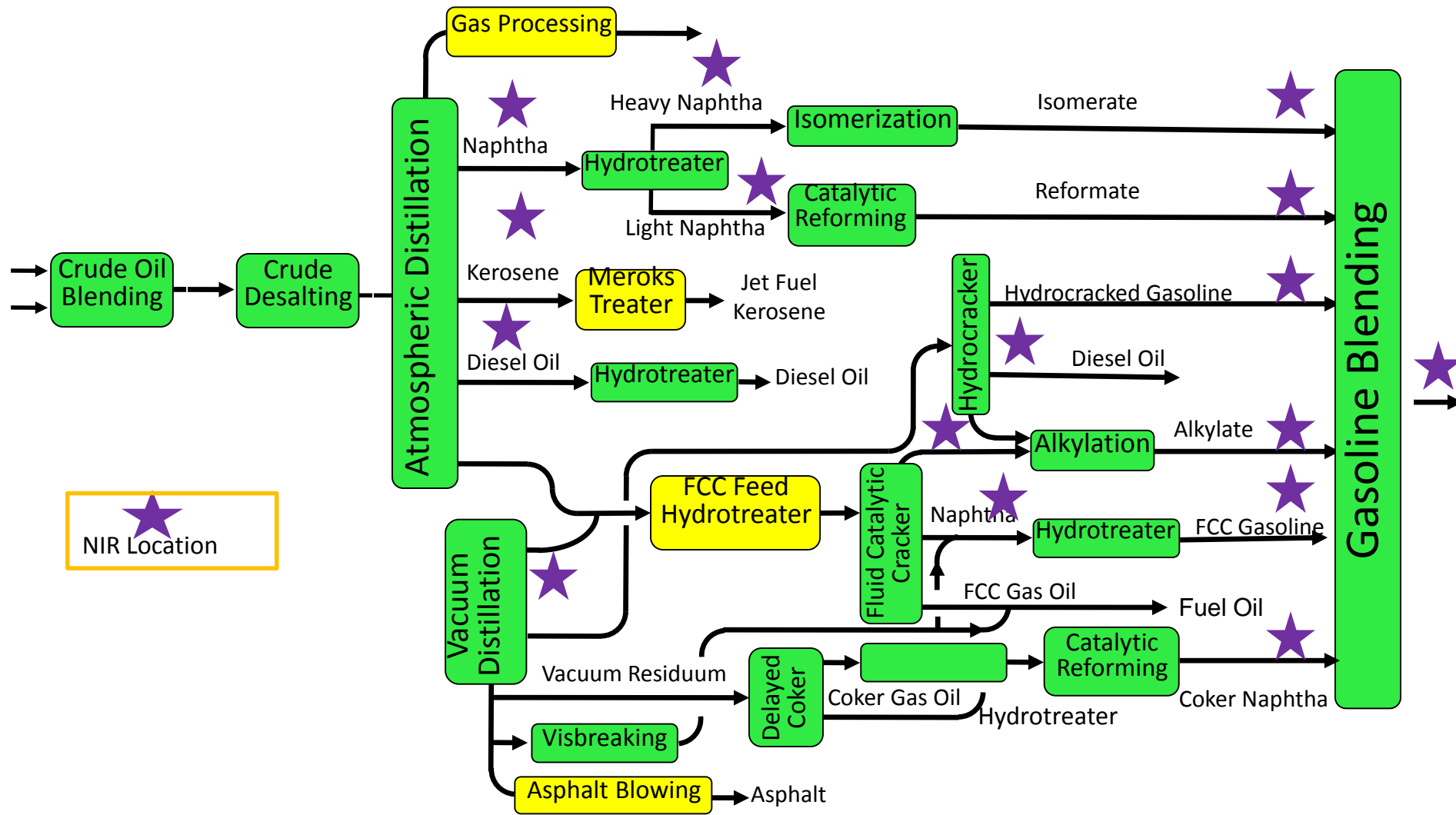
Challenge of NIR in Crude Distillation

- On line monitoring quality allows on line adjustment of process parameters, based on real time analytical data.

- Reduces influence caused by crude switching. It enables to execute real time process adjustments.

- On-line monitoring of crude and distillate enables accurate determination of both upper (T90% - FBP) and lower (T10% - IBP) distillation points enables accurate cut point.

Result

- Increased distillation capacity
- Increased CDU yield
- Reduced energy consumption
- Less production (storage) less valued distillates
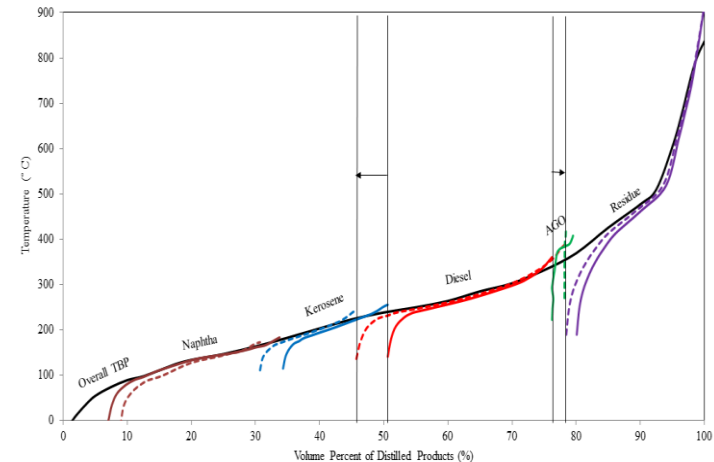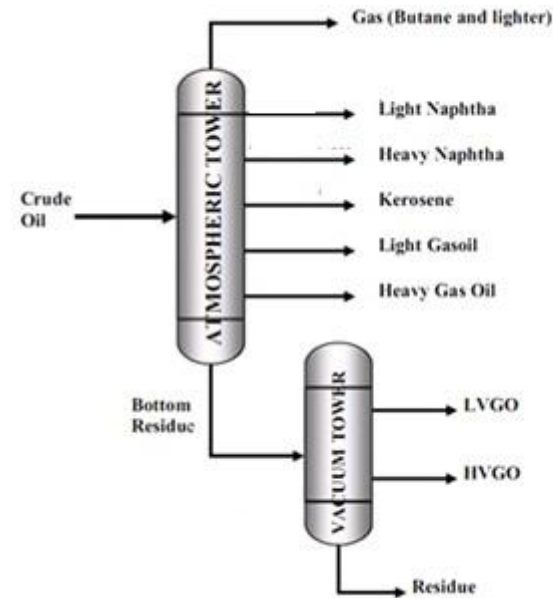
Gasoline Blending Station

Previously: **RON and MON Analyzers**.

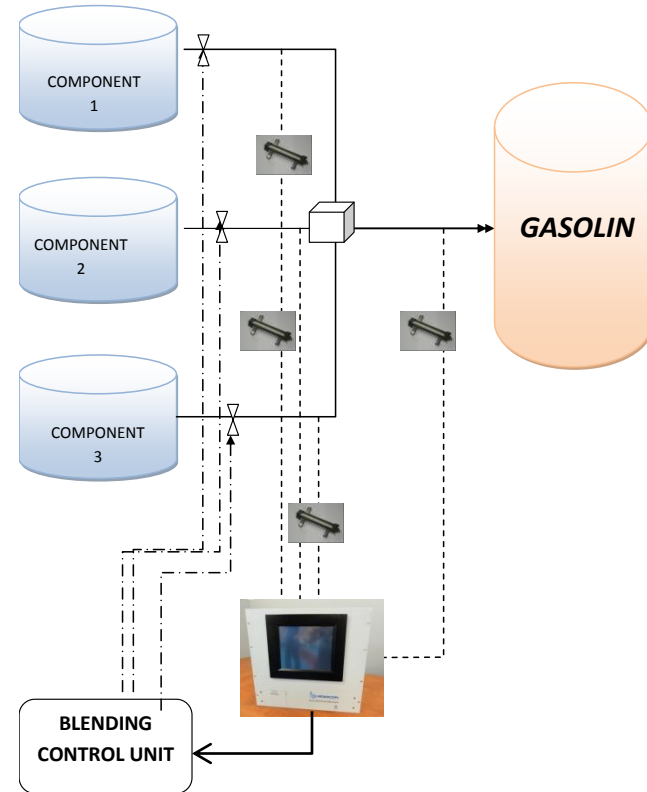*Expensive Maintenance in Hazardous Environment.*

Now: **NIR Process Analyzer**

Instantaneous monitoring of all process and final product streams.

No multiple analyzer systems required

On line instantaneous determination of RON, MON, RVP, Oxygenates, Density, olefins and density, Distillation BP's

Allows on line correction of the blending formulation

- **END OF EXPENSIVE ON-LINE KNOCK ENGINES!**

- **END OF FREQUENT MAINTENANCE OPERATIONS IN EX ZONE!**

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Remote Sensor NIR Process Analyzers

- **Enhance Process Control – Data centralized in control room**

- **Maximize Process Optimization**

- **Increases Safety**

- **More free space**

- **Less Maintenance in hazardous ExZone**

- **Low CAPEX**

- **Low OPEX**

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THANK YOU

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