



Supporting Strategic Initiatives at MOL with the PI System Infrastructure

Presented by Tibor Komroczi

MOL Group

MOL Group is a leading international, integrated oil and gas company from Hungary, the heart of Europe, with over 75 years' experience and a proven track record.

MOL Group's Downstream Division operates 6 production units with a total capacity of 20.9 mtpa refining and 2.1 mtpa petrochemicals with more than 1900 service stations under 8 brands in 11 CEE countries, all supported by a far-reaching logistics system and driven by Supply Chain Management.



MOL Group

40 COUNTRIES

OPERATIONS IN EUROPE, MIDDLE EAST, AFRICA AND ASIA.

38 MILLION BARRELS

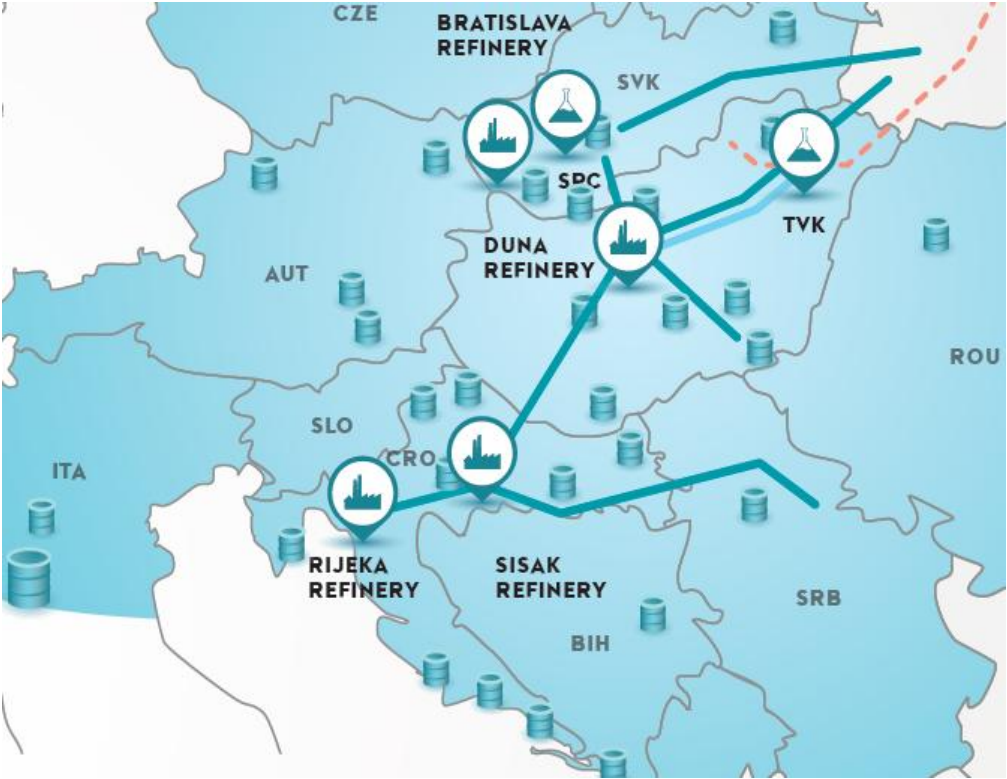
OF OIL-EQUIVALENT HYDROCARBONS ARE PRODUCED ANNUALLY WHICH COULD FILL A TANKER TRAIN 1,206 KM LONG.

750.000 TRANSACTIONS OF RETAIL CONSUMERS

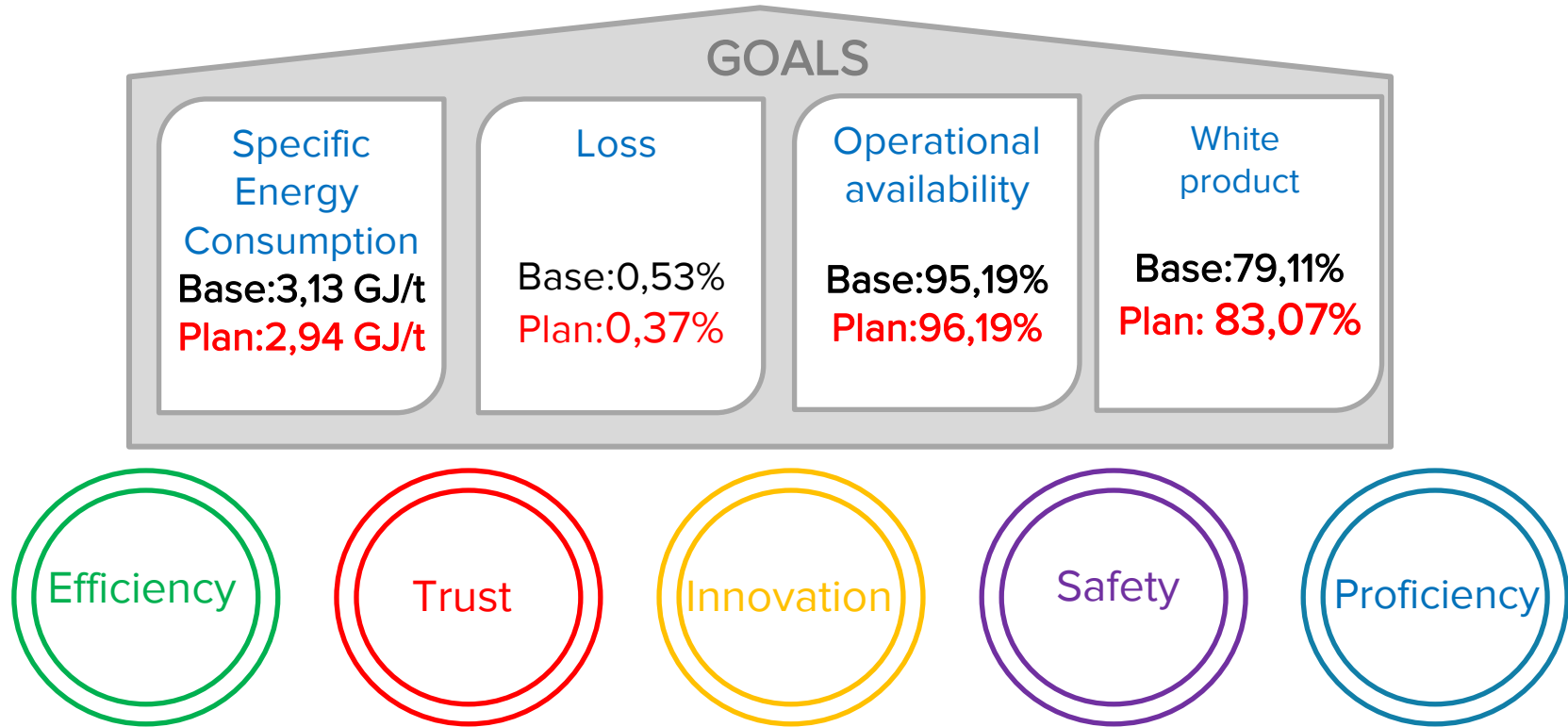
PER EVERY YEAR WE SERVE THE EQUIVALENT OF THE ENTIRE POPULATION OF BRASIL, COLOMBIA AND BOLIVIA ALL TOGETHER

REFINING

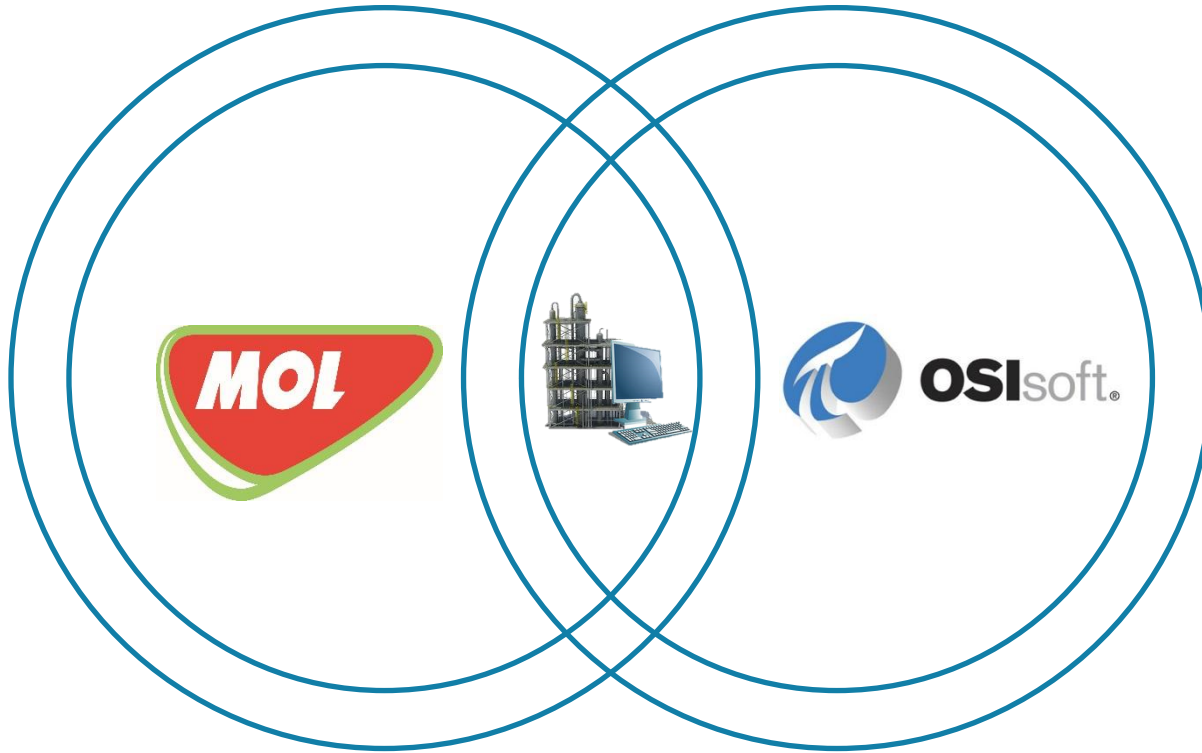
	Capacity in mtpa	NCI Index
Duna refinery	8.1	10.6
Bratislava refinery	6.1	11.5
Mantova refinery*	2.6	8.4
Rijeka refinery	4.5	9.1
Sisak refinery	2.2	6.1



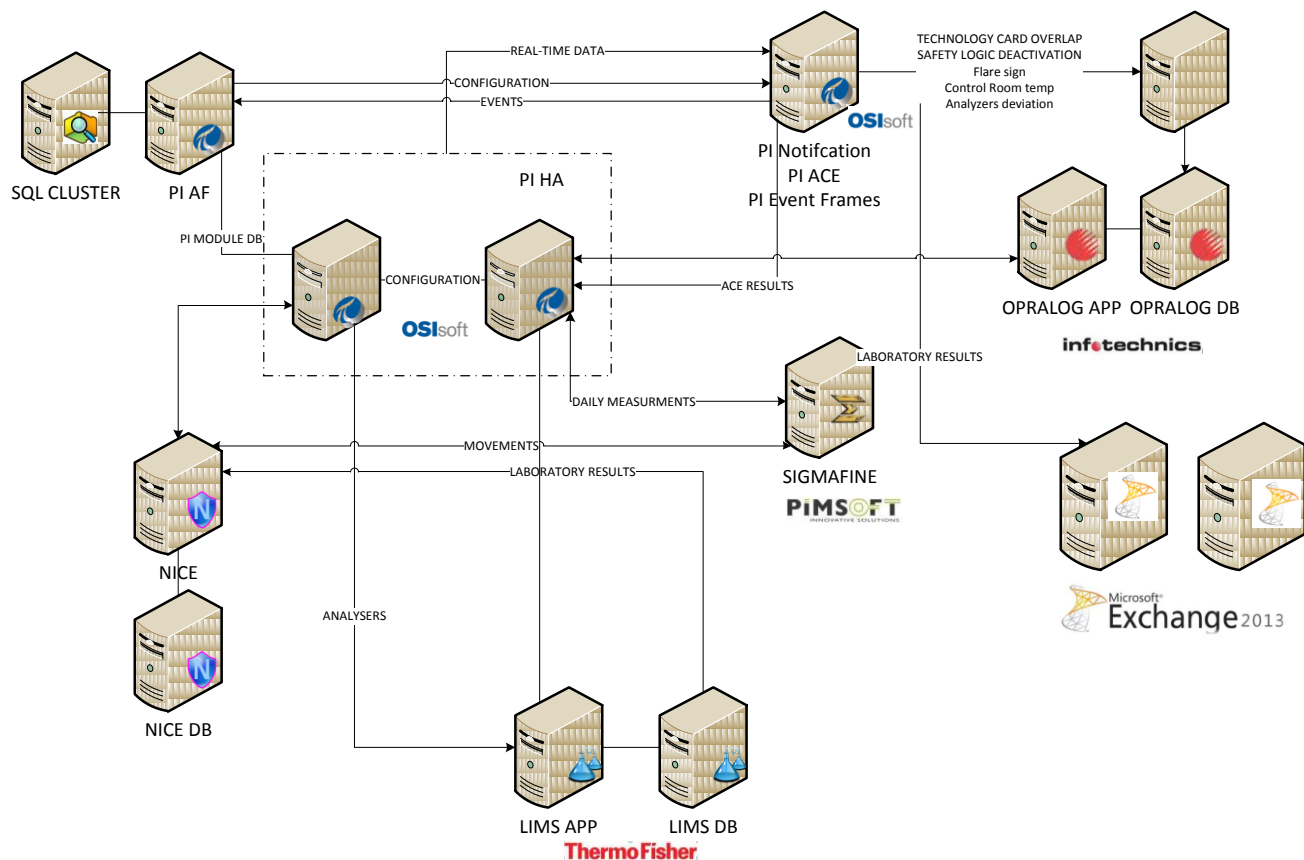
Focus areas of Next Downstream program



Asset Framework (AF)



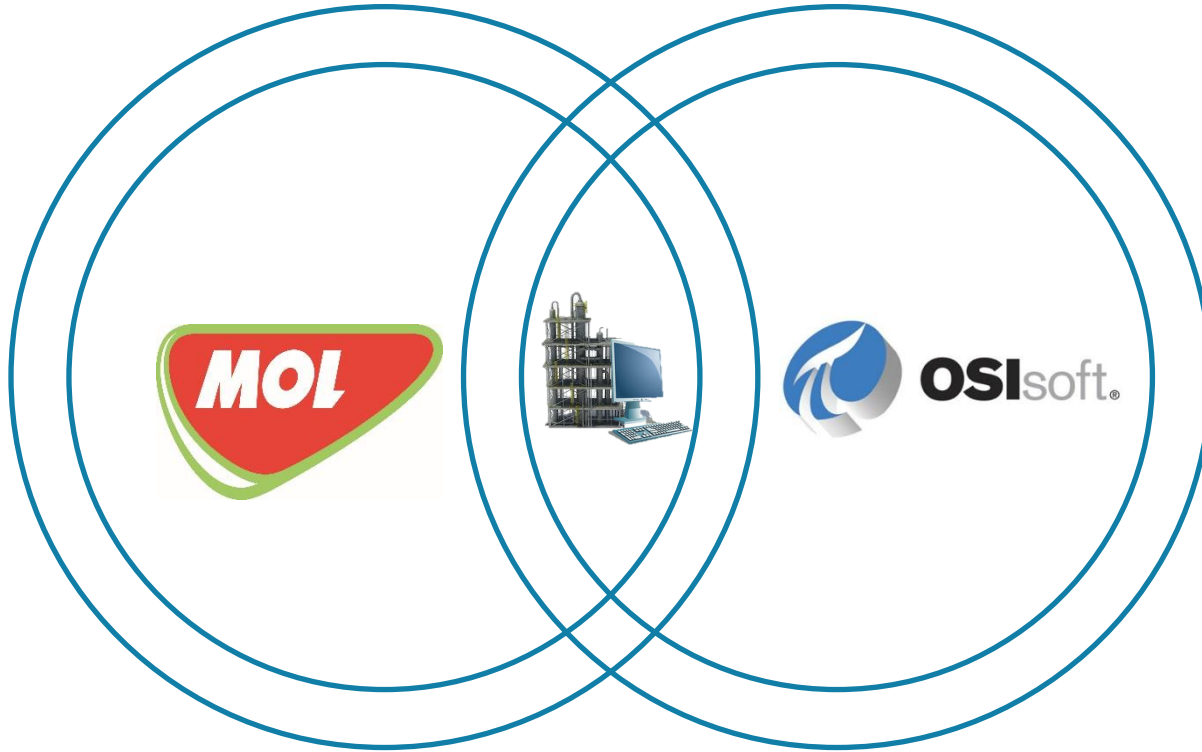
MOL AF structure



MOL AF structure elements

- Interlock statuses
 - Operating envelopes
 - Alarm management
 - Energy KPI breakdown (6 tiers)
 - Column Dashboards
 - Normal mode of control loops
 - APC monitoring
- Energy Monitoring
 - CH, Utilities and Energy balances
 - Flare activities
 - Corrosion control
 - Crude Blending Control
 - Natural Gas and Fuel gas forecasting
 - Control rooms' temperature

Solutions



Interlock statuses

Problem

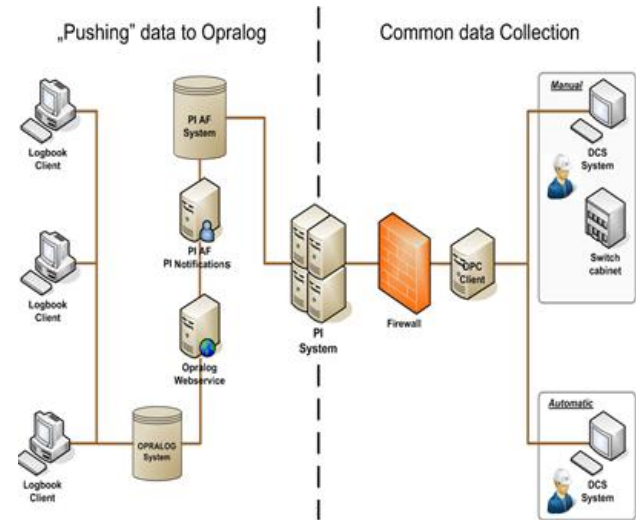
- Overridden interlocks mean unsafe operation
- There are thousands of interlocks and override switches
- The number of disabled interlocks have to be kept on the lowest possible level

Solution

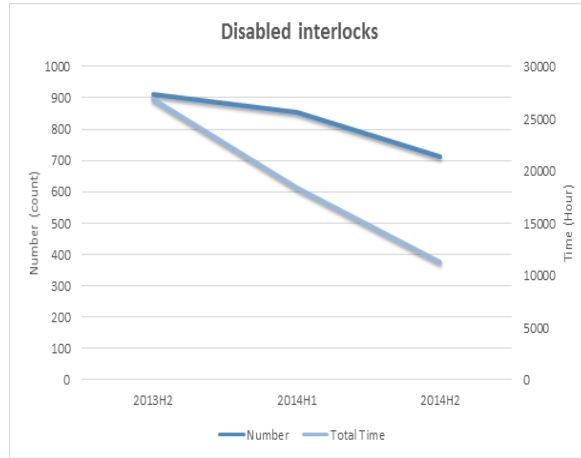
- Central system
- Available for every users
- System Structure:
 - MOS, POS Statuses stored in PI Server
- Unit Structure, Descriptions, interlock names stored in AF
- Calculation in Performance Equations
- Results in Excel Report and shift logbook

Interlock statuses

- Automatic data entry for every interlock override event
- Description field for comments (Why disabled?)
- Information transfer between shifts
- Possibility for reporting of events and causes
- Connecting to PI Server with PI SDK (Visual Basic scripts)
- Comprehensive report about the:
 - Units → Asset Teams
 - Blocks → Process Safety Management experts
- Data in the report:
 - Number of interlock events
 - Period of interlock events



Interlock program benefits



*2013 /11 pcs. shutdowns = 84 lost operation hours

Calculated loss based on EDC is **1.000.000 €**

EDC: Equivalent Distillation Capacity – Solomon study

Switched off interlocks more than 1 day	2013 (H2)	2014 (H1)	2014 (H2)
Pcs.	912	852	714
Days	26.924	18.434	11.256

Total switched off interlocks	2013 (H2)	2014 (H1)	2014 (H2)
Pcs.	2172	2123	1909
Days	29.668	21.900	11.436

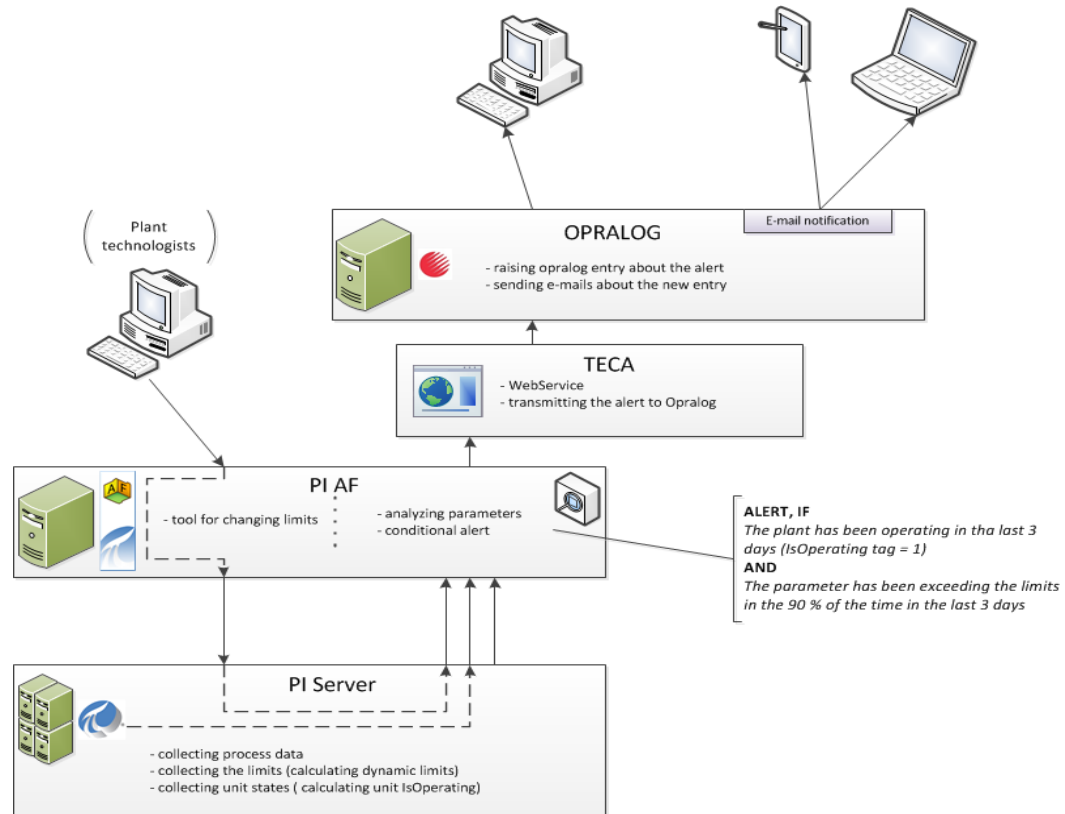
	2013 (H2)	2014 (H1)	2014 (H2)
Interlock relevant events (pcs.)	111	51	32
Unit shutdowns due to interlocks (pcs.)*	11	2	4

*2014 /6 pcs. shutdowns = 32 lost operation hours

Calculated loss based on EDC is **300.000 €**



Operating envelopes – techno card



Technological card parameter definition in AF level

Data storage in Data Archive level

AF Technological card limit data evaluation

AF & Opralog connection via Web service

Opralog notification about Technological cards' entries

Integrity Operating Window

File Edit View Go Tools Help

Database Query Date Back Check In Refresh New Element

Elements

- Elements
 - APC
 - ARGUS
 - Control loops DR
 - Danube Refinery
 - Energy Consumption Predictions
 - Energy KPI System
 - EzIttEgyTeszt
 - Flare Monitoring
 - IOW
 - DHGY2 IOW
 - Alapanyag - Hidrogéntartalom
 - Siófok
 - System
 - Tanks

IOW

General Child Elements Attributes Ports Analyses Version

Name: IOW

Description: Integrity operating envelope

Template:

Categories:

Default Attribute: <None>

[Extended Properties](#)

Find: [Parents](#) [Models](#) [Layers](#) [Connections](#) [Children](#) [Event Frames](#)

General Child Elements Attributes Ports Analyses Version

Name: Feed Hydrogen content

Description: DSR2KA10106.PV

Template: IOW element Template

Categories: IOW

Default Attribute: <None>

Vessel Wall

- Operating limits, parameters assigned to process variables that can effect the reliability of the units.
- KPI monitoring prevent high temperature hydrogen attack, which occurs when hydrogen atoms diffuse into carbon steel and react with the carbon to form methane. The methane accumulates in the steel and causes stress and fissures.

Alarm management

Move the alarm systems from its traditional reactive state to a predictive state

Modification PLCs and interlocks

New POS switches

Enable shelved alarms

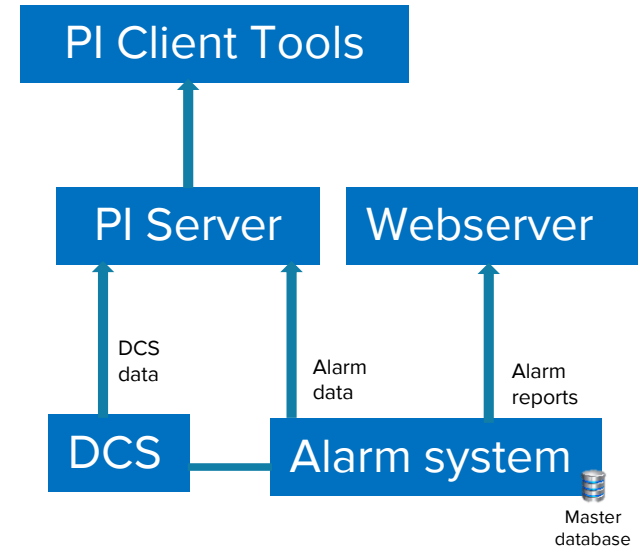
DCS display's modification

Temporarily (168 hours) shelved BADPV alarms

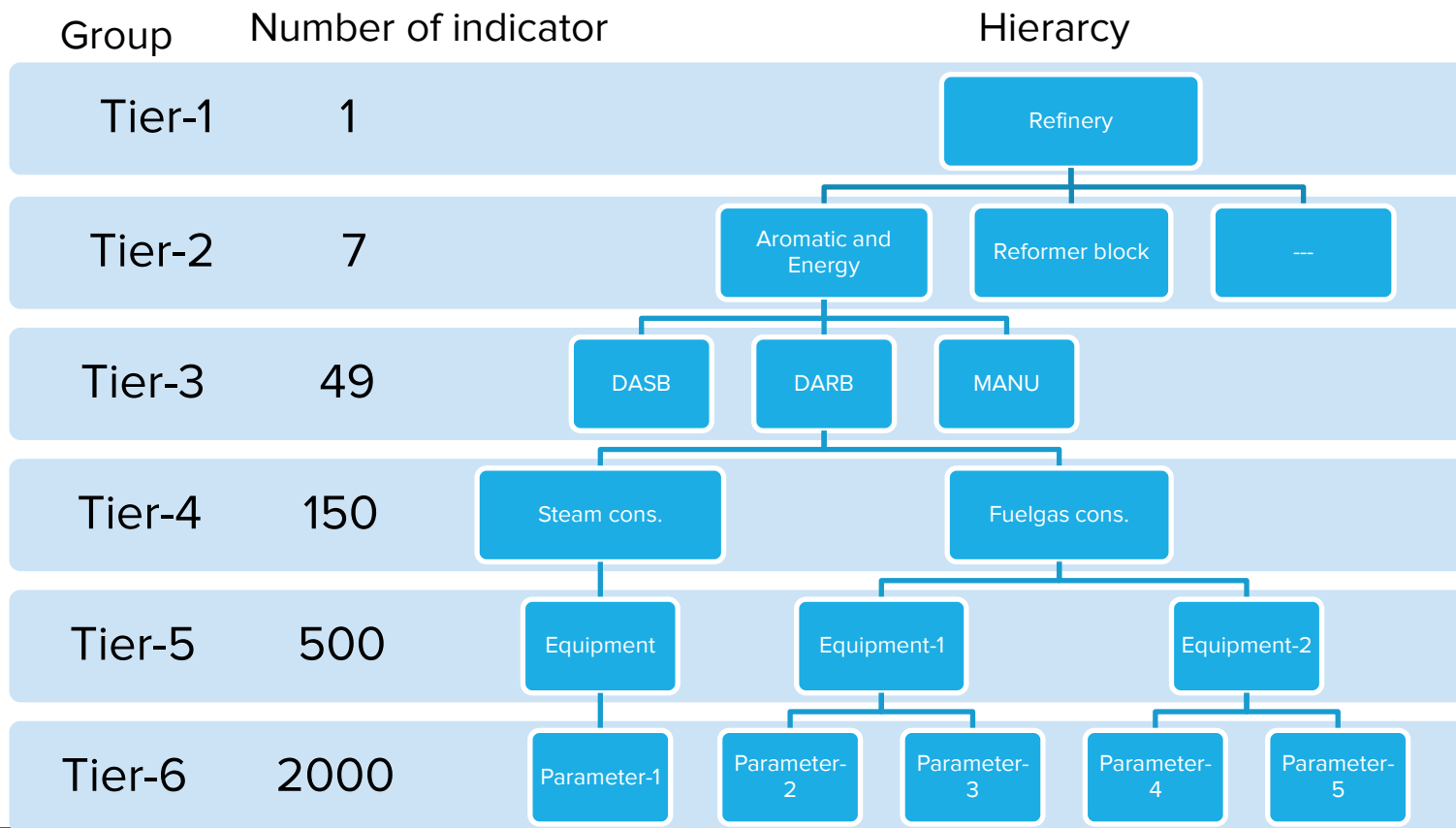
Inhibition of the „Not necessary” alarms

New packages (first out –shut-down alarm;
restart sequences -> alarms only when stuck them)

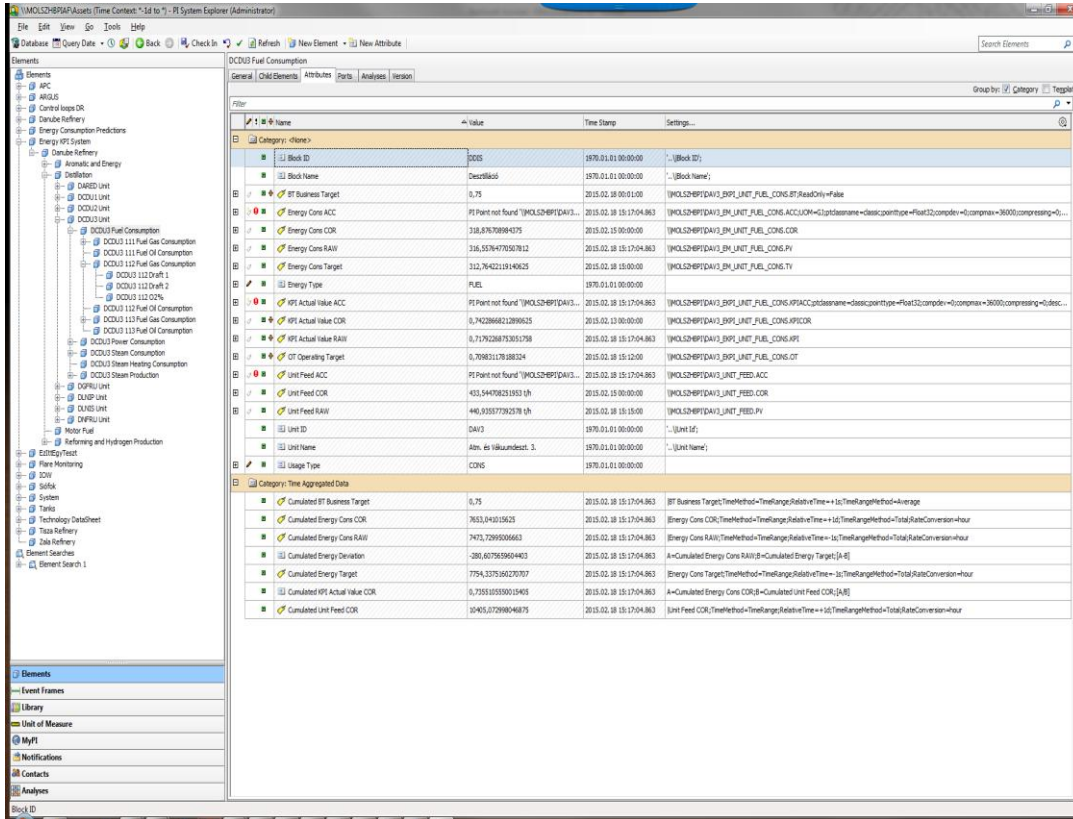
- Furnaces
- Compressors
- Electrostatic Precipitator (ESP)
- NIR analyzers



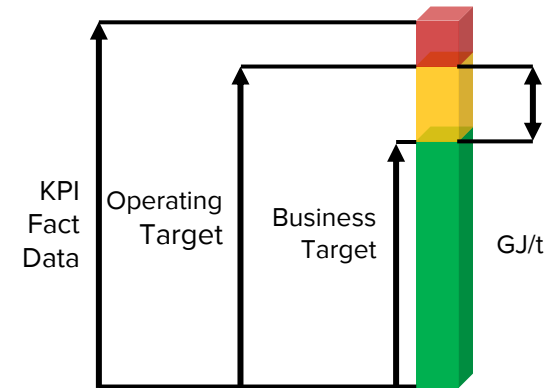
KPI breakdown



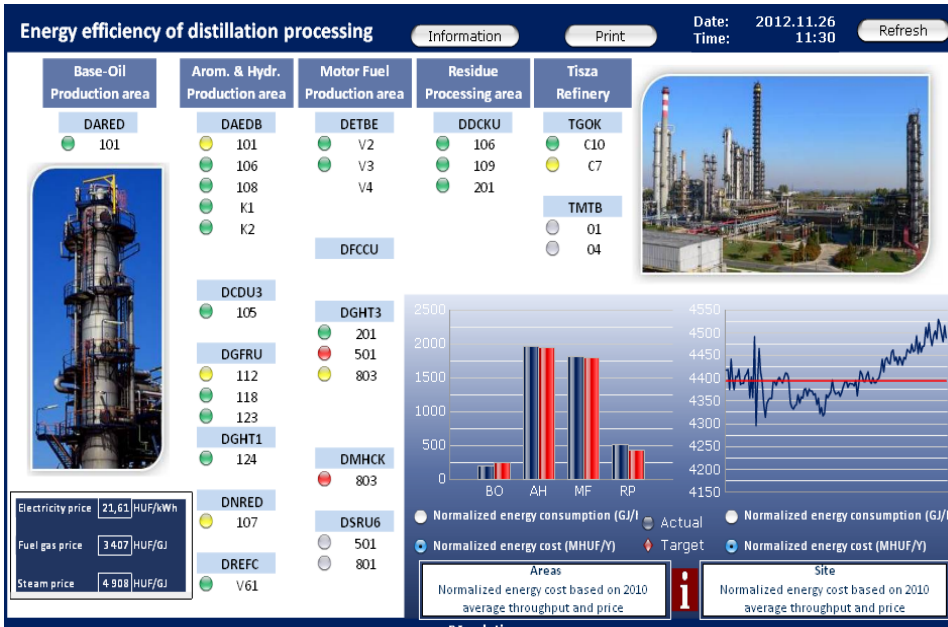
Energy monitoring



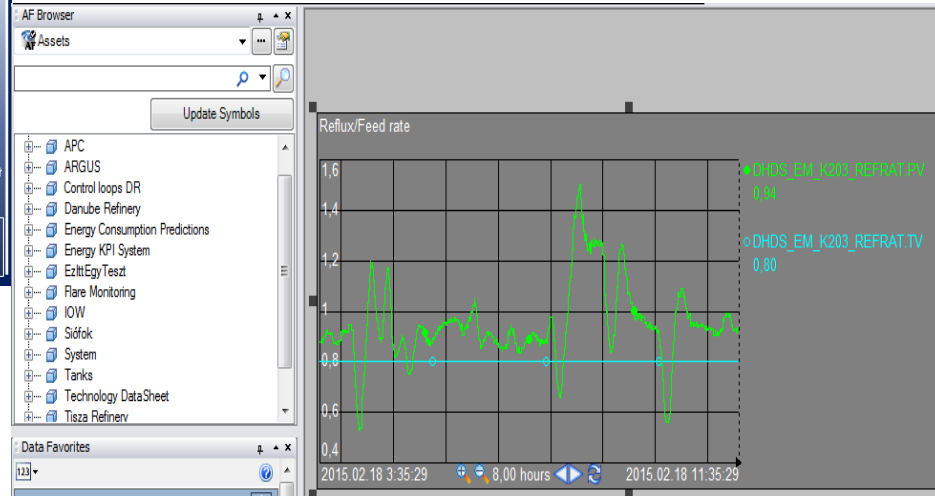
- Operating target can be achieved by proper operation
- Business target can be reached with projects or development
- The fact data calculation must be unified, public and transparent
- Standard tools are needed for the online monitoring and periodic reporting



Column dashboard



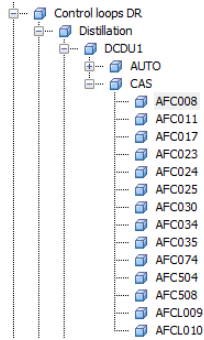
- Expected total savings
 - 2% of steam and fuel gas consumption
 - 3.5 M EUR/y operational cost reduction
 - 20,000 t/y CO2 reduction



Future plan:

- KPI completion with Energy monitoring data
- AF structure establishment

Normal mode of control loops



Filter

Name	Value
Category: <None>	
IsNotNorm	1
MODE	AUTO

AFC008

General Child Elements Attributes Ports Analyses Version

Name Backfilling

normal cascade

Name	Expression
boolresult	<code>Compare('MODE', "*cas*") And (not Compare('MODE', "*man*"))</code>
intresult	<code>If boolresult then 0 else 1</code>
FinalResult	<code>If '..\..\ Is Operating' Then IntResult Else 0</code>

[Add a new expression](#)

- Collect data in a structured form
- Diagnose performance problem
- Report result

APC monitoring

Elements

- APC
 - Aromás és Energiaszolgáltatás
 - DARB
 - 1/101
 - BEN TOL Soft-Sensor**
 - 2/108
 - 3/102
 - K1
 - K2A-K2B
- Desztilláló
 - DAV1
 - DAV2
 - DAV3
 - GFR
 - PEM
- Maradékfeldolgozás
 - Kokszoló
- Motorhajtóanyag gyártás
 - ETBE
 - FCC
 - GOK3
 - HDS
- Reformáló és Hidrogéngyártás

BEN TOL Soft-Sensor

General Child Elements Attributes Ports Analyses Version

Filter

Name	Value
Category: <None>	
Accuracy	5
CL	0
Laboratory	38
LCL	-5
Soft-sensor	38,74864
UCL	5

\\WOLSHBPIAF\Assets\APC\Aromás és Energiaszolgáltatás\DARB\K2A-K2B

- System has high availability
- Non-availability reasons:
 - Measurement errors
 - Software hardware maintenance



Soft – sensor notification

Notifications

Soft-Sensor (75)

- Soft-Sensor (430 V8BTM Propilen Soft-Sensor)
- Soft-Sensor (GO E95 Soft-Sensor)
- Soft-Sensor (SN E95 Soft-Sensor)
- Soft-Sensor (REF 100 Benzene Soft-Sensor)
- Soft-Sensor (KMG0 PMLP Soft-Sensor)
- Soft-Sensor (Naphtha VFP Soft-Sensor)
- Soft-Sensor (V3Top H2O Soft-Sensor)
- Soft-Sensor (BTM Benzene Soft-Sensor)
- Soft-Sensor (Side Benzene Soft-Sensor)
- Soft-Sensor (Side Xylene Soft-Sensor)
- Soft-Sensor (LNA EBP Soft-Sensor)
- Soft-Sensor (Side Toluene Soft-Sensor)
- Soft-Sensor (HCGO Conradson Soft-Sensor)
- Soft-Sensor (HCGO E95 Soft-Sensor)
- Soft-Sensor (LCGO E95 Soft-Sensor)
- Soft-Sensor (BTM C4 Soft-Sensor)
- Soft-Sensor (TOP C5 Soft-Sensor)
- Soft-Sensor (HVA IBP Soft-Sensor)
- Soft-Sensor (BTM PP Soft-Sensor)
- Soft-Sensor (TOP PN Soft-Sensor)
- Soft-Sensor (430 V1Head C4 Soft-Sensor)
- Soft-Sensor (TOP Benzene Soft-Sensor)
- Soft-Sensor (C4 C3 Soft-Sensor)
- Soft-Sensor (HVA E95 Soft-Sensor)
- Soft-Sensor (410 V8Top C5 Soft-Sensor)
- Soft-Sensor (LPG CS Soft-Sensor)
- Soft-Sensor (LNA IBP soft-Sensor)
- Soft-Sensor (TOL BEN Soft-Sensor)
- Soft-Sensor (TOL EB Soft-Sensor)
- Soft-Sensor (V11 VYT Soft-Sensor)

Elements

Event Frames

Library

Unit of Measure

MyPI

Notifications

Contacts

Model Analyses

Analyses

Soft-Sensor

Overview Trigger Message Subscriptions History

Target: \\MOLSHBPIAF\Assets\APC\Motorhajóanyag gyártás\HDS\K201 Frakcionáló\SN E95 Soft-Sensor

Conditions

New Condition

Rule Configuration Time

SQC

Source Delta

UCL UCL

CL CL

LCL LCL

Clear on Control Limit Change

Pattern Tests

Outside Control 1 of 1 Above

Outside 2 Sigma 2 of 3 Both

Outside 1 Sigma 4 of 5 Both

One Side of Center Line 8 of 8 Both

Stratification 15 of 15

Mixture 8 of 8

Trend 8

OK Cancel

Time Rule: Natural

Options

Notify only on change in status

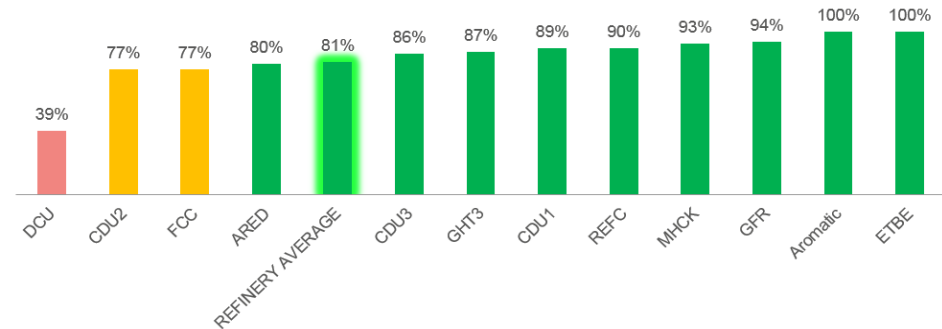
Resend Interval: 0 Seconds

Non Repetition Interval: 0 Seconds

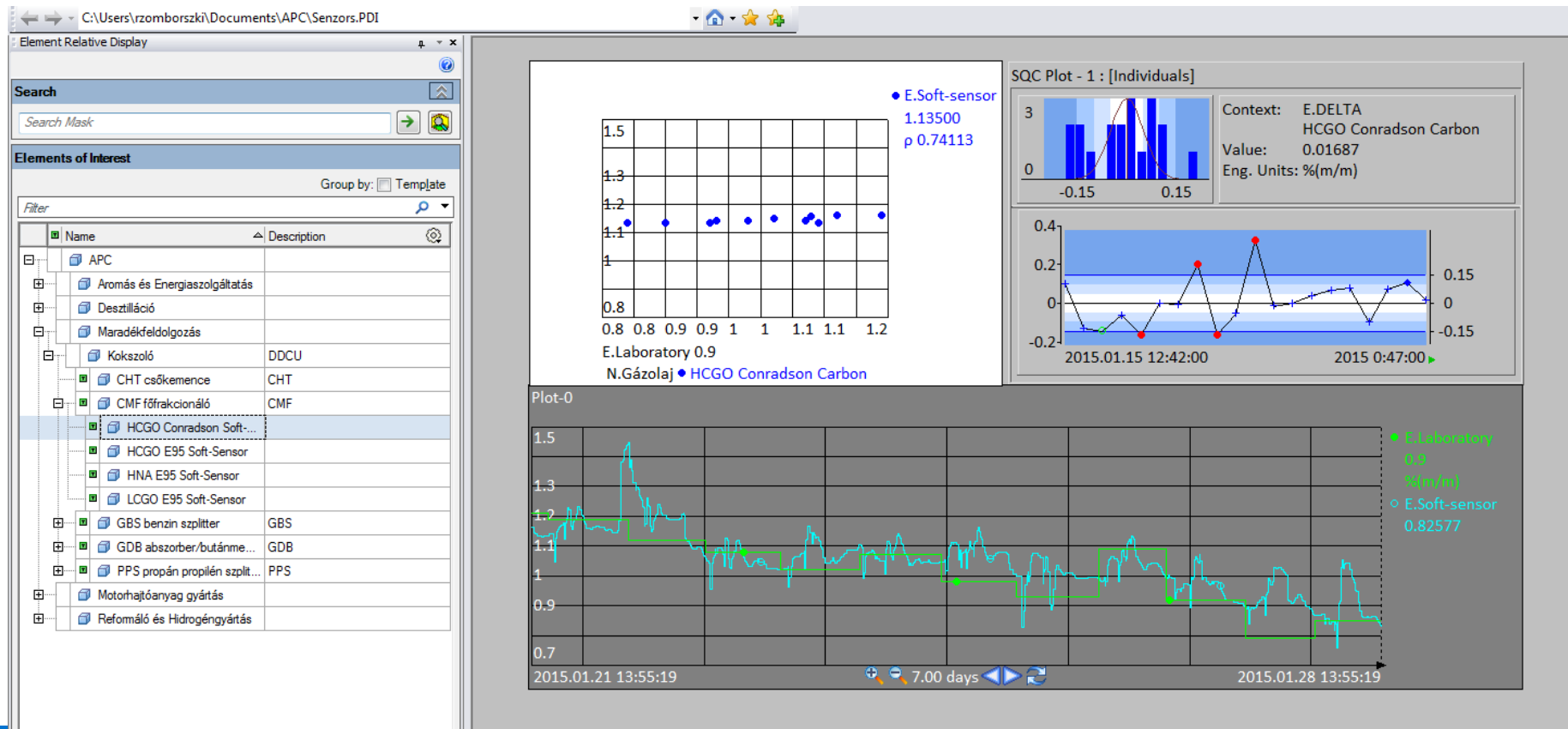
Soft sensor accuracy:

- Accuracy of quality estimations.
(If the accuracy is low, APC can not be used.)
- Accuracy effected by measurement errors and major operation change

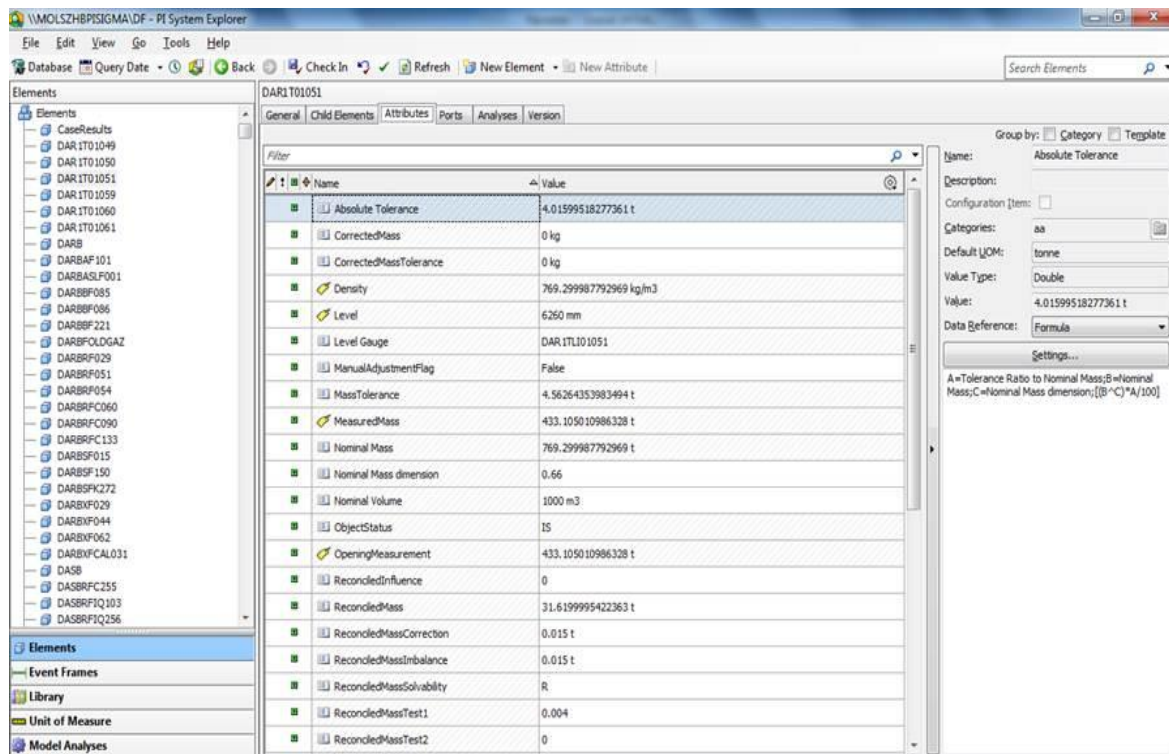
Soft Sensor Accuracy KPI



Soft-sensor monitoring via PI ProcessBook



CH, Utilities, and Energy balances



The screenshot displays the PI System Explorer interface. The main window shows the 'Attributes' tab for the element 'DAR1T01051'. A list of attributes and their values is shown in the center pane. The right pane shows the 'Settings' for the selected attribute, 'Absolute Tolerance'.

Name	Value
Absolute Tolerance	4.01599518277361 t
CorrectedMass	0 kg
CorrectedMassTolerance	0 kg
Density	769.299987792969 kg/m ³
Level	6260 mm
Level Gauge	DAR1TL101051
ManualAdjustmentFlag	False
MassTolerance	4.56264353983494 t
MeasuredMass	433.105010986328 t
Nominal Mass	769.299987792969 t
Nominal Mass dimension	0.66
Nominal Volume	1000 m ³
ObjectStatus	IS
OpeningMeasurement	433.105010986328 t
ReconciledInfluence	0
ReconciledMass	31.6199995422363 t
ReconciledMassCorrection	0.015 t
ReconciledMassImbalance	0.015 t
ReconciledMassSolubility	R
ReconciledMassTest1	0.004
ReconciledMassTest2	0

Settings for Absolute Tolerance:

- Name: Absolute Tolerance
- Description:
- Configuration Item:
- Categories: aa
- Default UOM: tonne
- Value Type: Double
- Value: 4.01599518277361 t
- Data Reference: Formula

Formula: $A = \text{Tolerance Ratio to Nominal Mass}; B = \text{Nominal Mass}; C = \text{Nominal Mass dimension}; [(B - C) * A / 100]$

Sigmafine performs the functions of data validation by running a configurable series of analyses on a model built with OSIsoft's AF.

PI System Explorer is another tool that you can use to build/edit a model and run analyses on it.

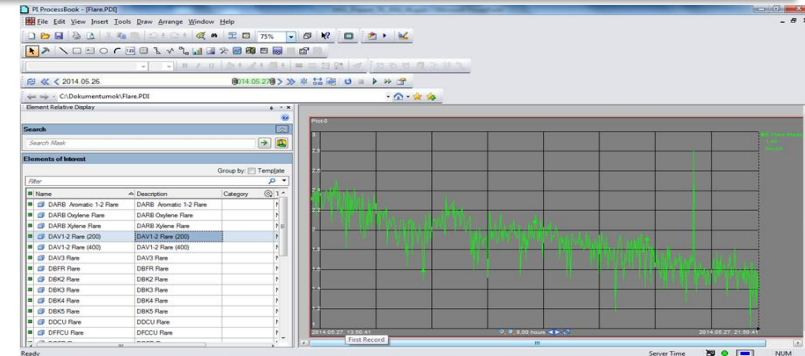
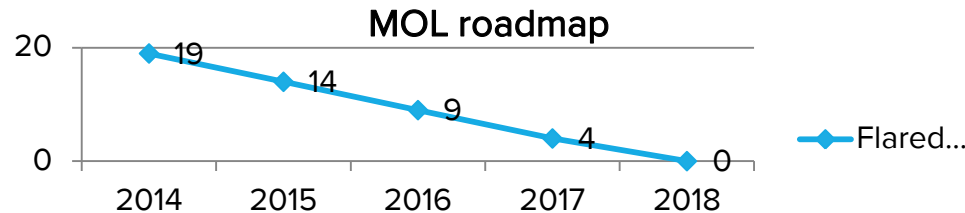
Sigmafine tank attribute store Refinery daily balance managed via AF environment.

Flare activities

Flare Monitoring	
DARB Aromatic 1-2 Flare	
DARB Oxylene Flare	
DARB Xylene Flare	
DAV1-2 Flare (200)	
DAV1-2 Flare (400)	
DAV3 Flare	
DBFR Flare	
DBK2 Flare	
DBK3 Flare	
DBK4 Flare	
DBK5 Flare	
DDCU Flare	
DFCCU Flare	
DGFR Flare	

Category: <None>	
Averaging period	10
External link	HDS_flare
Flare Measure...	0,00038000941276550293
Flare name	HDS (187.j.) flare
Flare PI tag	DHDSFF001.PV
Is operating	1
Measuring range	10
Notification Limit	1
Notification tun...	1,2

- In 2013 MOL initiated E-flare program which uses PI client tools and Opralog logbook application – to record flaring activities
- Aim of the project to reduce the losses by 5-10 % supported by a full PDCA cycle establishment.



Natural Gas Consumption Prediction

BackGround

- Huge saving possibilities in the decrease of contracted natural gas daily maximum amount

Problem

- High penalty on daily amount exceedance
- Alerting system was needed

Solution

- Consumption prediction calculations in PI Analysis
- Detailed information on PI Coresight display (about consumption, prediction, contacts of decision makers)
- E-mail alerting system in Notifications

The screenshot shows the PI Coresight interface. On the left is the 'Elements' tree, which includes a hierarchy for 'MOLHU NatGas Cons' with sub-elements like 'DF C3 compressor stop', 'DF Fuel Oil Burning in BoilerPlant', etc. On the right is the 'General' tab of the Properties window. It contains a 'Filter' section and a table of data.

Category	Value
Category: <None>	
CoreSight Link: http://moiszhbpicore/Coresight/#/PSD...	
Category: Auxiliary Calculations	
Category: Consumption Calculations	
Cumulated Daily Consumption	18723164 MJ
Current Consumption	1991855,5 MJ/h
Predicted Daily Consumption	49276016 MJ
Category: Exceedance Calculations	
Alert State	4
HI Limit Exceedance	0 MJ
Category: Limits	
HI Alert	59500000 MJ
HIHI Alert	61000000 MJ
LO Alert	0 MJ
LOLO Alert	0 MJ

The screenshot shows the 'Analyses' tab of the Properties window. It contains a table with columns for Name, Configuration, Schedule, Output(s), and Backfilling. Below the table is an 'Expression' section with a table of Name and Expression.

Name	Configuration	Schedule	Output(s)	Backfilling
fe0 Auxiliary Calculations	RemainingDayRatio := In...	Frequency=120...	RemainingDayPart; RefD...	
fe0 CumulatedDailyConsumption	CumulatedDailyConsump...	Frequency=120...	Cumulated Daily Consum...	✓
fe0 CurrentConsumption	CurrentConsumption := T...	Frequency=120...	Current Consumption	✓
fe0 PredictedDailyConsumption	SecondsToNextGasDayTu...	Frequency=120...	Predicted Daily Consump...	✓

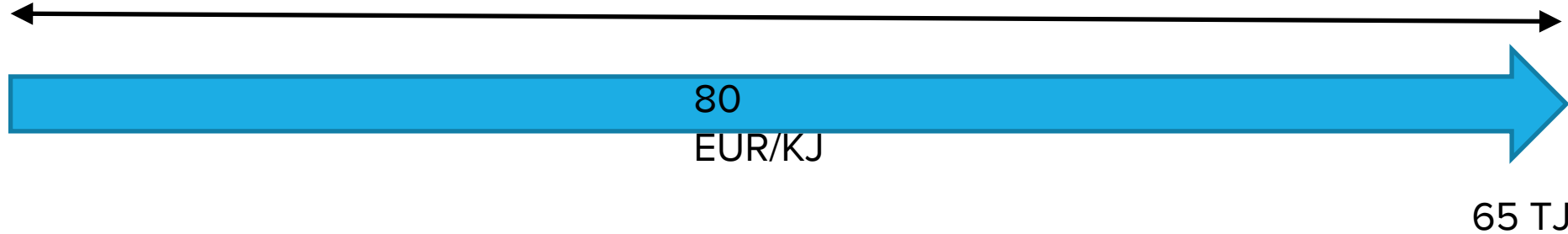
Name	Expression
SecondsToNextGasDayTurn	<code>Int(Bod('*-6h')+'+30h'-'*')</code>
PredictedDailyConsumption	<code>'Cumulated Daily Consumption'+ 'Current Consumption'*SecondsToNextGasDayTurn/3600</code>

[Add a new expression](#)

New Availability Contract

Availability fee
BEFORE

5 280
kEUR/yr



Availability fee
AFTER

5 120 kEUR/yr

Saving:
240 kEUR/yr



System in action

Problem

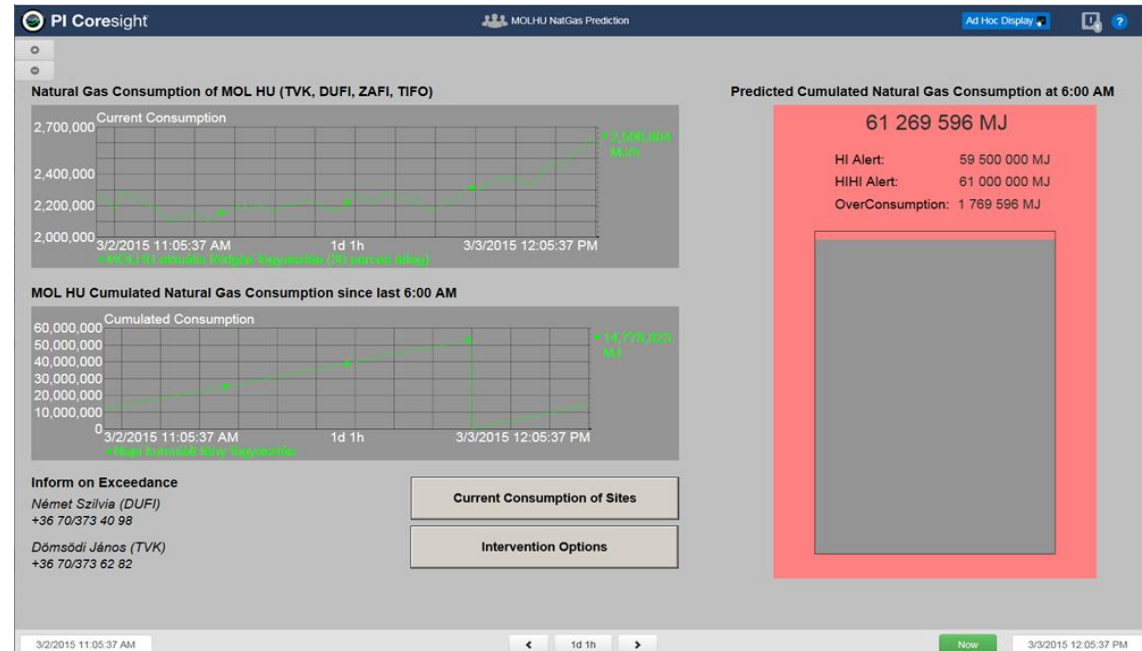
- Unit startup in both of our sites
- Problems during startup resulted in unexceptedly high gas consumption

E-mail alert

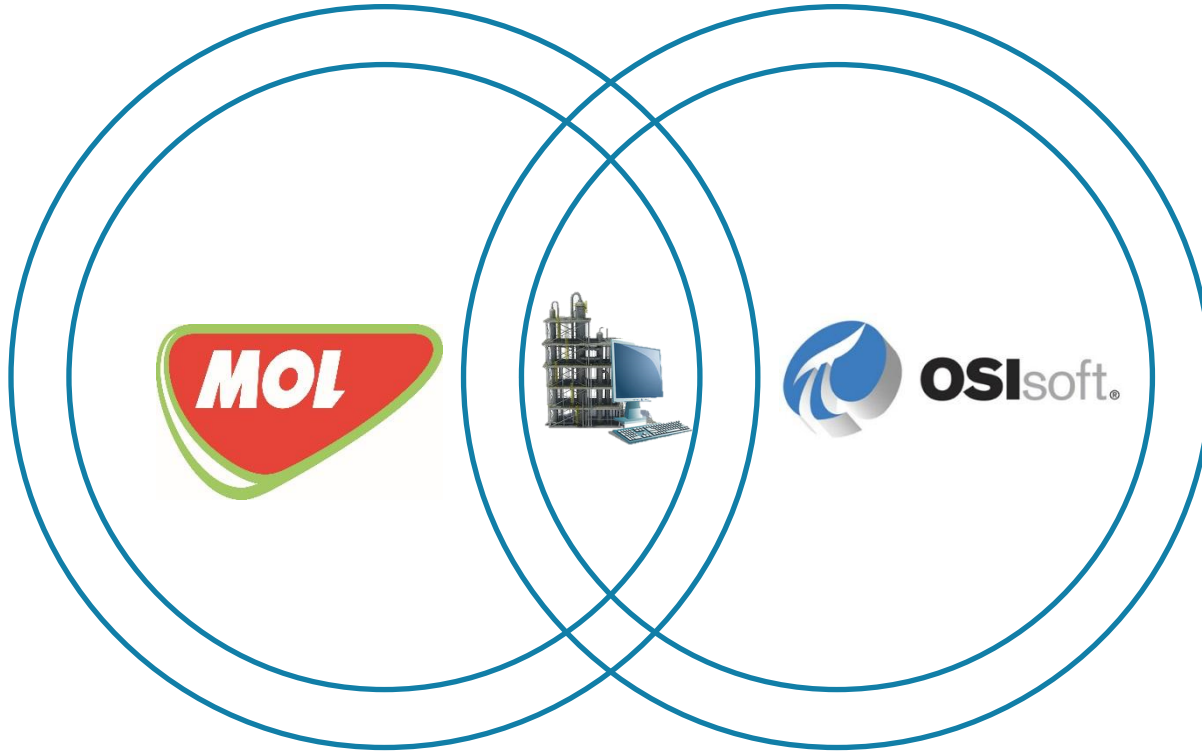
- The dispatchers and managers were informed in e-mail
- Communication started about the intervention possibilities
- Cooperation between sites (200 km distance) to find the cheapest intervention

Further improvement possibility

- High availability AF Analytics solution

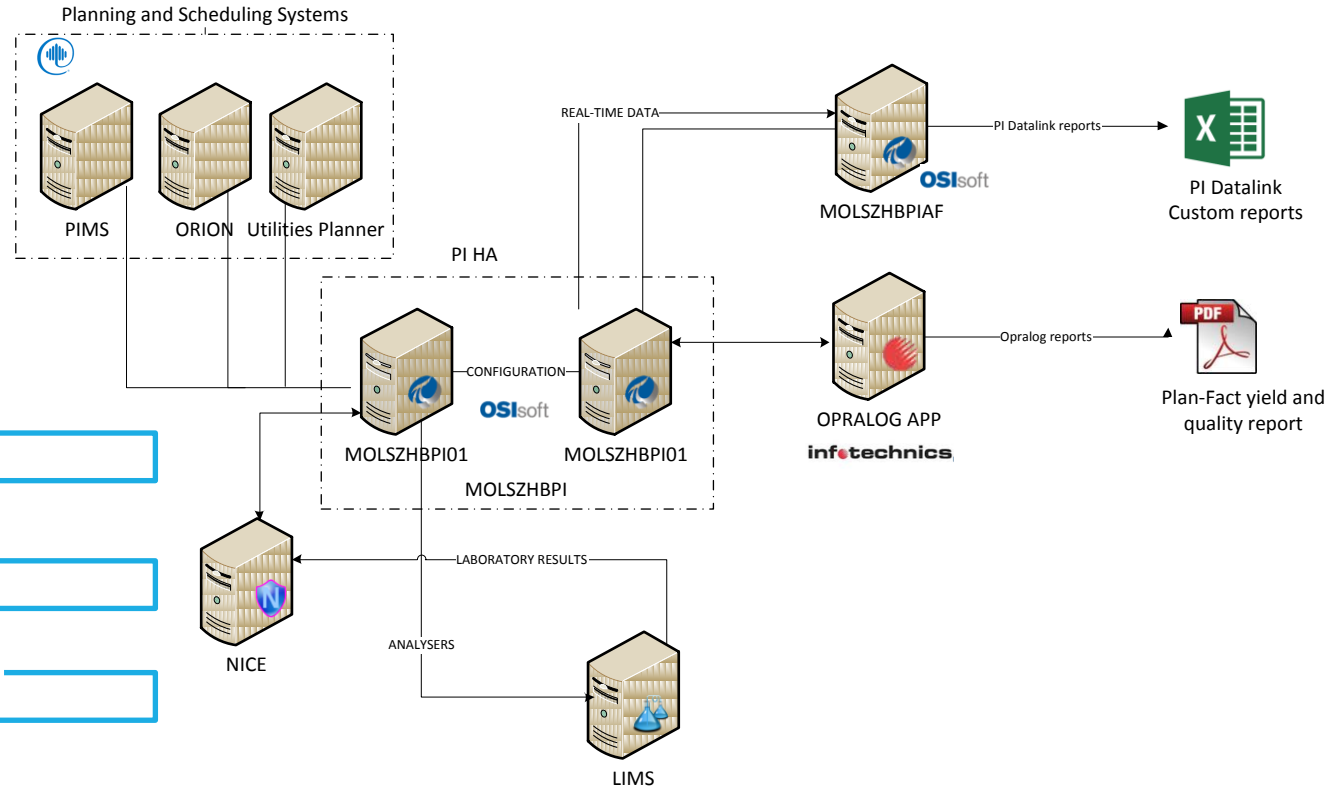


Future



Future Data

Testing with Planning and Scheduling Data



Simplier Architecture

Better Collaboration
between SCM & Production

PI System is the main report provider

Summary

„High achievement always takes place in the framework of high expectation. „

Charles Kettering



Business Challenges

- A. Corporate Initiatives – e.g. Lean manufacturing, ISO 50001 implementation
- B. Technological support for different DS areas
- C. Process goals – increases yield, improved efficiency

Solution(s)

- A. New data warehouse & report establishment, structured data visualization
- B. Corrosion & crude blending control via AF
- C. Monitoring flaring activity, energy consumption

Results and Benefits

- A. Goals and Initiatives Achieved
- B. The Measurable Value Realized
- C. Transparent business objectives and processes

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MOL, PLC



Questions

Please wait for the **microphone**
before asking your questions

State your
name & company





THANK
YOU

