



# Use of PI to increase refinery margin

Presented by **Tomas Montin – Production Engineering Manager**



OSIsoft®

# REGIONAL SEMINARS 2012

The **Power** of **Data**

# Agenda

1. A few words about me
2. A few words about Nynas
3. Nynas PI system – General structure
4. How we use PI to enhance production
  - Monitoring of performance
  - Increased reliability
  - Operator support and plant optimization
  - Operator training
5. Summary

## A few words about me – Tomas Montin

- Exam from Royal Institute of Technology Stockholm 1979
- Employed by Nynas since 1984:
  - Project manager engineering
  - Planner Group Optimisation
  - Manger Process control systems
  - Plant manager crude distillation unit
  - Planning manager Nynäshamn refinery
  - Manger Corporate Planning and Optimization
  - Asset Manager NSP units
  - Production engineer and manger production engineers

# A global business



- ▶ Nynas concentrate on specialised oil applications bitumen
- ▶ Nynas has over 850 employees with specialist knowledge

# Our specialised oil applications

## Specialty oils

- Tyre oils
- Base oils
- Process oils
- Transformer oils
- Insulating Oil Management

## Bitumen applications

- Paving grades
- Performance asphalt
- Surface treatment
- Cold paving technology
- Industrial applications

## Nynas operates three refineries in Europe:

- Nynäshamn (Sweden)
- Gothenburg (Sweden)
- Dundee (UK)

All three refineries have a common PI database running on a server in Nynäshamn





## Nynas PI system in general

- All process displays from DCS has been duplicated in PI ProcessBook.
- We have developed many Excel applications which uses PI DataLink to retrieve data.
- We also use PI Batch
- Web-applications has been developed (Mainly using ASP code)
- PI ProcessBook run in a Citrix environment.
- The PI database contains about 10 000 tags and about 200 performance calculations.
- The system was implementation by Plant Soft and was up running 2007 in Nynäshamn



## PI system components in use at Nynas

- ProcessBook
- DataLink
- PI Batch
- PI SQC Client (installed but not in active use)
- PI WebParts

## **Nynas PI system integrates data from different sources**

- Data from control system - all three Nynas refineries
- Tank-farm data (levels, mass and volume inventory, temperatures etc.)
- Lab-data for all product streams.
- Quality limits – target values, control limits and slop limits.
- Production value for each stream
- Planned flow rates for different feed and product streams.
- Product flow rates to approved tanks as well as to slop tanks.

Operators select mode of operation from DCS (DeltaV) display and this information is used in PI

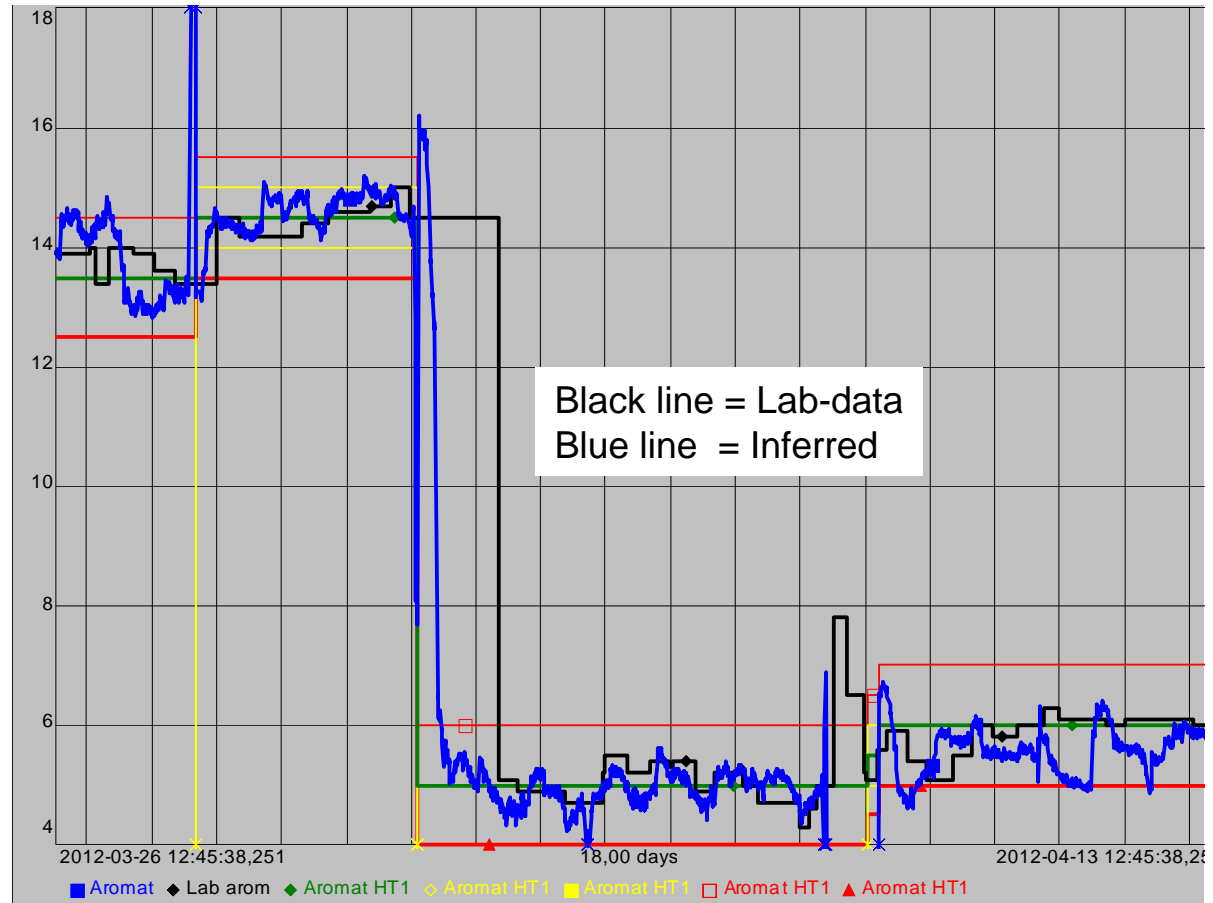
VD2 KÖRFALL 7

1. B300/310L	LAGT UTBYTE FR2
4. B300/312	INJICERING
5. B300/316	INJICERING
6. B300/318	
7. B55/506	OXIDERING
8. B55/507	OXIDERING
9. B55/511L	LAGT UTBYTE FR2
12. B55/512	INJICERING
13. B55/515	
14. B55/518	INJICERING
17. D800C/800	CAPTAIN
19. D900CL/901	CAPTAIN/LEADON
21. D900/903	CAPTAIN/LEADON
23. STOPP	
24. D200CE/201	
25. D200CE/202	
26. D300CA/731	VINCENT/CAPTAIN
27. D401/ALBA	ALBA

02PC017 i 50HS076 i 11BA001A i 11BA001B i 68LCP002 i

## Quality against limits – Process Book

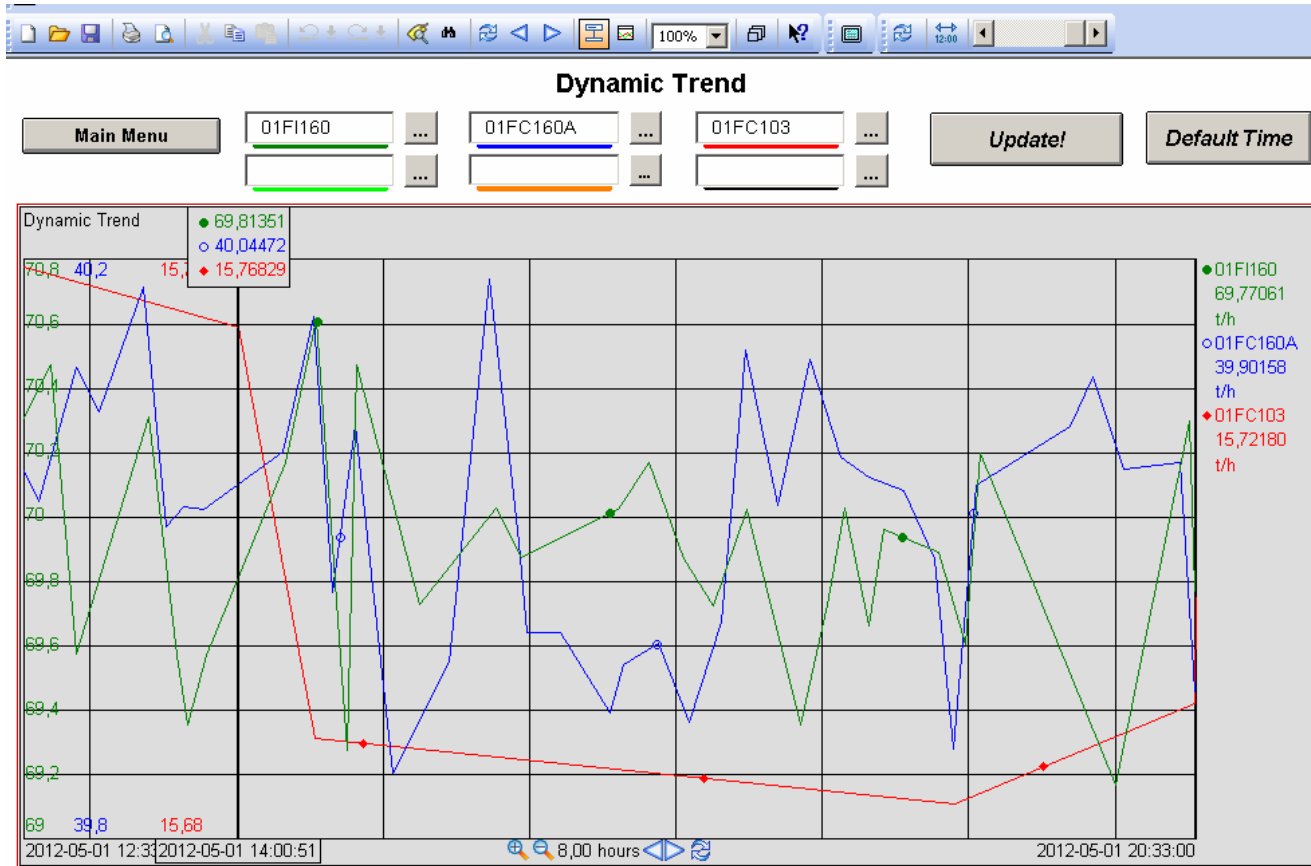
- Limits are retrieved from lab information system and is mode dependant.
- Most quality parameters are “inferred” – calculated – using model which is calibrated against lab-data.



## Plant Soft developed two useful data tools for us

- A general trend package
- A tool which calculates average data

# Trend tool to trend up to six signals



## Calculates average and accumulated values

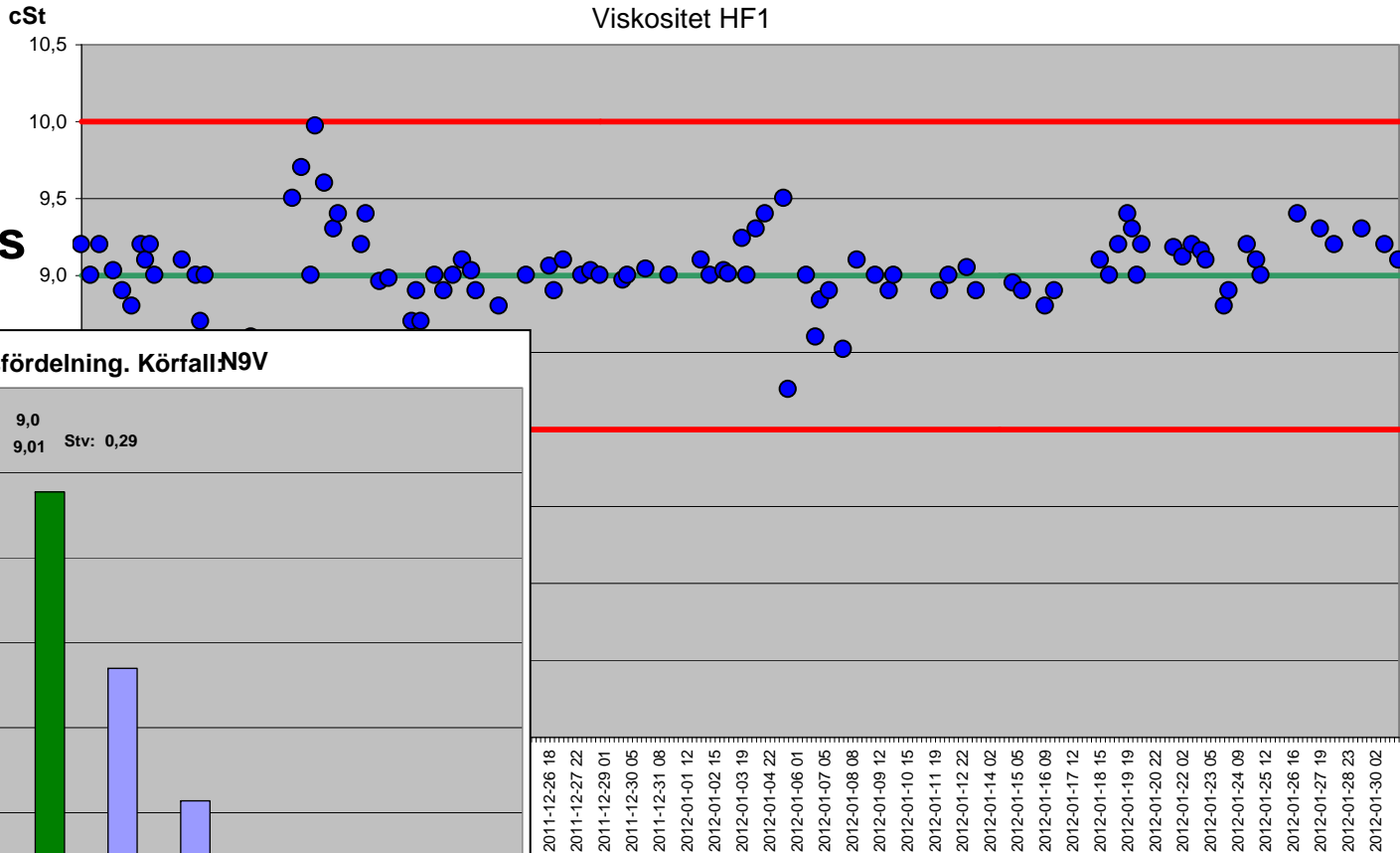
Time From:  To:   
 01-May-12 20:40:03 30-Apr-12 20:40:03

	08QI001_I	01FC103				
Description	Konverteringsgrad	FRAKTION 1				
Units	%	t/h				
Average	99,31	15,79				
Minimum	98,48	0,00				
Maximum	99,45	16,26				
StdDev	0,13	0,36				
Variance	0,02	0,13				
Total	n/a	378,89				
% Good	100,00	100,00				

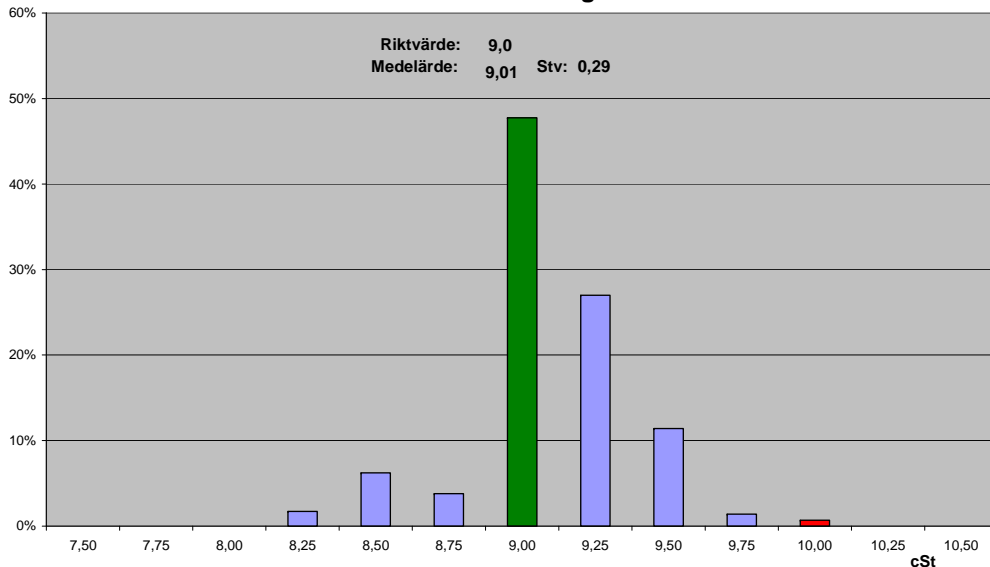


# PI used for monitoring of performance

# Nynas use Excel DataLink reports for monitoring of individual batches



**Viskositet labvärden - frekvensfördelning. Körfall N9V**



2011-12-26 18  
 2011-12-27 22  
 2011-12-29 01  
 2011-12-30 05  
 2011-12-31 08  
 2012-01-01 12  
 2012-01-02 15  
 2012-01-03 19  
 2012-01-04 22  
 2012-01-06 01  
 2012-01-07 05  
 2012-01-08 08  
 2012-01-09 12  
 2012-01-10 15  
 2012-01-11 19  
 2012-01-12 22  
 2012-01-14 02  
 2012-01-15 05  
 2012-01-16 09  
 2012-01-17 12  
 2012-01-18 15  
 2012-01-19 19  
 2012-01-20 22  
 2012-01-22 02  
 2012-01-23 05  
 2012-01-24 09  
 2012-01-25 12  
 2012-01-26 16  
 2012-01-27 19  
 2012-01-28 23  
 2012-01-30 02

# How to create Excel – DataLink – graphs with a variable time range

- Use the same number of data points (288 in this example) and calculate time interval

	C	D	E	F
Start date	2011-12-07 08:00	2011-12-07 08:00	274,58	
End date	2012-01-31 06:00	2012-01-31 06:00	274,58	
Time interval	274.58333333333321m	274.58333333333321m	274,58	

- Add an “m” for minutes

	C	D	E	F
Start date	2011-12-07 08:00	2011-12-07 08:00	274,58	
End date	2012-01-31 06:00	2012-01-31 06:00	274,58	
Time interval	274.58333333333321m	274.58333333333321m	274,58	

# Batch search for Excel to retrieve start and end time for batches

The screenshot shows the 'PI BatchView for Excel' application window. The 'Search' tab is active, displaying search parameters. The search criteria are: Find: All, PIUnitBatches, phdb01; Include: Both; Batch ID: \*, Product: \*, Unit Name: \*H\*; Time Range: Active, Between \*-1500 day and \*; Any Length: .

The results table below shows the following data:

Batch ID	Start Time	End Time	Product	Unit Name	Procedure	F
30	2012-04-30 02:1...	Still Running	T110CV	HT2	30	p
1	2012-04-28 21:5...	Still Running	N9V	HF1	1	p
4	2012-04-27 06:1...	Still Running	T22V	HT1	4	p
7	2012-04-23 07:2...	2012-04-30 02:1...	T110V	HT2	7	p
10	2012-04-21 11:4...	2012-04-27 06:1...	S9CV	HT1	10	p
23	2012-04-16 06:5...	2012-04-23 07:2...	S90C	HT2	23	p
30	2012-04-14 04:5...	2012-04-16 06:5...	T110CV	HT2	30	p
3	2012-04-13 19:5...	2012-04-21 11:4...	N58V	HT1	3	p
10	2012-04-13 10:5...	2012-04-28 21:5...	N9CV	HF1	10	p
1	2012-04-08 04:4...	2012-04-13 19:5...	N53V	HT1	1	p
1	2012-04-08 02:5...	2012-04-13 10:5...	N9V	HF1	1	p
3	2012-04-08 01:0...	2012-04-08 04:4...	N58V	HT1	3	p

At the bottom of the window, a summary row is visible:

7	09-mar-yy hh:20:10	21-mar-yy hh:59:42	T110V	Nynas\Batch\HT2	7	phdb01
---	--------------------	--------------------	-------	-----------------	---	--------

## Batch search is a powerful tool to compare individual batches

Anläggning	Produkt	Starttid	Sluttid	Körlängd	Verkligt	Flöde in		Verkligt	Flöde ut	
				Dagar		Planerat	Skillnad		Planerat	Skillnad
						t/h			t/h	
HT1	NS3V	2012-04-08 04:42	*	Pågår	24,4	25,0	-0,6	21,1	19,7	1,4
HF1	N9V	2012-04-08 02:54	*	Pågår	25,2	23,0	2,2	22,7	20,2	2,4
HT1	NS8V	2012-04-08 01:08	2012-04-08 04:42	0,1	24,1	7,4	16,7	20,7	7,3	13,4
HT2	T22V	2012-04-07 02:25	*	Pågår	27,9	30,0	-2,1	26,2	26,4	-0,2
HT2	T110C	2012-04-05 15:01	2012-04-07 02:25	1,5	27,5	28,0	-0,5	26,3	25,3	1,0
HT2	T400C	2012-04-02 16:05	2012-04-05 15:01	3,0	25,9	26,0	-0,1	25,3	23,9	1,4
HT1	S9CV	2012-04-01 02:30	2012-04-08 01:08	6,9	25,3	26,0	-0,7	23,8	23,0	0,7
HT1	T22V	2012-03-28 16:10	2012-04-01 02:30	3,4	24,1	25,0	-0,9	22,6	22,2	0,4
HT2	T110CV	2012-03-28 14:01	2012-04-02 16:05	5,1	25,3	26,0	-0,7	24,0	23,3	0,7
HT2	T110C	2012-03-26 01:53	2012-03-28 14:01	2,5	24,9	27,0	-2,1	24,3	24,4	-0,2
HT1	N9V	2012-03-22 11:46	2012-03-28 16:10	6,2	24,5	26,0	-1,5	22,9	22,8	0,2
HT2	T22V	2012-03-21 23:59	2012-03-26 01:53	4,1	24,3	24,0	0,3	22,9	21,4	1,6
HT1	NS8V	2012-03-10 11:18	2012-03-22 11:46	12,0	21,1	7,0	14,1	19,0	19,5	-0,5
HT2	T110V	2012-03-09 04:20	2012-03-21 23:59	12,8	25,0	27,0	-2,0	22,9	22,8	0,1
HT2	T110CV	2012-03-05 05:05	2012-03-09 04:20	4,0	22,3	26,0	-3,7	21,3	23,3	-2,0

Data has deliberately been changed for confidentiality reasons.

## PI used to increase reliability

# Running time for compressors and pumps are monitored

## Compressor Running Time Analysis

Starttid: 2011-05-02 00:00  
 Sluttid: 2012-05-01 00:00

2012-04-30 00:00  
 2012-05-01 00:00

Tag	Beskrivning	Current	"ON" state	Formula	Gångtid Timmar	% ON
24XL204A	Makeup kopressor A	1	1	('24XL204A' = 1)	<b>6238,1</b>	71,2%
24XL204B	Makeup kopressor B	1	1	('24XL204B' = 1)	<b>4257,1</b>	48,6%
24XL304A	Cirk kompressor A	1	1	('24XL304A' = 1)	<b>6471,6</b>	73,9%
24XL304B	Cirk kompressor B	1	1	('24XL304B' = 1)	<b>5469,0</b>	62,4%
24XL304S	Cirk kompressor S	1	1	('24XL304S' = 1)	<b>5050,4</b>	57,7%
24XL714	PC2403	1	1	('24XL714' = 1)	<b>7017,0</b>	80,1%
02PC0201A	Make.up A i drift	1	1	('02PC0201A' = 1)	<b>5430,0</b>	62,0%
02PC0201B	Make.up B i drift	0	1	('02PC0201B' = 1)	<b>3721,5</b>	42,5%
02PC0202A	CIRK A i drift	0	1	('02PC0202A' = 1)	<b>3648,6</b>	41,7%
02PC0202B	CIRK B i drift	1	1	('02PC0202B' = 1)	<b>6040,6</b>	69,0%



# Operating window measure process-parameters against limits

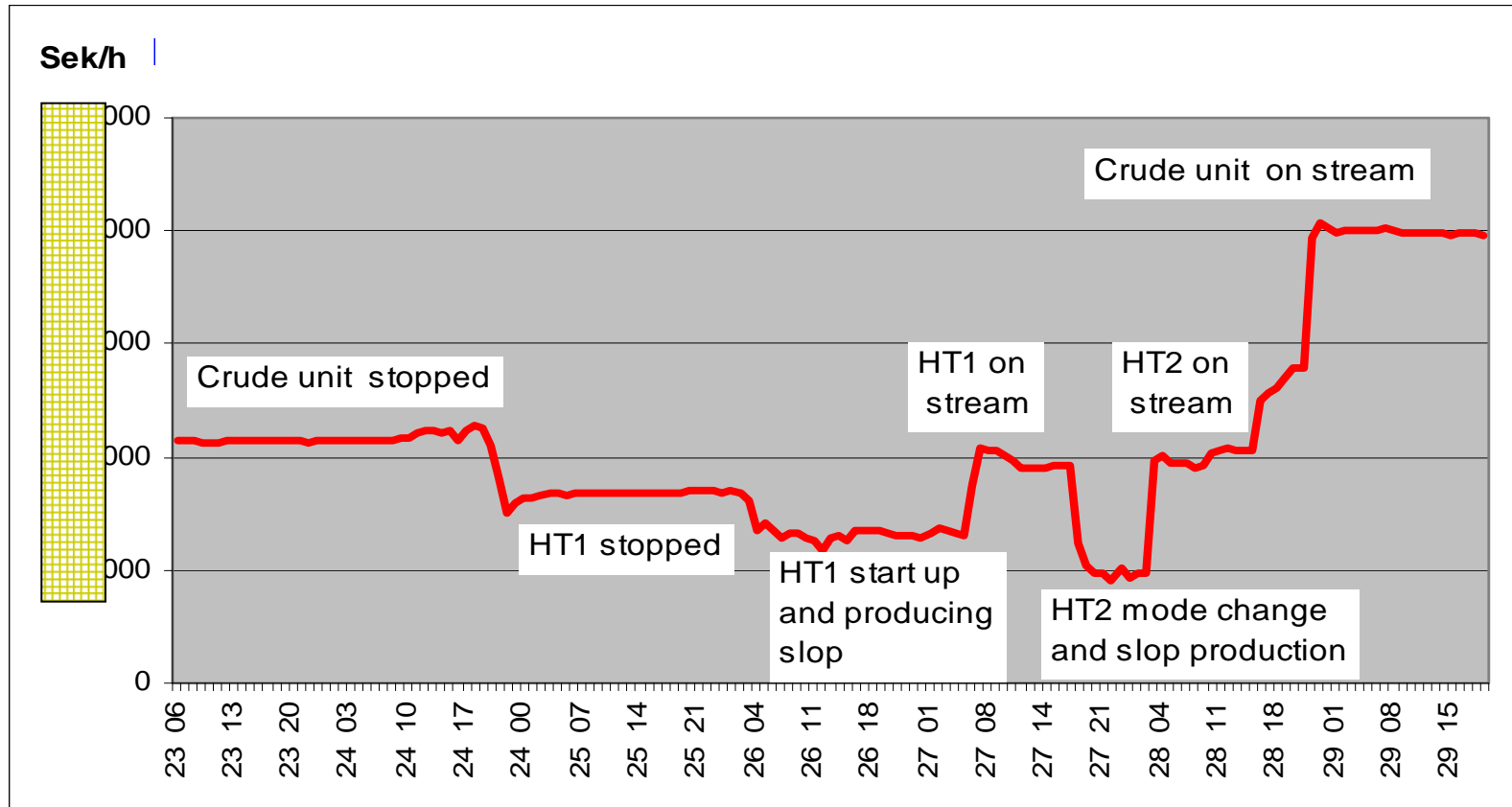
## Operating window analysis HF1

From: 2012-01-22 17:18  
To: 2012-05-01 17:18

Green fields to be updated

Tag	Descriptor	Current	Limit	Formula	Time above limit [h]	Time above limit [%]
<b>Design temperatures</b>						
12TI102	Matning 1202 A/B	92	343	('12TI102' > 343)	0,0	0,0%
12TI104	Högtr. gas	51	177	('12TI104' > 177)	0,0	0,0%
12TI105	Lågtrycksavskiljare	242	270	('12TI105' > 270)	0,0	0,0%
12TI106	Torrkolonn	175	250	('12TI106' > 250)	0,0	0,0%
12TI109	Vätskelås	29	100	('12TI109' > 100)	0,0	0,0%
12TI110	Före ugn	276	371	('12TI110' > 371)	0,0	0,0%
12TI129	Produkt 1205	107	300	('12TI129' > 300)	0,0	0,0%
12TI132	Efter TT1210	138	250	('12TI132' > 250)	0,0	0,0%
12TI133	GAS FÖRE TA1207	197	250	('12TI133' > 250)	0,0	0,0%
12TI140	Flashzon	195	270	('12TI140' > 270)	0,0	0,0%
12TR212	Olja efter ugn	380	371	('12TR212' > 371)	79,6	3,3%
<b>Design pressures</b>						

# Refinery margin is calculated and is e.g. used to estimate production loss costs



Data has deliberately been hidden for confidentiality reasons.

# PI used for operator support and plant optimization

# Program which calculates new set-points for controllers at feed rate change

PI WEB

- Drift Rapporter
- Tank Farm
- Blandat
  - PI Web Trend/tweb
  - Historik fyra Signale
  - Fartändrings beräkr
  - Bränsle Rapport
  - Fortum Rapport
  - Statoil Rapport
  - Co2 Rapport
  - UFT
  - IR Temperaturer
  - Ångbalans
  - Massbalans Nafta/
  - Raffinaderi Margina
  - Mätområden
  - Roller
  - Onödiga kostnader
  - Svavel till Flama
  - Test
- Översikt
  - Driftstatus
  - APC
  - Produktion senaste
  - Asset Portal
- API

Aktuell Råolja matning: 69,4 ton/h  Aktuell Injicering: 40,0 ton/h

## Nya börvärden vid fartändring

Gör steg ändringen med 15 minuters intervall

	Aktuella värden	Rekommenderade värden			
		Steg 1	Steg 2	Steg 3	Steg 4
Matning MFB160:	69,3	81,2	93	104,8	110
Injicering MFB160A:	40	34,2	28,4	22,5	20
Matn. ugn FI011/012:	56,5/55,5	59,1/59,1	62,2/62,2	65,2/65,2	66,6/66,6
Dragning FR1:	15,69	18,37	21,05	23,72	24,89
Dragning FR2:	20,5	24	27,49	30,99	32,52
Dragning FR3:	18,3	21,42	24,54	27,67	29,02
Dragning FR4:	0,01	0,01	0,01	0,01	0,01
Stripp ånga FR1:	0,2	0,23	0,26	0,3	0,31
Stripp ånga FR2:	0,7	0,82	0,94	1,06	1,11
Stripp ånga FR3:	0,3	0,35	0,4	0,45	0,48

## Tool to find set points from previous runs

PI WEB

Drift Rapport

Annas Uppföljning  
VD2 Avverk Rap  
HG  
HF1  
HT1  
HT2  
VD2  
VD2 Dynsrap  
NSP Dynsrap  
NSP Månadsrap  
DMs Drift Uppfö  
Körfalls tider  
Anl. tider  
Tillgänglighet

Tank Farm

Blandat

PI Web Trend(rtv  
Historik fyra Sigr  
Fartändrings ber  
Bränsle Rapport  
Fortum Rapport  
Statoil Rapport  
Co2 Rapport  
UFT  
IR Temperaturer  
Ångbalans

Körfall:

Starttid: 2012-05-01 19:00:00 Sluttid: 2012-05-01 20:00:00 Hämta data

2012-04-28 21:56:27 N9V  
NON  
2012-04-28 21:56:27 N9V  
2012-04-13 10:55:42 N9CV  
2012-04-08 02:54:25 N9V  
2012-01-31 21:15:17 N9CV  
2011-12-06 07:46:24 N9V  
2011-10-24 17:54:15 STOPP  
2011-10-03 09:53:35 STOPP  
2011-09-28 15:32:14 STOPP  
2011-09-28 13:59:02 STOPP  
2011-09-18 09:42:44 STOPP  
2011-09-01 11:21:04 N9V  
2011-08-16 12:37:19 N9BV  
2011-08-09 19:29:49 N9V  
2011-07-30 10:10:19 N9BV  
2011-07-06 13:35:09 N9V  
2011-06-27 06:38:04 N9BV  
2011-06-10 07:03:14 N9V  
2011-05-27 11:10:44 N9CV

### Driftrapport HF1

Medelvärden för perioden

	2012-04-29 21:56:00	Slut tid:	2012-04-29 22:56:00
	2012-04-29	Körfall:	N9V
	100	Kvot berg:	0
g:	10113	Cistern Product:	6324
g Berg:	0		

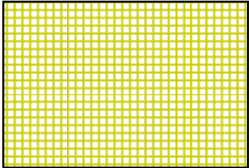
	PV	IVP	TAG	PV	IVP	TAG	PV	IVP
	13,95	-	12FC202	13,98	41,55	12FI220	12,18	-
	12FC224	14,11	27,7	12FC225	0	0	-	-
	12TC202	242,5	75	12TI110	276,51	-	12FC217	0,12
	12FC203	104,09	60,32	12PDC309	1,8	30,56	12FC309	2455,11
Ugn								67

# Application which identifies overall unit constrain and calculates the cost for not running at the constrain

## Production against constrains

Start time 2012-04-27 16:09  
 End time 2012-04-27 17:09  
 Period 0.04 days

### NSP units

Unit	Mode	Feed t/h	Constrain	Max feed t/h	Diff ag max t/h	Lost prod ton	Lost revenu	
							SEK/h	SEK in total <i>During 0,04 days</i>
HT1	T22V	25.7	Feed pumps	26.5	0.8	0.8		
HT2	T110V	28.5	Furnace	28.9	0.4	0.4		
HF1	N9CV	22.6	Reac. temp	28.6	0.9	0.9		
<b>Totalt</b>		<b>76.8</b>		<b>84.0</b>	<b>2.1</b>	<b>2.1</b>		

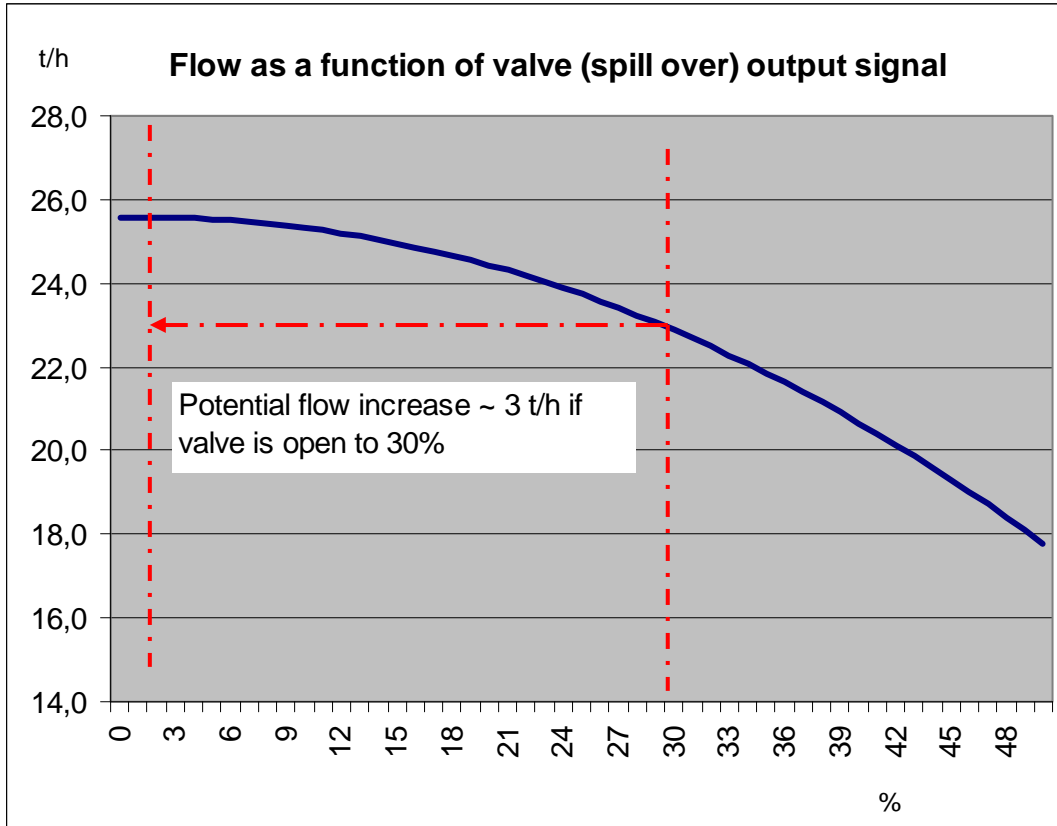
Data has deliberately been changed or hidden for confidentiality reasons.

## Constrains evaluated in Feed Max application

- Pump capacity
- Maximum reactor temperatures
- Column flooding
- Furnace duty
- Product quality

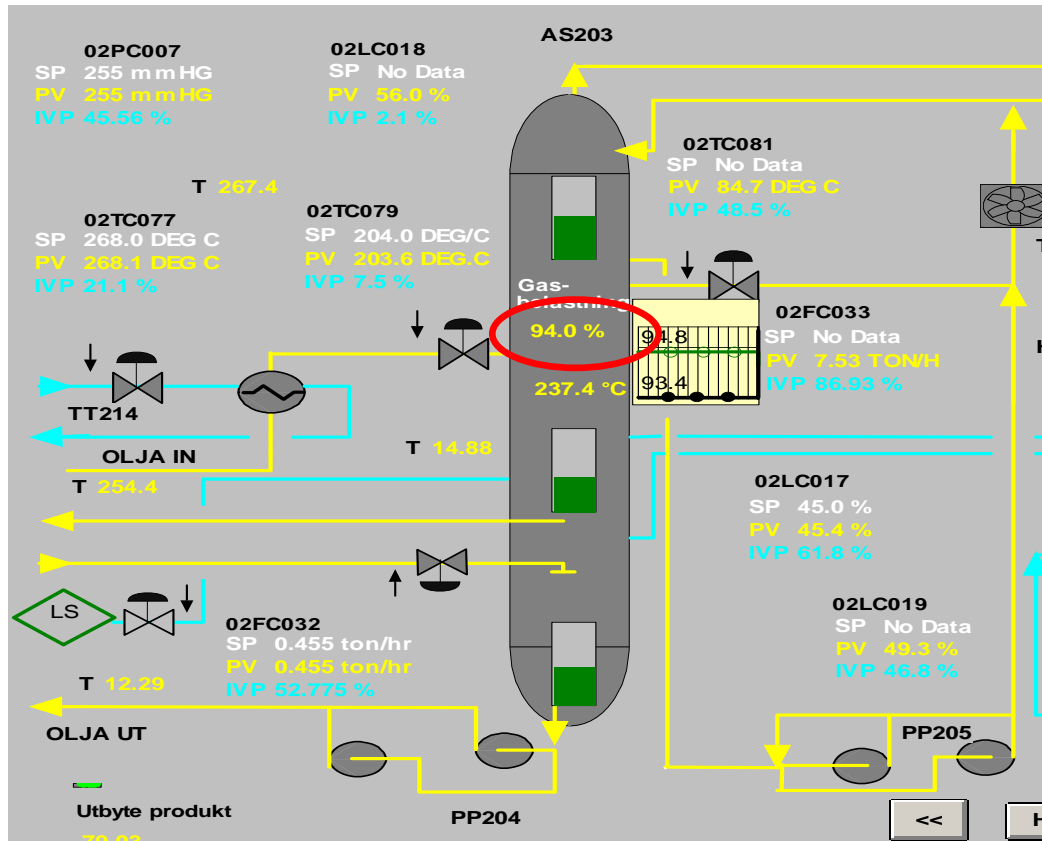


# Evaluation of constrains – Pump capacity



Data has deliberately been changed for confidentiality reasons.

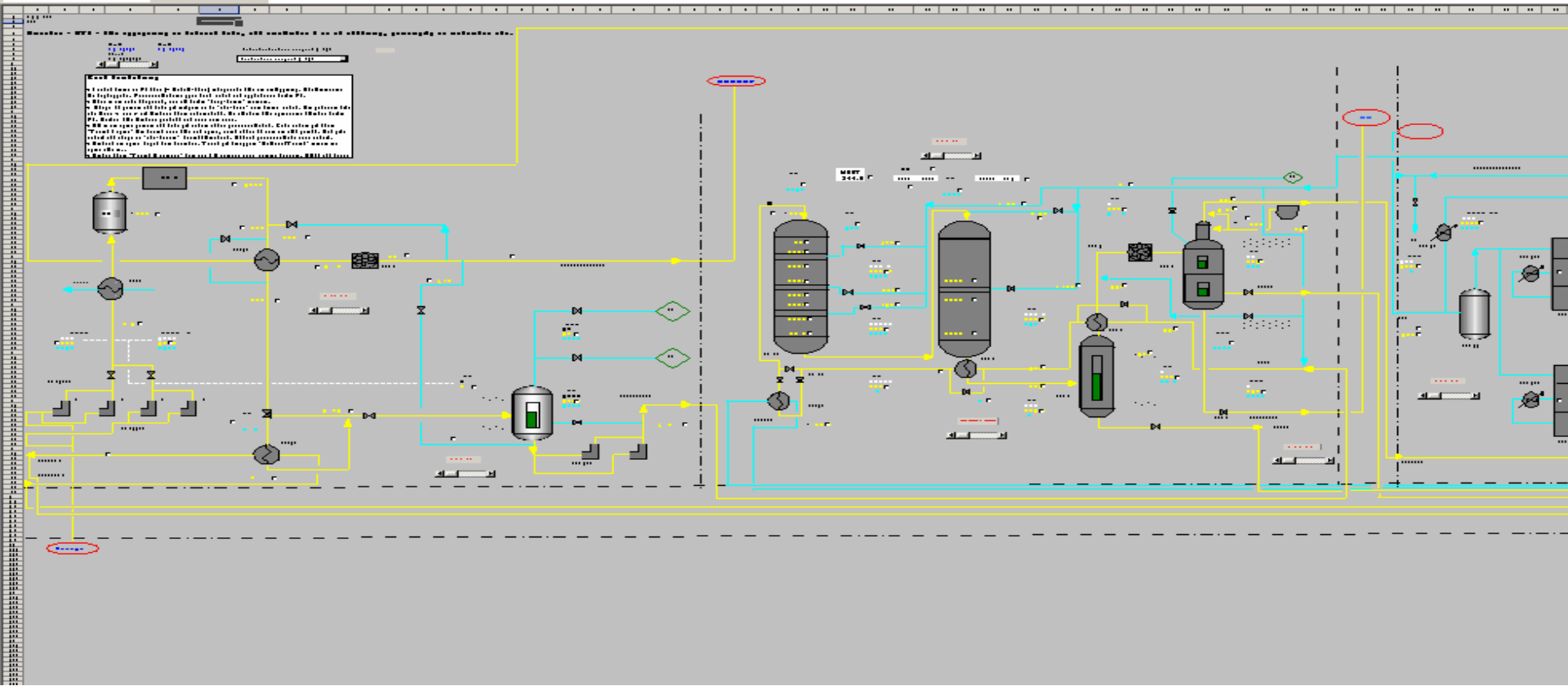
# One constrain to be evaluated is the load in vapor load in columns



## PI used for operator training

- An Excel application has been developed which makes it possible to “play back” events for a certain process unit.
- The graphical background from the ProcessBooks displays have been copied into to Excel and streams have been connected.
- Process values for different TAGs has been located in the cells in the sheet. (about 200 TAGs)
- Time can be changed within a selected time interval and all data in the sheet will update. Different occurrences (e.g. incidents) can be pre-defined and selected from a drop down list.
- All TAGs can be trended and the selected is marked with a red dot in the diagram

# Operator training tool for “play-back of process events – e.g. incidents



# Historical events from disturbances can be chosen from a drop down list

2010-10-08 / V7  
NKC

**Simulator - HT1 - för uppspelning av historisk data, att användas t ex vid utbildning, genomgång av incidenter etc.**

Starttid: 2010-04-01 00:00 Sluttid: 2010-04-25 00:00  
Aktuell tid: 2010-04-02 10:33

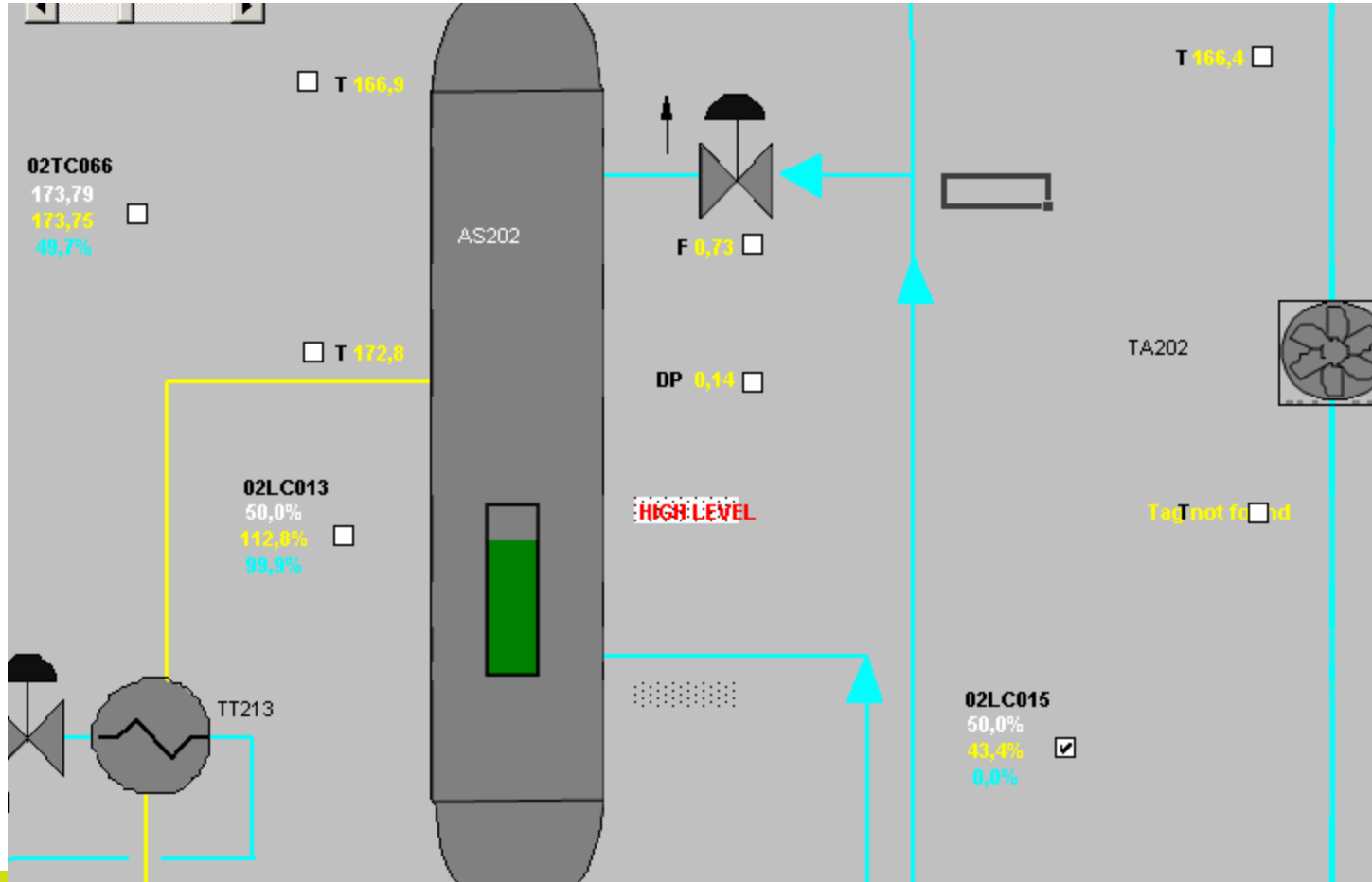
Valt körfall:3. Incident:Vatten i matningen -- 2010-04

3. Incident:Vatten i matningen -- 2010-04  
1. Cirkulation -- 2010-03  
2. Skiftning N9V till N9CAV -- 2010-01  
3. Incident:Vatten i matningen -- 2010-04

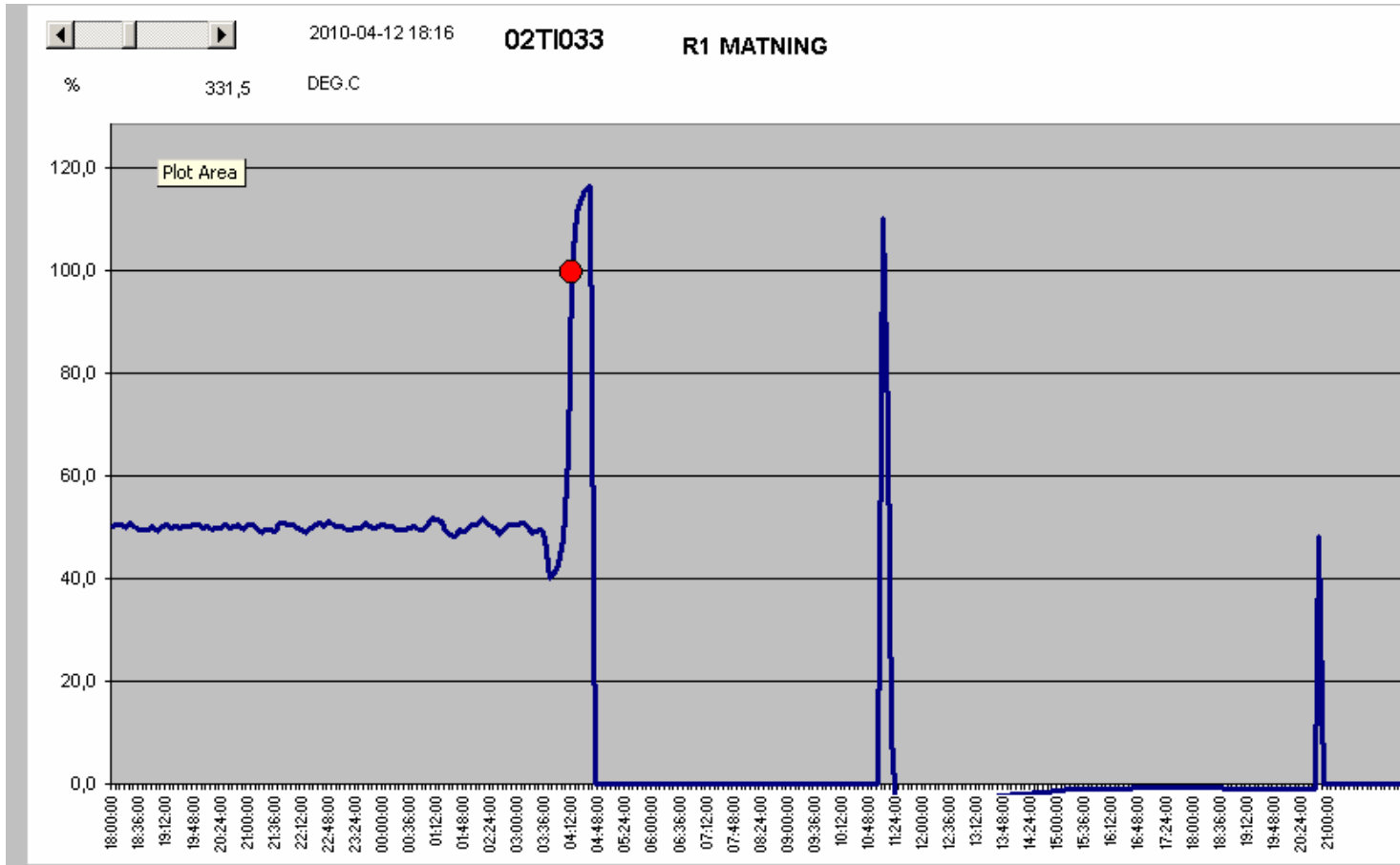
**Kort handledning**

- I arket finns alla PI bilder (= DeltaV-bilder) inkopierade för en anläggning. Strömmarna är ihopkopplade. Processvärdena ligger dock i arket och uppdateras från PI.
- Skriv in en valfri tidsperiod, eller välj från "drop-down" menyn.
- Stega i tid genom att klicka på någon av de "slide-bars" som finns i arket. Om pekaren hålls stilla över ◀ eller ▶ så ändras tiden automatiskt. Alla värden för signalerna hämtas från PI. Nivåer i kärl ändras grafiskt och vissa larm visas.
- Välj in en signal genom att klicka på rutan efter processvärdet. Klicka sedan på fliken "Trend 1 signal" En trend visas för vald signal, samt aktuell tid som en röd punkt. Det går också att stega via "slide-baren" i trendfönstret. Aktuellt processvärde visas också.
- Endast en signal i taget kan trendas. Tryck på knappen "DeSelectTrend" innan ny signal väljs in..

# Data for all TAGs will update as well as level indicators and some alarms



# All TAGs can be trended



## **PI used for operator training is used for**

- To review and discuss incidents with the operators
- Operator training



## In summary – PI used at Nynas

- PI is highly integrated with other systems
- PI is an indispensable tool for i.e. operators and process engineers to monitor and optimize production
- PI supply information to many other business critical systems e.g. planning system and accounting systems.



# THANK YOU

Brought to you by  **OSIsoft.**