Valmet DNA Machine Monitoring

Power Plants

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Key figures in 2017

Valmet Corporation

Orders received
EUR 3,272 million

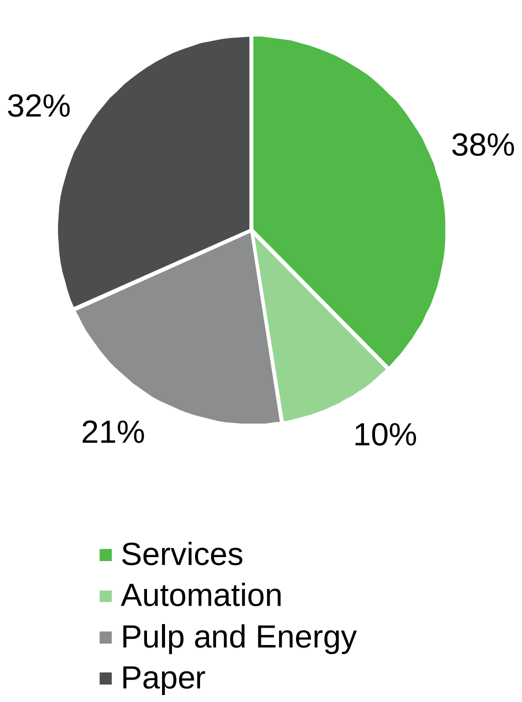
Net sales
EUR 3,058 million

Comparable EBITA
EUR 218 million

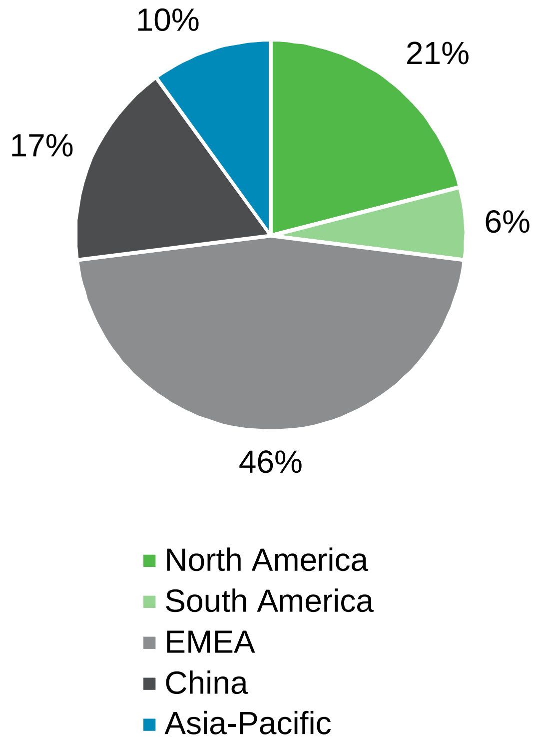
Comparable EBITA margin
7.1%

Employees (on Dec 31, 2017)
12,268

Orders received by business line

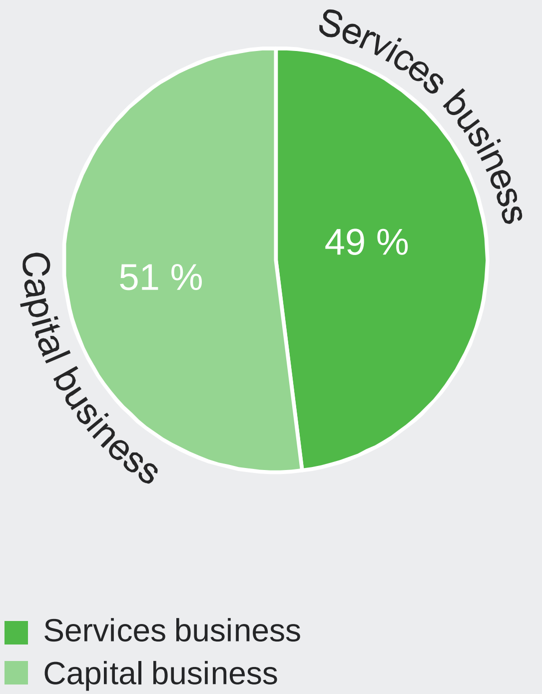


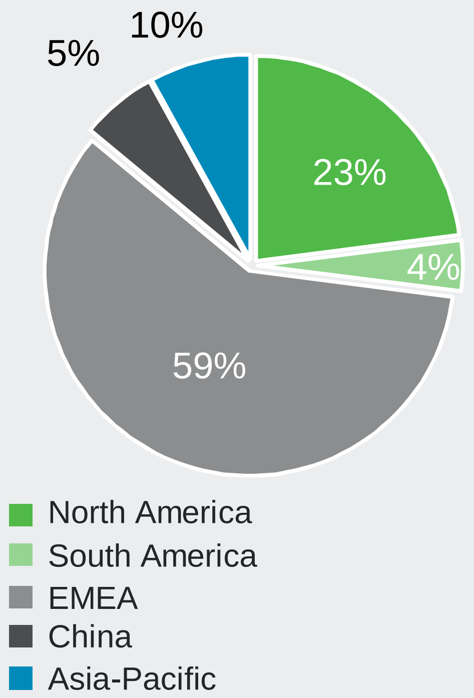
Orders received by area

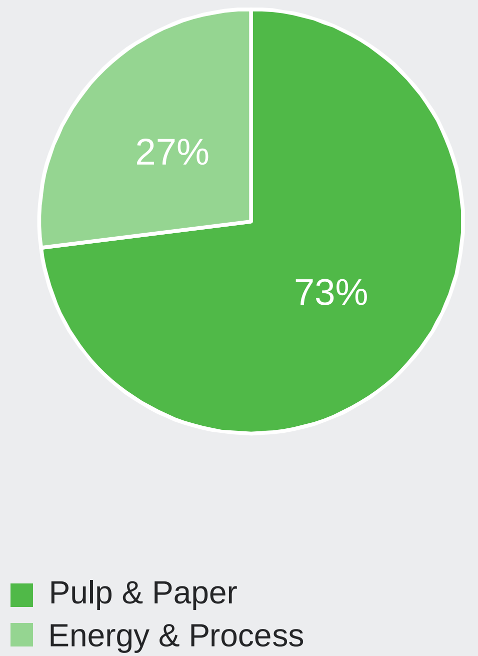


Automation business line overview

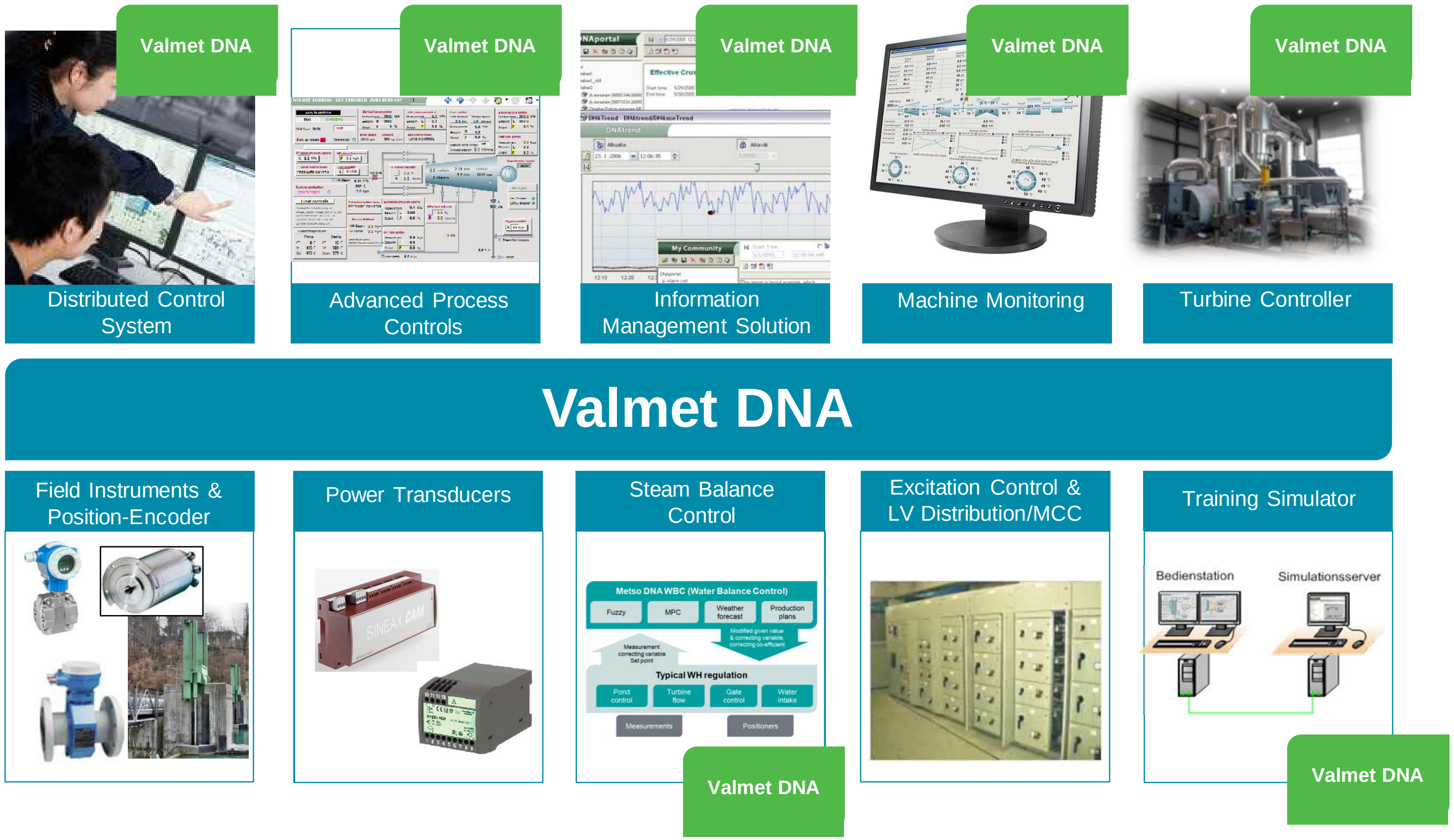
Orders received 2017







Valmet Automation’s solution for Power Plants



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Valmet´s Machine Monitoring

Offering in Brief

- **DNA Machine Monitoring (on-line)**
  - **Paper & board**
    - **condition, runnability, lube oil**
  - **Tissue**
    - **including crepe blade chatter**
  - **Pulp mill**
    - **total plant, including slowly rotating machinery**
  - **Power plants**
    - **TG protection and analysis**
    - **BOP analysis and possible protection**

- **Valmet Maintenance Pad**
  - **as a tool for end customer**
  - **as a cervice concept & tool for Valmet**

- **Services**
  - **remote monitoring, at site analysis, IoT**
  - **system services, sensors&cables, etc**

Mechanical monitoring and protection systems for power plant

- **Turbine Generator Vibration Protection**
  - **•Mechanical measurements, real time analysis (100 ms cycle) and safety interlocks**

- **Turbine Generator Diagnostics**
  - **•Mechanical measurements with advanced analytical calculations**
  - **•Dedicated analysis of different operating stages (idling, shut down /run-up, steady stage)**

- **Condition Monitoring for auxiliary machines (BOP)**
  - **•”Less critical” machinery: pumps, fans, motors etc.**

DNA Machine Monitoring

Monitoring in Valmet DNA control system, key benefits in short

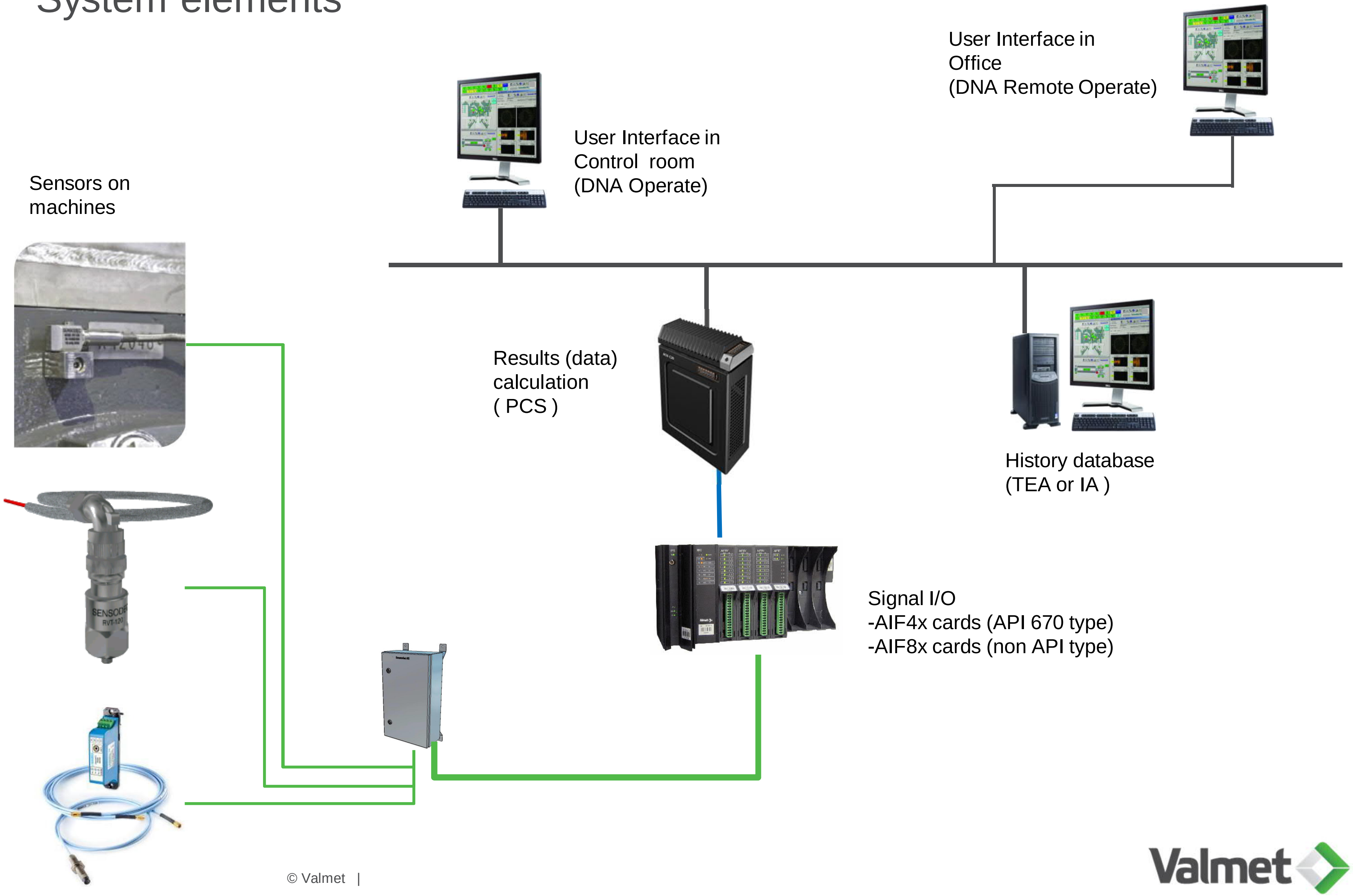
- Common user interface for machine and process control and condition monitoring
  - Lower user barrier especially for operators
  - Easier to use and share information between operation and maintenance
- Common history database for all control and machine condition data
  - Efficient analysis and reporting
  - Easy comparison of different data
  - One source of data for Valmet IoT
- One system and one engineering environment for condition monitoring and process control
  - Cost efficient to build and maintain
- Linking into ERP and data sharing (DNA Diary)
  - Only one link for all needs (operations, instrumentation, machinery)
  - Supports information sharing between all teams

User-interface supports different user profiles

- Operators
  - Overall levels (bar graphs), changes & alarms in levels, trends
- Mechanical maintenance
  - Predictive maintenance team / mechanical diagnostic
    - Overall level & trends
    - Additional characteristics & trends / fault causes, early warning
    - Vector data & their history / FFT's, signals and orbit plots
- Machine suppliers and Valmet Analysis Centers
  - Operation & diagnostic of the supplied machine
  - Service contracts, machinery guarantees, efficiency & capacity
  - System maintenance and system service
- External consultants
  - Like machine suppliers or mechanical maintenance or vibration specialists

Valmet DNA Machine Monitoring Technology

System elements



Valmet DNA solution for turbine generator mechanical vibration protection and diagnostics

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Turbine Generator Machine Protection

- Monitoring of Turbine-Generators with measurements of:
  - thrust position with eddy probes
  - shaft movement with eddy probes
  - case expansion with eddy probes or LVDT´s
  - differential expansion with eddy probes, single or swap-over
  - shaft eccentricity with eddy probes
  - absolute vibration with accelerometers or velomitors
- Designed according to API670 standard
  - Protective monitoring by the I/O cards
  - Cards operate even if connection into PCS is lost
  - Redundant power supply unit
  - Redundancy supported for protection only solution

Valmet DNA Turbine Protection I/O

Machine protection

AIF4E

Eddy current measurement for shaft position or vibration measurement

- 4 input channels
- each channel configurable for both static and dynamic values,
- 2 calculated values per channel supported
- 100 ms update rate (API670)
- raw signal sample buffers for diagnostic application
- 4 output channels 4 – 20 mA , any value to any output

Machine protection

AIF4V

Absolute vibration measurement using accelerometers or velomitors

- 4 input channels
- each channel configurable for 2 calculated values per channel, rms or peak, vibration acceleration or velocity
- 100 ms update rate (API670)
- raw signal sample buffers for diagnostic application
- 4 output channels 4 – 20 mA , any value to any output 4 input channels

Machine protection

AIT4L

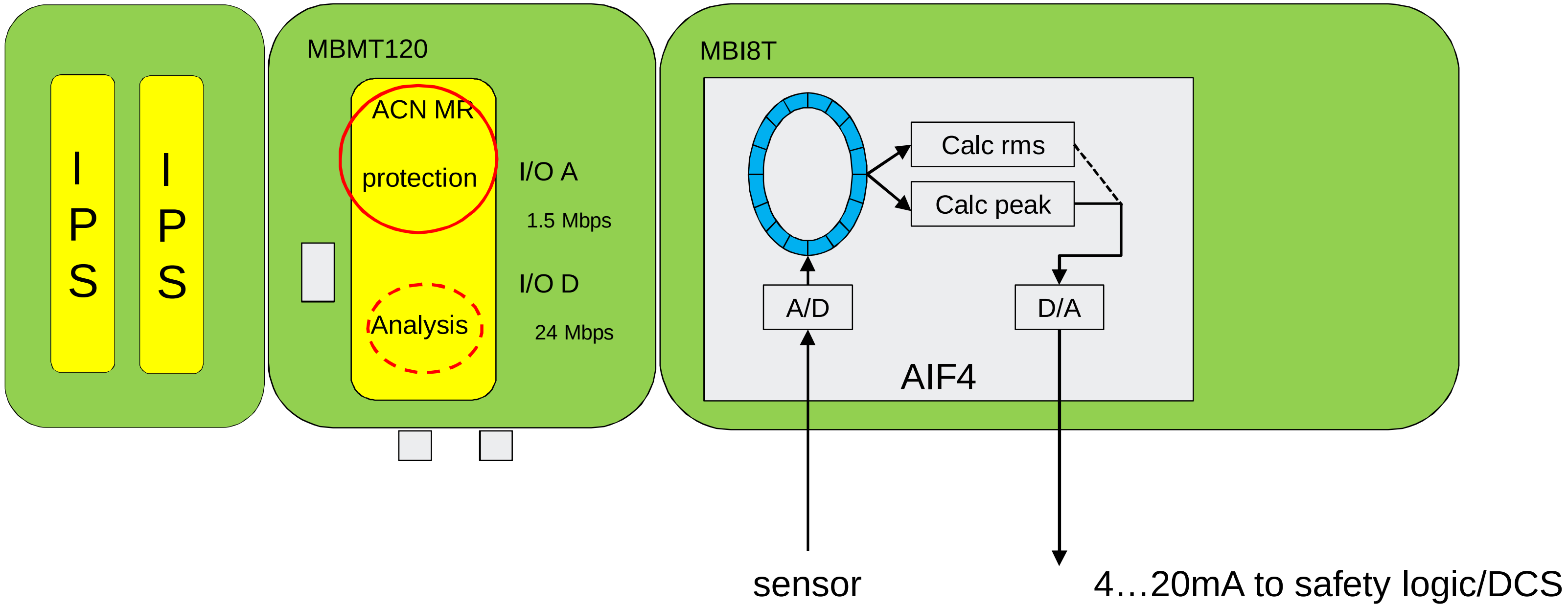
Casing absolute expansion and valve position

- 4 LVDT/RVDT input channels
- 5 and 6 wire LVDT/RVDT support
- all electronics in card, only LVDT sensor out in the field
- input update interval 1 ms
- settable measurement filter
- 16 bit A/D converter

Isolation

- Field to system 1500 VAC
- Between channels 1500 VAC

Safety and analysis calculations



Calculation is updated in 6.4ms

Monitoring group management

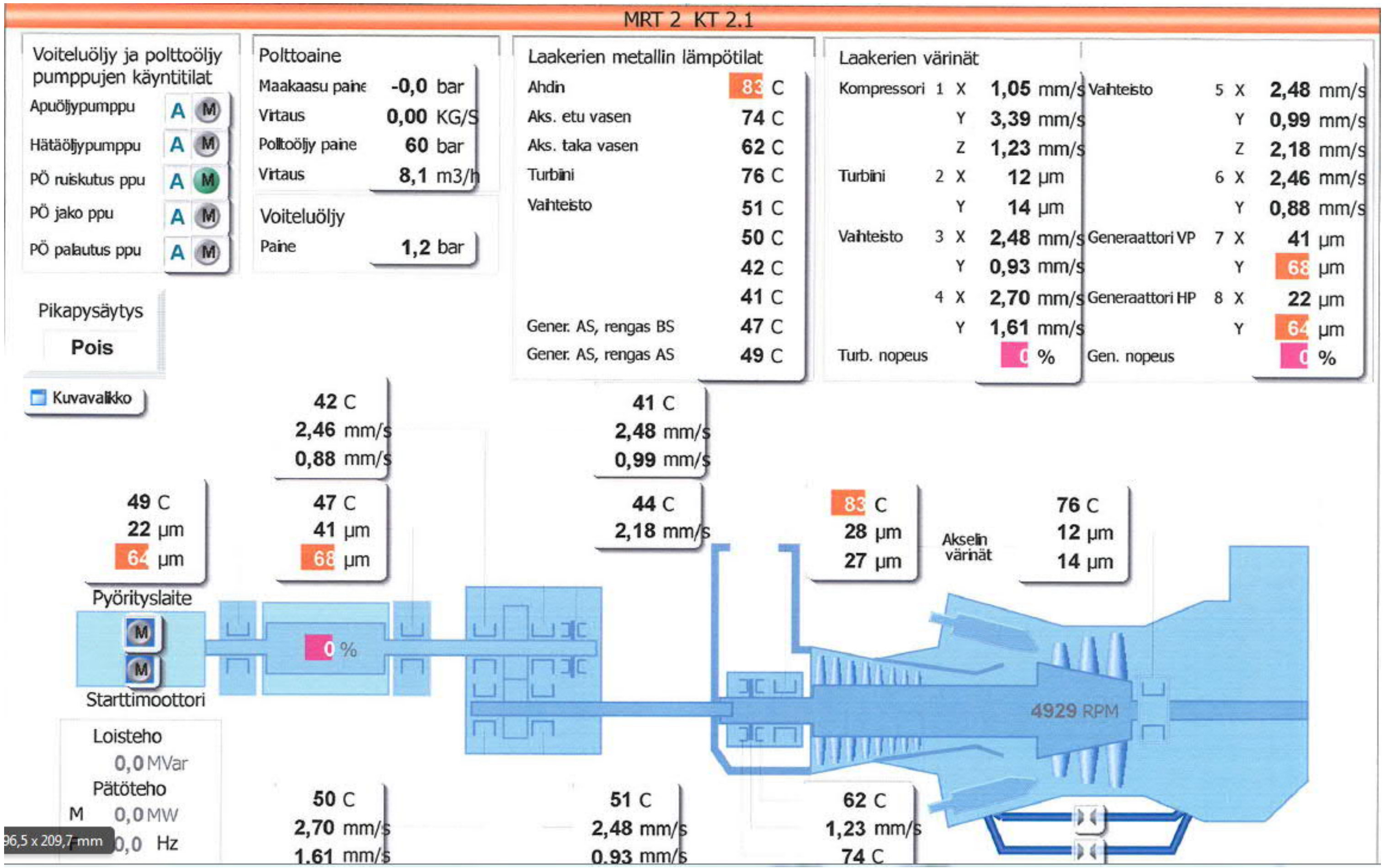
Controller and power supply functions

ACN MR, 2x IPSP

- redundancy in HW and SW
- redundant power supply
- self diagnostic
- communication to 3rd party (Modbus TCP, Profibus, etc)
- integrated part of Valmet DNA system network
- alarms and events
- configuration of I/O cards with EAS SW
-card parameter download when card is changes(hot swap)
- optional diagnostic enabling

Valmet DNA Operate display

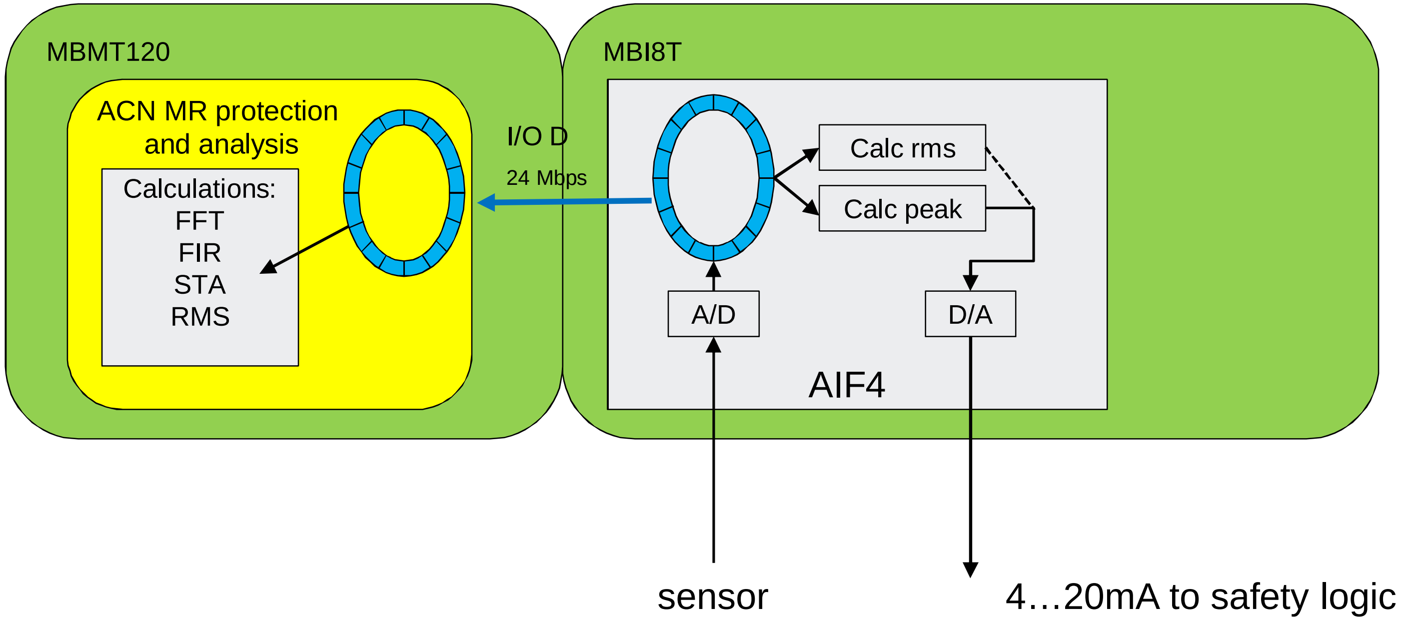
Gas Turbine with DNA Machine Monitoring for protection



Turbine vibration analysis
Principles (on top of protection solution)

- Further scalar values are calculated from signals
  - for improved indication of developing faults, to have longer warning time and planning tome for actionse)
  - like; 1x+phase, 2x+phase, 0,5x, Smax
- Also vector type datas (signals, spectrums, orbit plots) are provided
  - for vibration specialist to make a detailed analysi of situation and severity of possible fault
- Techically this means
  - a process controller with vibration calculation functions in the end of the I/O group
  - history database into which measurements are collected (process historian)
    - trends, spectrum, etc histories
    - steady state data and run-up/coast data can be shown separately, so run-ups where you run through turbine critical speeds can be verified and compared to earlier run-ups as events
  - additional tools into DNA Operate for follow-up and reaction into alarms (operators) and also vibration analysis tools
  - vibration versus process status is easy to compare since histories are in same database

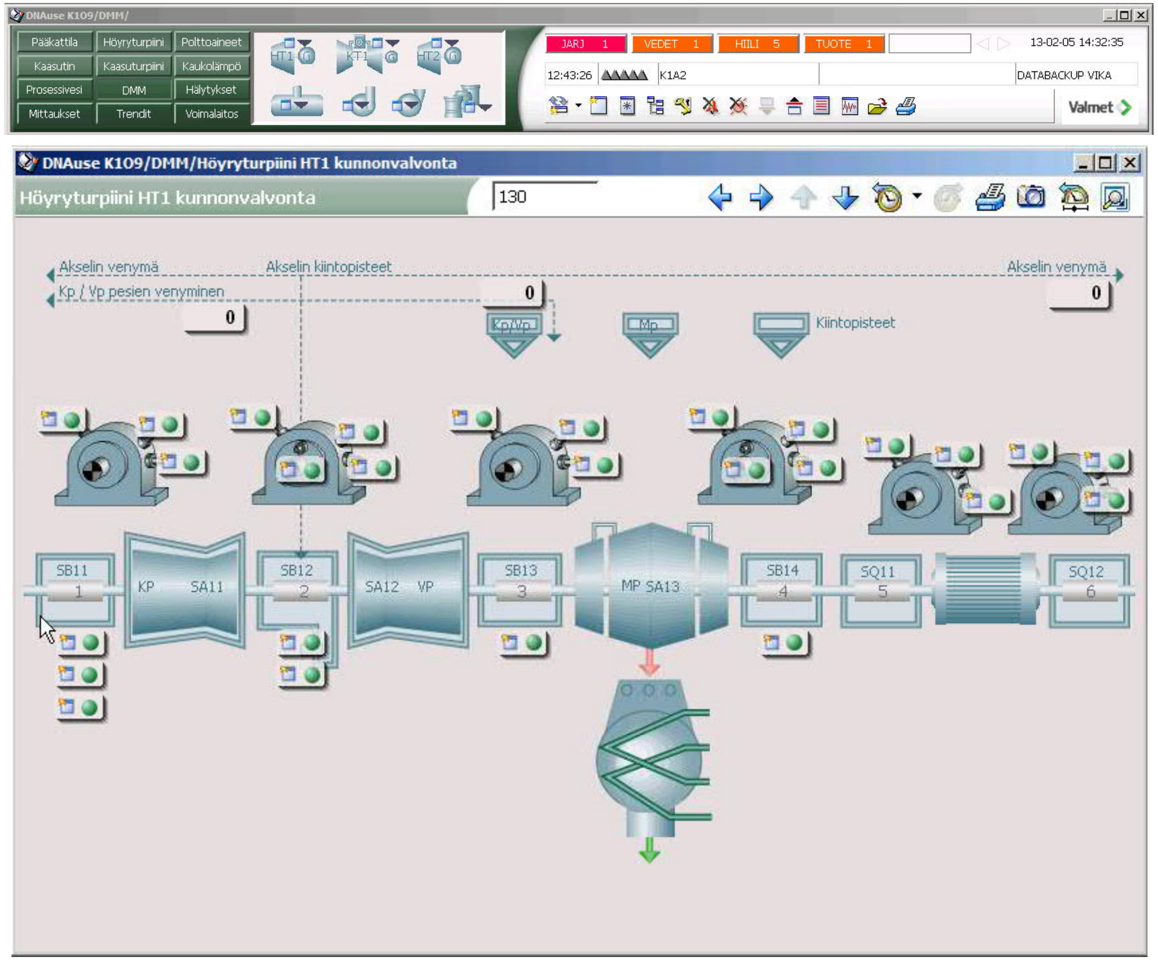
Safety and diagnostic calculations



Calculation is updated in 6.4ms

Valmet DNA Operate display

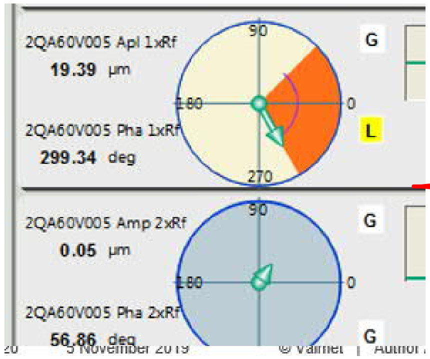
DNA Machine Monitoring diagnostic main page, ST

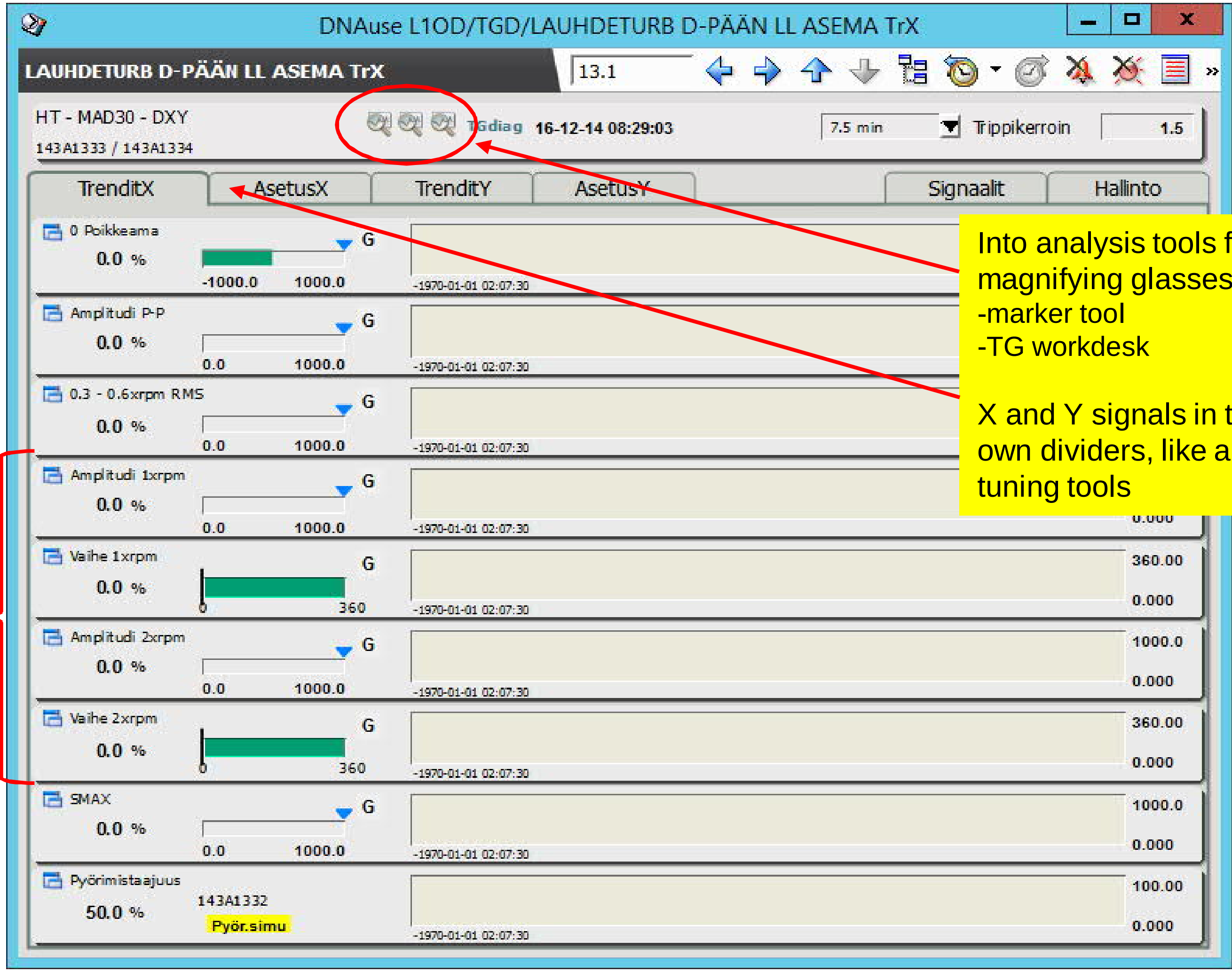


Valmet DNA Operate, T-G

2nd layer in UI, bars & trends page

1X + phase and 2X + phase visualization improved in 2018



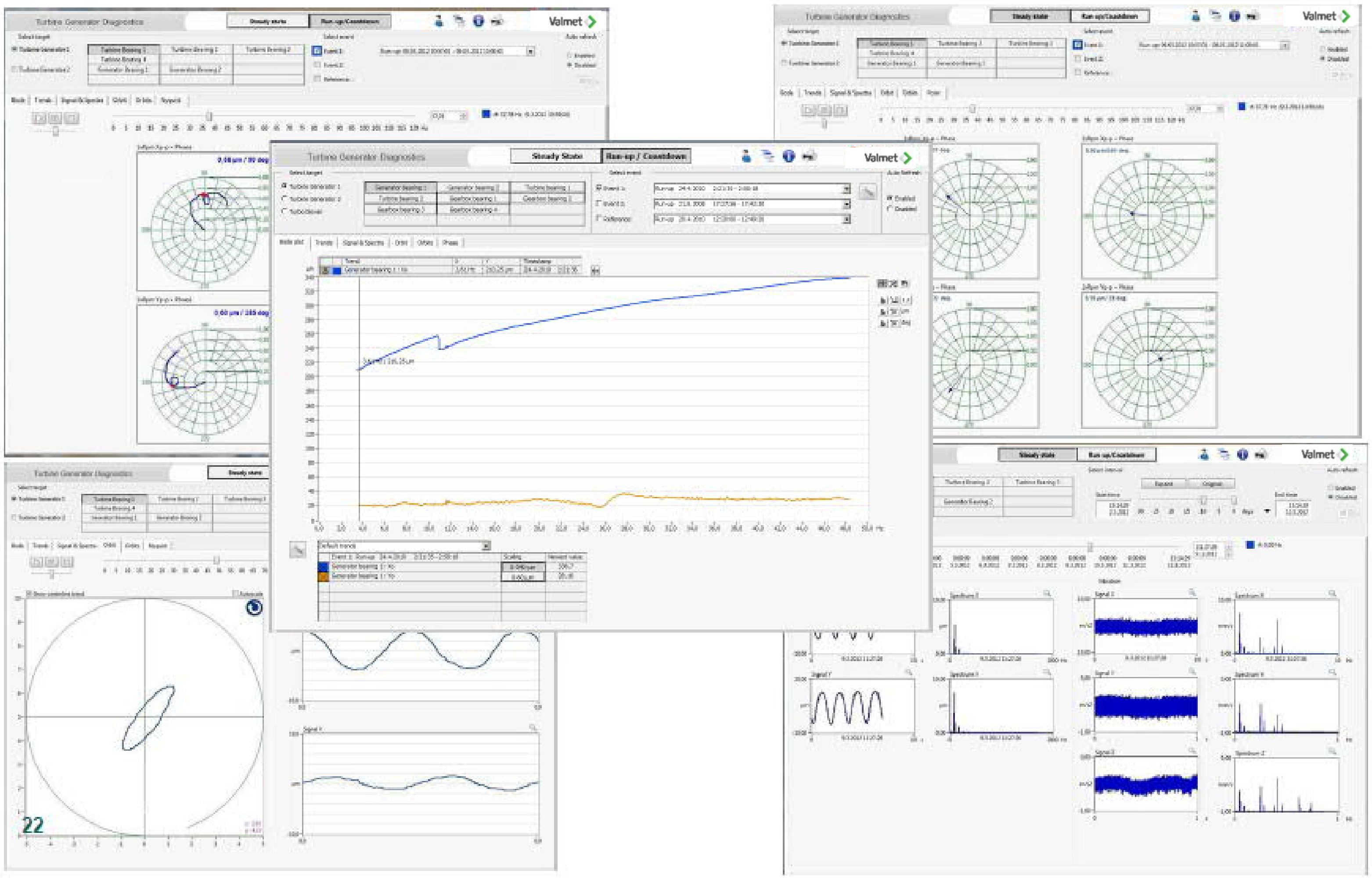


Into analysis tools from magnifying glasses
-marker tool
-TG workdesk

X and Y signals in their own dividers, like also tuning tools

Turbine diagnostic special user interface

”workdesk” for diagnostic work (steady state & run-up/coast-down)

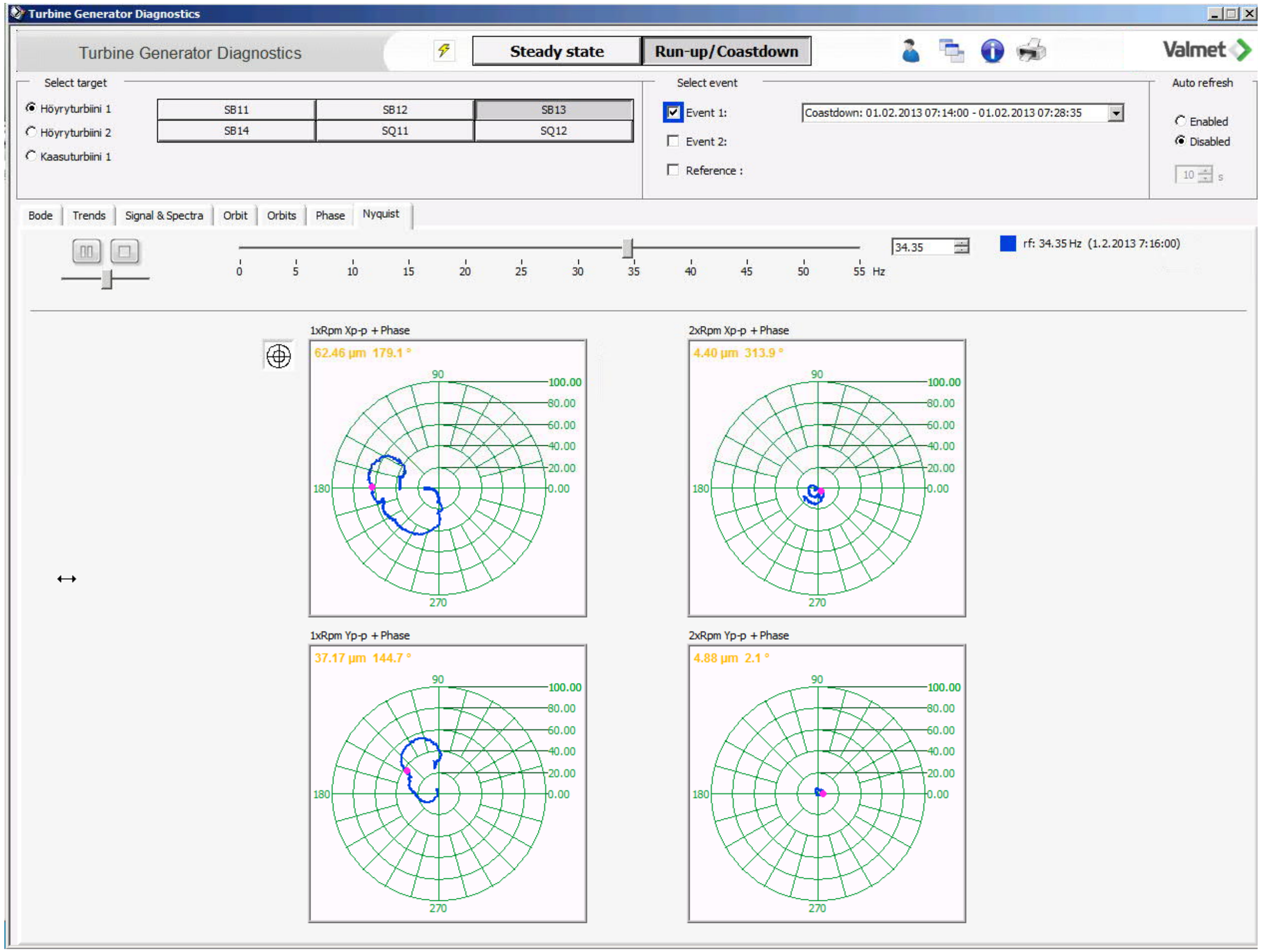


Valmet DNA Operate, T-G workdesk

Bode plot

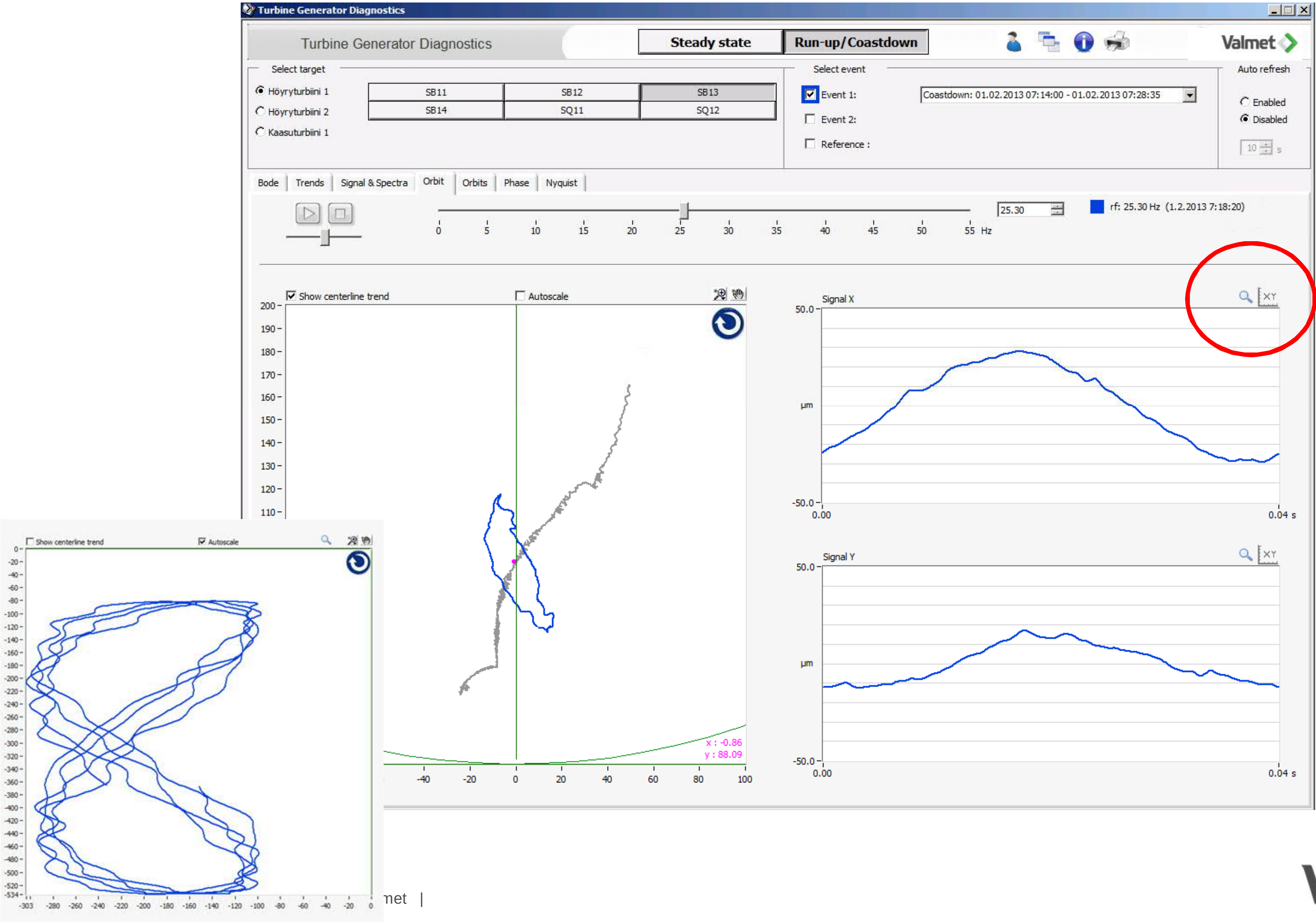
Valmet DNA Operate, T-G workdesk

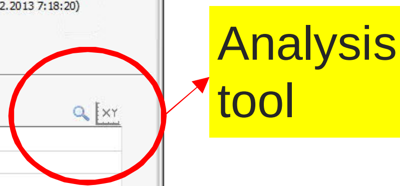
Nyqvist plot + replay from history database



Valmet DNA Operate, T-G workdesk

Orbit plot with shaft centerline trend





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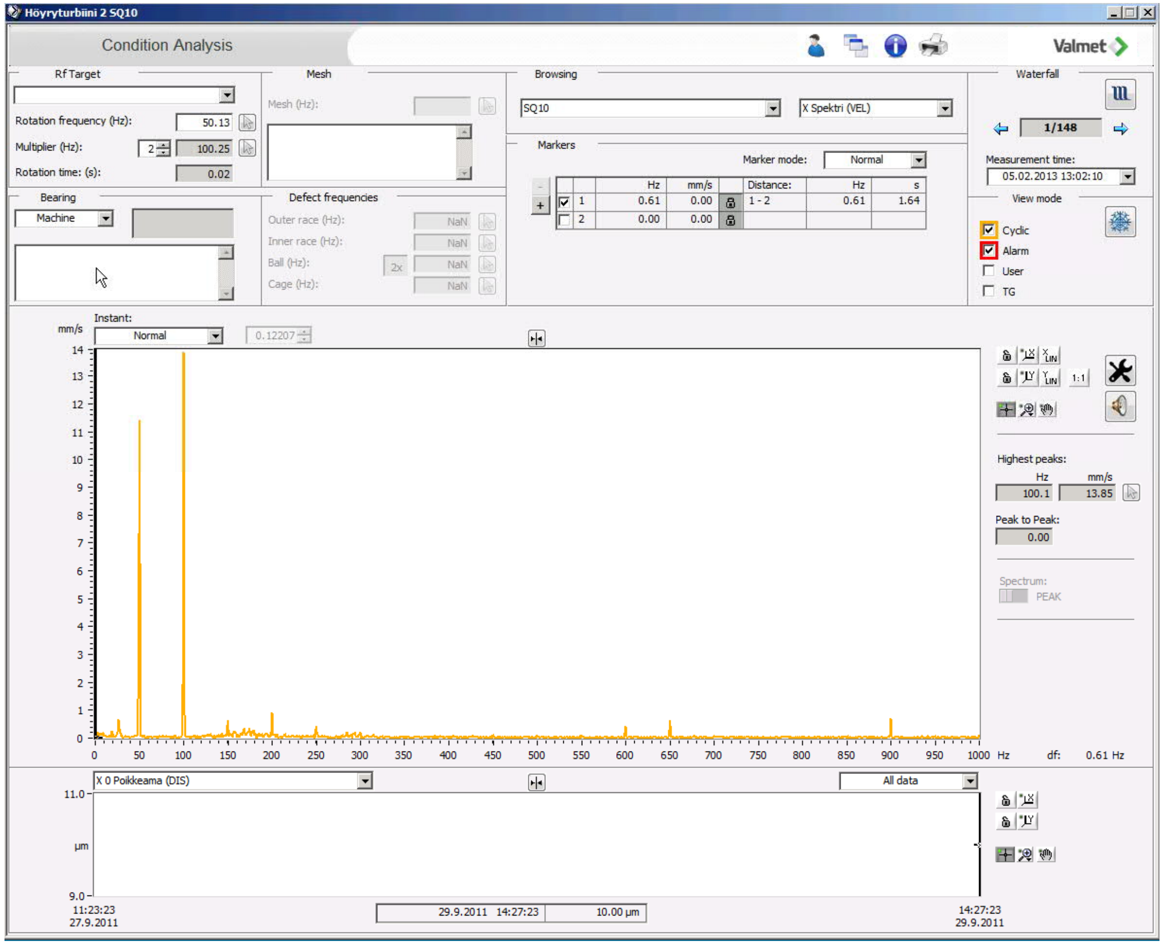
Valmet DNA Operate, marker tool

T-G bearing housing absolute vibration (mm/s)



Valmet DNA solution for BOP machines diagnostics monitoring

Valmet DNA Machine Monitoring

System technology for auxiliary machines (BOP), non-protective

- Data processing in process controller
  - ACN CS, ACN RT, ACN MR

- ACN I/O modules, diagnostic only
  - Two 8-channel I/O units for fast dynamic measurements (AIF8V and AIF8T)
  - Max. 128 channels per I/O group, 2 pcs MBI8
  - Several I/O groups can be connected to one ACN
  - ACN I/O are M120 series

- Rules of thumb (PCS sizing, RAM based)
  - one full I/O group with MR G2
    - but max 11 cards if MR in the I/O group
  - Two full I/O groups per ACN CS
  - Three full I/O groups per ACN RT G4

Valmet DNA Machine Monitoring

System technology for auxiliary machines (BOP), protective (API 670 type)

Scope may be with or without diagnostic functionality

- ACN I/O modules, with protection calculation
  - AIF4V, AIF4E cards (like for turbines)
  - Max. 16 cards / group (64 channels) with 2xMBI8
  - Several I/O groups can be connected to one ACN
  - ACN I/O are M120 series

- Diagnostic data processing in process controller
  - ACN CS, ACN RT, ACN MR

- For diagnostics, rules of thumb (PCS sizing, RAM based)
  - Two full I/O groups per ACN CS
  - one full I/O group with MR G2
    - but max 11 cards if MR in the I/O group
  - Three full I/O groups per ACN RT G4

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FM4 - harsh environment I/O module

Field mountable 4-channel multisignal I/O module

Possible signals:
- Vibration (IEPE)
- Shaft movement(eddy probe)
- Trigger (RTS-xxx)
- General analog (mA or V)

Connection into DNA MM:
- Star Ethernet (I/O bus)
- Chained I/O bus
- POE (I/O bus), single line
- Wireless Ethernet (I/O bus)

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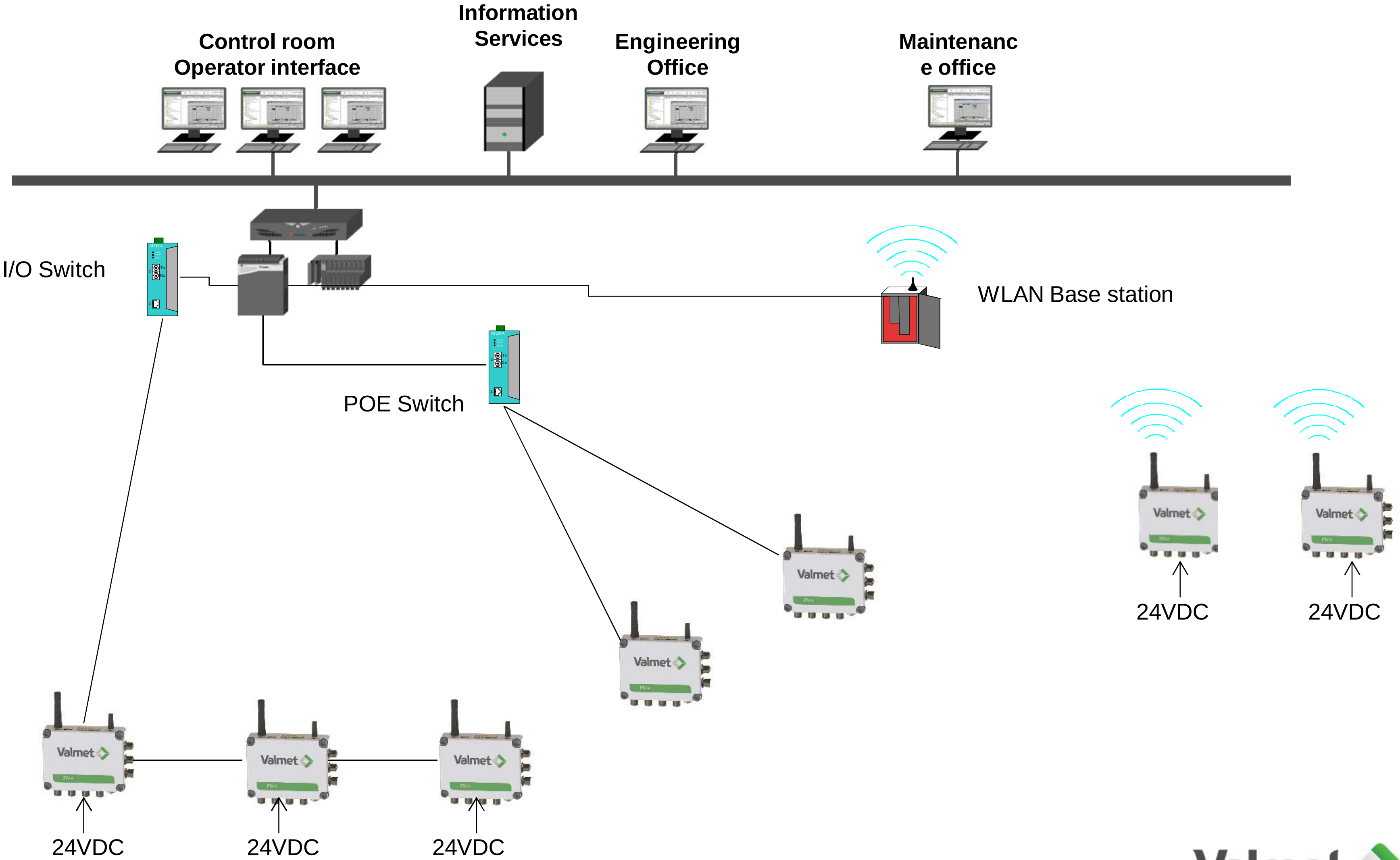
FM4 (Field mountable 4-ch I/O module)

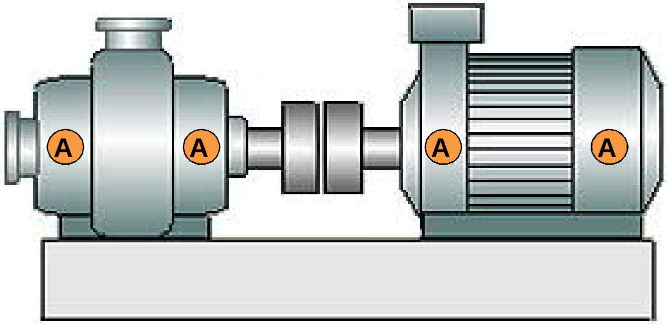
Connection possibilities into DNA MM



Examples of machines with sensor locations

Machines can be fixed speed or variable speed, constructions vary

Horizontal pump + motor



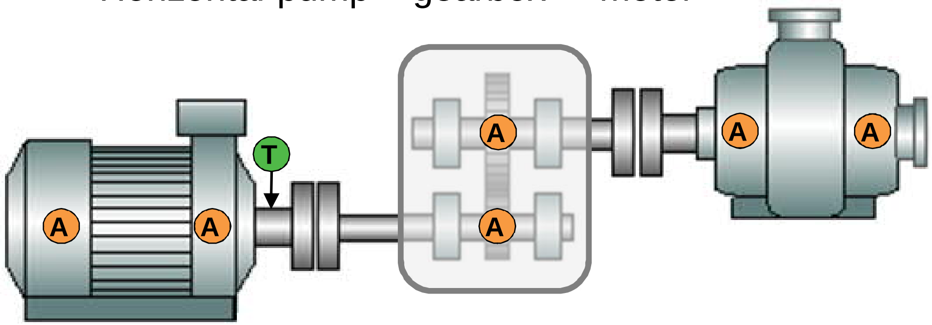
Monitoring has to be detailed anough to pick up different fault modes

- Multiple fault specific scalars calculated in the monitoring analysis (”template”)

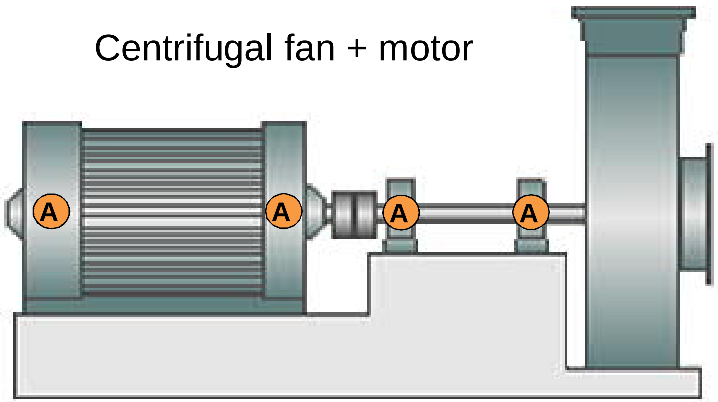
Still simple & efficient to execute

- Machinery templates used, variation via parameters in the template

Horizontal pump + gearbox + motor



Centrifugal fan + motor



A = acceleration sensor (vibrations)

T = speed trigger sensor (rotational frequency)

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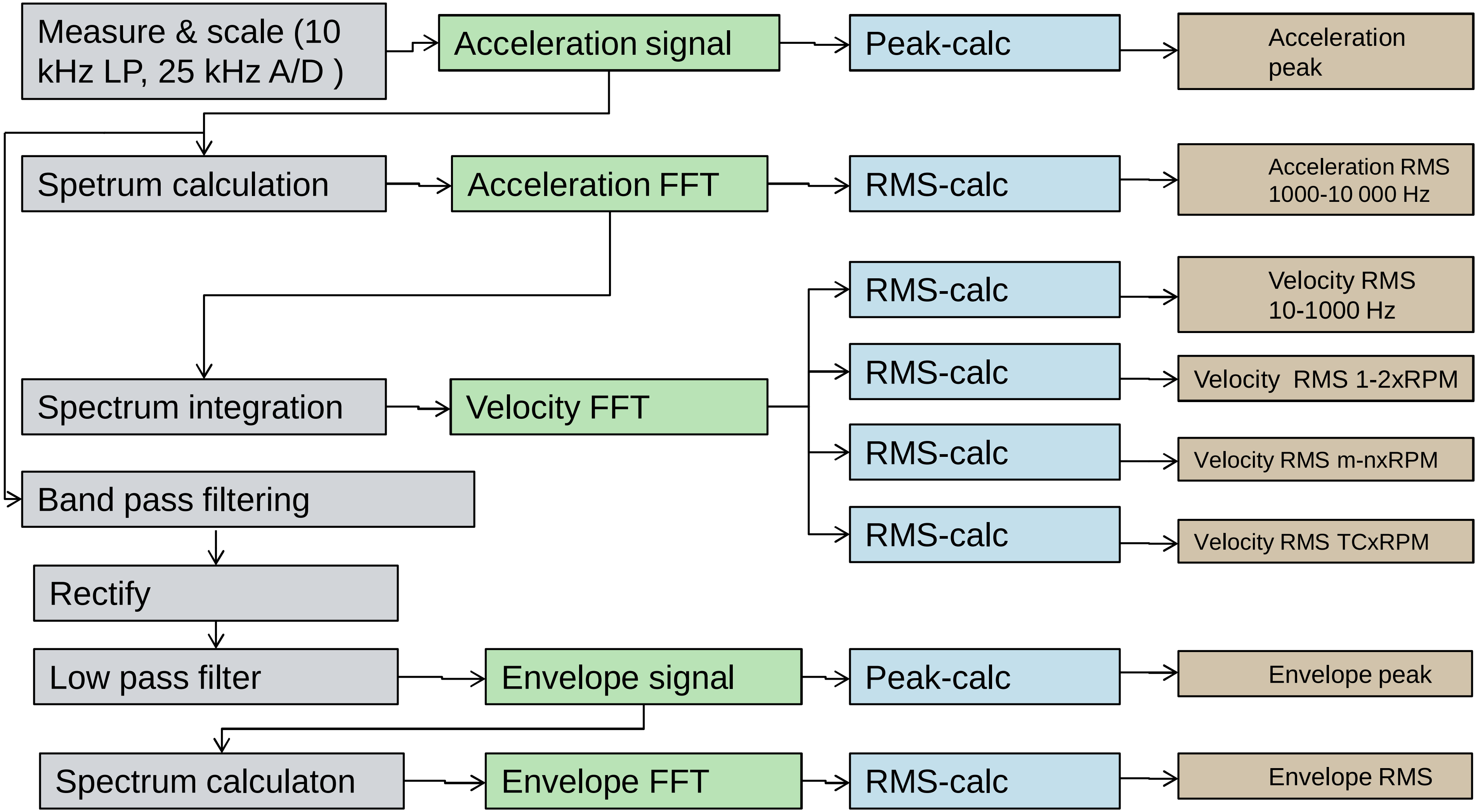
Typical application template structure

Typical calculated characters vs faults

Monitored phenomena	Character
ISO/DIN machine vibration severity (load, stress)	Vibration velocity rms, from frequency range 10 Hz –1 kHz
Faults creating high frequency vibration or impacts , like; -Rolling element bearing fault -Lack of lubrication -Cavitation Coupling fault Rolling element bearing fault impulses	Vibration acceleration rms frequency range 1 kHz -10 kHz Envelope signal peak and FFT rms Acceleration peak value Vibration velocity rms Frequency range 5-20xrpm (rotation frequency)
Unbalance and alignment	Vibration velocity rms 1xrpm + 2xrpm
Gearbox faults	Vibration velocity in gear mesh frequency
Detailed diagnostic	Signal, FFT, envelope signal and FFT, STA analysis

One typical application template structure, 2/2

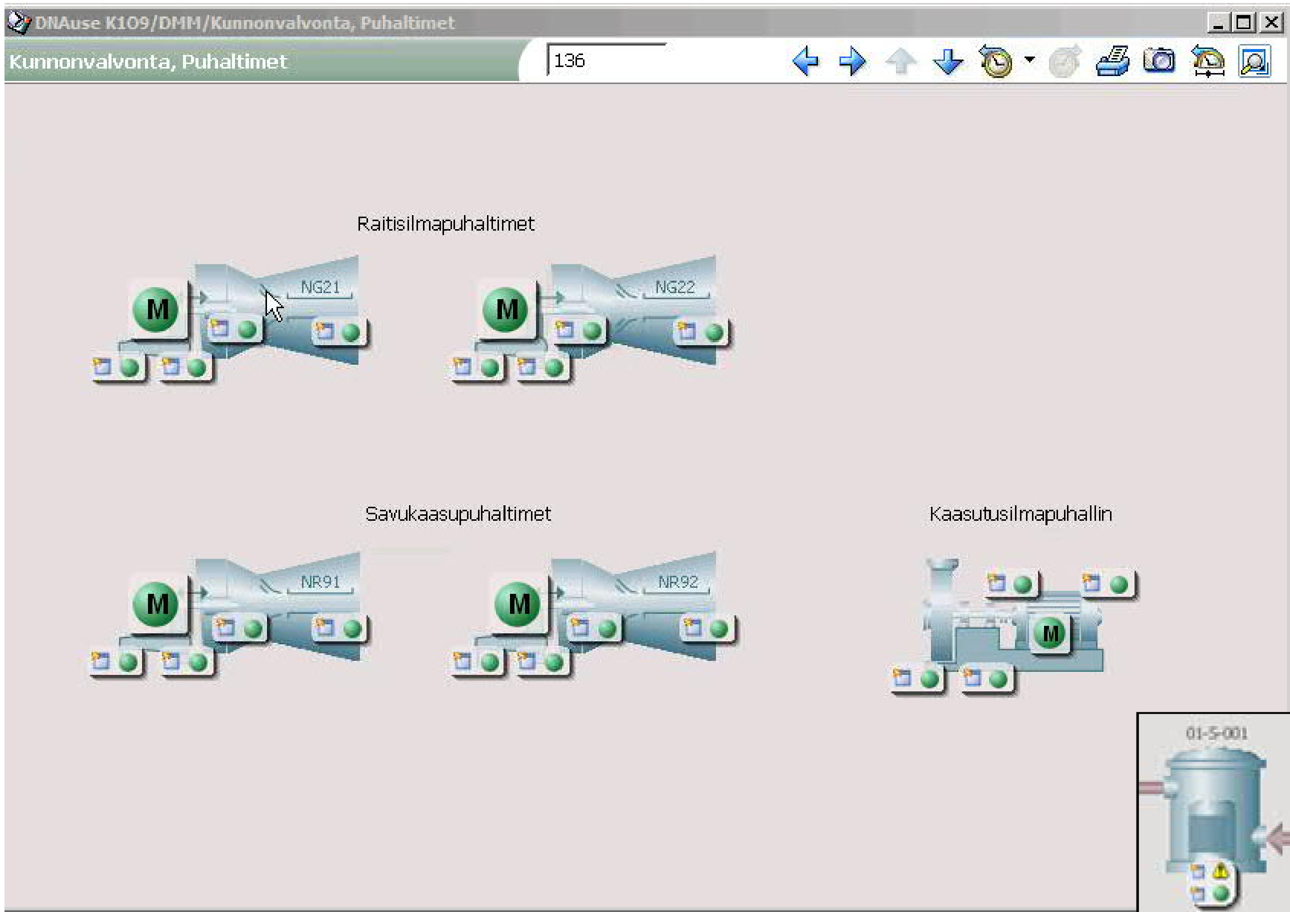


= Signals and spectrums into User Interface and waterfall save

= Scalars into User Interface and trends

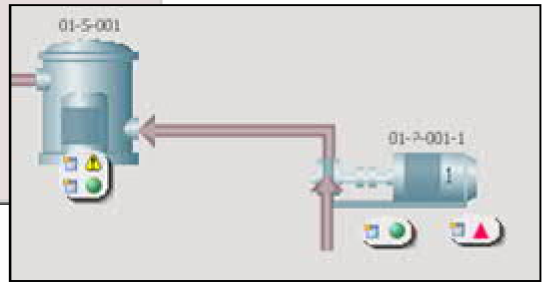
Valmet DNA Operate, auxiliary machines

Power plant air and flue gas fans



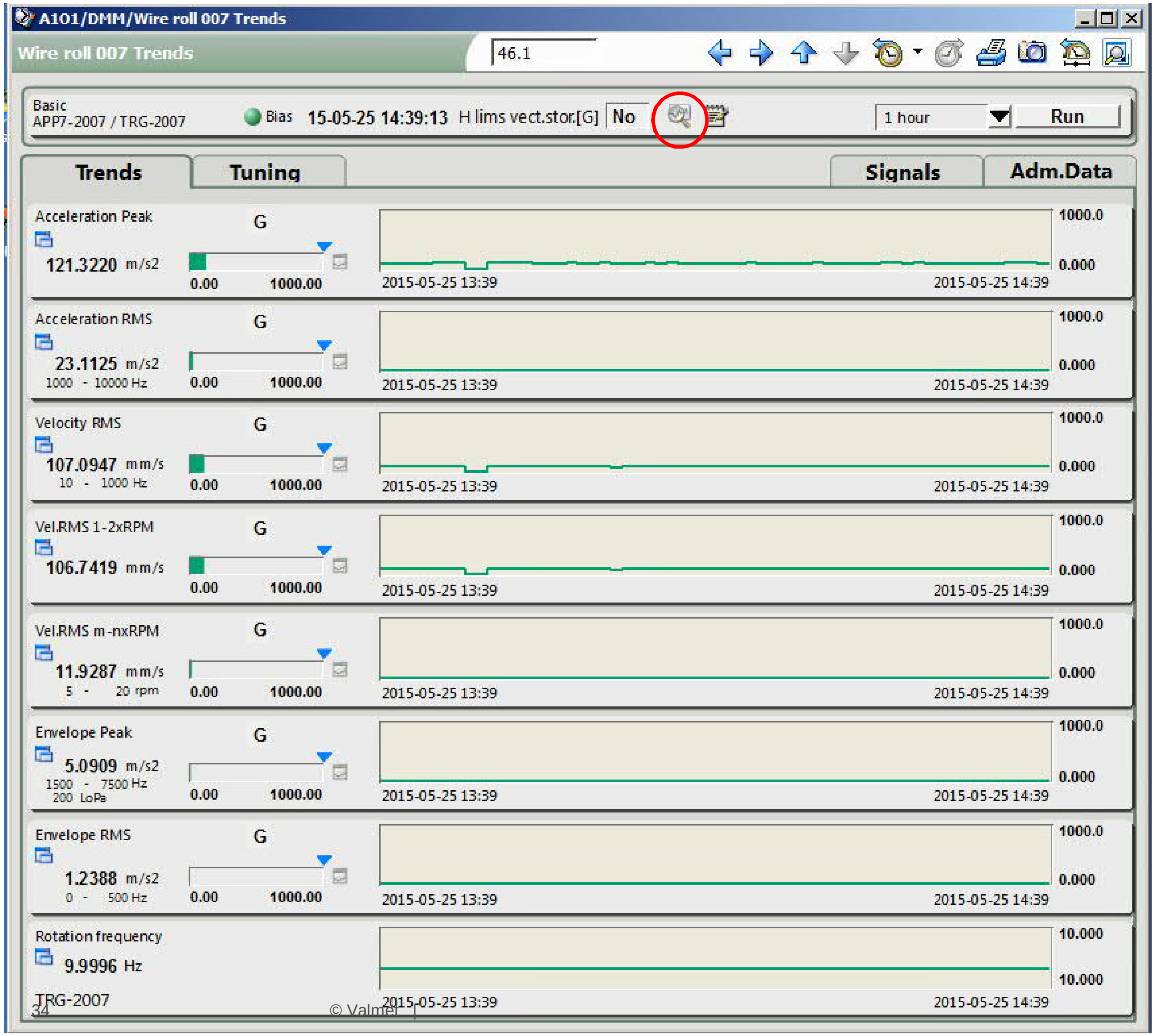
Monitored targets
With worst status indicator
and ”link box”

-From ”link boxes” into next layer
= results page
-status is shown with color and
shape change



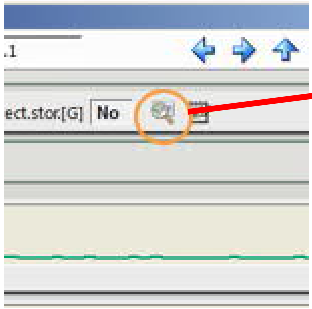
Valmet DNA Operate, auxiliary machines

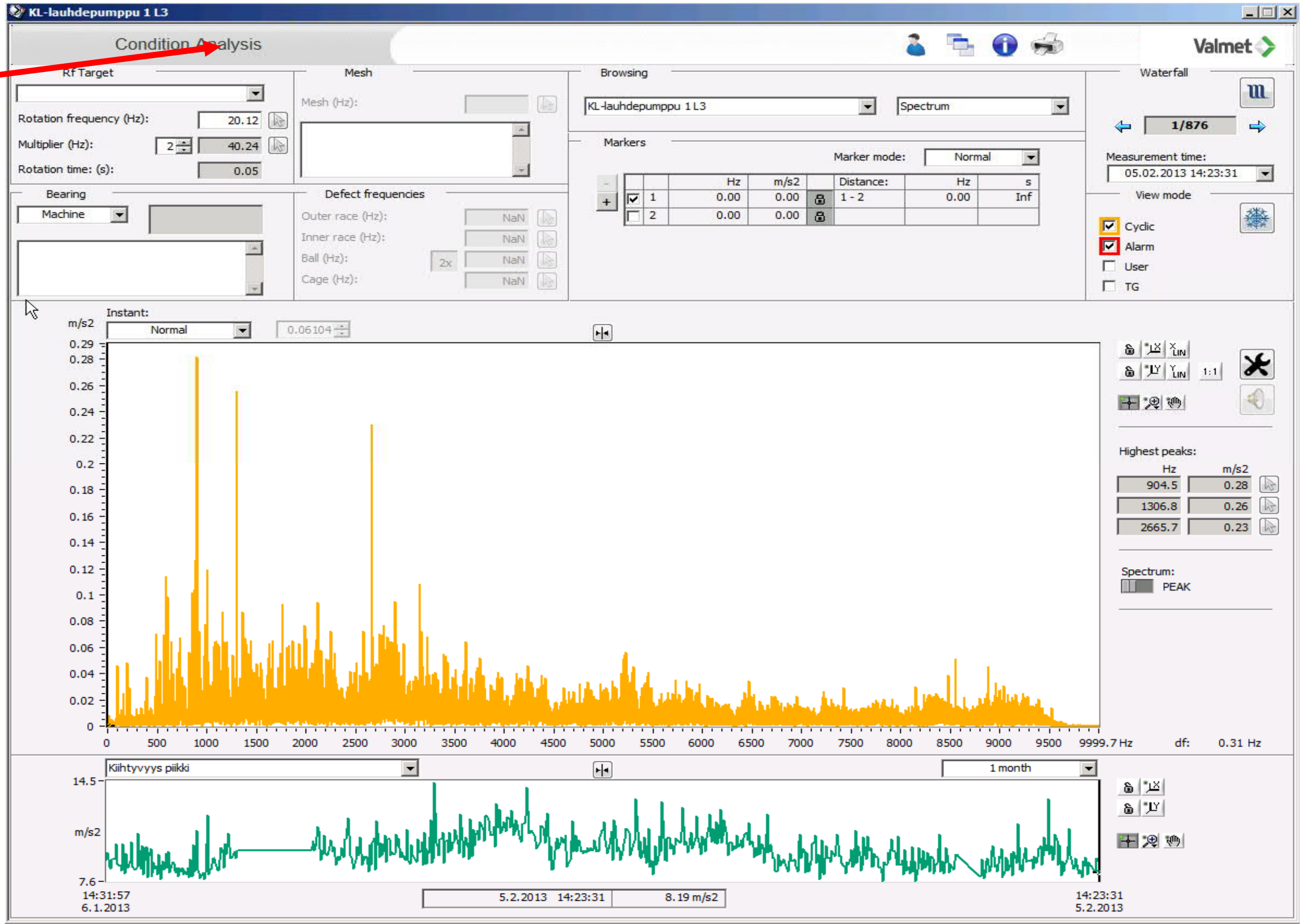
2nd layer, bars and trends



DNA Operate, marker tool (Analysis toolbox)

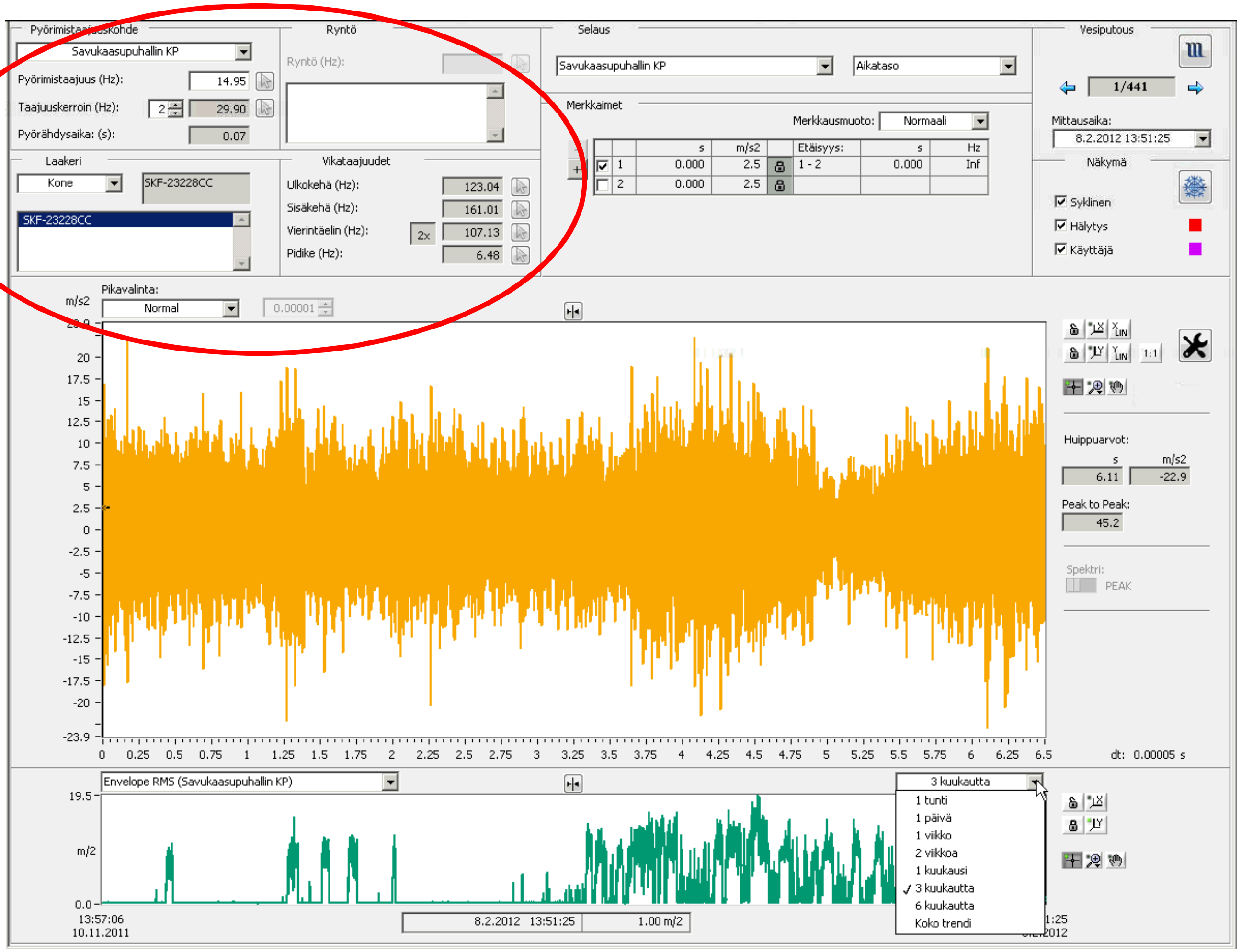
Signals, spectrums, with zooming and marking tools





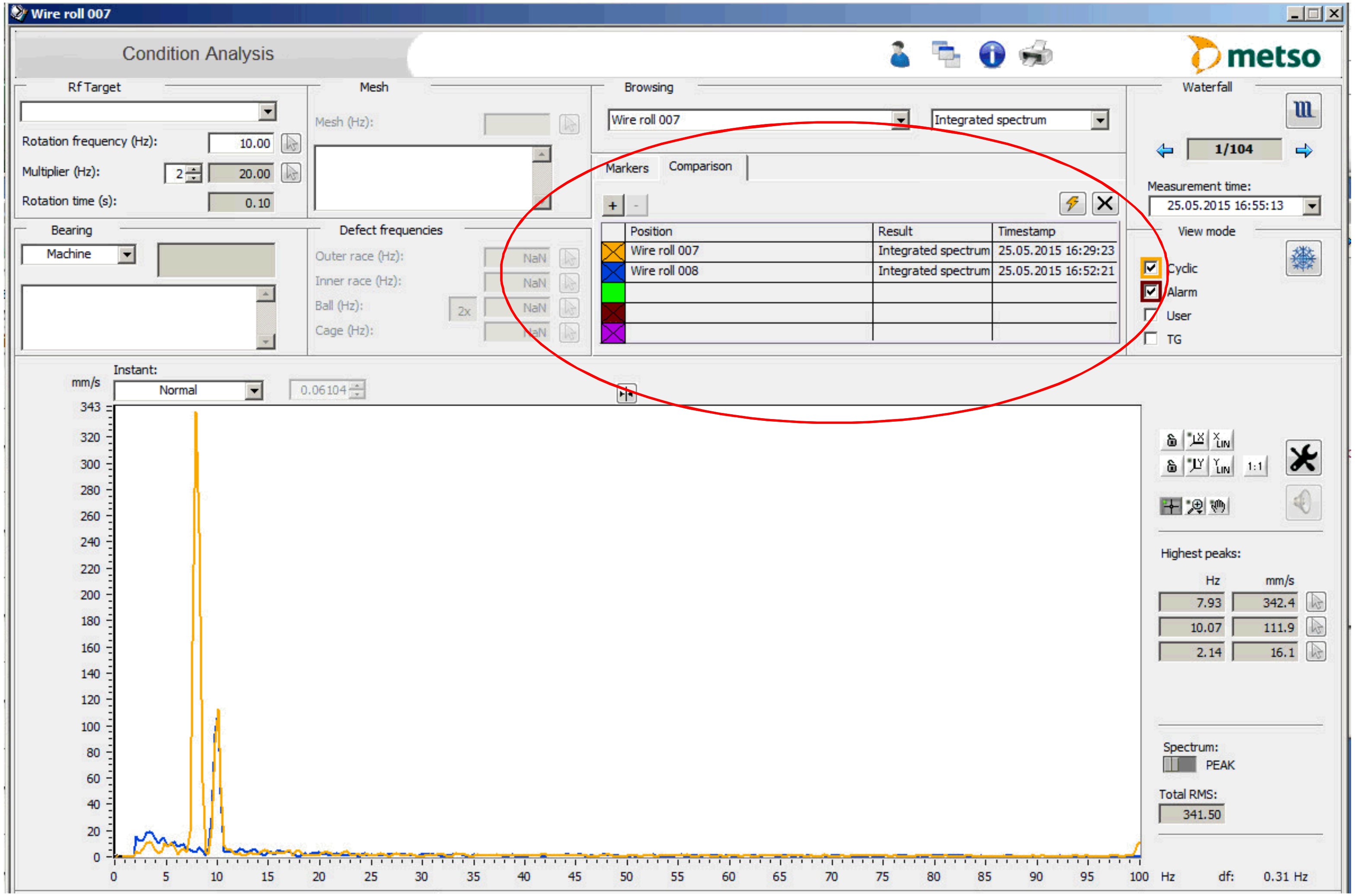
Analysis toolbox

Signals, spectrums, with zooming and marking tools



Comparison tool

"Comparison" feature to DNA MM Analyzing tool, to compare vectors



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Valmet DNA Operate, to see total view

Mix trends (vibrations, process parameters)

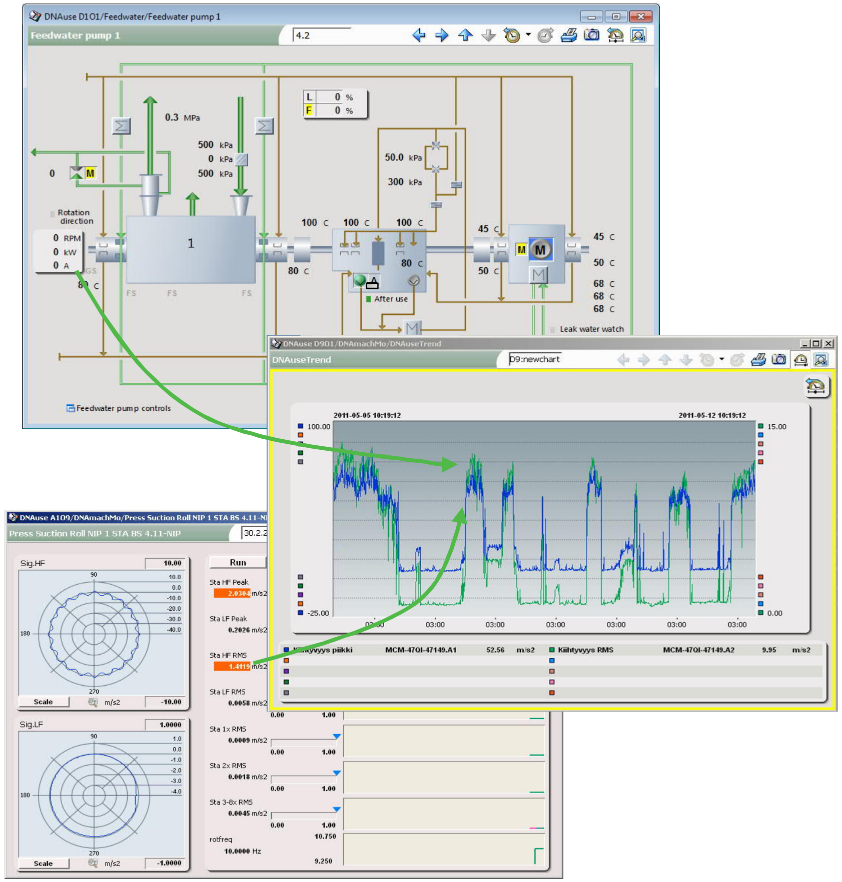
Condition monitoring results and process data can be viewed and analysed in same trends using DNA history tools

- This will enable maintenance engineer to simultaneous viewing of vibrations and related process values in the same trends
- This can be very valuable to optimize machine operation, think about cases like;

a. Fan vibration versus motor power or air flow

b. BFP vibration versus steam / casing heat up curve (changes in case shape)

c. Pump vibrations versus pump pressure / water flow etc.



Vector storing principle

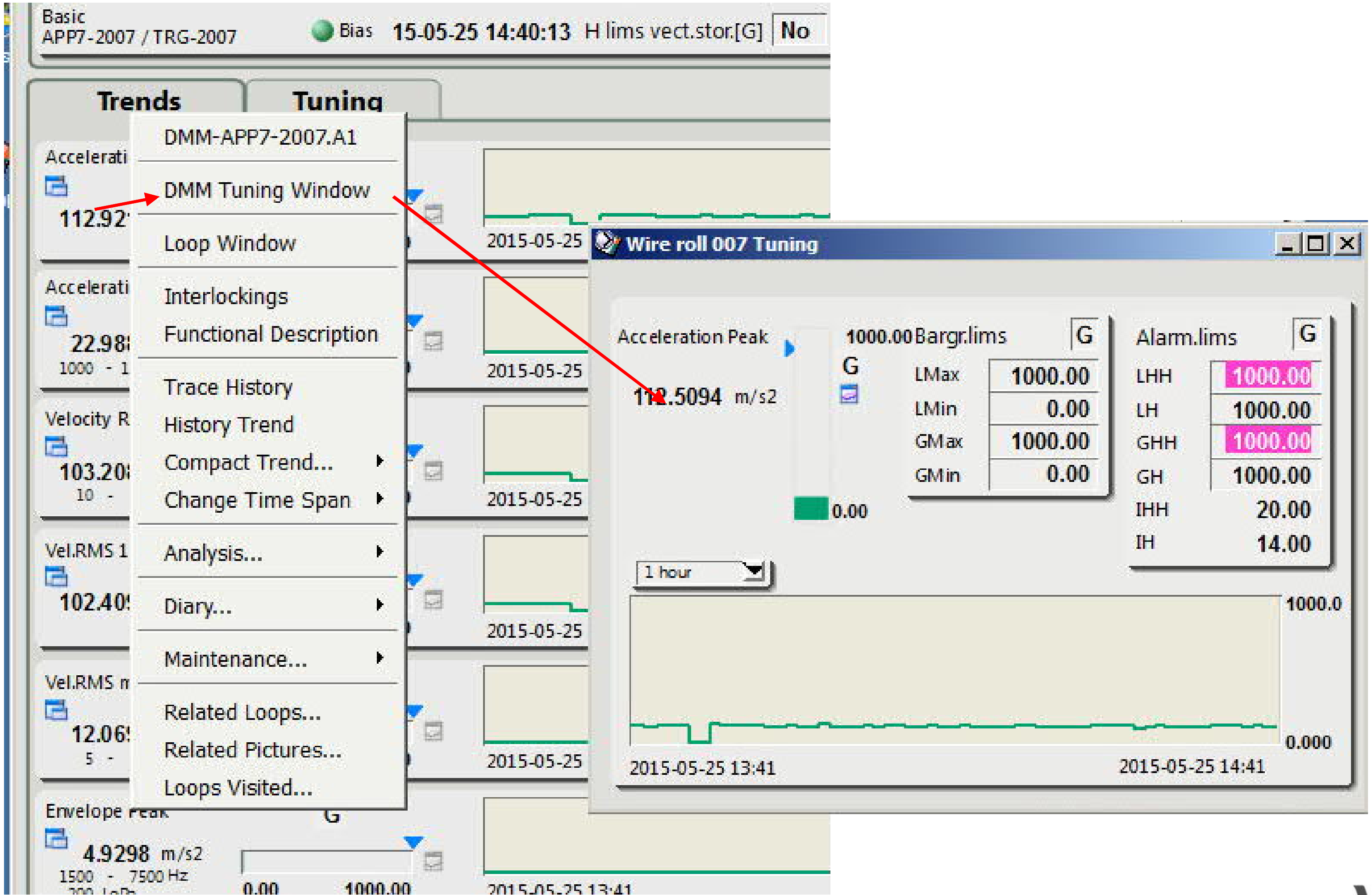
To have good history without excess load into database =data management in SQL database

- Vectors (signal, spectra and equal) are stored in 3 levels
  - Short history
  - Medium history (vectors removed from short history based on delta-time between them)
  - Long history (again removing based on delta-time)
  - Does not effect to vectors stored by ”alarm” or ”user” or from TG run-up/coasts-down stage (these have their own history piles)

Management of the machinery

Valmet DNA Operate, auxiliary machines

Right click from scalar value opens ”tuning window” for that scalar (”DNA style operation”)



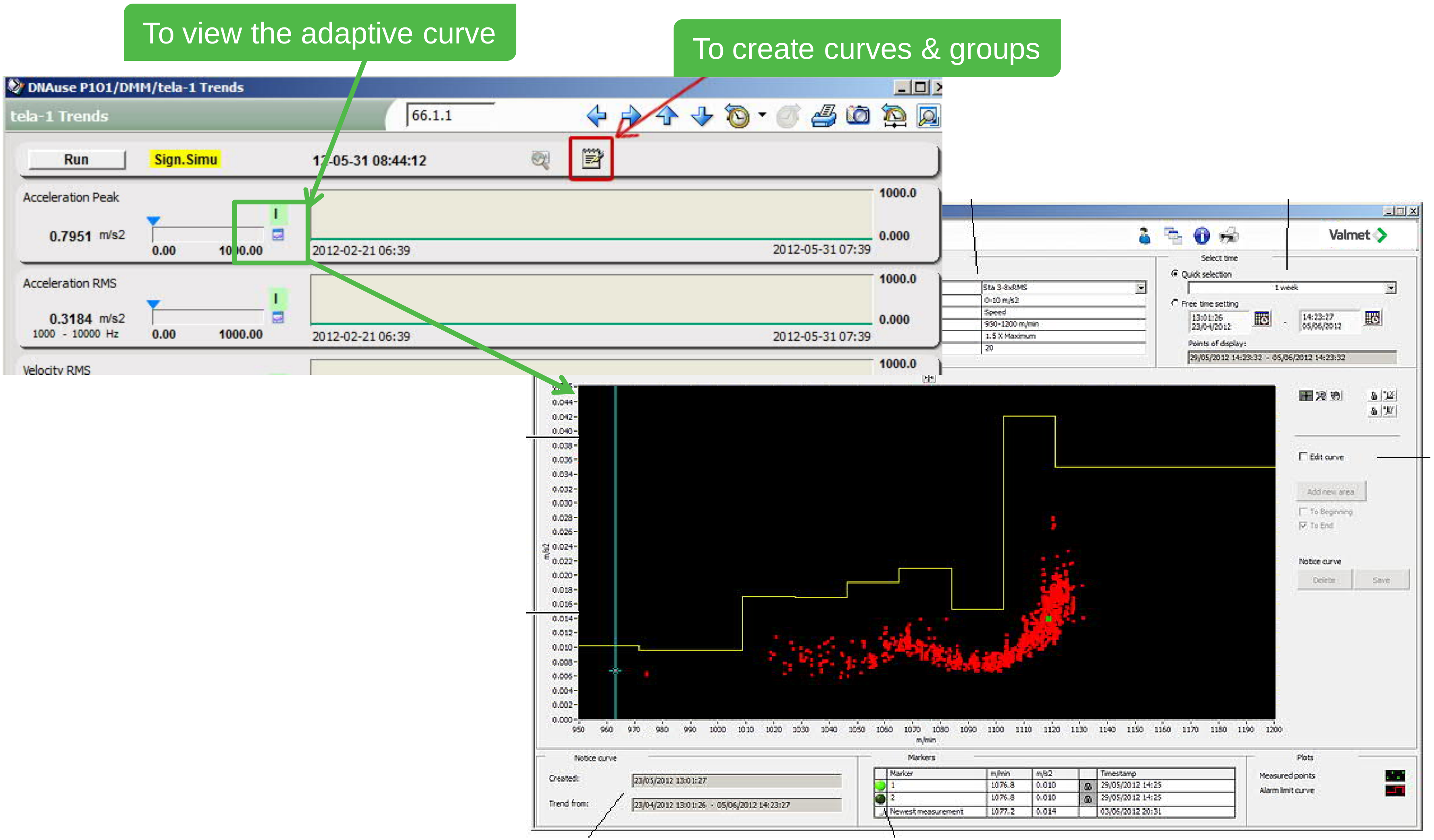
Adaptive alarm limit handling application (”IAH)

What it means

- ”Standard” alarm limit handling has been to use fixed warning (H or L) and alarm (HH or LL) limits for vibration values
- Adaptive handling brings the possibility to adapt alarm limits into changes in operating conditions, typically;
  - Machine speed (m/min) / rotating frequency (Hz)
  - Machine load
- A separate application to tune the limits after system /machine / productions start

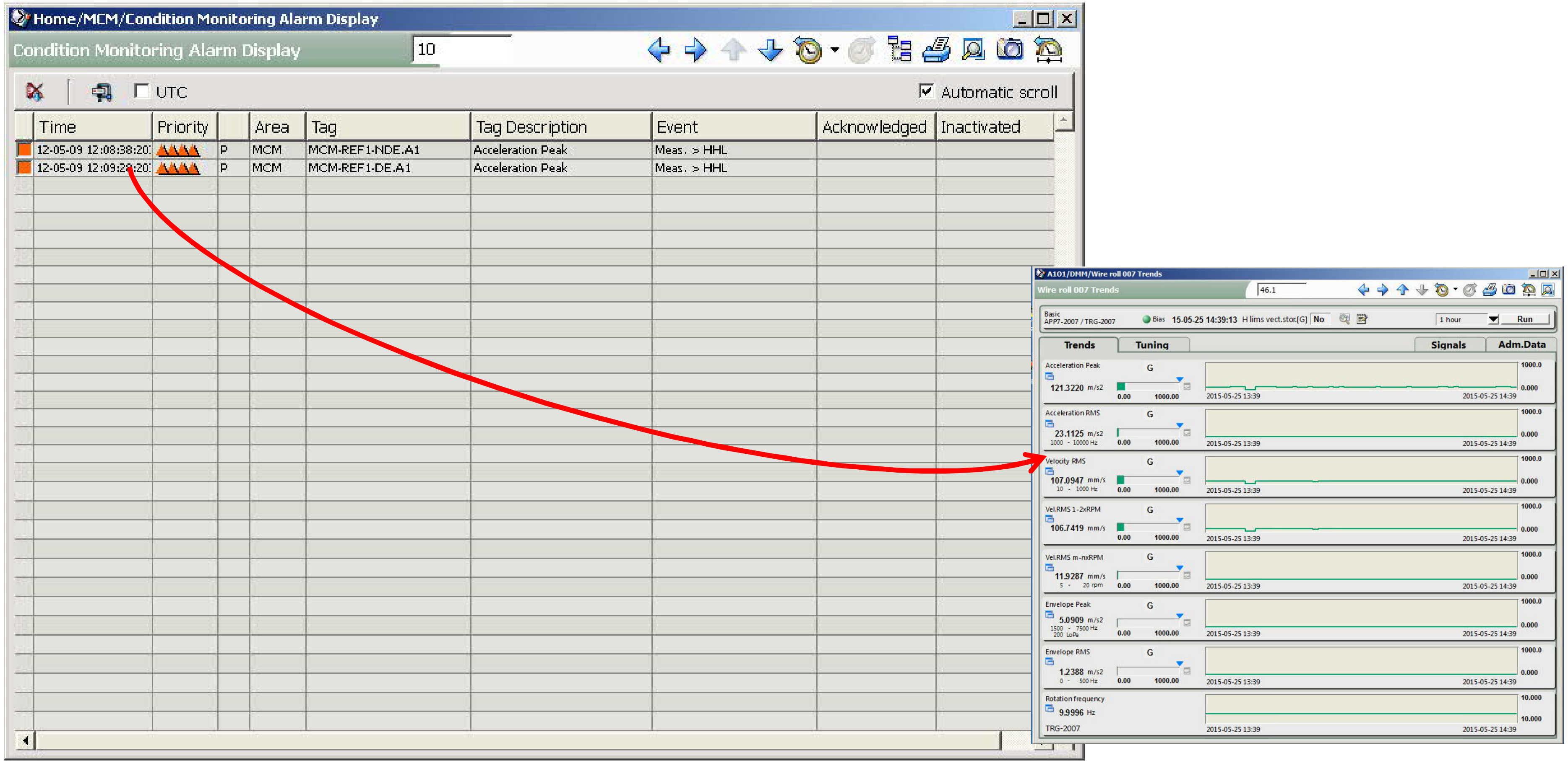
Adaptive alarm limin handling

DNA Operate view & new elements



Alarm and Event Lists for Condition Monitoring

The same alarm management as for controls



DNA Machine Monitoring reports

Change detection and reporting to reduce manual analysis work

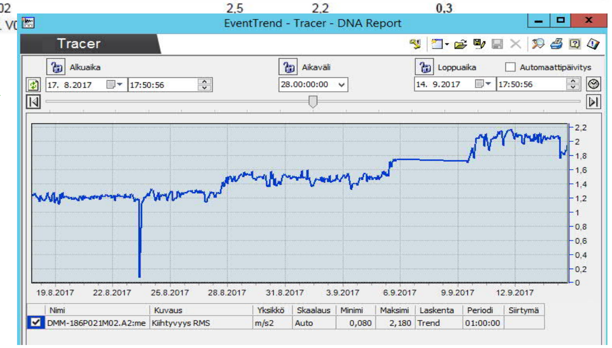
- Detecting growth in key vibration indicators
  - Top 30 lists per indicator in each process department
    - Fast developing faults: Absolute and relative change between last two weeks
    - Slowly developing faults: Absolute and relative change between last week and last month
  - Each line has a link to trend display
- Highest vibration levels
  - Top 30 lists of biggest absolute values
- Unstable or ”frozen” signals
  - Top 30 lists of highest and lowest standard deviation
- Reports give a quick overall view and can be used as predictive maintenance task list
- Even if alarm limits are not set accurately, machine faults can be detected
  - System start-up period
  - Large systems with thousands of vibration indicators

Fibre line

Acceleration RMS

Time 2.11.2017 0:00:00 **Defference between two previous weeks** Print time: 2.11.2017 8:55

Equipment	This week m/s2	Previous week m/s2	Difference m/s2
121K034 MUSTALIPEÄSUODIN 1 M02	143,1	82,1	**61,0**
121K034 MUSTALIPEÄSUODIN 1 M01	25,2	17,0	**8,2**
121K044 MUSTALIPEÄSUODIN 2 M02	35,1	27,7	**7,3**
121C003 HAKEMITTARI MOOTTORI 1 M02	15,0	12,7	**2,4**
125P017 O2 DD1 PALAUTUSSUODOS M02	3,9	2,2	**1,8**
121K044 MUSTALIPEÄSUODIN 2 M01	12,1	10,6	**1,5**
124K040 TERTIÄÄRILAJITIN M02	35,9	34,6	**1,3**
123P002 DD1 MC-PUMPPU P02	3,1	1,9	**1,2**
121P052 TULISTUKSEN POISTOPUMP. P02	10,6	9,4	**1,2**
126P088 D1 DD-REIKÄLEVYN PESU M02	15,7	14,7	**1,0**
123P002 DD1 MC-PUMPPU P01	3,1	2,1	**1,0**
121P042 MUSTALIPEÄPUMPPU P02	7,7	6,7	**1,0**
121P052 TULISTUKSEN POISTOPUMP. M02	9,8	8,9	0,9
121P052 TULISTUKSEN POISTOPUMP. P01	8,5	7,6	0,9
123B141 HAPETUSREAKTORIN SEK. M02	9,2	8,5	0,7
121K044 MUSTALIPEÄSUODIN 2 S02	7,8	7,2	0,6
121C003 HAKEMITTARI MOOTTORI 1 M01	9,5	8,9	0,6
121K030 KEITTIMEN YLÄRUUVI M01	4,4	3,8	0,6
121P042 MUSTALIPEÄPUMPPU P01	5,3	4,8	0,5
124K020 COMBI 2 OKSANEROTUS 2 M04	2,5	2,0	0,5
124P075 REJEKTIPESURIN AKSEPTI M02	1,7	1,2	0,5
126P028 D0 DD REIKÄLEVYN PESUP. P02	5,7	5,3	0,4
124K040 TERTIÄÄRILAJITIN M01	9,4	9,0	0,4
121P042 MUSTALIPEÄPUMPPU M01	3,2	2,8	0,4
126P100 VALKAISTUN MASSAN MC P02	8,9	8,5	0,4
121K023 IMEYTYSTORNIN POHJAKAAV M02	9,5	9,2	0,3
126K052 EOP DD-PESURI M02	16,7	16,3	0,3
126P028 D0 DD REIKÄLEVYN PESUP. P01	7,4	7,1	0,3
121P034 KEITTOKIERTOPUMPPU M02	2,5	2,2	0,3
123B141 HAPETUSREAKTORIN SEK. V[illegible]			



Last week and previous week, absolute and relative changes, top 30 per area

Typical scalars;
Acceleration rms
Vibration velocity rms
Enveloped Acceleration rms

Tehdas

Nopeus RMS

Kahden edeltävän viikon erotus

ika 16.10.2017 0:00:00 Tulostusaika 16.10.2017 14:45

Toimilaite	Tämä viikko	Edeltävä viikko	Erotus
121K044 MUSTALIPEÄSUODIN 2 S02	13,3	5,3	8,1
121K021 IMEYTYSTORNIN YLÄRUUVI V01	8,2	3,9	4,3
121K021 IMEYTYSTORNIN YLÄRUUVI M01	9,6	5,4	4,2
121K021 IMEYTYSTORNIN YLÄRUUVI V02	7,3	3,5	3,8
121K021 IMEYTYSTORNIN YLÄRUUVI M02	8,1	4,5	3,6
141K038 TUHKALINKO K02	5,5	3,0	2,4
146F011 K.JÄÄHD. PÖL.POISTOPUH M01	2,8	1,0	1,9
146F011 K.JÄÄHD. PÖL.POISTOPUH F02	2,4	0,6	1,7
125P027 LAJ. SYÖTTÖLAIMENNUSP. M02	2,8	1,2	1,6
141K038 TUHKALINKO K01	3,4	1,9	1,5
124K020 COMBI 2 OKSANEROTUS 1 M02	4,4	3,0	1,4
125P027 LAJ. SYÖTTÖLAIMENNUSP. P02	3,0	1,7	1,3
121K044 MUSTALIPEÄSUODIN 2 M02	4,1	2,8	1,3
141P100 H2 KIERTOPUMPPU 2 P02	6,5	5,3	1,2
146F011 K.JÄÄHD. PÖL.POISTOPUH F01	1,7	0,5	1,2
121K023 IMEYTYSTORNIN POHJAKAAV M02	2,9	1,9	1,1
146F011 K.JÄÄHD. PÖL.POISTOPUH M02	1,5	0,4	1,0
124P039 TERTIÄÄRILAJ. SYÖTTÖP. M02	2,2	1,2	1,0
125P021 HAPPIVAIHEEN SUODOSP. 1 M02	2,2	1,2	1,0
142P010 RUISKUTUSVESIPUMPPU 1 M02	2,0	1,0	1,0
113C272 HAVU HIHNA 1 M02	4,9	3,9	1,0
141P148 TYHJÖPUMPPU 1 P02	3,0	2,0	1,0
121K034 MUSTALIPEÄSUODIN 1 S02	2,9	1,9	0,9
125P027 LAJ. SYÖTTÖLAIMENNUSP. P01	2,9	2,0	0,9
191P027 RAAKAVESIPUMPPU 2 P01	2,8	2,0	0,9
191P027 RAAKAVESIPUMPPU 2 P02	2,8	2,0	0,9
125P022 HAPPIVAIHEEN SUODOSP. 2 M01	1,8	1,0	0,9
126K023 D0 DD-PESURIN RUUVI V01	3,3	2,5	0,9
191P026 RAAKAVESIPUMPPU 1 P01	2,7	1,9	0,8
146F014 POLTIN PRIM-ILMAPUH. F02	1,1	0,3	0,8

Nopeus RMS

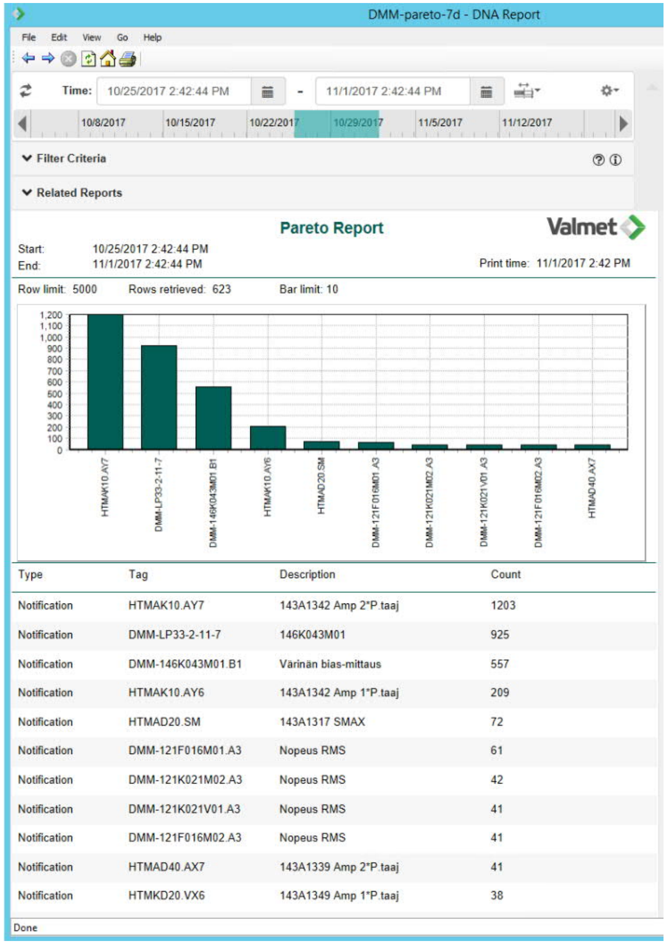
Kahden edeltävän viikon suhteellinen erotus

16.10.2017 0:00:00 Tulostusaika 16.10.2017 14:45

ilaite	Tämä viikko	Edeltävä viikko	Erotus	Suhteellinen erotus
F014 POLTIN PRIM-ILMAPUH. M01	0,8	0,2	0,6	309%
F011 K.JÄÄHD. PÖL.POISTOPUH F02	2,4	0,6	1,7	271%
F011 K.JÄÄHD. PÖL.POISTOPUH F01	1,7	0,5	1,2	253%
F014 POLTIN PRIM-ILMAPUH. F02	1,1	0,3	0,8	243%
F011 K.JÄÄHD. PÖL.POISTOPUH M02	1,5	0,4	1,0	242%
P026 VIHERLIPEÄPUMPPU 2 M02	1,0	0,3	0,7	234%
F014 POLTIN PRIM-ILMAPUH. F01	0,7	0,2	0,4	209%
F011 K.JÄÄHD. PÖL.POISTOPUH M01	2,8	1,0	1,9	193%
F004 KAASUTUSILMAPUHALLIN 2 M01	0,3	0,1	0,2	164%
K044 MUSTALIPEÄSUODIN 2 S02	13,3	5,3	8,1	153%
F004 KAASUTUSILMAPUHALLIN 2 M02	0,3	0,1	0,2	150%
F003 KAASUTUSILMAPUHALLIN 1 M02	0,5	0,2	0,3	144%
F004 KAASUTUSILMAPUHALLIN 2 F02	0,4	0,1	0,2	140%
P027 LAJ. SYÖTTÖLAIMENNUSP. M02	2,8	1,2	1,6	132%
F003 SAVUKAASUPUHALLIN F01	0,2	0,1	0,1	132%
F014 POLTIN PRIM-ILMAPUH. M02	0,3	0,1	0,2	126%
P026 VIHERLIPEÄPUMPPU 2 P01	0,5	0,2	0,3	123%
P103 H4 KIERTOPUMPPU 1 P02	1,0	0,4	0,5	119%
F003 SAVUKAASUPUHALLIN M02	0,3	0,2	0,2	117%
K021 IMEYTYSTORNIN YLÄRUUVI V01	8,2	3,9	4,3	111%
P025 VIHERLIPEÄPUMPPU 1 P02	1,2	0,6	0,6	110%
P026 VIHERLIPEÄPUMPPU 2 P02	1,2	0,6	0,6	110%
K021 IMEYTYSTORNIN YLÄRUUVI V02	7,3	3,5	3,8	108%
F003 KAASUTUSILMAPUHALLIN 1 M01	0,3	0,2	0,2	106%
P026 VIHERLIPEÄPUMPPU 2 M01	0,7	0,3	0,3	99%
P010 RUISKUTUSVESIPUMPPU 1 M02	2,0	1,0	1,0	98%
P051 HEIKKOVALKOLIPEÄPUMPPU 1 M01	1,1	0,6	0,5	95%
P103 H4 KIERTOPUMPPU 1 P01	0,8	0,4	0,4	93%
P116 VAHVALIPEÄPUMPPU 1 P02	0,5	0,3	0,2	92%
P029 SEK.LAJITTIMEN SYÖTTÖP. M02	1,3	0,7	0,6	91%

DNA Machine Monitoring alarm reporting and maintenance diary

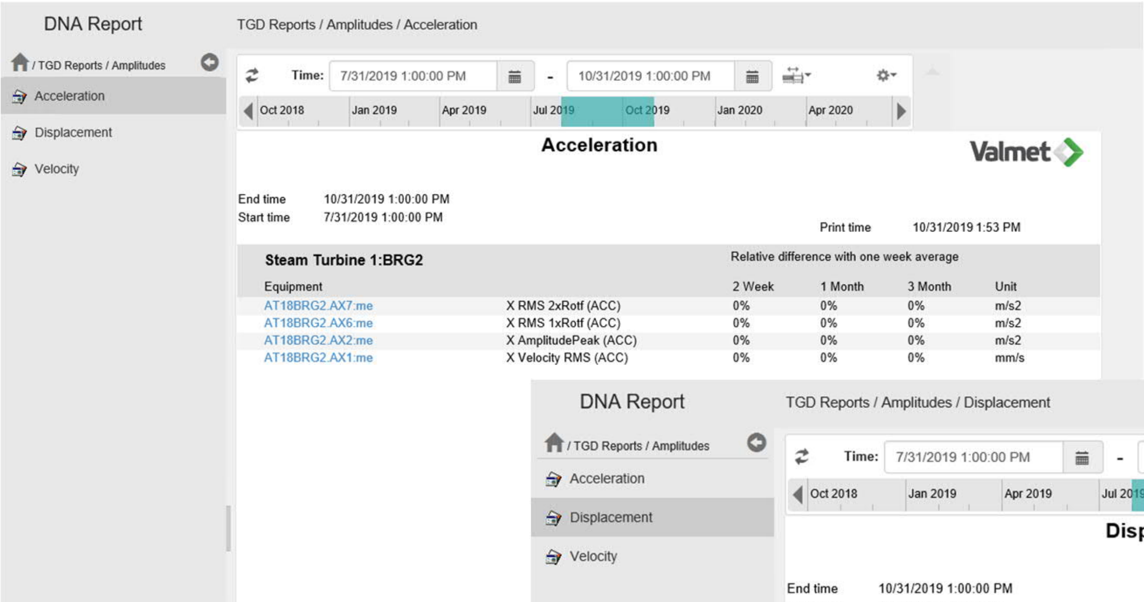
- DNA Alarm Reports
  - Focusing on most critical targets: Active alarms
  - Analyzing alarm development: Alarm trend 180 days
  - Finding positions that cause plenty of alarms: Pareto lists 24 h, 1 week , 1 month
- DNA Diary for maintenance
  - Diary tailored for condition monitoring entries
  - Reports for reviewing diary entries per shift / per day
  - Enhanced two-way communication
    - Between operators and maintenance
    - Between customer and Valmet remote service team
  - Entries can be linked to customer's CMMS system



Type	Tag	Description	Count
Notification	HTMAK10.AY7	143A1342 Amp 2*P.taaj	1203
Notification	DMM-LP33-2-11-7	146K043M01	925
Notification	DMM-146K043M01.B1	Värinän bias-mittaus	557
Notification	HTMAK10.AY6	143A1342 Amp 1*P.taaj	209
Notification	HTMAD20.SM	143A1317 SMAX	72
Notification	DMM-121F016M01.A3	Nopeus RMS	61
Notification	DMM-121K021M02.A3	Nopeus RMS	42
Notification	DMM-121K021V01.A3	Nopeus RMS	41
Notification	DMM-121F016M02.A3	Nopeus RMS	41
Notification	HTMAD40.AX7	143A1339 Amp 2*P.taaj	41
Notification	HTMKD20.VX6	143A1349 Amp 1*P.taaj	38

Reporting on Turbine

Changes, last week average versus previous time span averages



DNA Report

TGD Reports / Amplitudes / Acceleration

/ TGD Reports / Amplitudes

- Acceleration
- Displacement
- Velocity

Time: 7/31/2019 1:00:00 PM - 10/31/2019 1:00:00 PM

Oct 2018 Jan 2019 Apr 2019 Jul 2019 Oct 2019 Jan 2020 Apr 2020

Acceleration

Valmet

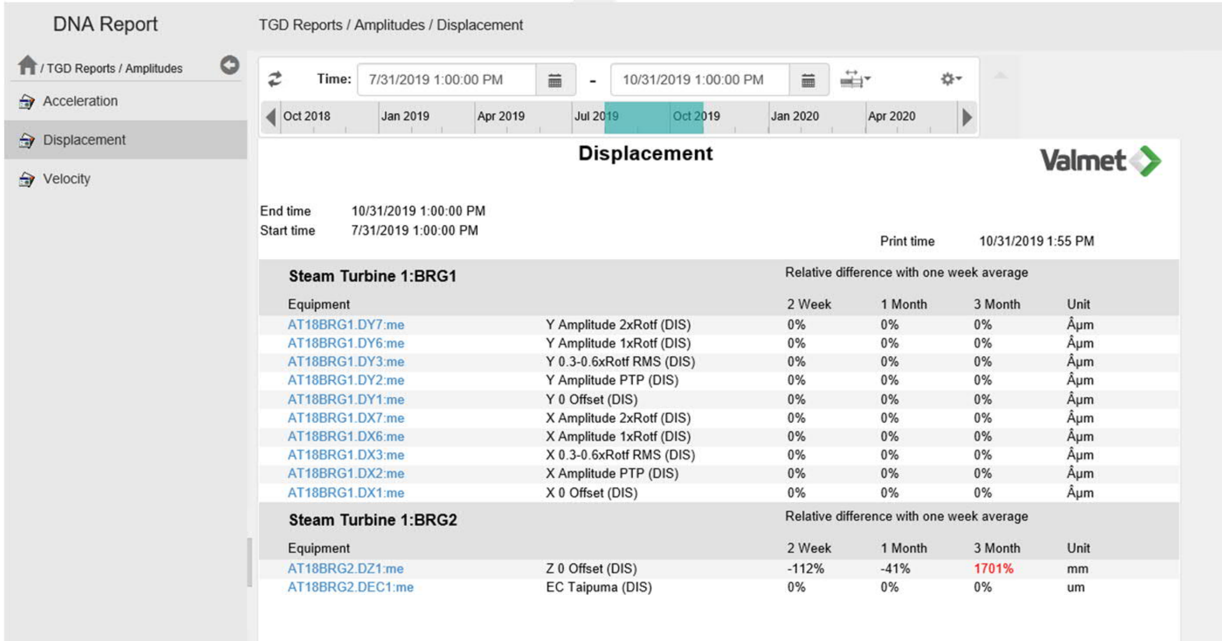
End time 10/31/2019 1:00:00 PM
Start time 7/31/2019 1:00:00 PM

Print time 10/31/2019 1:53 PM

Steam Turbine 1:BRG2 — Relative difference with one week average

Equipment		2 Week	1 Month	3 Month	Unit
AT18BRG2.AX7:me	X RMS 2xRotf (ACC)	0%	0%	0%	m/s2
AT18BRG2.AX6:me	X RMS 1xRotf (ACC)	0%	0%	0%	m/s2
AT18BRG2.AX2:me	X AmplitudePeak (ACC)	0%	0%	0%	m/s2
AT18BRG2.AX1:me	X Velocity RMS (ACC)	0%	0%	0%	mm/s

Templates are built as per customer´s turbine
(amount of brg blocks, etc)
Different report forms are avaialble in the left
You choose the report yiou want to view from left side menu



DNA Report

TGD Reports / Amplitudes / Displacement

/ TGD Reports / Amplitudes

- Acceleration
- Displacement
- Velocity

Time: 7/31/2019 1:00:00 PM - 10/31/2019 1:00:00 PM

Oct 2018 Jan 2019 Apr 2019 Jul 2019 Oct 2019 Jan 2020 Apr 2020

Displacement

Valmet

End time 10/31/2019 1:00:00 PM
Start time 7/31/2019 1:00:00 PM

Print time 10/31/2019 1:55 PM

Steam Turbine 1:BRG1 — Relative difference with one week average

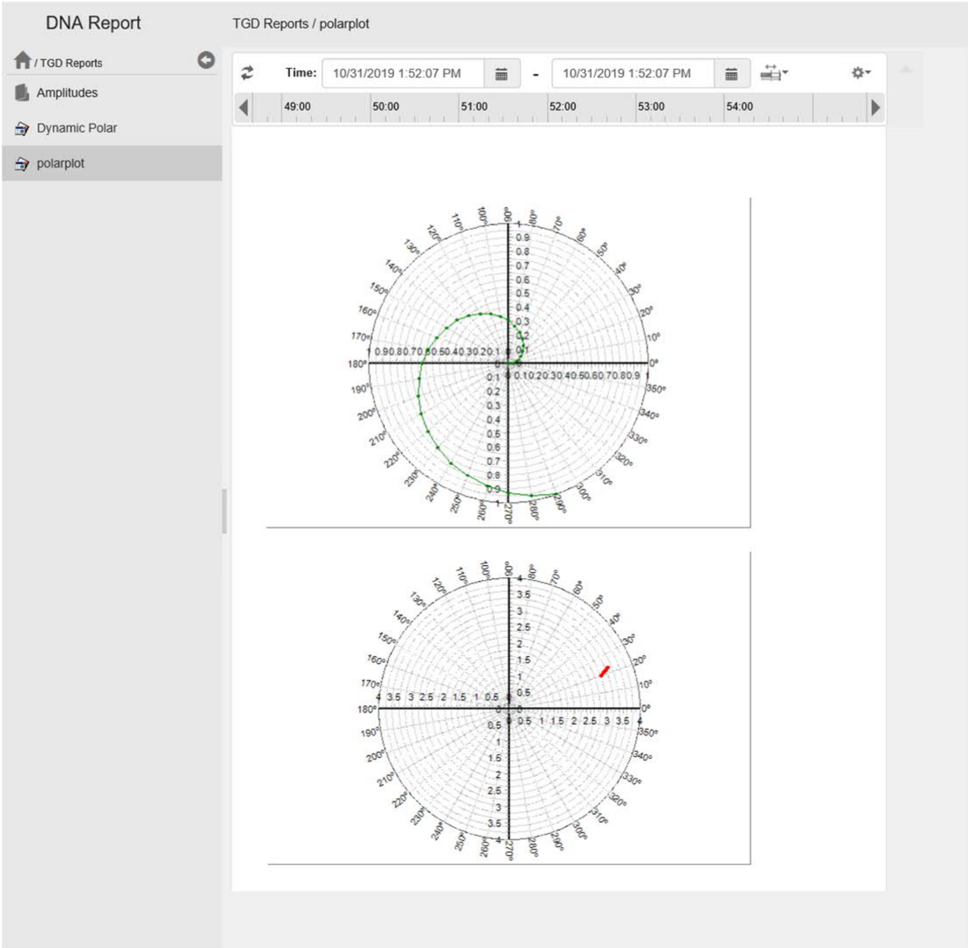
Equipment		2 Week	1 Month	3 Month	Unit
AT18BRG1.DY7:me	Y Amplitude 2xRotf (DIS)	0%	0%	0%	Åµm
AT18BRG1.DY6:me	Y Amplitude 1xRotf (DIS)	0%	0%	0%	Åµm
AT18BRG1.DY3:me	Y 0.3-0.6xRotf RMS (DIS)	0%	0%	0%	Åµm
AT18BRG1.DY2:me	Y Amplitude PTP (DIS)	0%	0%	0%	Åµm
AT18BRG1.DY1:me	Y 0 Offset (DIS)	0%	0%	0%	Åµm
AT18BRG1.DX7:me	X Amplitude 2xRotf (DIS)	0%	0%	0%	Åµm
AT18BRG1.DX6:me	X Amplitude 1xRotf (DIS)	0%	0%	0%	Åµm
AT18BRG1.DX3:me	X 0.3-0.6xRotf RMS (DIS)	0%	0%	0%	Åµm
AT18BRG1.DX2:me	X Amplitude PTP (DIS)	0%	0%	0%	Åµm
AT18BRG1.DX1:me	X 0 Offset (DIS)	0%	0%	0%	Åµm

Steam Turbine 1:BRG2 — Relative difference with one week average

Equipment		2 Week	1 Month	3 Month	Unit
AT18BRG2.DZ1:me	Z 0 Offset (DIS)	-112%	-41%	1701%	mm
AT18BRG2.DEC1:me	EC Taipuma (DIS)	0%	0%	0%	um

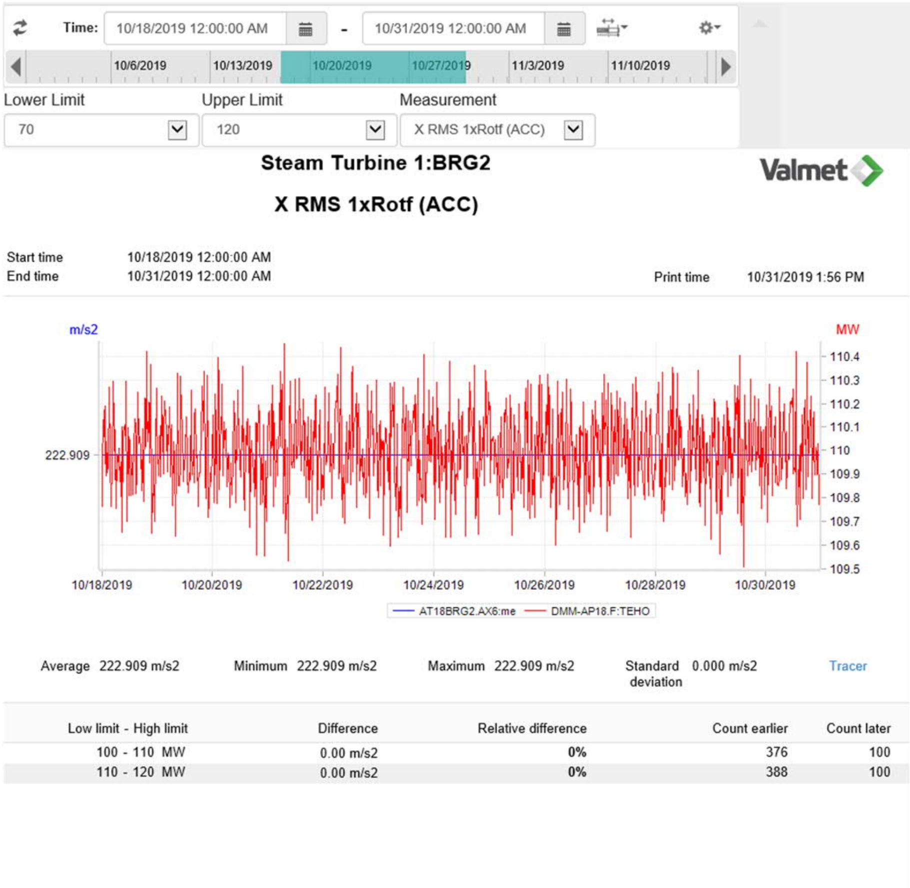
Reporting on Turbine

Graphical reporting, for example run-up



Reporting on Turbine

Change classification

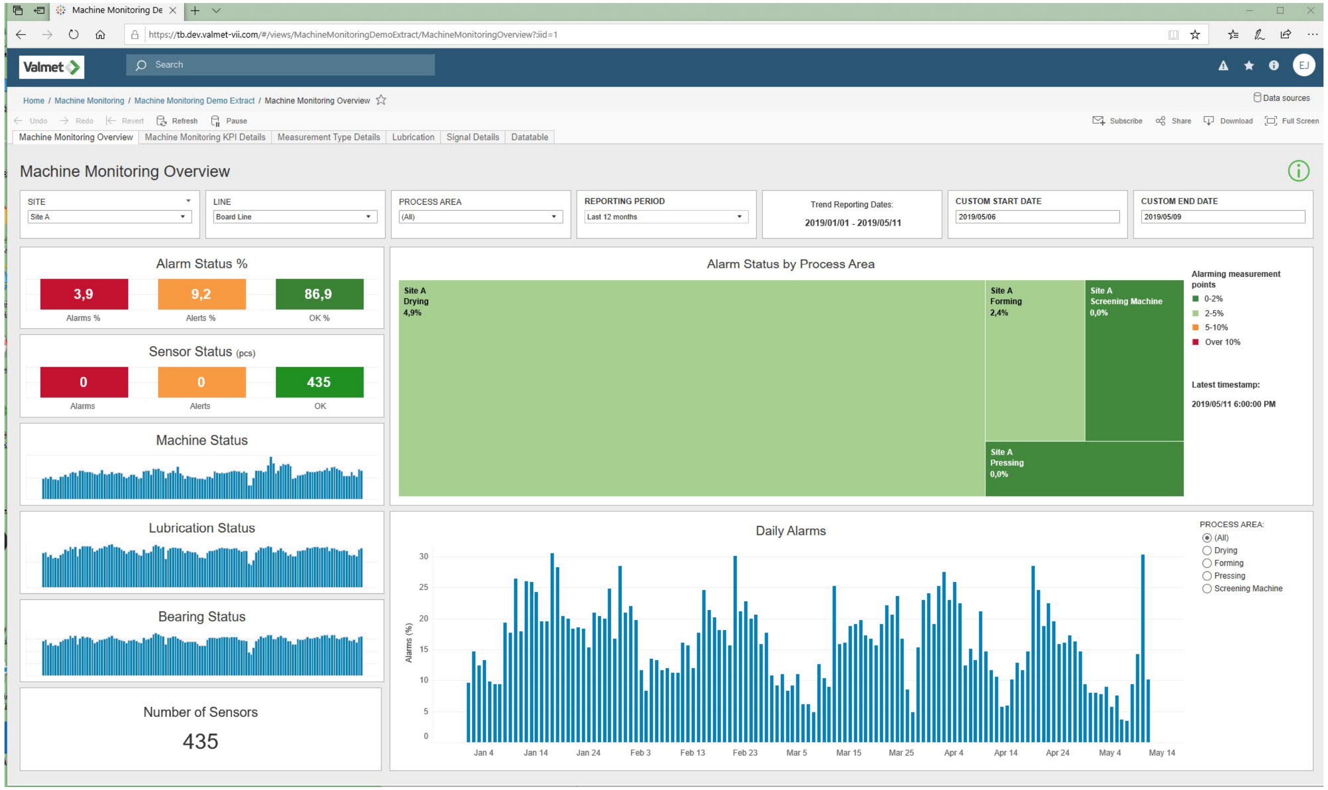


Change comparison can also be classified into different "buckets"
-based on rpm (BOP) or based on PM speed for paper industry
-in TG one possibility could be power based classification

-in addition to change lists, you may open trend comparison vlue versus power

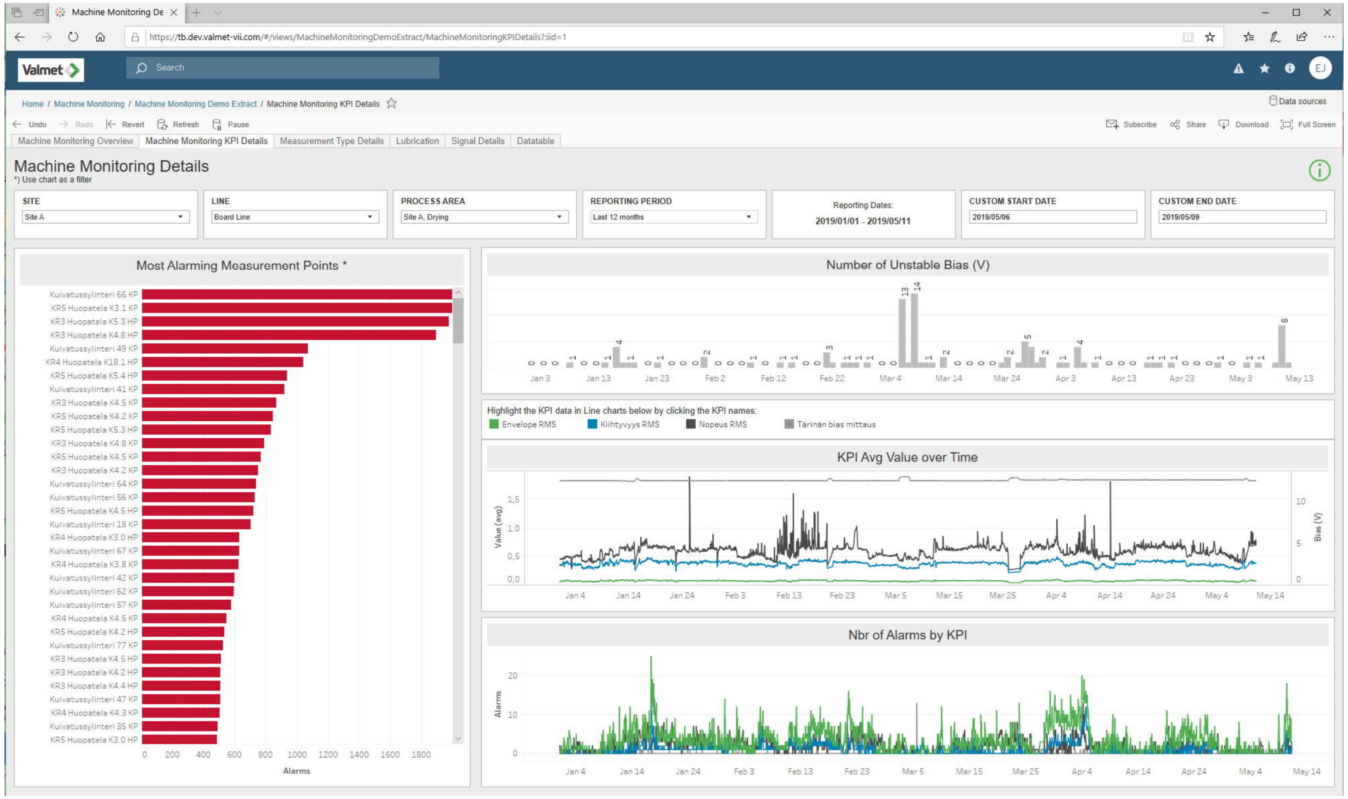
Dashboards (Valmet Industrial Internet)

Overview



Dashboards

Drill down to details



System technology for Condition Monitoring

Hardware and software is based on Valmet DNA DCS

- High reliability
  - isolated I/O´s , PCS robustness
- Scalability
  - HW, SW, Functionality
- Supports different network topologies (ring, star) and redundancy
- System structure centralized or distributed or a mix of these
- Can be a dedicated CM system or part of control system
- Global support from Valmet Automation local operations
- 24/7 system support (3 time zones principle)
- Layered User Interface structure
- Several ways to communicate into 3rt party systems
- Tools to mix trends, share information and link into EPR system (DNA Diary)
- Seamless integration into Valmet IoT
  - Operation dashboards
  - roll wear/runtime predictors

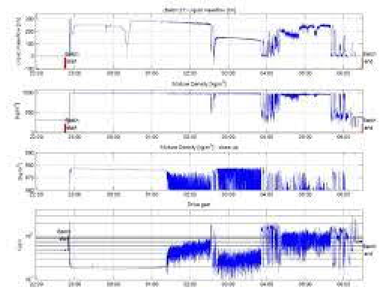
Other offering from us

Measurement System

Data collection and analysis using DNA as platform

Targets:

- Collect measuring data
- Trends monitoring in real-time/history mode
- Storing data for later analysing
- Automatic disturbance report
- Support tool for analyzing different process behaviours



Solution:

- Valmet DNA Information System for storing the data
- Valmet DNA tools for data analysing
- Valmet DNA process stations and IO as interface between DNA system and process

Steam turbine control for new turbine
Raahen Voima Oy, Raahe Power Plant, Finland, 2015

Situation

- A new delivery in co-operation with Power Machine
- LMZ: condense turbine, 120 MW
- Turbine installed in 2015

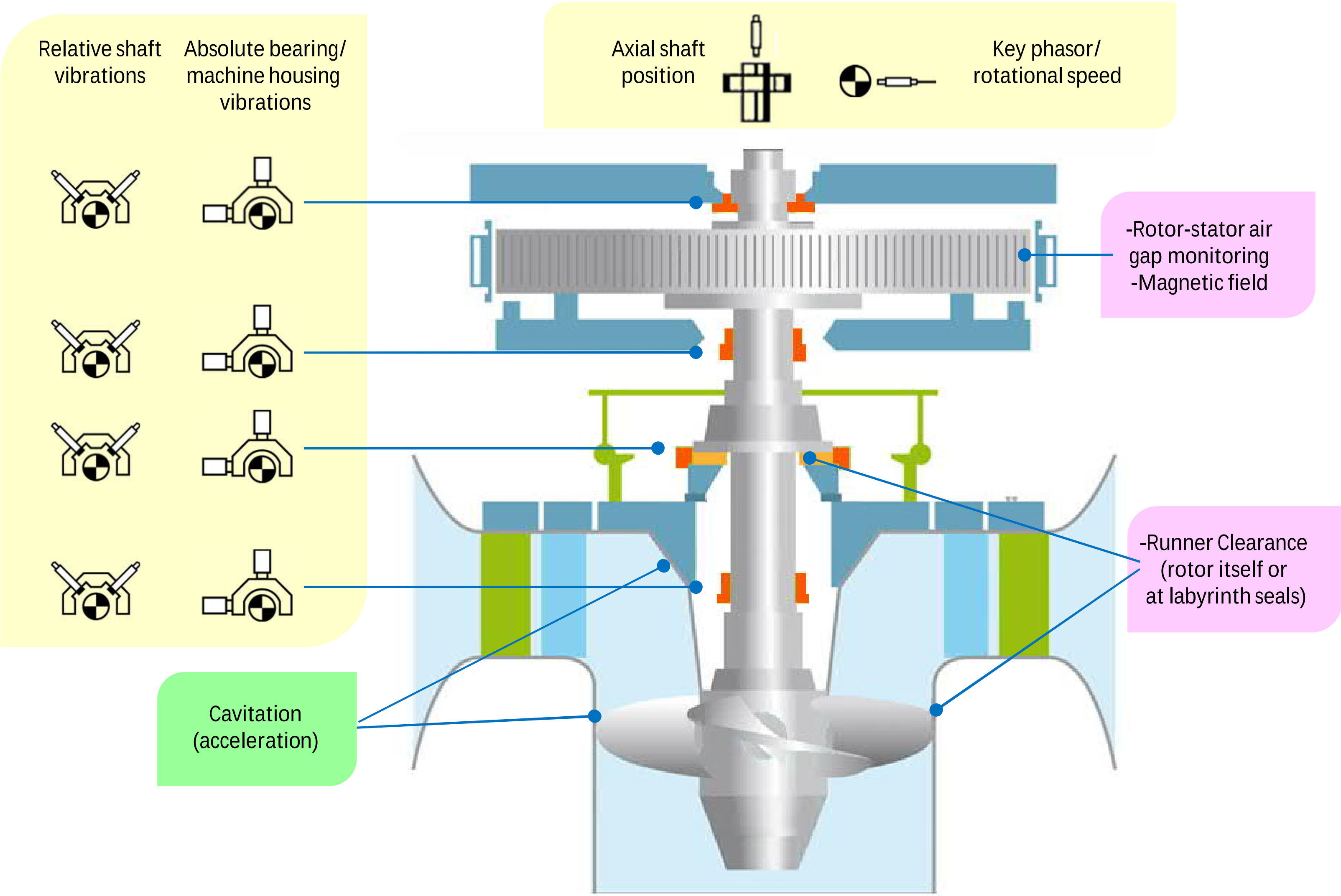
The following controllers were implemented at DNA steam turbine automation and new hydraulic control and protection system were delivered also:

- Speed control using temperature-dependent starting program with quick run through resonance frequency bands
- Island mode, load-, live steam control
- Limiters: generator power MIN/MAX, life steam pressure MIN, condense pressure MAX
- 2oo3 voted overspeed protection
- 2oo3 voted turbine protection with Himax system e.g. lube oil-, condense pressure, etc.
- Hydraulic power unit high pressure 115 bar
- 4 pcs Servomotors for control valves
- 2 pcs Servomotors for trip valves
- 1 pcs Trip-Con hydraulic 2/3-voted system

Upper level vibration diagnostic part purchased by end customer (TG and BOP machinery)

Hydro Turbine monitoring and protection

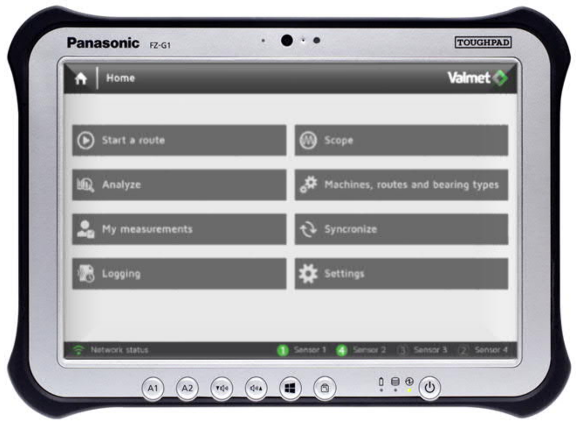
Possible monitoring points and parameters



Valmet Maintenance Pad

Key features

- Tool for off-line vibration measurements
  - Vibration data collection
  - Route and off-route measurements
  - Analysis tools and history database on Pad
  - Data transfer into DNA MM and Sensodec 6S
- Wireless vibration measurement
  - Standard WiFi interface, no wires
- Support for inspection routes
  - separte or mixed with vibration measurements
- Built on Windows operating system
  - Valmet Maintenance Pad is not limited to vibration data collection only
    - Also other Windows applications can be used (camera, email, Office tools, etc)
  - Works as on-line system field terminal for Valmet DNA or Sensodec 6S
  - 2 Panasonic Toughpad models available
    - 10” for most cases 7” is aimed for Operator Inspections
- CMMS link’
  - SAP implementes as per today
  - others as needed

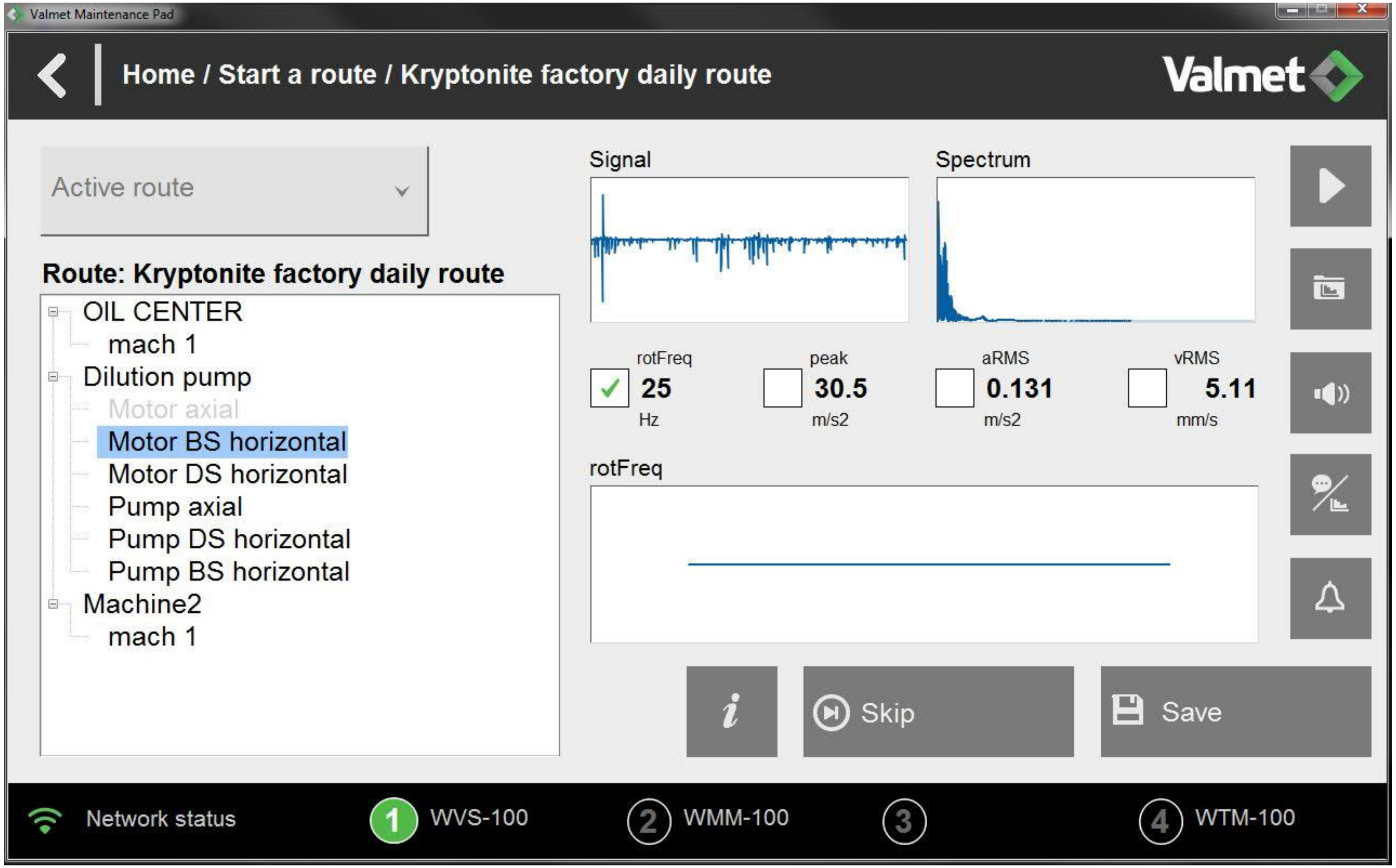


Valmet Maintenance Pad

Valmet Machine Analyzer, main view

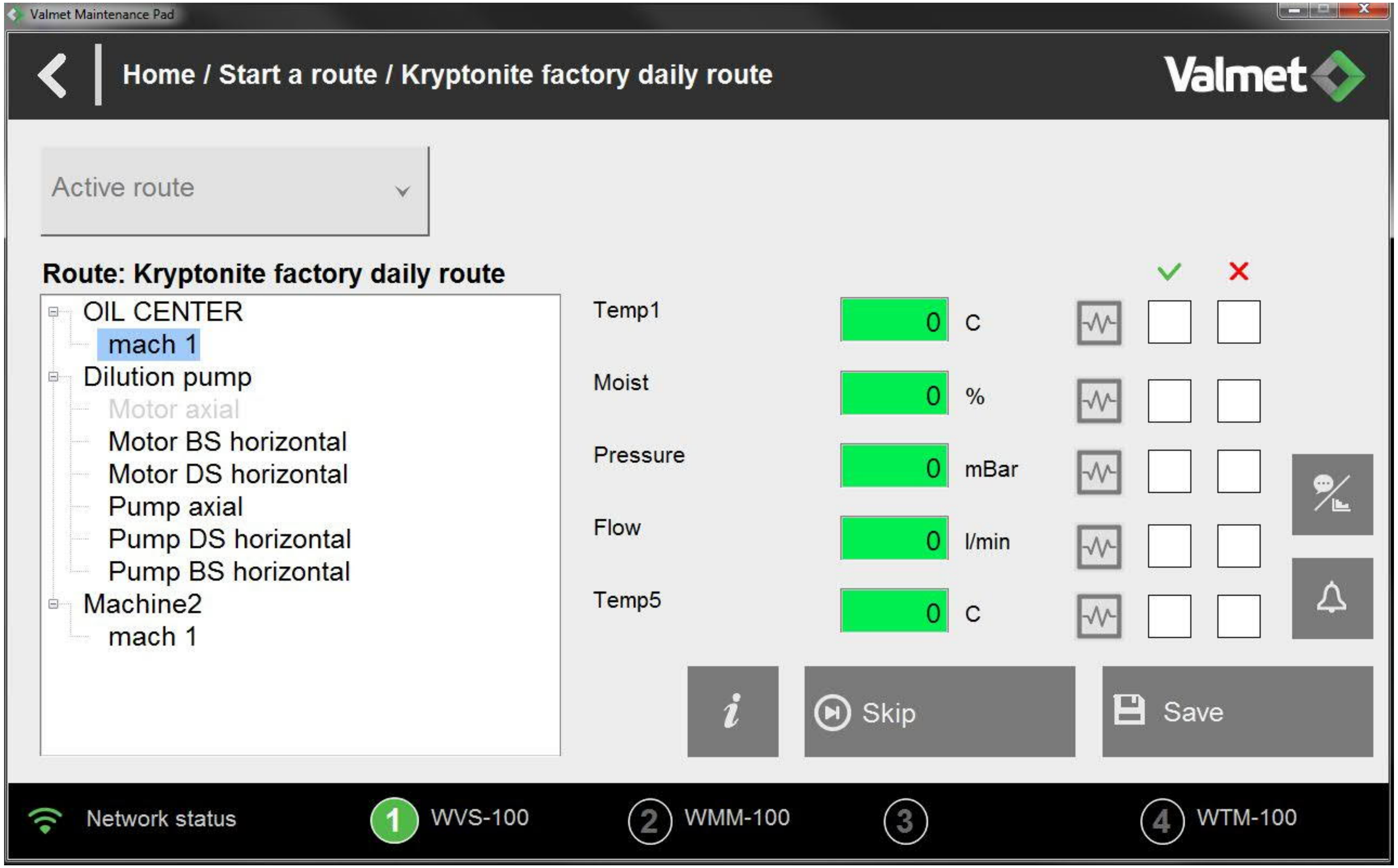
Valmet Maintenance Pad

Valmet Machine Analyzer, measurement



Valmet Maintenance Pad

Valmet Machine Analyzer, operator route checks



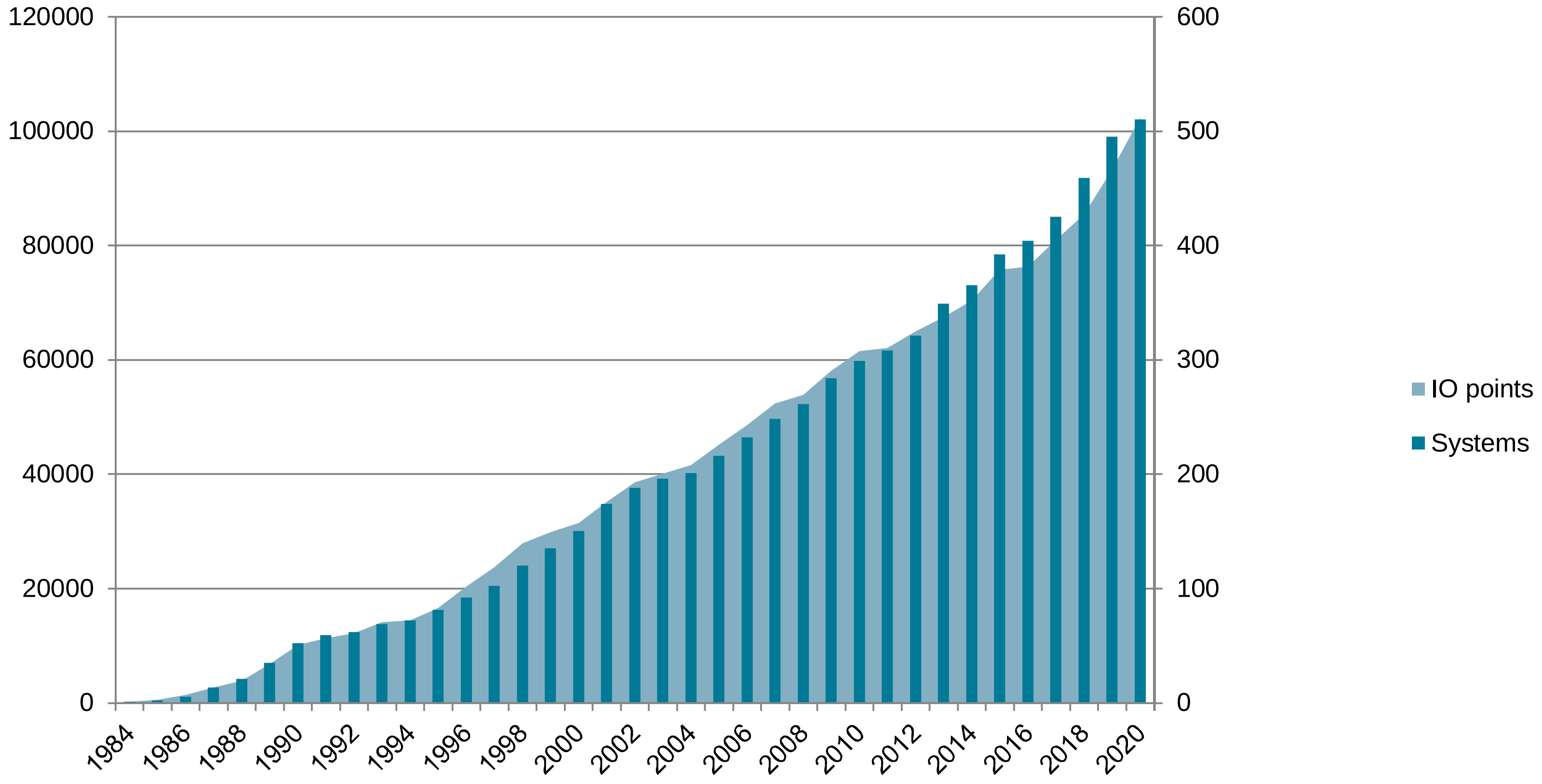
Fault notification to CMMS from Maint Pad

Fault notice user interface window includes following objects:

- Functional location (indicator)
  - from route or from NFC tag on machine
- Notice type (user selectable)
  - Malfunction report
  - Activity report
  - Work request
  - Notification
- Title (user can change)
  - By default current machine name
- Description (user can type)
  - Description of the fault
- Reported by (indicator)
  - Windows login name
- Priority (user selectable)
  - Safety / Environmental
  - Production loss
  - Possible Production loss
  - No production risk

Valmet Condition Monitoring Systems

Deliveries



DMM in Power

Latest cases

386	Nokianvirran Energia	Nokia	Finland	BOP	Power plant	2015	DMM	40	
393	K+S Kali Gmbh	Zielitz	Germany	GT1 and GT2	Power plant	2015	DMM	4	
394	K+S Kali Gmbh	Unterbraizbach	Germany	GT3	Power plant	2015	DMM	2	
395	Sabah Electricity SDN BHD	Sabah (Melawi)	Indonesia	GT	Power plant	2015	DMM	7	
397	Peterborough EfW facility	Peterborough	UK	ST, BOP	Power plant	2015	DMM	34	
399	Kotkan Energia	Kotka	Finland	ST	Power plant	2016	DMM	25	
403	Dunbar Energy	Dunbar	UK	BOP	Power plant	2017	DMM	30	
404	Power Machines	Kigi	Turkey		Power plant	2016	DMM	87	Hydro Power
404	MF Kemi	Kemi	Finland	ST	Power plant	2015	DMM	25	
405	Gantisan		Indonesia	GT 1 and 2	Power Plant	2017	DMM	4	
406	MF Joutseno	Joutseno	Finland	ST	Power plant	2017	DMM	22	
407	Kilpilahti Power	Porvoo	Finland	BOP	Power plant	2017	DMM	70	
408	BEC Cuijk		Netherlands	ST	Power plant	2017	DMM	10	
416	London Energy	London	UK	TG1-4	Power plant	2017	DMM	40	
421	Kuopion Energia	Kuopio	Finland	TG1, TG2	Power plant	2017	DMM	34	
422	Sappi	Kirkniemi	Finland	TG	Power plant	2018	DMM	25	
423	Yara Suomi Oy	Siilinjärvi	Finland	TG1, TG2, BOP	Power plant	017, 201	DMM	100	
425	KKS Energia	Siikakoski	Finland	TG1, TG2	Hydro Power	2018	DMM	14	
426	Vapo	Forssa	Finland	TG1	Power Plant	2018	DMM	12	
427	Dong Energy		Denmark	TG1	Power Plant	2019	DMM	55	
429	Lenzing AG	Lenzing	Austria	TG	Power plant	2018	DMM	9	
432	Bharat Heavy Electricity (Tuticorin)		India	BOP	Power plant	2018	DMM	100	
433	Laakirchen		Austria	TG1&2	Hydro power		DMM		
435	Grupa Azoty Zaklady	Kedzieryzyn-kozle	Poland	TG1	Power plant	2018	DMM	2	
456	Zellstoff Stendal Gmbh	Stendal	Germany	TG1	Power plant	2018	DMM	16	
457	Scottish & Southern Energy	Burghfield	UK	GT	Power plant	2018	DMM	4	
458	Bharat Heavy Electricity (Ennore)		India	BOP, U1 and U2	Power plant	2017	DMM	770	
459	GS Danjin, Bio 2		Korea	TG and BOP	Power plant	2019	DMM	111	
460	Bayer Ag	Bergkamen	Germany	TG	Power plant	2019	DMM	28	
461	Scottish & Southern Energy	Chickerell	UK	GT	Power plant	2018	DMM	10	
462	Stora Enso	Veitsiluoto	Finland	ST	Power plant	2018	DMM	10	
463	Fortum Power and Heat	Uimaharju	Finland	ST	Power plant	2018	DMM	21	
464	Kotkan energia	Hovinsaari	Finland	BOP	Power plant	2018	DMM	40	
465	Austro Cell	Hallein	Austria	ST	Power plant	2019	DMM	24	
468	EON VärmeSwerige AB	Malmö	Sweden	ST11 and ST12	Power plant	2018	DMM	20	
471	Stora Enso	Kaukopää, Imatra	Finland	ST6	Power plant	2019	DMM	17	
479	Lahti Energia	Lahti, Kymijärvi	Finland	BOP 3	Power plant	2019	DMM	84	

Valmet

FORWARD