Implementing a Long Term Asset Management Strategy with the PI System

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OT ENERGY SERVICES

Company profile

Headquartered in the Czech Republic, CEZ Group is an established, integrated energy group with operations in a number of Central and Southeastern European countries and Turkey. CEZ's power generation portfolio consists of nuclear, coal-fired, gas, hydroelectric, and other renewable sources accounting more than 13 GW of installed capacity

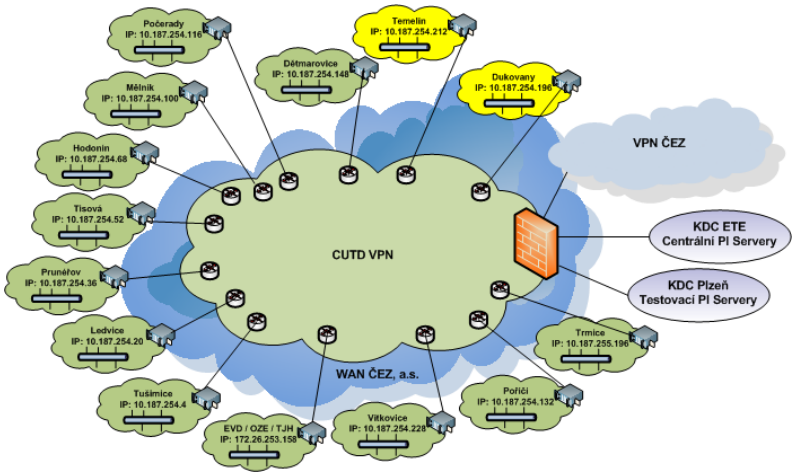
OT ENERGY SERVICES

OT Energy Services (OTES) is a leading supplier of complex solutions for technological process control and optimization and for asset management. Our services cover the entire life cycle of software, equipment, or systems in power generation sector.

PI System in ČEZ – Platform of Future

Single store and hub of all operational data for Information Systems (CUTD Project – 16 Facilities, 200.000 Tags)

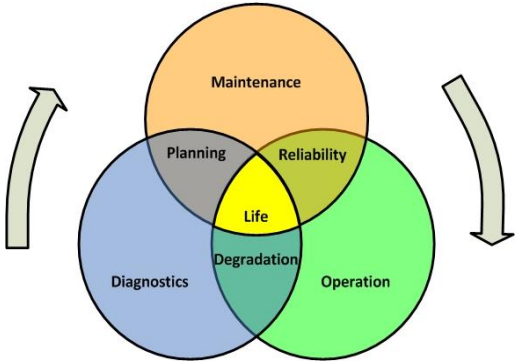
- Developed solutions:
  - LTOs (Long Term Operation suite)
  - PowerOPTI
  - Valves Diagnostics
  - Vibro Diagnostics
  - Energy Balances
- Solutions in progress:
  - Online CBM
  - Chemical Laboratories System



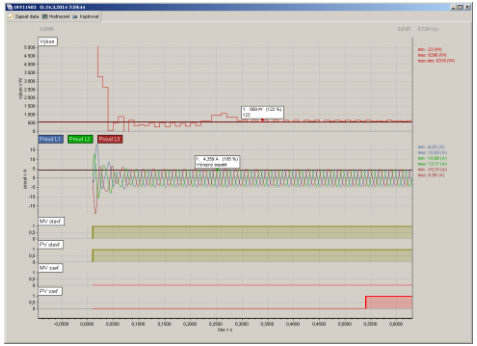
Condition Based Monitoring - Aims

Technical Control and Diagnostics Department started an smart asset management project aimed to expand the asset life time by deploying a condition based monitoring and maintenance strategy using the data already available in the company as result of the CUTD project.

- Business challenge is to transmit all essential signals to the central repository, evaluate them and use them for:
  - Early Warning Systems
  - Condition Based Maintenance
  - Life Cycle Management
  - Optimization of equipment outage
  - Long Term Operation support



Condition Based Monitoring – Online & Offline

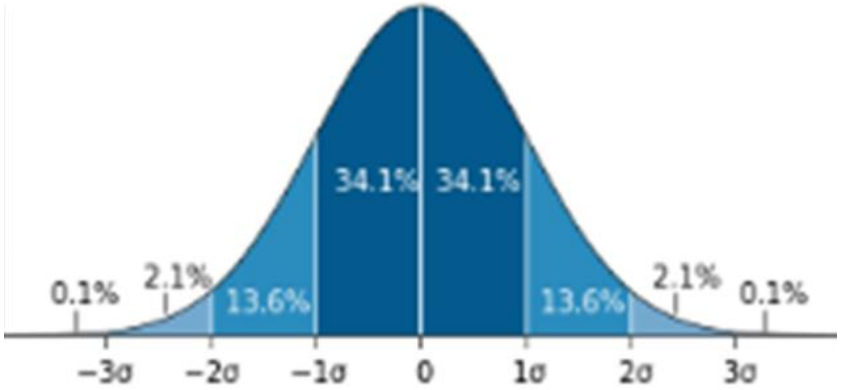


- Online Condition Based Monitoring
  - On-line monitoring of critical parameters
  - Setting of alarms
  - Behavior change data
  - Statistical evaluation
  - Currently we are working only with the data from stable operation

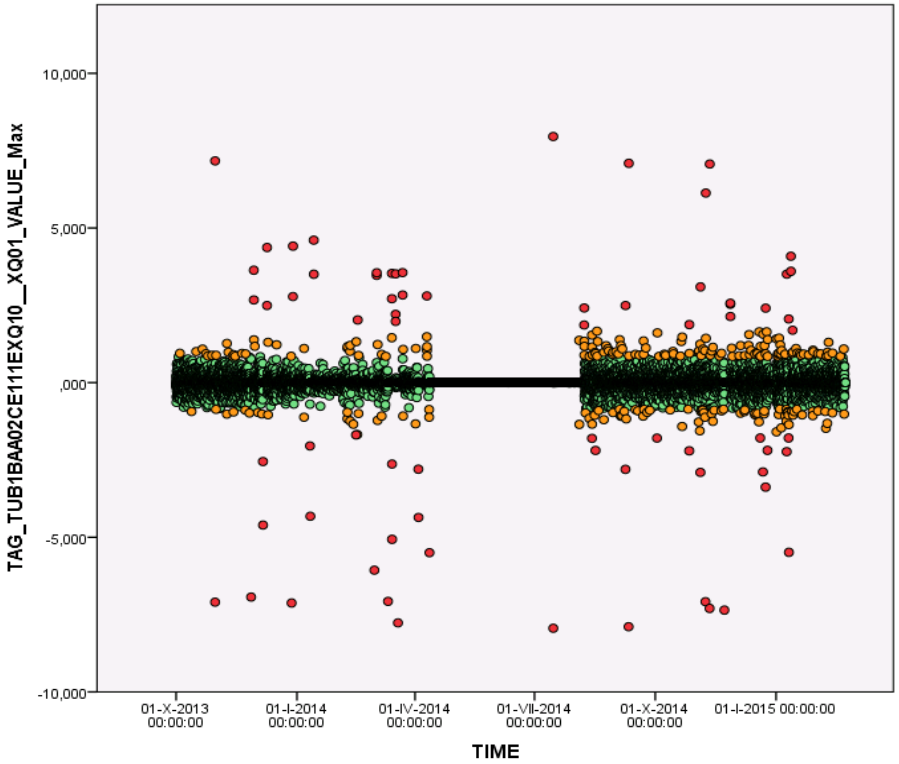
- Offline Condition Based Monitoring in LTOs
  - Planning and performing technical controls and diagnostics
  - Evaluating diagnostic and inspection data together with historized real-time data

Setting of alarm

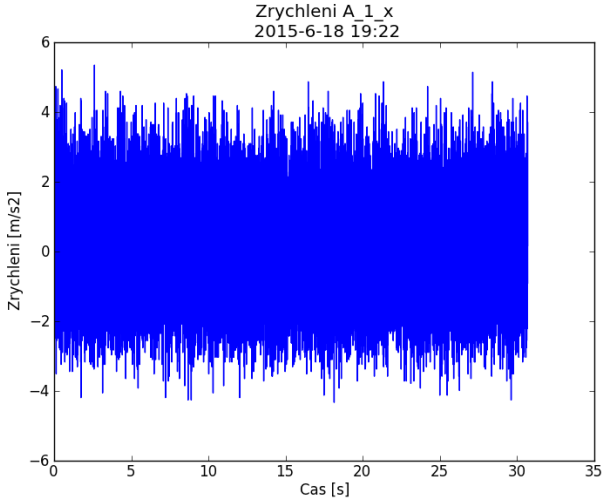
Assuming a normal (Gaussian) distribution determined for each TAG traffic light, which captures its current value (1σ=green, 2σ=orange, next=red)

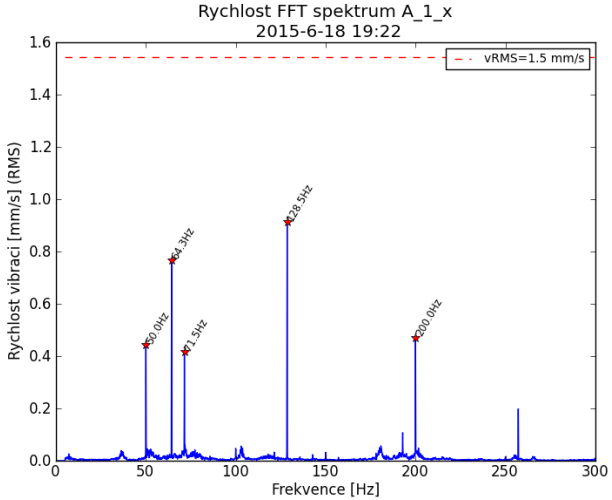


Setting of alarm



Frequency spectrum





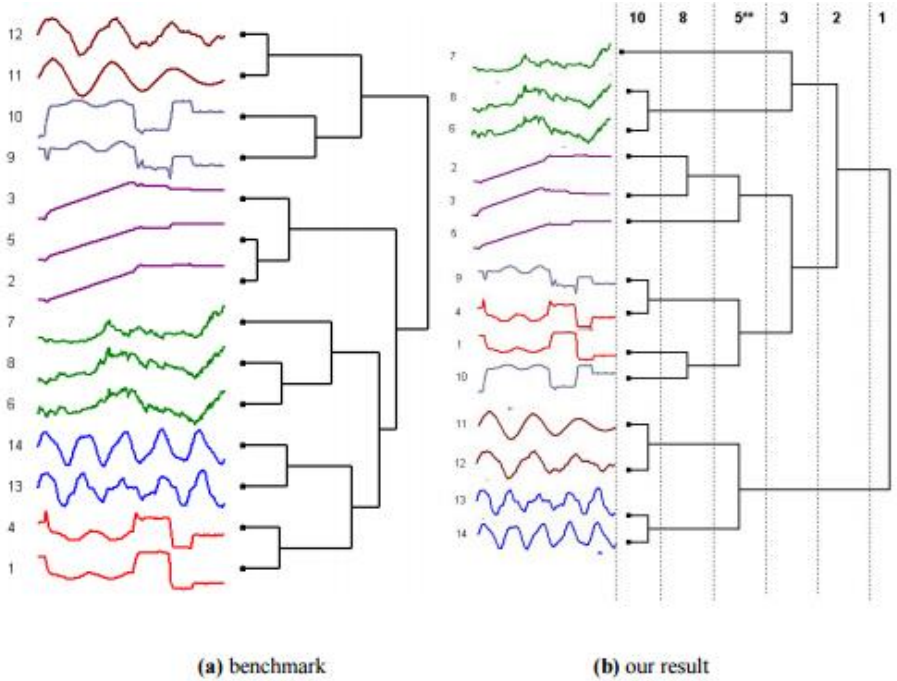
Time series are divided to identical sections. These sections are transformed to the frequency Spectrum where it is possible to clearly identify alarms. These alarms are compared with Gaussian distribution. If they are consistent alarm is solved.

Correlation analysis

	TU.b0C.el.vyrobaSvorkova	TU.b0D.el.vyrobaSvorkova	TU.b21.el.vyrobaSvorkova	TU.b22.el.vyrobaSvorkova	TU.el.vyrobaSvorkova	TUA1BAA02CE111EXQ10__XQ01	TUA1BAC01GS011_XB01__XB01	TUA1BAC01GS901___XB10	TUA1LBA01CF001___XQ01.iD1	TUA1LBA02CQ901___XQ01	TUA1LCA77CF001___XQ01	TUA1MAA01CT904__SW_XQ50
TU.b0C.el.vyrobaSvorkova	1	0,364	0,069	-0,009	.	0,222	0,236	0,234	0,229	0,224	0,264	0,191
TU.b0D.el.vyrobaSvorkova	0,364	1	0,335	0,511	.	0,214	0,215	0,213	0,222	0,213	0,226	0,180
TU.b21.el.vyrobaSvorkova	0,069	0,335	1	0,542	.	0,350	0,350	0,348	0,422	0,353	0,383	0,260
TU.b22.el.vyrobaSvorkova	-0,009	0,511	0,542	1	.	0,219	0,256	0,253	0,240	0,236	0,309	0,164
TU.el.vyrobaSvorkova	.	.	.	.	.	.	.	.	.	.	.	.
TUA1BAA02CE111EXQ10__XQ01	0,222	0,214	0,350	0,219	.	1	0,967	0,974	0,944	0,987	0,947	0,571
TUA1BAC01GS011_XB01__XB01	0,236	0,215	0,350	0,256	.	0,967	1	0,992	0,950	0,974	0,974	0,576
TUA1BAC01GS901___XB10	0,234	0,213	0,348	0,253	.	0,974	0,992	1	0,948	0,975	0,977	0,579
TUA1LBA01CF001___XQ01.iD1	0,229	0,222	0,422	0,240	.	0,944	0,950	0,948	1	0,951	0,925	0,577
TUA1LBA02CQ901___XQ01	0,224	0,213	0,353	0,236	.	0,987	0,974	0,975	0,951	1	0,949	0,575
TUA1LCA77CF001___XQ01	0,264	0,226	0,383	0,309	.	0,947	0,974	0,977	0,925	0,949	1	0,564

Correlation analysis present TAGs which are in the connection. Physical connection is then described by engineer. Mutual relation is put to the PI System for monitoring of each equipment.

Cluster analysis



(a) benchmark (b) our result

Cluster analysis is used for elimination of false alarm. When one TAG of group is assigned to alarm and the other are O.K. we believe that everything is O.K. and problem is in the signal.

Example of use

- Pressure parts of boiler and pipe line.

  For documenting the technical safety of boiler pressure parts is monitored and evaluated statistically temperature

- Rotating machines

  Every day is necessary check approx. 500 devices in an on-line software by 3 persons. Using SW PI we achieve time saving of vibro specialists. They control in the specialized software only devices where is a significant increase value of vibration.

- Life cycle management of transformer

  Checking usage of the step-up transformers due to temperature and current load

Example of use

- Optimization of equipment outages

Calculation of the growth of oxide layer on the basis of process data of the superheater and reheater (data are processing by SW PI using equation of EPRI)

Recommendations for shutdown and control of dynamic effect of the shutdown on oxide layer.

Offline Condition Based Monitoring – LTO suite

Long Term Operation suite

Software platform integrating all equipment data to evaluate its condition, understand its ageing and enable safe life extension beyond the design life.

Equipment categories covered

- Boiler pressure parts, steam lines, turbines, condensers, heat exchangers, cooling towers, desulphurization, steel and civil structures, electrical equipment, meters

Benefits and uses of outputs

- Shifting the dates of technical controls and diagnostics
- Detect and identify causes of equipment defects in a timely manner
- Data for condition based maintenance
- Data for equipment/system/unit life time extension
- Equipment/system/unit rating and benchmarking
- Develop and create new engineering knowledge and capabilities of the operator

Offline Condition Based Monitoring – LTO suite

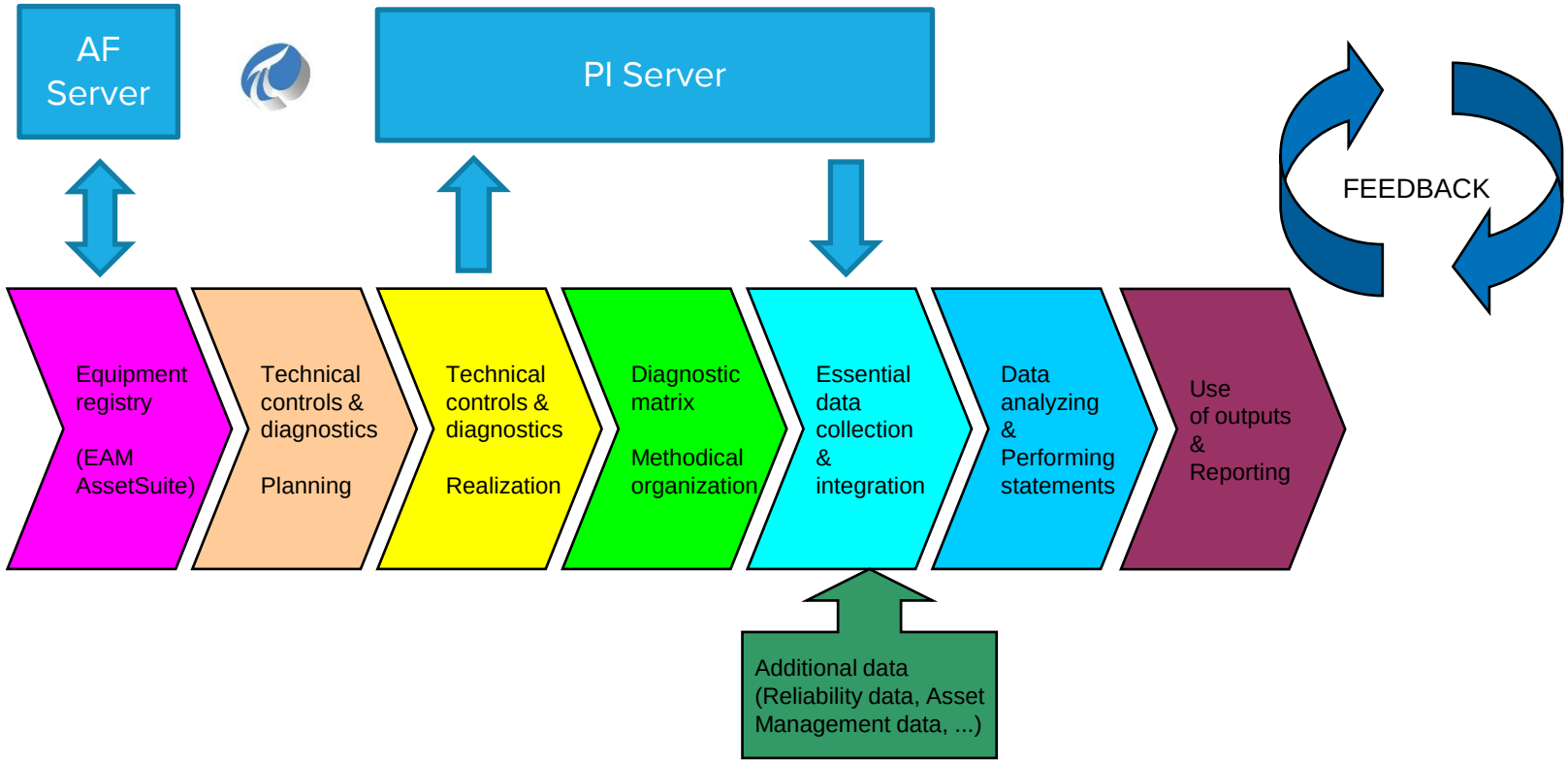
Diagnostic Layer

- Equipment breakdown from EAM system synchronized with Asset Framework (AF)
- Planning of technical controls and diagnostics
- Collecting data from inspections and diagnostics using smart protocols and load of such data into PI Server

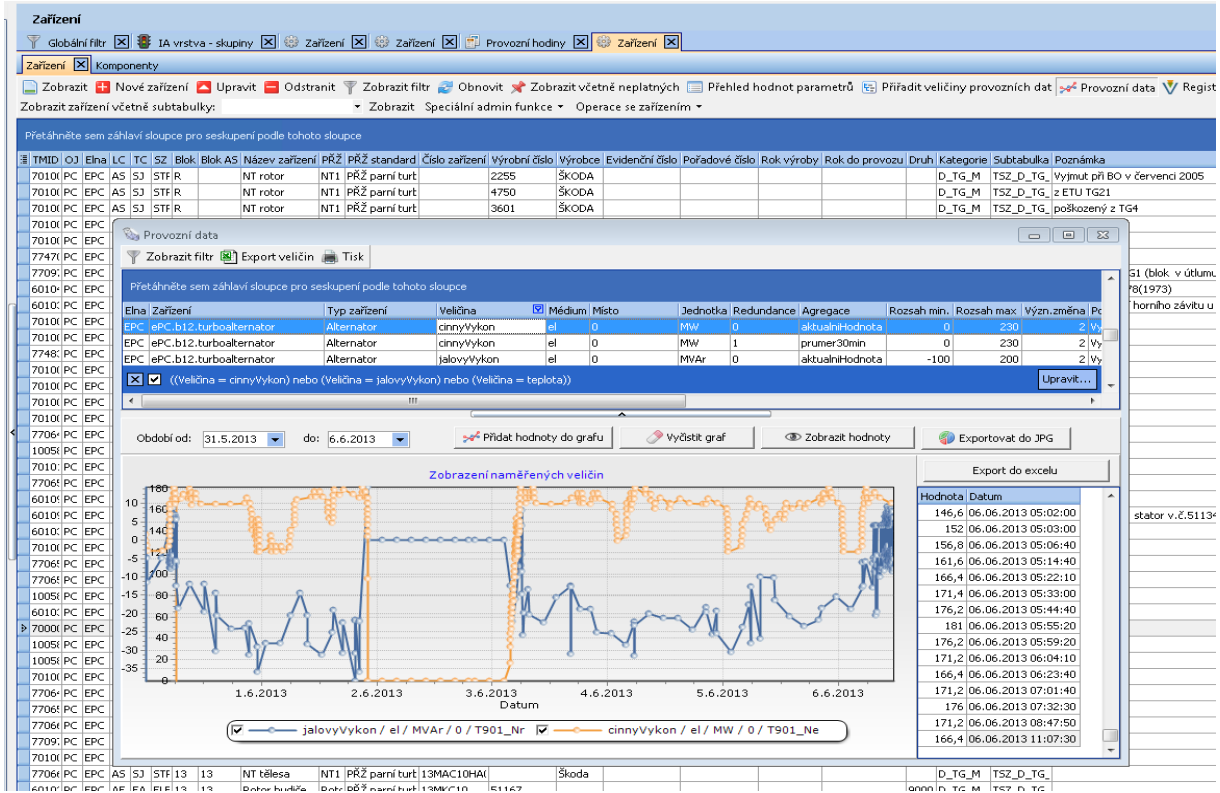
Analytical Layer

- Matrix of diagnostic methods and equipment categories
- Integration and presentation of diagnostics data, historized technological data, operation data and maintenance data
- Support of expert decision about equipment condition
- Residual lifetime evaluation (PI Totalizer & PI ACE pre calculations)
- Equipment rating and benchmarking among units and facilities

LTO suite – main process



LTO suite – real-time data visualization using PI SDK



Summary

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BUSINESS CHALLENGES

A. Detection of approaching failure

B. Recommendation for shutdown or maintenance

C. Increase of technical safety

SOLUTION

A. Setting of alarms – early warning

B. Residual lifetime evaluation in LTOs

C. Systematic equipment monitoring and ageing management

RESULTS AND BENEFITS

- Decreasing number of unplanned outages
- More effective predictive maintenance
- Rating and benchmarking
- Increased technical safety
- Increase of technological know-how
- Reduction of diagnostics staff

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Questions

Please wait for the microphone
before asking your questions

감사합니다

谢谢

Danke

Gracias

Merci

Thank You

ありがとう

Спасибо

Obrigado

Děkujeme