



# 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

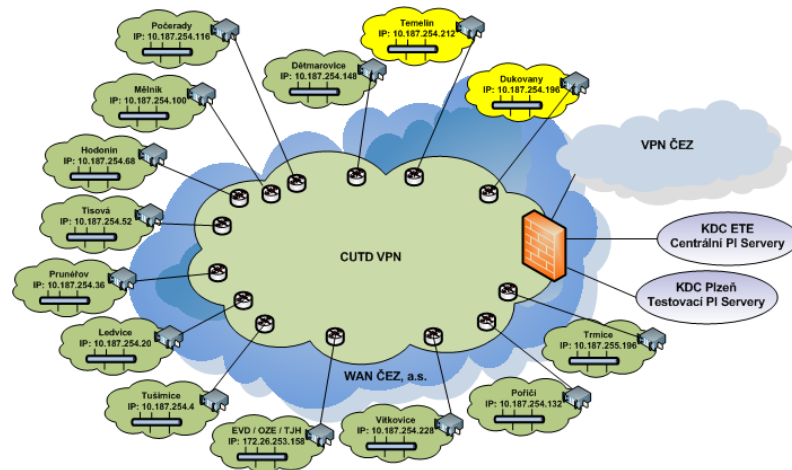


OT Energy Services (OTES) is a leading supplier of complex solutions for technological process control and optimization and for asset management. Our services cover the entire life cycle of software, equipment, or systems in power generation sector.

# 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)

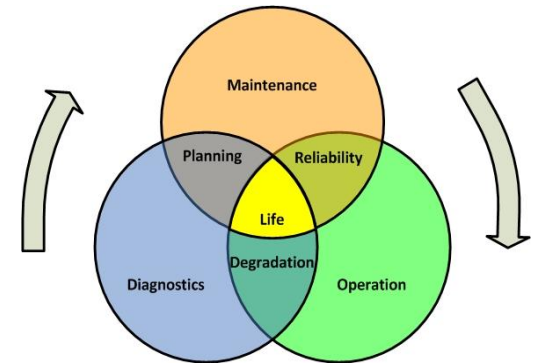
- Developed solutions:
  - LTOs (Long Term Operation suite)
  - PowerOPTI
  - Valves Diagnostics
  - Vibro Diagnostics
  - Energy Balances
- Solutions in progress:
  - Online CBM
  - Chemical Laboratories System



# Condition Based Monitoring - Aims

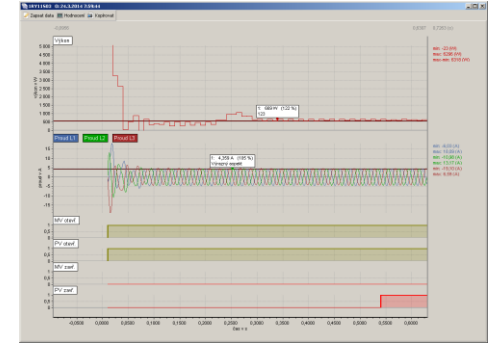
Technical Control and Diagnostics Department started an smart asset management project aimed to expand the asset life time by deploying a condition based monitoring and maintenance strategy using the data already available in the company as result of the CUTD project.

- 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



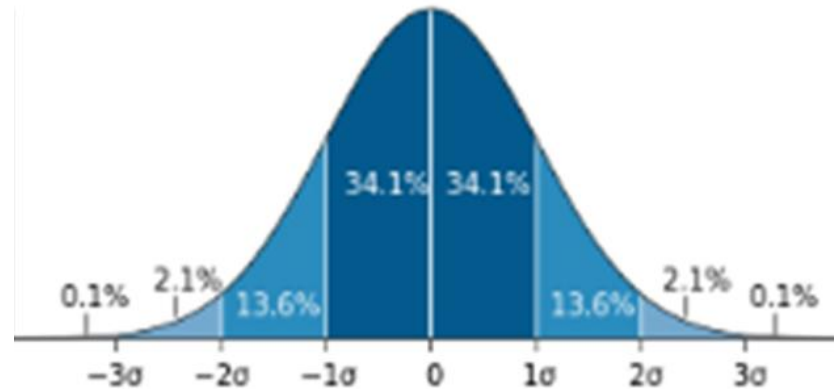
# Condition Based Monitoring – Online & Offline

- 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

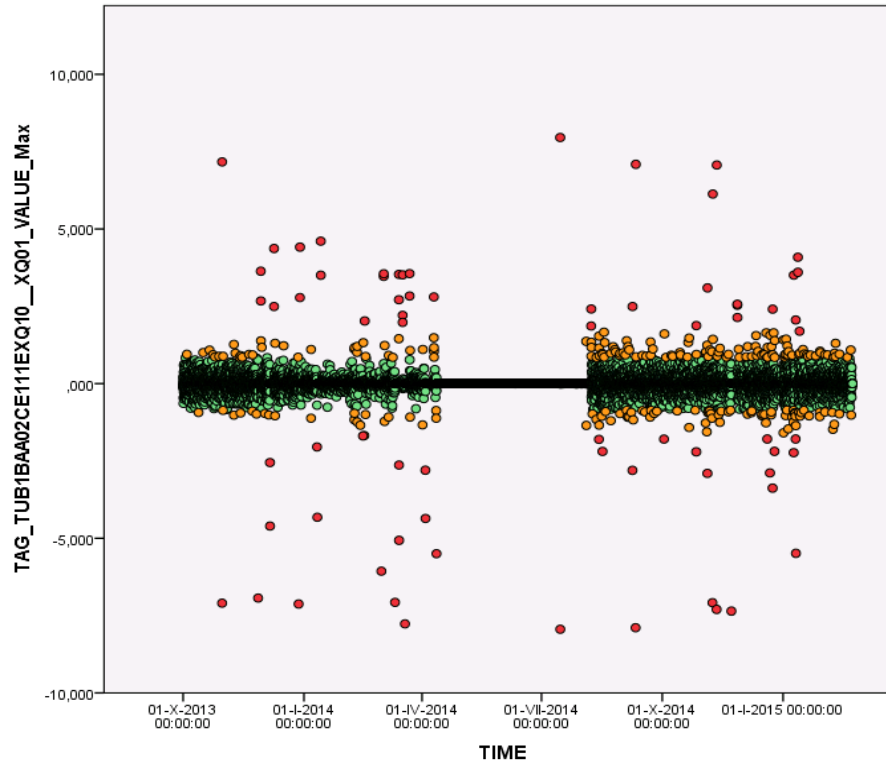


# Setting of alarm

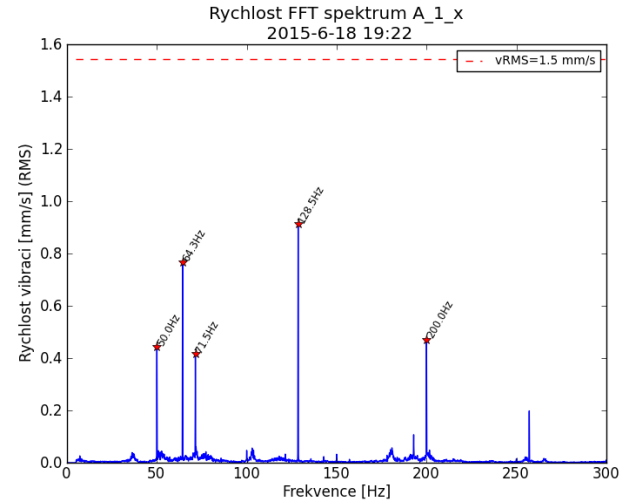
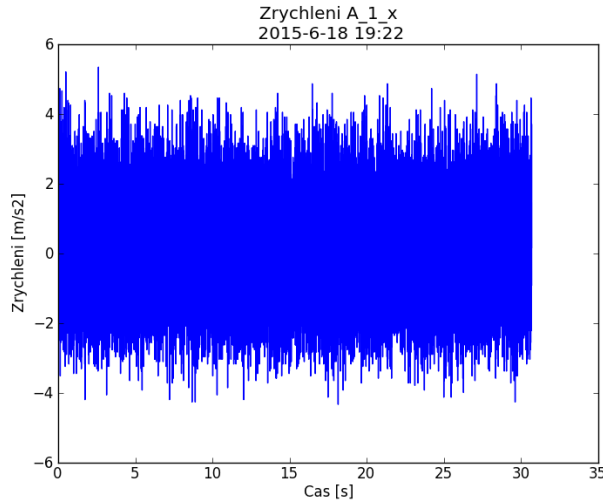
Assuming a normal (Gaussian) distribution determined for each TAG traffic light, which captures its current value ( $1\sigma$ =green,  $2\sigma$ =orange, next=red)



# 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.

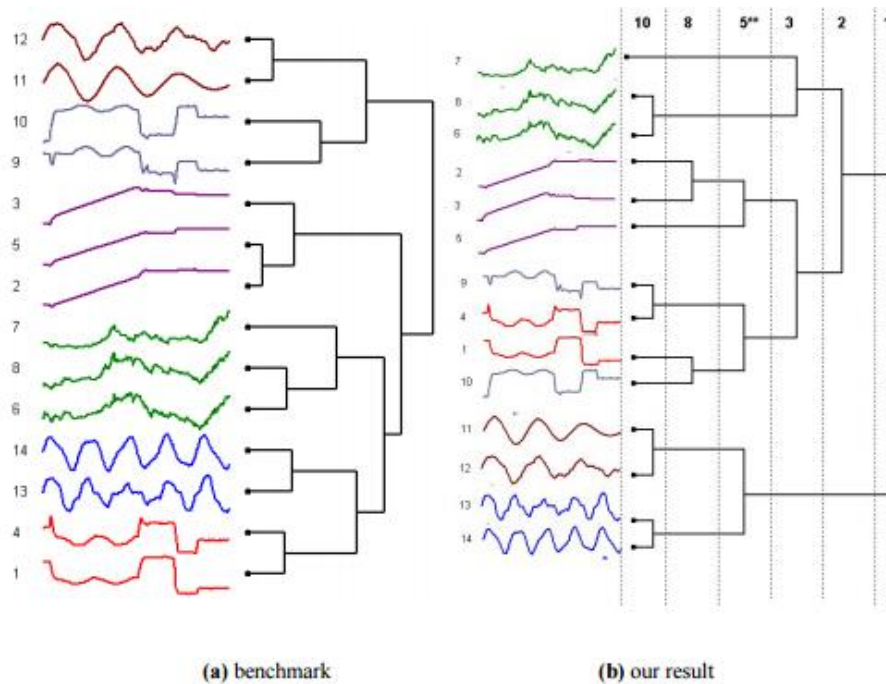


# Correlation analysis

	TU.b0C.el.vyrob aSvorkova	TU.b0D.el.vyrob aSvorkova	TU.b21.el.vyrob aSvorkova	TU.b22.el.vyrob aSvorkova	TU.el.vyrobaSvo rkova	TUA1BAA02CE1 11EXQ10__XQ0 1	TUA1BAC01GS 011_XB01__XB 01	TUA1BAC01GS 901__XB10	TUA1LBA01CF0 01__XQ01.ID1	TUA1LBA02CQ 901__XQ01	TUA1LCA77CF0 01__XQ01	TUA1MAA01CT9 04__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



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

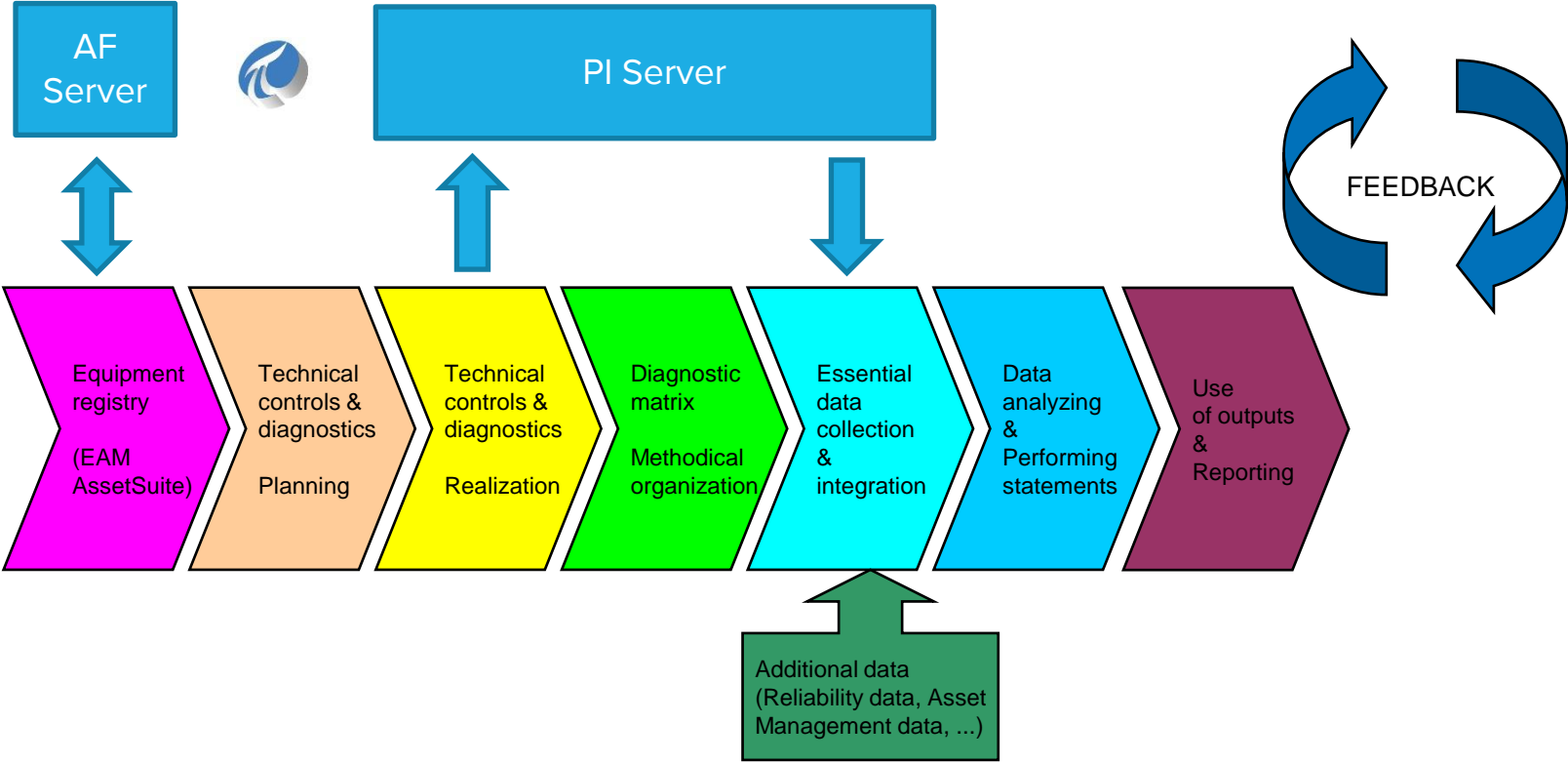
## Diagnostic Layer

- 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

**Zařízení**

Globální filtr 
  1A vrstva - skupiny 
  Zařízení 
  Zařízení 
  Provozní hodiny 
  Zařízení

Zařízení | Komponenty

Zobrazit 
  Nové zařízení 
  Upravit 
  Odstranit 
  Zobrazit filtr 
  Obnovit 
  Zobrazit včetně neplných 
  Přehled hodnot parametrů 
  Přiřadit veličiny provozních dat 
  Provozní data 
  Registr

Zobrazit zařízení včetně subtabulky:  Zobrazit  Speciální admin funkce  Operace se zařízením

Přetáhněte sem záhlaví sloupce pro seskupení podle tohoto sloupce

TMID	OJ	Elna	LC	TC	SZ	Blok	Blok AS	Název zařízení	PRŽ	PRŽ standard	Číslo zařízení	Výrobní číslo	Výrobce	Evidenční číslo	Pořadové číslo	Rok výroby	Rok do provozu	Druh	Kategorie	Subtabulka	Poznámka	
7010	PC	EPC	AS	S3	STF	R		NT rotor	NT1	PRŽ parní turt		2255	ŠKODA						D_TG_M	TS2_D_TG		Vyjmut při BO v červenci 2005
7010	PC	EPC	AS	S3	STF	R		NT rotor	NT1	PRŽ parní turt		4750	ŠKODA						D_TG_M	TS2_D_TG		z ETU TG21
7010	PC	EPC	AS	S3	STF	R		NT rotor	NT1	PRŽ parní turt		3601	ŠKODA						D_TG_M	TS2_D_TG		poškozený z TG4

Provozní data

Zobrazit filtr  Export veličin  Tisk

Přetáhněte sem záhlaví sloupce pro seskupení podle tohoto sloupce

Elna	Zařízení	Typ zařízení	Veličina	Médium	Místo	Jednotka	Redundance	Agregace	Rozsah min.	Rozsah max.	Význ.změna	Pc
EPC	ePC.b12.turboalternator	Alternátor	cinnyVykon	el	0	MW	0	aktuálníHodnota	0	230	2	Vy
EPC	ePC.b12.turboalternator	Alternátor	jalovyVykon	el	0	MW	1	prumer30min	0	230	2	Vy
EPC	ePC.b12.turboalternator	Alternátor	jalovyVykon	el	0	MVAr	0	aktuálníHodnota	-100	200	2	Vy

((Veličina = cinnyVykon) nebo (Veličina = jalovyVykon) nebo (Veličina = teplota))

Období od: 31.5.2013 do: 6.6.2013  Přidat hodnoty do grafu  Vyčistit graf  Zobrazit hodnoty  Exportovat do JPG

Zobrazení naměřených veličin

Export do excelu

Hodnota	Datum
146,6	06.06.2013 05:02:00
152	06.06.2013 05:03:00
156,8	06.06.2013 05:06:40
161,6	06.06.2013 05:14:40
166,4	06.06.2013 05:22:10
171,4	06.06.2013 05:33:00
176,2	06.06.2013 05:44:40
181	06.06.2013 05:55:20
176,2	06.06.2013 05:59:20
171,2	06.06.2013 06:04:10
166,4	06.06.2013 06:23:40
171,2	06.06.2013 07:01:40
176	06.06.2013 07:32:30
171,2	06.06.2013 08:47:50
166,4	06.06.2013 11:07:30

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# Summary



## OT ENERGY SERVICES

### 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

# Contact Information

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# Questions

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





감사합니다

谢谢

Danke

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado

Děkujeme