PI System in ČEZ from Implementer Point of View

Presented by **Petr Hoření & Vladislav Koutník**

OT ENERGY SERVICES

Introduction of ČEZ Group

ČEZ Group is an integrated electricity company with operations in a number of countries in Central and Southeastern Europe and Turkey, with its headquarters in the Czech Republic (Installed capacity 15199 MW).

ČEZ Group currently operates

    in the Czech Republic
- 2 nuclear power plants
- 15 coal-fired power plants
- 35 hydropower plants, including 3 pumped storage plants

    abroad:
- 2 wind power plants (Fantanele 600MW)
- 3 coal-fired power plants

ČEZ is the largest electricity producer in the Czech Republic
- producing nearly 60 TWh a year (approximately 50% in NPP)

**Leading supplier of comprehensive services
in the area of I&C systems, electrical systems
and IT systems for industry with a strong history
in the nuclear power sector in Czech Republic**

OT Energy Services - Products

- **Service** (nuclear, industrial)
  - OT Energy Services is one of the largest Czech suppliers of **comprehensive services in the area of control systems and LV, HV and EHV electrical equipment** for various industrial applications, including system integration and support. Our comprehensive services also include servicing of protective systems in buildings, including electronic fire protection systems, as well as servicing of equipment in non-industrial buildings.

- **Capital Projects**
  - OT Energy Services delivers **industrial automation and electrical system projects in a comprehensive fashion** – from drawing up studies and project documentation, software development, system integration and system support, through supplying, assembling, and commissioning to regular warranty and post-warranty service.

- **Power Production Optimization**

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Power Production Optimization Division
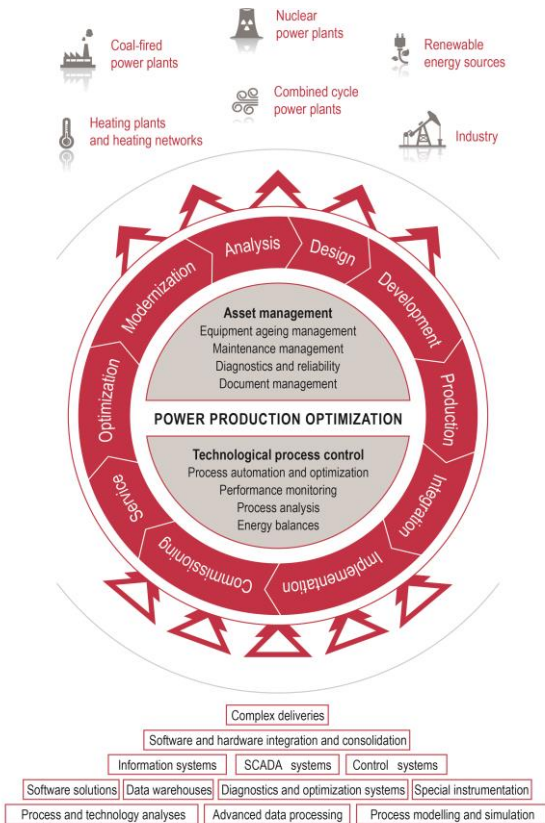

OUR CUSTOMERS ARE:

- **Power plants:**
  - Nuclear
  - Coal-fired
  - Combined cycle
  - Renewable energy sources
- **Heating plants and heat supply systems**

WE DELIVER TO OUR CUSTOMERS:

- Process and technology **analyses;** Advanced **data processing;** Process **modeling and simulation**
- **Software solutions; Data warehouses; Diagnostics and optimization systems; Special instrumentation**
- **Information systems; SCADA systems; Control systems**
- **Software and hardware integration and consolidation**
- **Complex deliveries**

Power Production Optimization Division
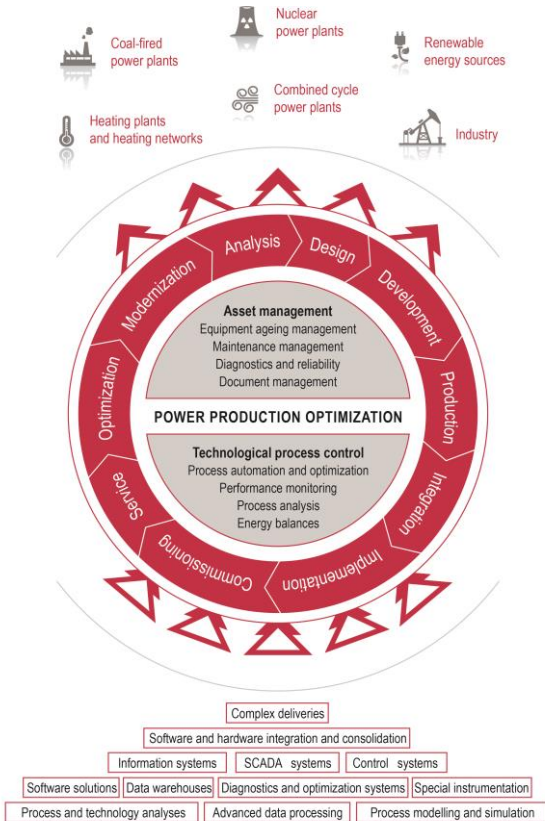
- **Asset management**
  - ☐ Equipment ageing management (**LTOs**)
  - ☐ Diagnostics and reliability
  - ☐ Maintenance management (Ventyx partner)

- **Technological process control**
  - ☐ Process automation and optimization (**PowerOPTI**)
  - ☐ Performance monitoring
  - ☐ Process analyses
  - ☐ Energy balances

- **Special solutions**
  - ☐ Data warehouses & Information systems (**CUTD**)
  - ☐ Special instrumentation

PI System in ČEZ – CUTD Project

(Central Storage of Technology Data)

Aims:
- One Version of the Truth
- Data Visibility and Availability in Office Network

Scope:
- New PI System & Interfaces Implementation
- Replacement of Existing Historians
- Migration of History
- Switching of Applications to CUTD

Power sources
- nuclear
- hydro
- pumped-storage
- brown coal
- biomass combustion
- power-heating
- black coal
- wind
- photovoltaic
- black coal with coke gas combustion
- biogas

Mines
- brown coal

NAME OF POWER SOURCE/MINE – owned by ČEZ, a. s.
NAME OF POWER SOURCE/MINE – owned by other CEZ Group member (sources in operation)

PI System in ČEZ – CUTD Project

- Implementation 12/2012 – 6/2014, 16 facilities
- 3 PI Servers, 120.000 tags (more than 56.000 used)
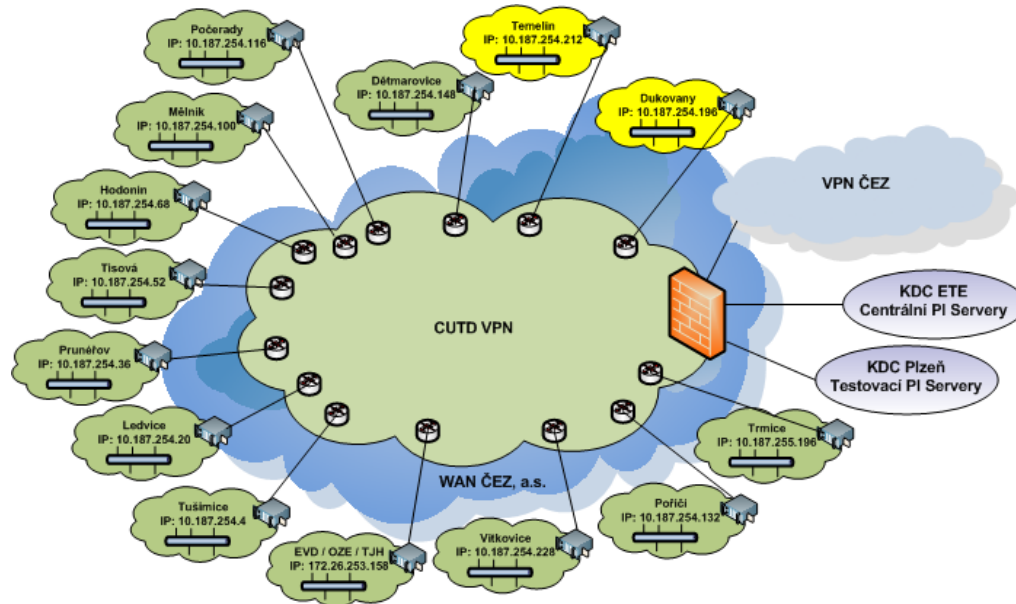
PI System in ČEZ – Integration

Applications are integrated using PI Web Services or using standardized SQL Interface on MS SQL Server 2012.
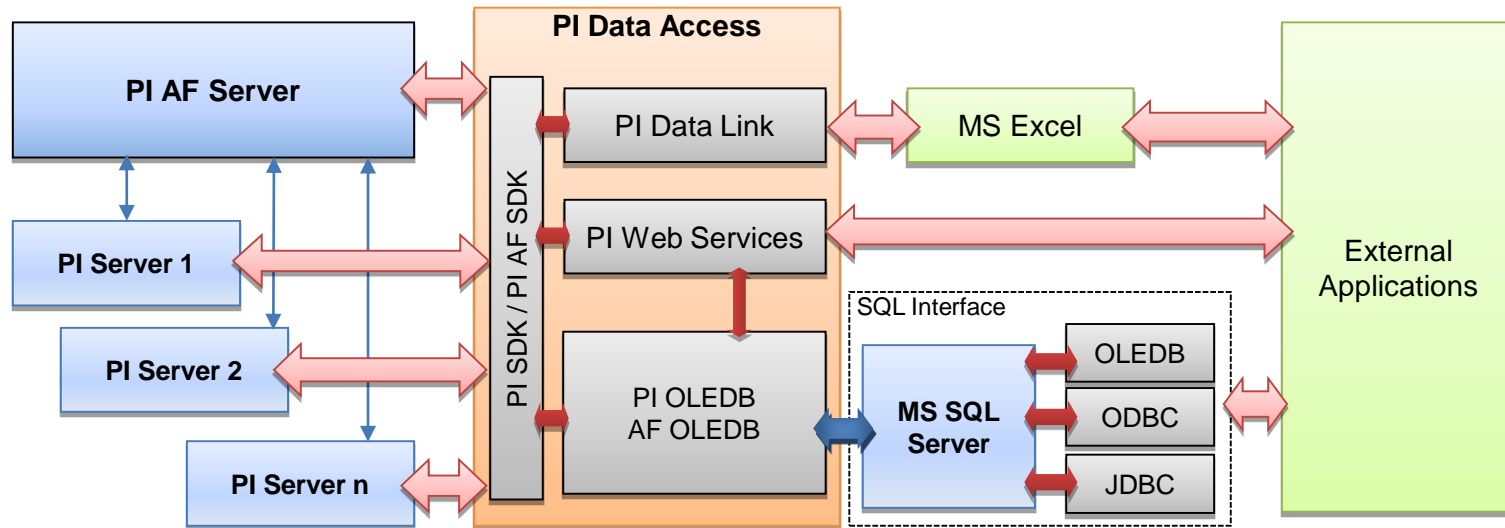
PI System in ČEZ – Identity Delegation

- Security as key issue
- Effort to use tag based authorization in PI System
- Client identity is propagated through SharePoint or MS SQL to PI Server and to AF Server
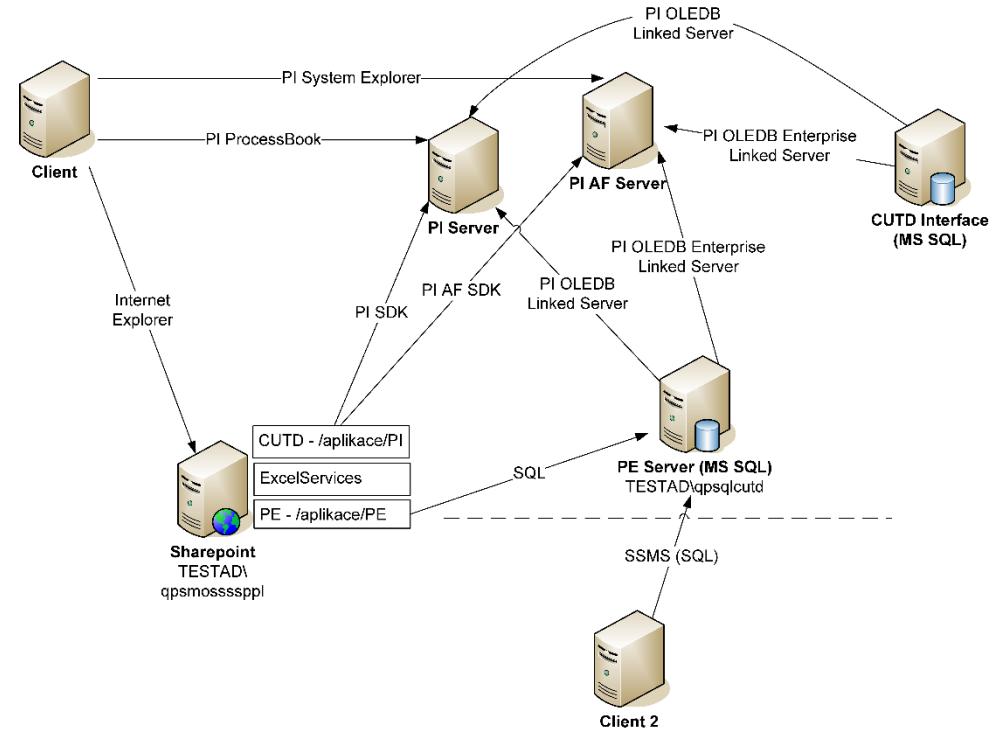
PI System in ČEZ – Platform of Future

- Single store and hub of all operational data for IS
- SharePoint applications using PI WebParts are preferred
- Developed solutions:
  - **PowerOPTI**
  - **LTOs**
  - Operation Economy
  - Valves Diagnostics
- Solutions in progress:
  - ChemPack
  - Vibro Diagnostics
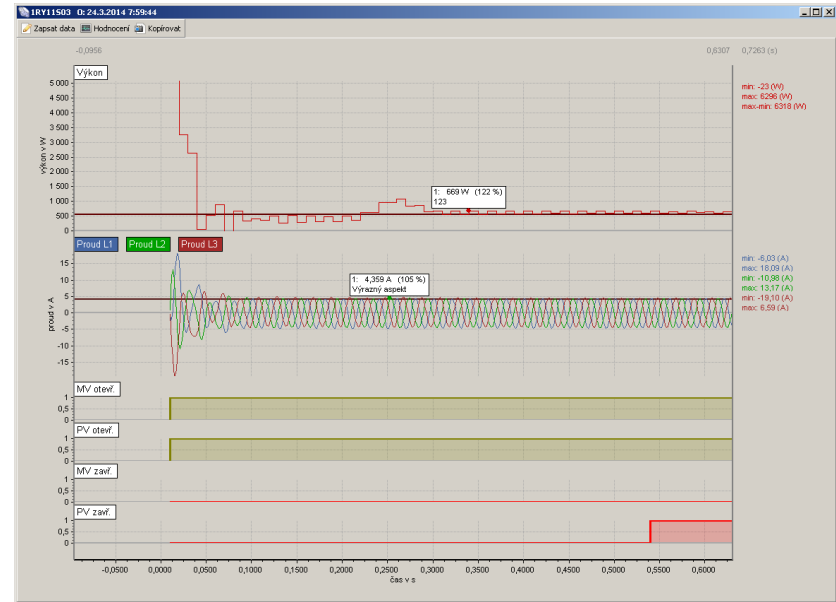
PowerOPTI – Data Reconciliation

Measurement: X_m
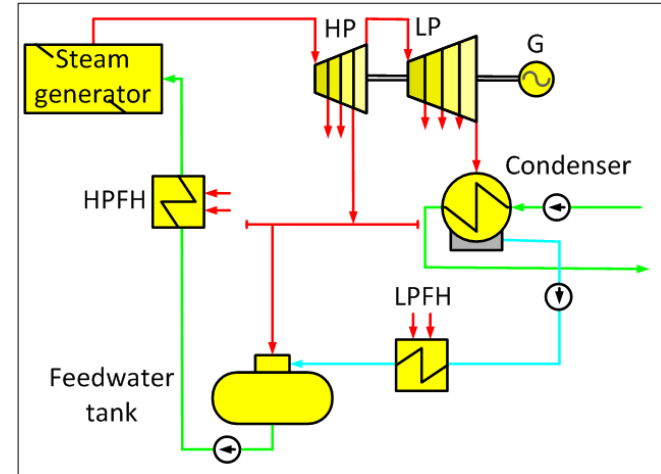
Reconciliation: X_r

Calculation: Y_{cal}

Measured values are processed through thermodynamic model

Measurement penalty: $V_{corr} = X_r - X_m$

PowerOPTI – Data Reconciliation

Reconciled values are obtained by solution of optimization task:

$$\min \chi^2 \equiv \sum_i \frac{V_{corr}^{\ 2}}{\sigma_i^2}$$

Mathematical model is based on analytical redundancy of measurements - more measurements than independent equations

$\downarrow$

Greater reliability and truthfulness of measured values &

Calculated values of unmeasured quantities &

Detection of faulty meters

PowerOPTI – Architecture
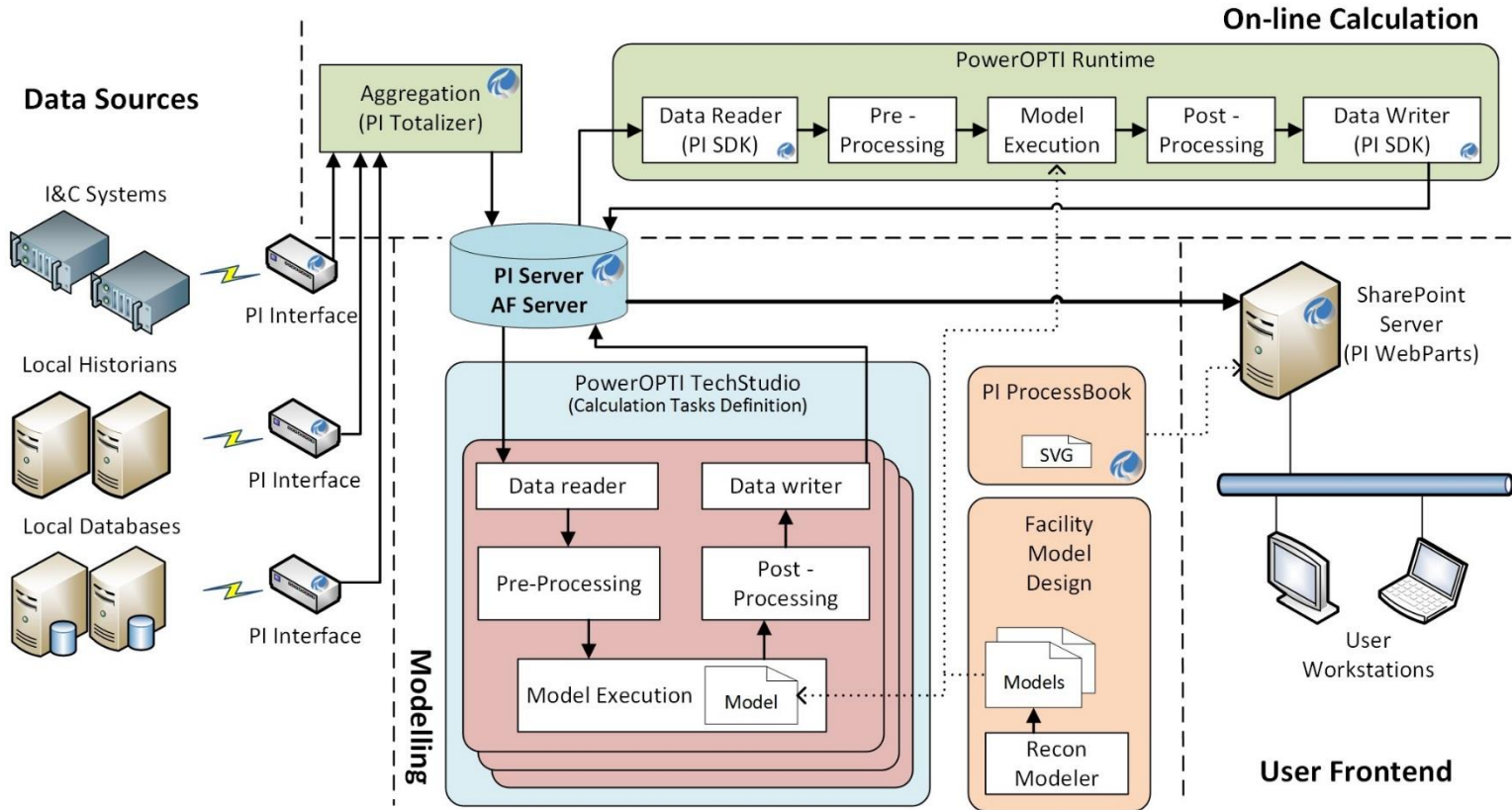
Introduction of Porici Power Plant (EPO)

Commissioned in 1957
Bus arrangement
Fluidized bed boilers K7, K8
(1997-8) (CNIM)
178 MWt, 250 t/h, eff. 92,5 %

TG 1,2,3 – 55 MWe,
8,8 MPa, 510 °C

2013
Esv – 481 429 MWh,
Qtep – 1 502 608 GJ
Net efficiency 42,9 %

PowerOPTI – EPO Project

Aim - to get real information about the operation using validation

Implementation process

2012 – model of the boiler FK7

2013 - model of the entire Porici power plant

2014 – final tuning of the model validation

Jmenovité parametry:

Výkon	250 t/hod
Teplota	520 °C
Tlak	9,9 MPa

Vzduch (primární a sekundární)

Ostrá pára

Spaliny, popílek

PP3

PP1

LUWO

Odluh,odkal

PP2

EKO

CaCO₃

Napájecí voda

Palivo (uhlí + štěpka)

Struska/popílek
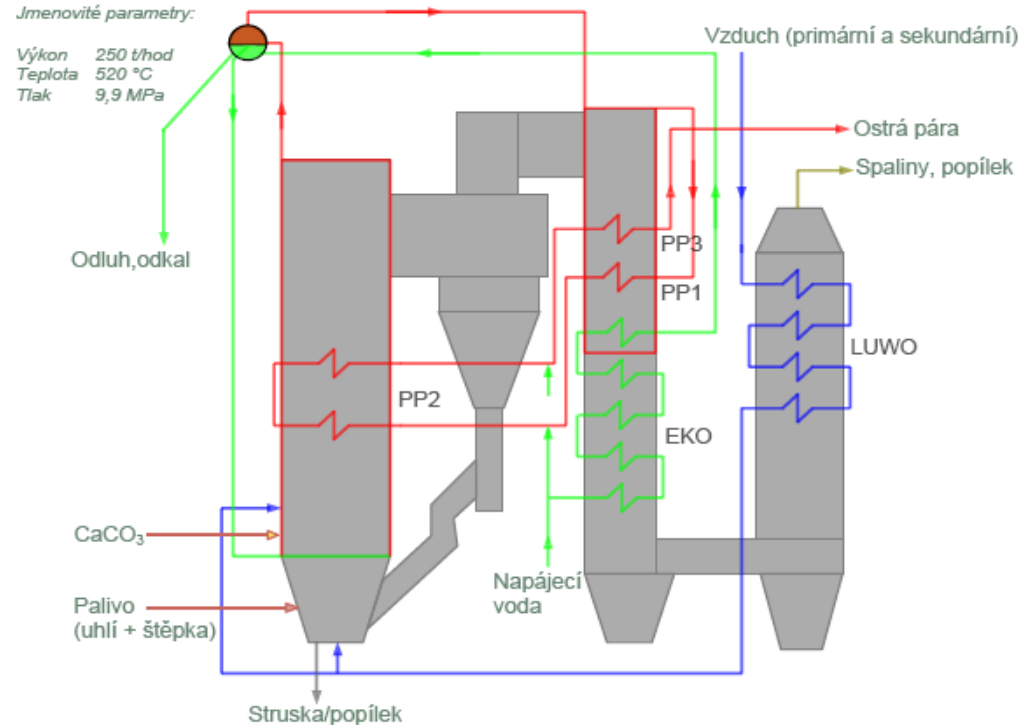
PowerOPTI – Model of EPO Power Plant

Validation model consists of the **general model** and following sub-models:

- Boiler FK7
- Boiler FK8
- Water treatment
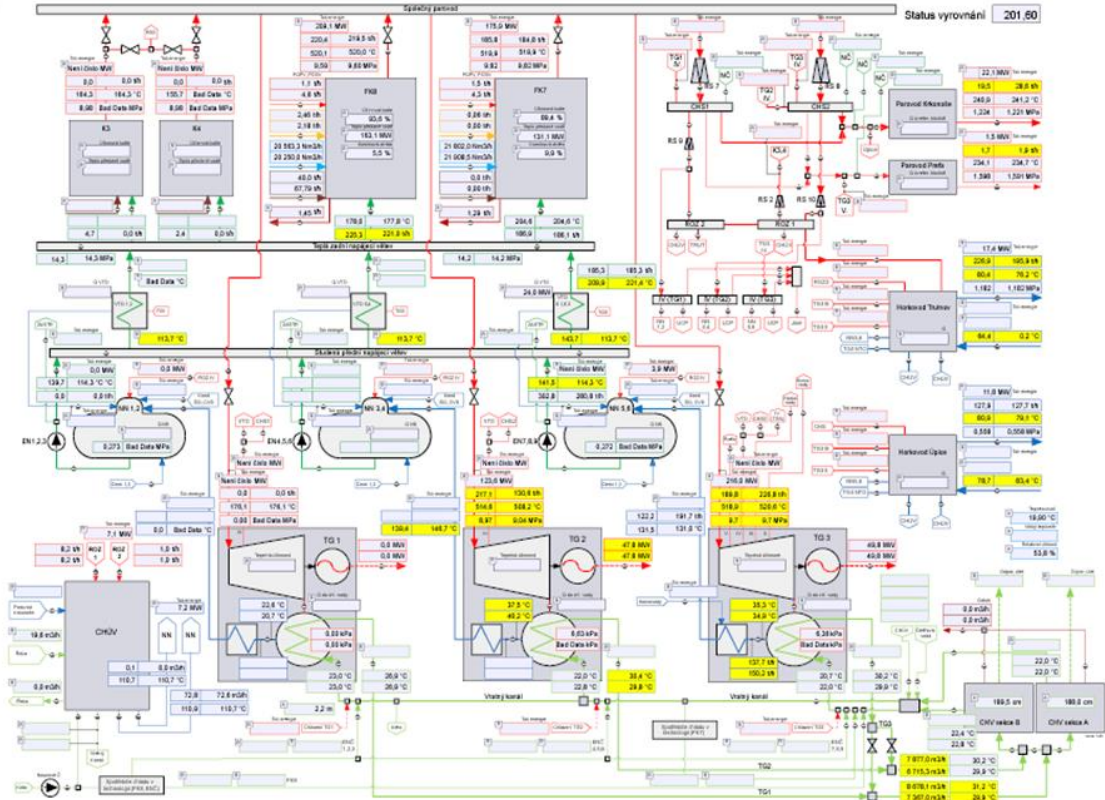
PowerOPTI – User Frontend (WebParts)
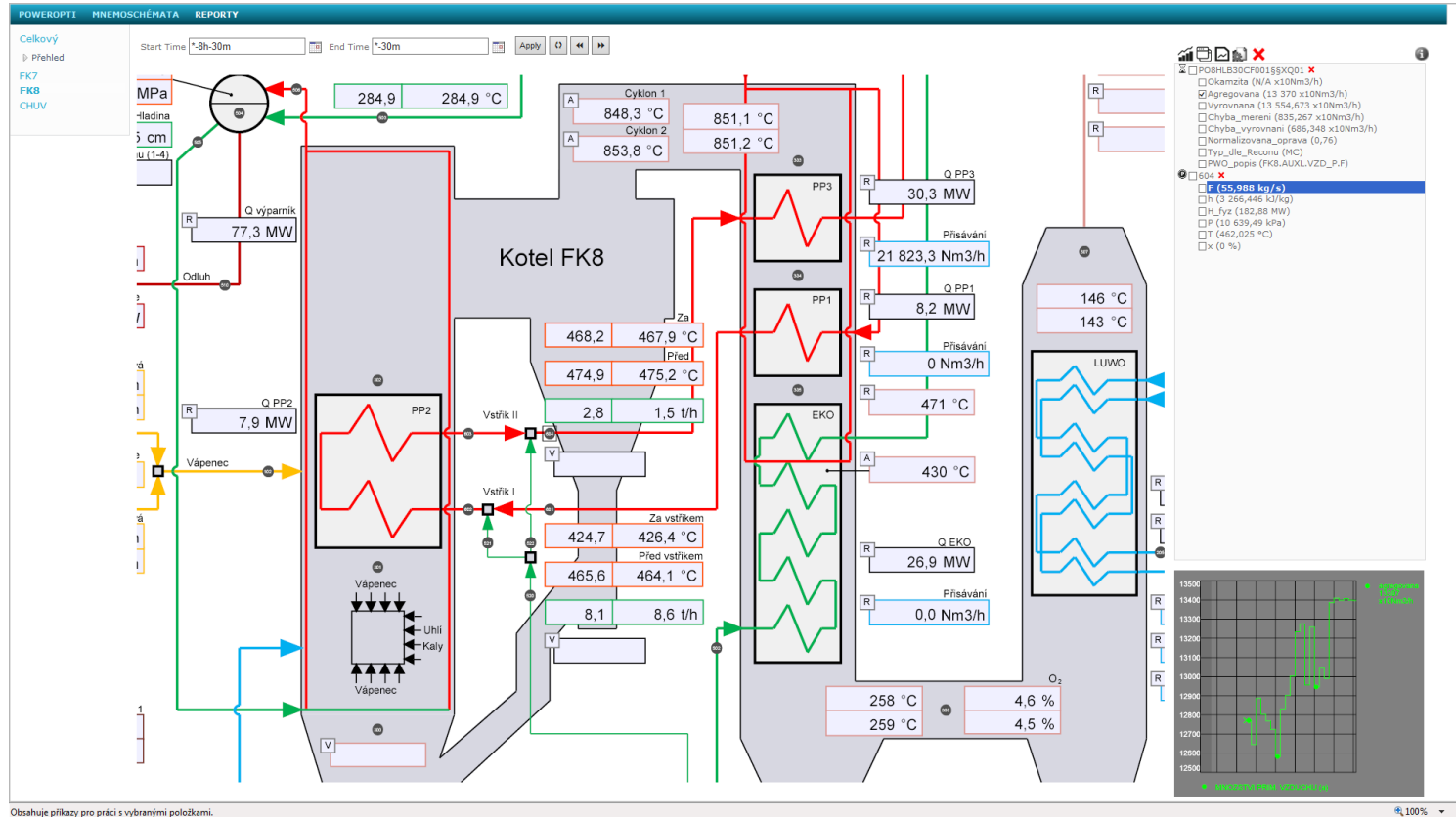
PowerOPTI – Benefits in EPO

- Monitoring of faulty functioning measuring points and components
- Real time monitoring of production unit condition
- Monitoring of water/steam loss on production units
- Operational tests to establish the optimal operating mode
- Increase of the unit efficiency - Implementation of the correction factors
- Early warning of bad equipment condition

Direct impact on efficiency

Implementation of the correction factors	+ 0,15%
Real time monitoring of production block condition	+ 0,1%
Corrections based on findings during model tuning	+ 0,2%

Other benefits

- Faulty meters and components detection
- Calculation of unmeasured quantities
- Data for monthly energy balance reports

LTOs Solution

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.
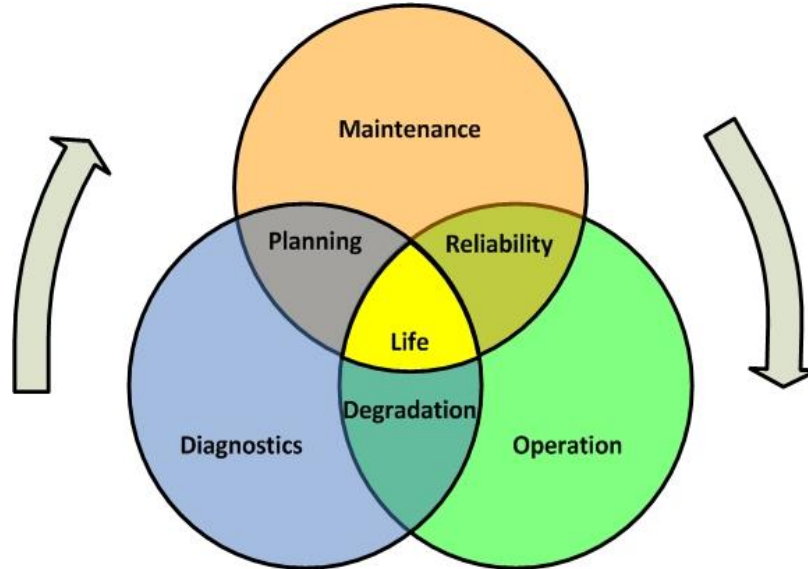
LTOs – Process
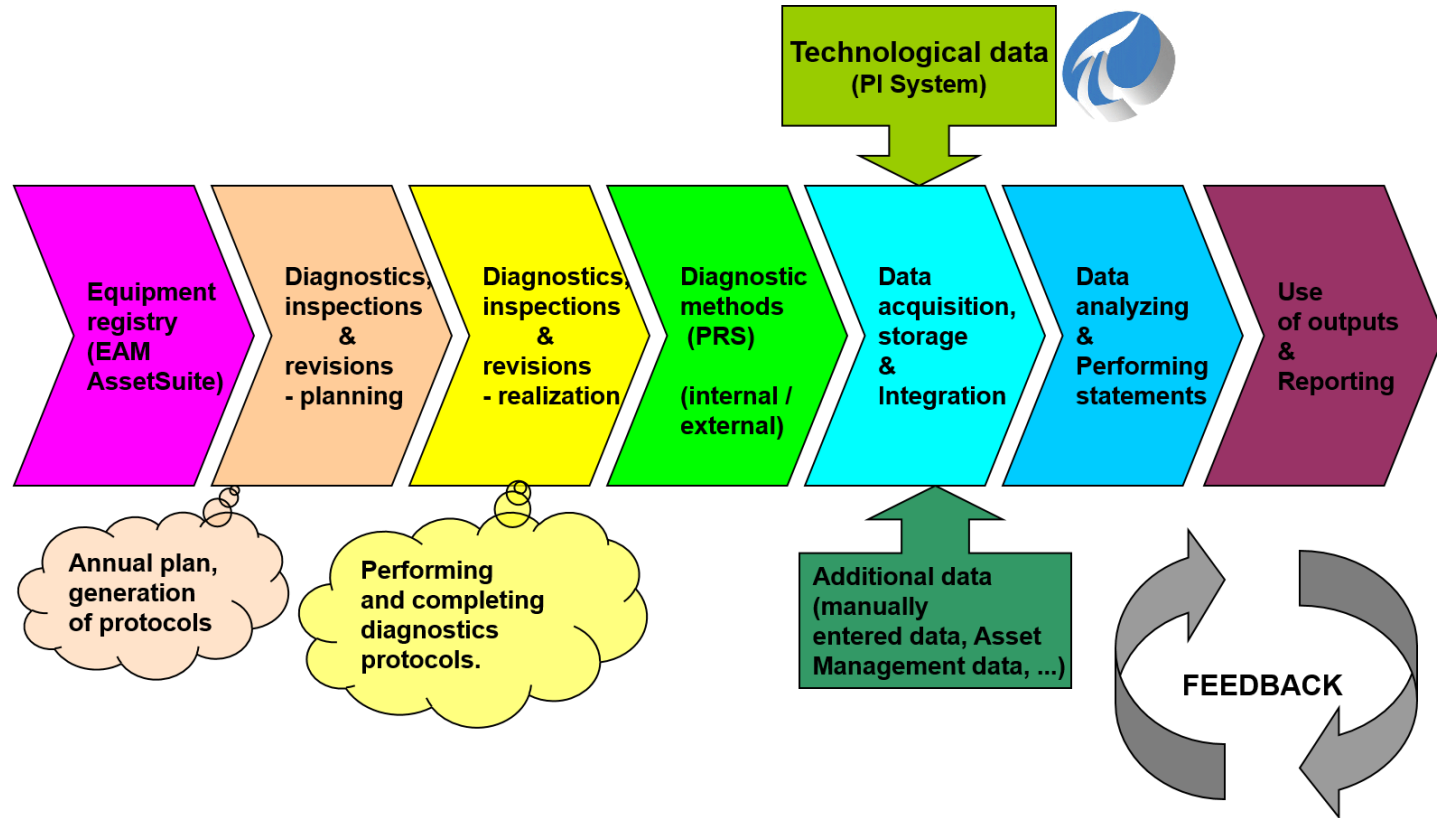
LTOs – Coverage

EQUIPMENT CATEGORIES:

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

BENEFITS / USE OF OUTPUTS:

- Shifting the dates of inspection 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

- Benchmarking and early warning capabilities

- Develop and create new engineering knowledge and capabilities of the operator
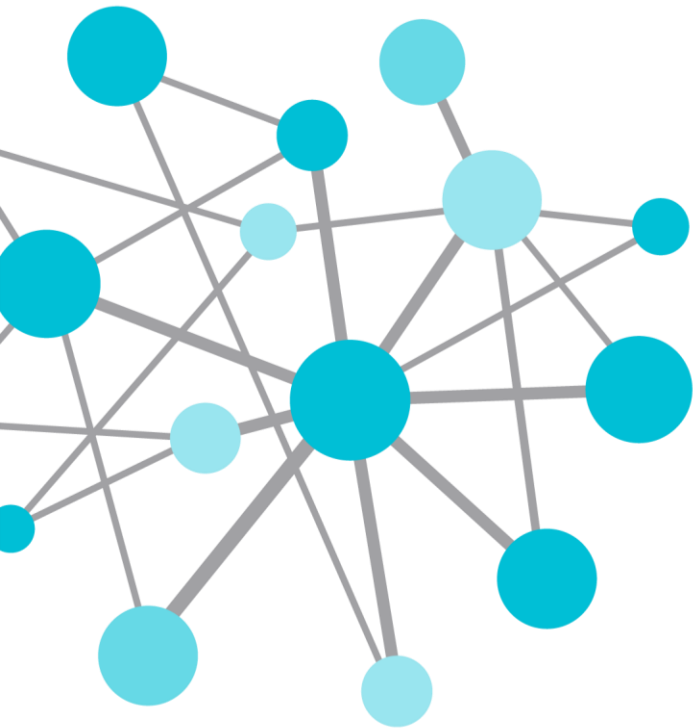
LTOs – On-line Data

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OT Energy Services a.s. (Olajterv Group)

THANK YOU

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