

THE INTEGRATED DATA WAREHOUSE AS A CONTROL AND DECISION MAKING SUPPORT SYSTEM IN THERMAL POWER PLANTS

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Motivations, long term

- **Liberalization and re-regulation of ESI**
- **New players (IPP, GenCo), Market, concurrency.**
- **Power system complexity increase.**
- **Business technical and commercial-financial aspects getting more complex.**
- **New capacity building slow down**
- **Fuel prices increase+ Economy crisis**

Challenges in Generation

- **Increased requirements on environment protection (emission of CO₂, SO_x, NO_x,...).**
- **Older and older equipment/plants require best possible O&M practice.**
- **Older workforce, with valuable knowledge base, that can be easily lost**
- **Pressure to reduce production cost (€/MWh)**
- **Increased threats to security, ...**

Challenges for GenCo's and IPP's

- To be able to take competitive technical and commercial decisions **need adequate and timely process data from the power plants on the regular basis.**
- **Numerous power plant data are needed** (technical, process historic, real-time and non-real time).
- Between them **on-line, real-time, available unit capacity, unit efficiency and unit production cost** (as ¢/kWh, based on the unit heat rate) are of the prime importance.

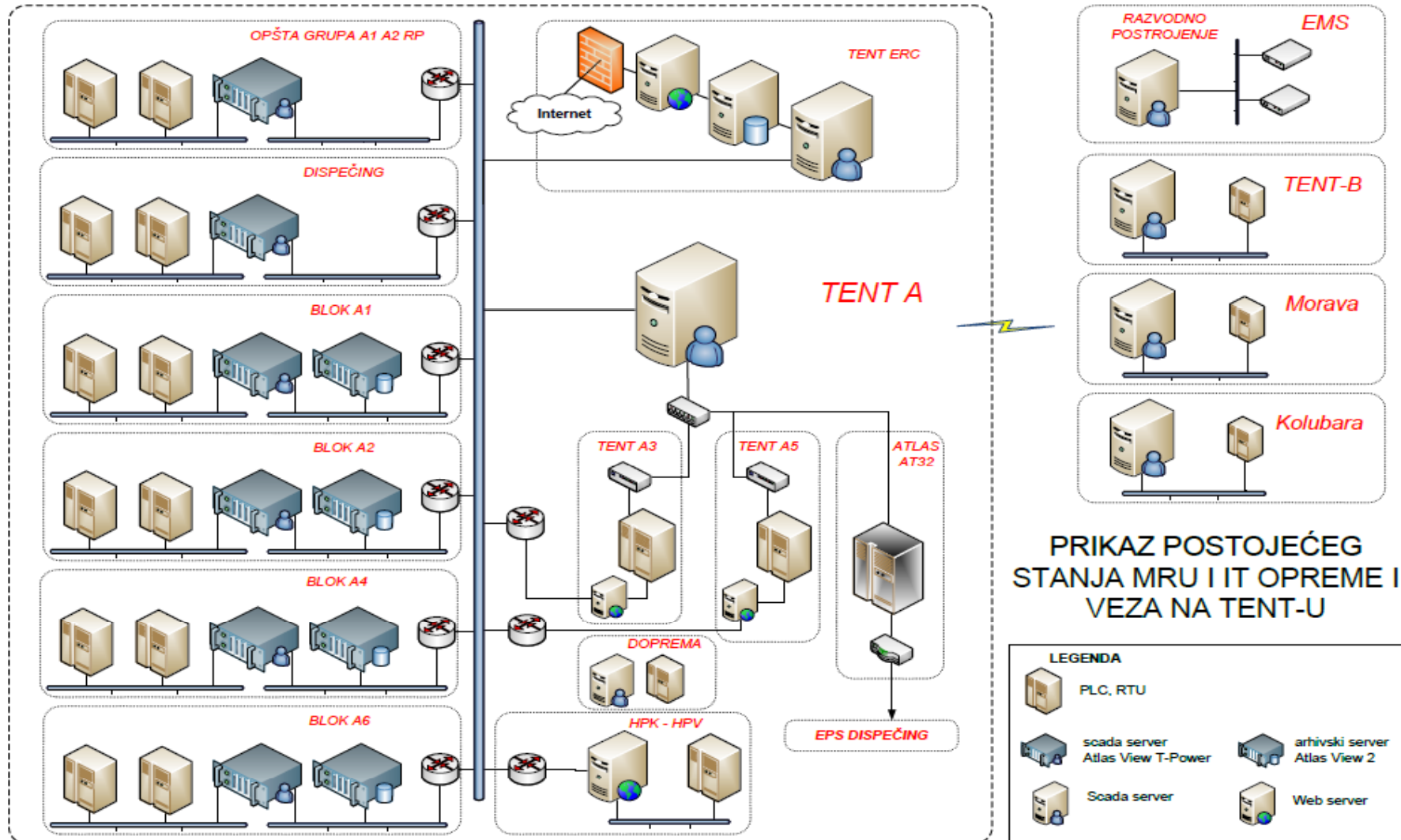
Typical GenCo's and IPP's ICT support

- **On-line real-time performance monitoring and analysis system** (of the individual power plants/units are to be followed and analyzed), fleet wide.
- **MMS plus activities on coordination of power plant maintenance.**
- **Generation Management System (GMS)** are used to perform functions related to resources scheduling.

Motivation: New possibilities

- ❑ **Progress in the area of automatic control methods, and tools**
- ❑ **Modernization of process interface, intelligent transmitters, gas/liquid analyzers, sensor networks, increasingly wireless...**
- ❑ **Progress in the area of ICT: DW, DM, BI...**
- ❑ **Modernization of control of almost all units at EPS of Serbia, ongoing**

Existing ICT for process control at TPP TENT



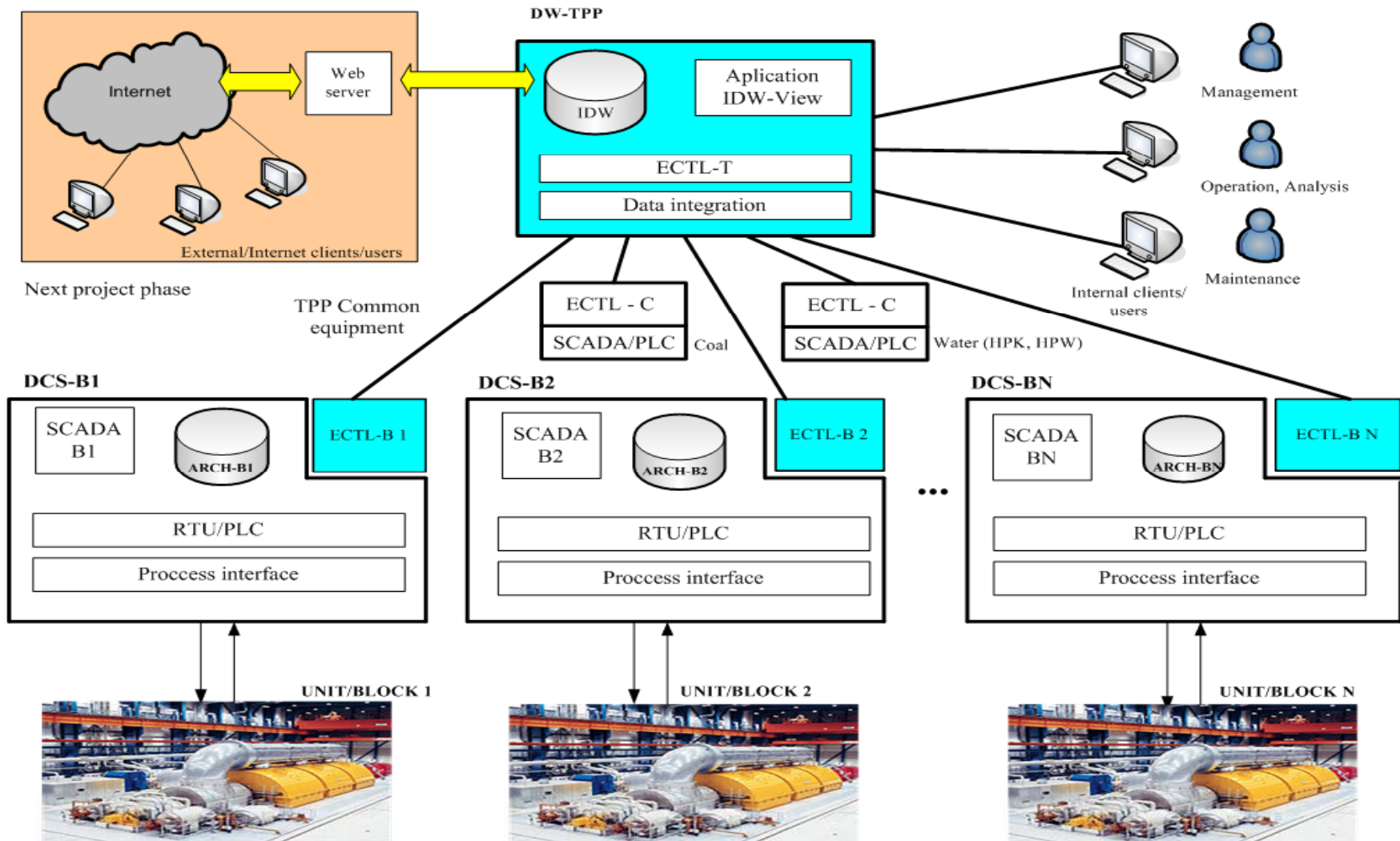
DCS Typical constraints

- **All data are in local proprietary archives, relatively closed. Proprietary protocols.**
- **Used solely for process monitoring, command and automatic regulation.**
- **Modest use of the data outside the unit control room.**
- **No automatic relation with the Daily report application. i.e. repeated manual data entry.**
- **Data in "siloses", un related.**
- **Minimal use of analytic applications.**

TPP DW System proposed

- The DW-TPP system proposed and developed, in its essence represents a specific information system of the **DSS type**, intended for **decision making support** in the domain of **TPP operation effectiveness, operations planning and energy efficiency**.
- The system as its central part has an **integrated data warehouse (IDW)** that contains all relevant (almost) real-time and historic process data, but also data from other sources.
- **Additional service and user software (ECTL, T-View)**
- **Fits in designed multi level control hierarchy**

TPP N.Tesla A DW Architecture



TPP-DW data content

- Each unit generates about **4000-6000 measurements on every scan** (2-5 seconds). Adding calculated and derived data, we come to about **10.000 data per unit**, or 60.000 "measurement" data per TPP (6 units).
- Of approximately **1600 analogue measurements/unit** about 1000 are from boiler, 400 from turbine and 200 from generator and aux.
- **Available measurements: electrical** (like I, V, f, P/Q, Wa/Wr, etc.) and **non-electrical** (like temperatures, pressures, levels, flows, vibrations, speed of rotation, concentration, etc.) that plant/unit SCADA/DCS/PLC system can provide.

TPP-DW contains **two main data groups**:

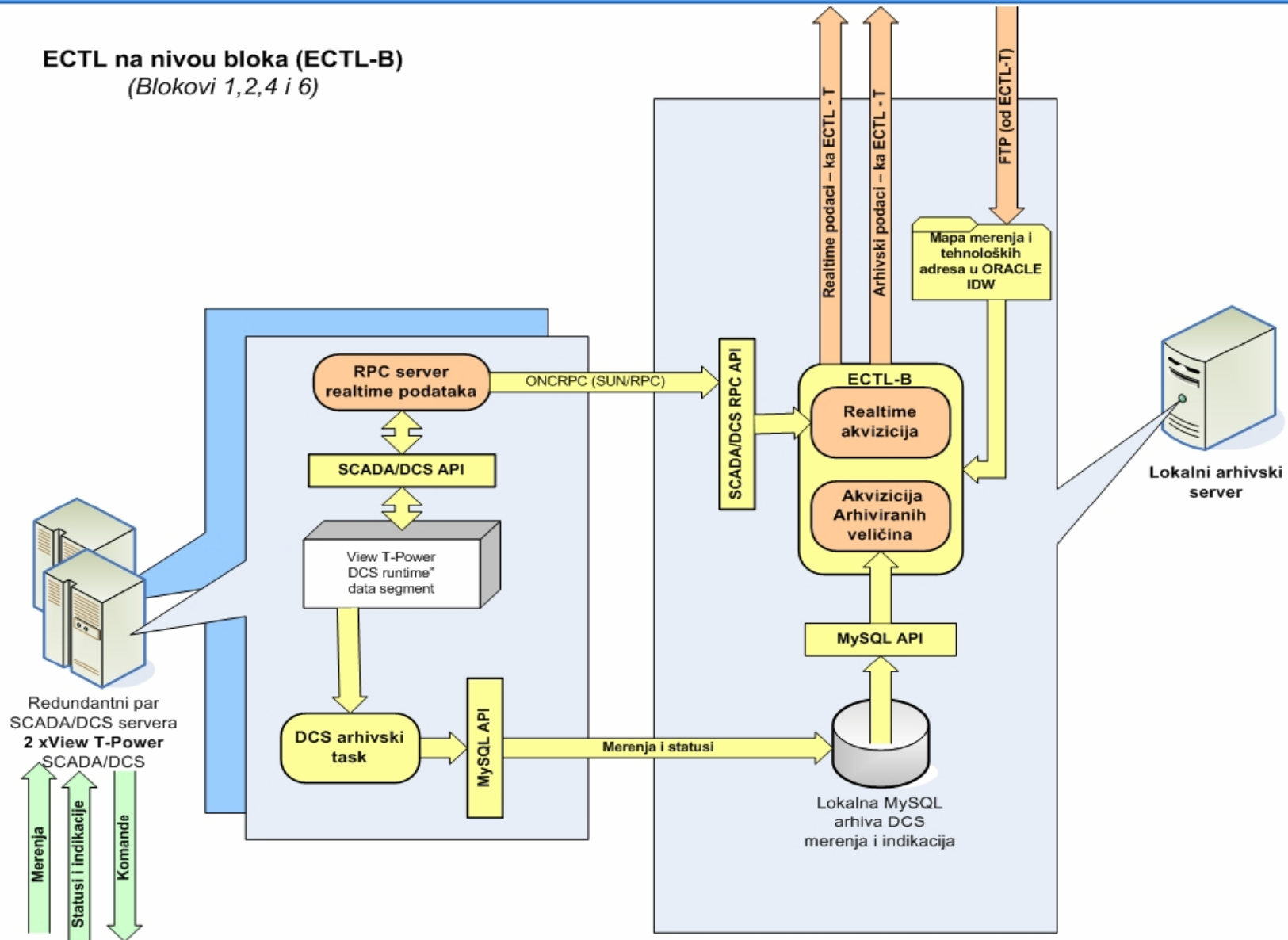
- **"Catalog", model data** that describe the plant/unit structure and their elements.
- **Data extracted from the SCADA/DCS systems**, before all measurements from the process.
- **Historical (time tagged) DW data** are organized in three tables ("archives"):
 - Daily archives (with a 5-15 min. resolution)
 - Monthly archives (with a daily resolution)
 - Yearly archives (with monthly resolution)

ECTL-B Programs functions:

- **Access to real-time data** in the DCS run-time segments
- **Data extraction** from the DCS historical archives
- Data extracted processing and **their conversion** in a form suitable for data transfer
- Connection and processed **data transfer** to Oracle data base

ECTL-B Programs structure

ECTL na nivou bloka (ECTL-B)
(Blokovi 1,2,4 i 6)



IT Platform: heterogeneous, stnd. based

- **API: C++**
- **ETL: C++**
- **RDBMS/DCS side: My SQL**
- **RDBMS/DW side: Oracle 11g**
- **Viewer Application: Oracle APEX**

Conclusions

The DW for the biggest TPP at EPS that:

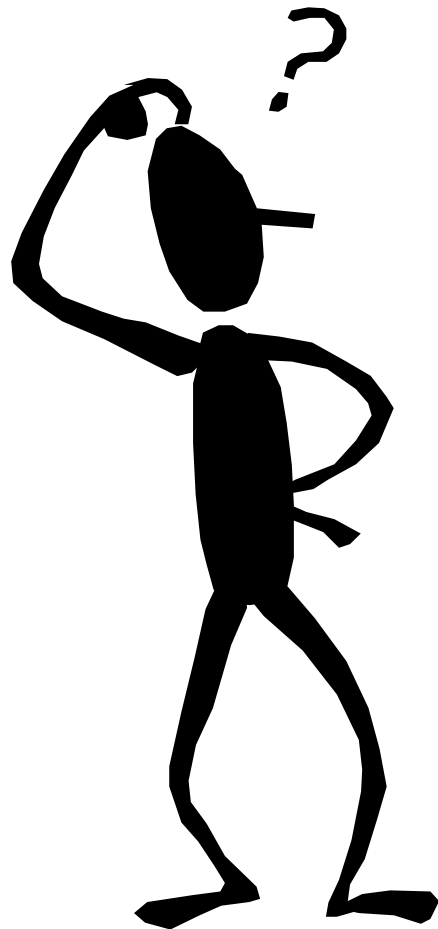
- 1. Integrates at the power plant level relevant process data collected from the individual unit DCS's and other PP data sources.**
- 2. Serve as a platform for different applications that will use mainly historic process data from the data warehouse.**
- 3. The system was developed in strong cooperation with the end user (EPS TENT A) and is based on robust design approaches and technologies used.**

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**Thanks for your
attention!**

Questions?