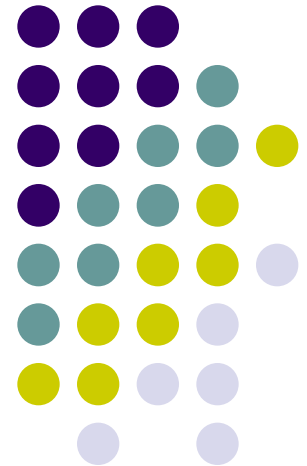


SUCCESSFUL IMPROVEMENT OF CONTROL SYSTEM FOR THE PRODUCTION AND DISTRIBUTION OF HEAT ENERGY IS AN ESSENTIAL PREREQUISITE FOR INCREASING EFFICIENCY OF THE DISTRICT HEATING SYSTEM

Ms. Tatjana Nušić, Mr. Petar Vasiljević
DH “Beogradske elektrane”,
Belgrade, Serbia





Contest

- Introduction
- Modernization of Belgrade district heating system
 - Modernization of plants SCADA system
 - Modernization of substations
 - Implementation of substations SCADA system
- Further district heating system optimization
 - Implementation of software package Termis
- Law regulation
- Conclusion



Introduction

- Belgrade district heating system
 - Plants started to work during 60's , mostly 70's in the previous century
 - Today installed capacity 3000MW
 - District heating network 1200km
 - Substations 8200
 - Mostly indirect connection boilers to the DH network
 - Heating space 22 million m²

District heating system modernization objectives



BASIC OBJECTIVES



Through the high level of the plant automation

Plant management

- Reliable
- Simple
- Energy efficient

ADDITIONAL OBJECTIVES



Through the high level of substations automation

DH system oriented to the end customer

FINAL OBJECTIVE

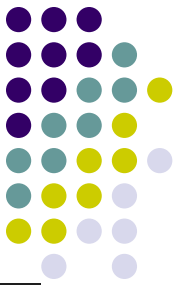


With lower operation and investment costs

Further optimization of DH system operation

Belgrade DH area map

Modernized plant SCADA systems



Kfw donations

- 5.5 mil DM Kfw1
- 5.0 mil Euro Kfw2

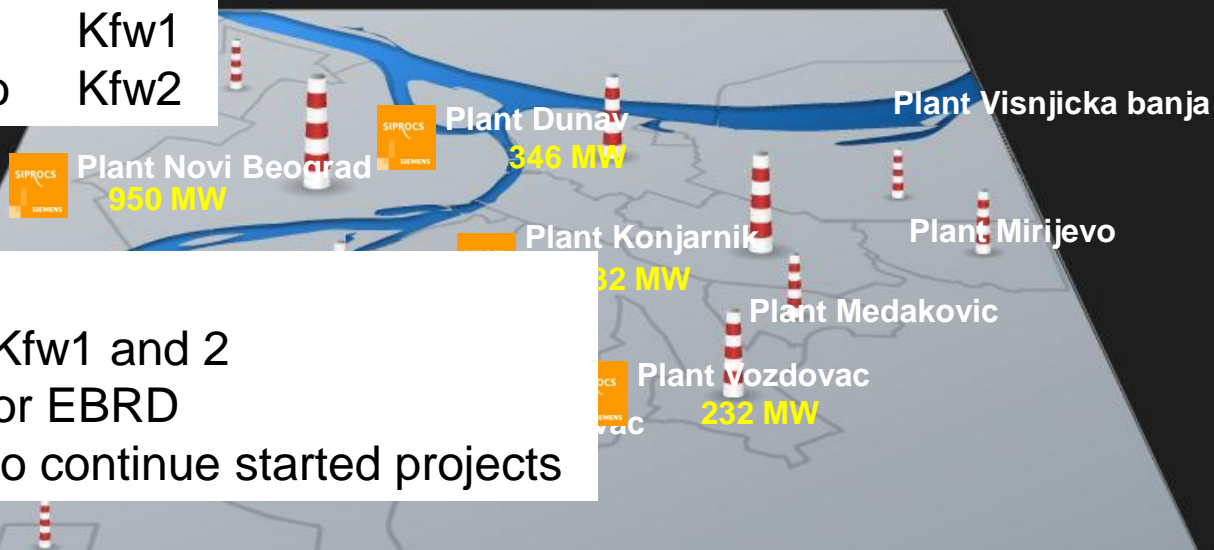
Domestic

- 3 mil Euro Kfw1 and 2
- 8 mil Euro for EBRD
- 11 mil Euro to continue started projects

Boiler room
Zeleznik

EBRD

- 20 mil Euro credit
- 2 mil Euro donation SIDE
- 2 mil Euro donation for consultants
- 2 mil Euro for modernization and connection on DHS of University center Belgrade



Main characteristics of plant's operation with modernized SCADA system



- **High level of reliability**

- Redundancy in system configuration
- Extremely fast flow and data processing
- Appropriate software solutions
- Combined selection of software platforms Linux and Windows

- **High level of automation**

- Precisely defined and implemented technology of plant operation, system reacts fast on disturbance
- Sequential and logic control of individual entities and entire plant
- Operator decisions are controlled by PLC
- Clear and intuitive process visualization

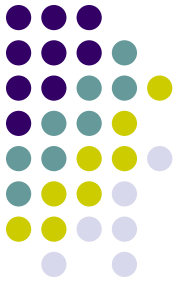
Automatic control of plant's operation



has been realized in accordance with:

- **Direct requirement from Dispatch center** to the operator who set up value to the SCADA system which automatically starts the sequences
- **Curve set in SCADA system** that presents dependence of outgoing water temperature to the network from the outdoor temperature

New project – proofed concept

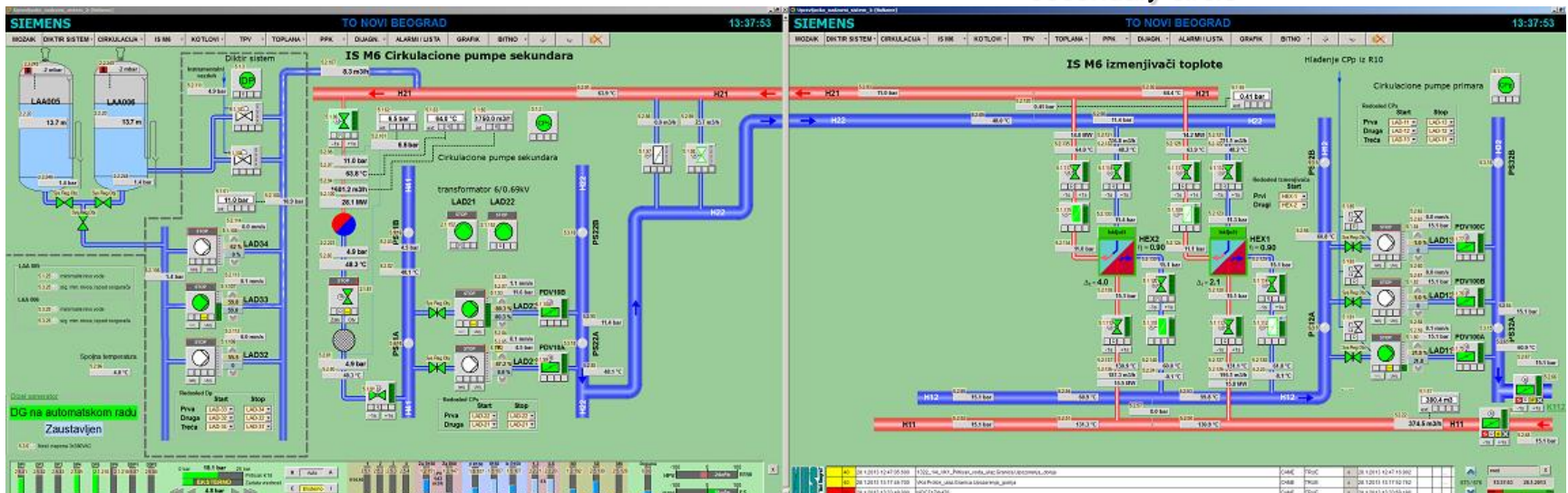


Heat exchanger station 200MW

- Safe operation
- Improvement of automation level
- Clear insight into the process to be able to control process without difficulty

Panel for pressure system and primary circle in the heat exchanger station

Panel for heat exchangers and secondary circle



Process data overview for the biggest plant in DH system



	2004 after 1st faze	2013 now
Installed capacity	800	950
Analog measurements	525	759
Digital outputs	581	862
Digital inputs	2098	3070
Regulation circles	66	111
Access points PLC - servers	18984	39070

Increase in operation efficiency



	2001	2012
Installed power	2700 MW	3000 MW
Generation plant efficiency	0.780	0.880
End user specific energy consumption	150 KWh/m²	140 KWh/m²

DH system- customer oriented system

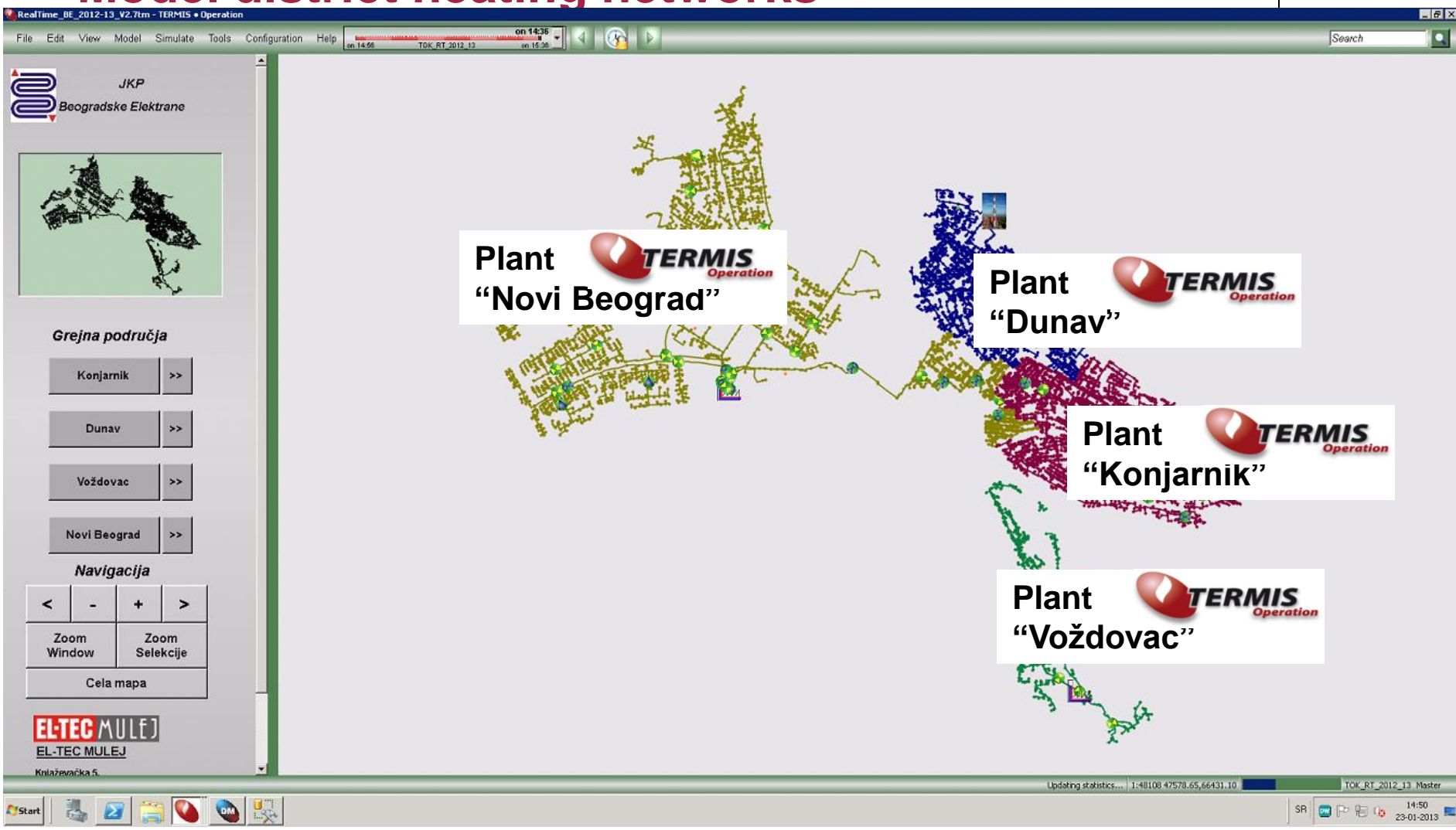


- Substations were modernized too – 95 % of total number which is 8200
 - customer takes from the heating system as much heating energy as he needs
 - bills according to the actually consumed heating energy is possible
- Substations SCADA system providing view into them – only some characteristic substation are implemented

TERMIS - software package for further DH system optimization



Model district heating networks



The screenshot displays the TERMIS software interface for modeling district heating networks. The main window shows a map of a network with four specific plants highlighted and labeled with callouts:

- Plant "Novi Beograd"
- Plant "Dunav"
- Plant "Konjarnik"
- Plant "Voždovac"

The interface includes a sidebar on the left with the following sections:

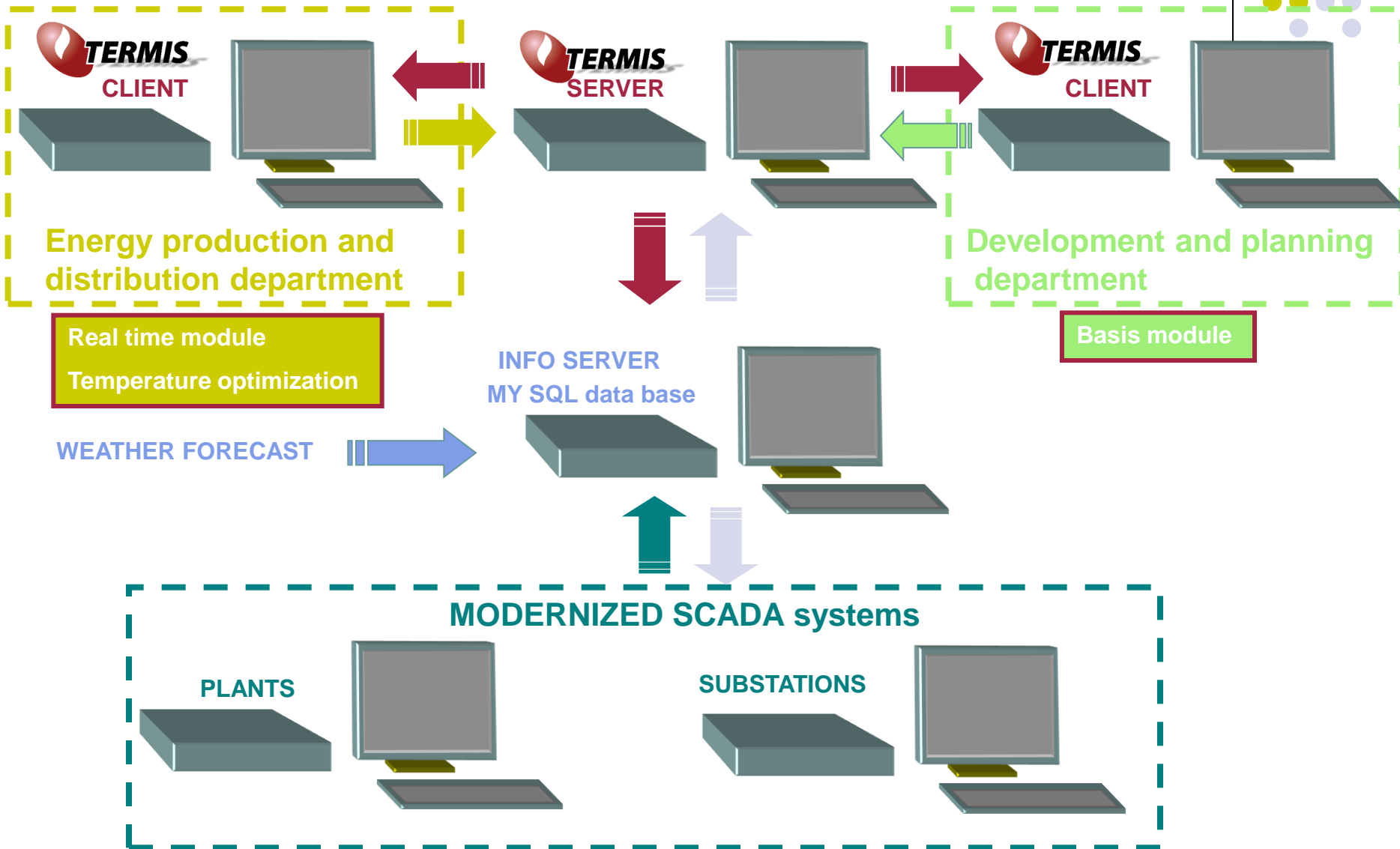
- JKP Beogradske Elektrane** logo and a small map thumbnail.
- Grejna područja** (Heating areas): Buttons for Konjarnik, Dunav, Voždovac, and Novi Beograd, each with a right-pointing arrow.
- Navigacija** (Navigation): Buttons for zooming in (+), zooming out (-), and a "Cela mapa" (Full map) button.
- EL-TEC MULEJ** logo and address: Knjaževačka 5.

The top of the window shows a menu bar (File, Edit, View, Model, Simulate, Tools, Configuration, Help) and a status bar with the text "on 14:36" and "TOK_RT_2012_13". The bottom of the window shows a Windows taskbar with the Start button, system tray, and date/time (14:50, 23-01-2013).

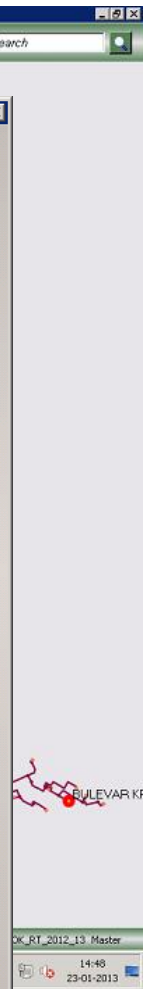
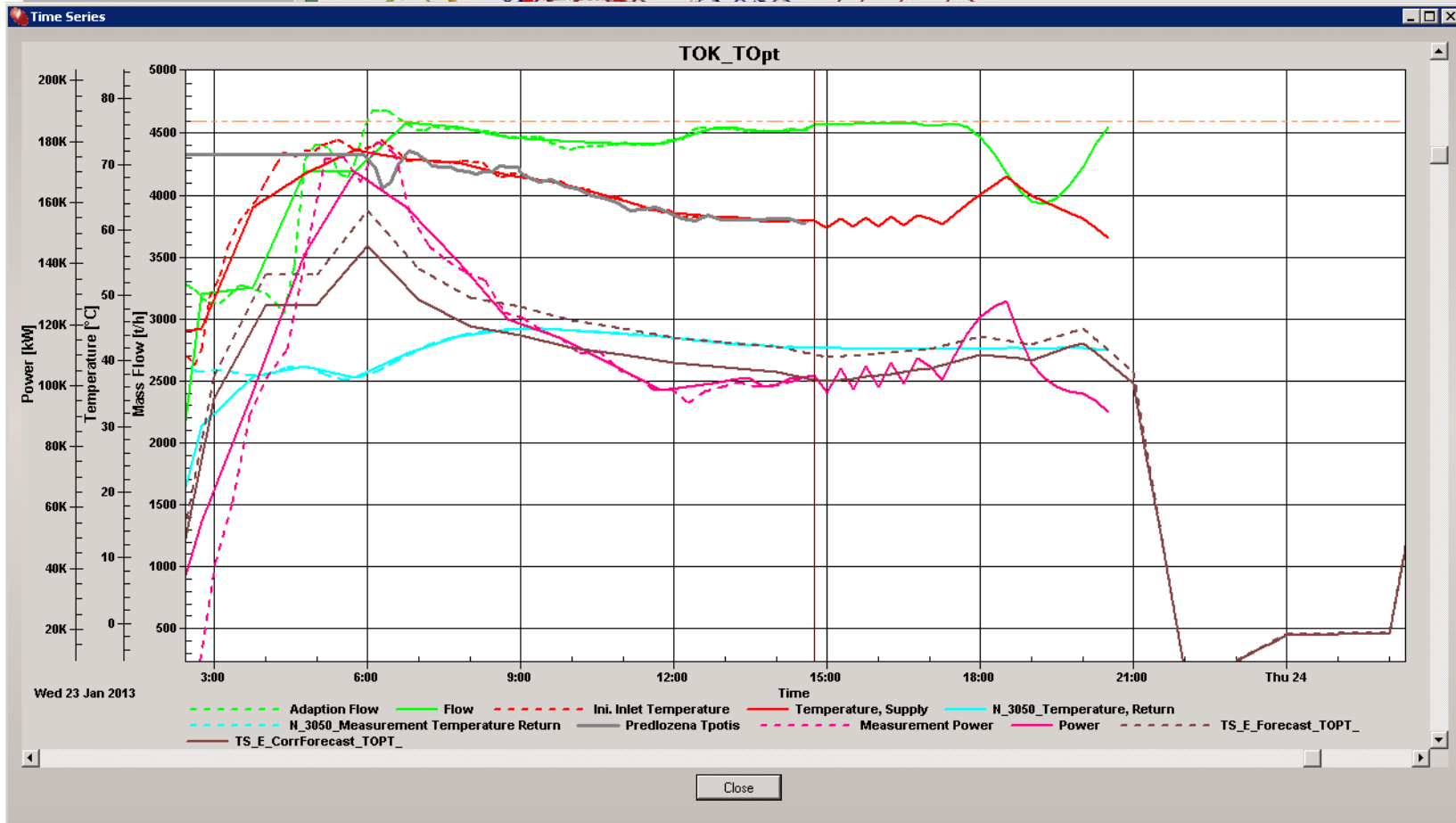
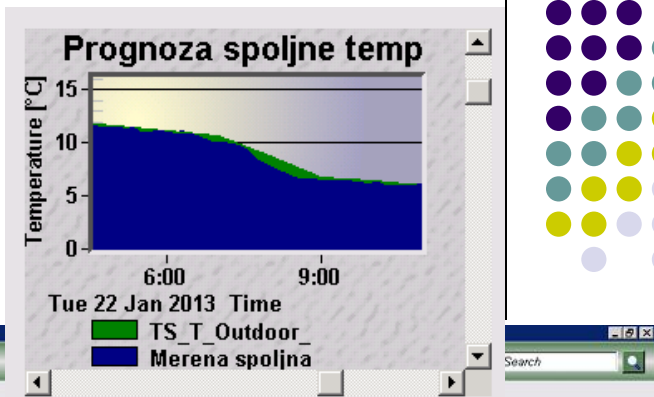


- **Termis basis**
 - Creation and calibration of DH network models
 - Planning, development, hydraulic analysis
- **Real time modul**
 - Control of system operation in the real time
 - Uses calibrated model, SCADA system data, performs cyclic simulation
- **Temperuture optimization**
 - Optimization of operation mode by reduction of water temperature at the outlet of the plant
 - Uses simplified calibrated model, on line data from SCADA system, forecast of outdoor conditions, power profile from the previous season, limit values for temperature, pressure and flow

SCADA – TERMIS connections



Temperature optimization - plant "Konjarnik"



Law regulations



- December 2012. – draft **Law on energy efficiency**, the adoption in March 2013
 - Switching to collection in accordance with quantity of heat energy delivered
 - Term of 18 months to provide metering in each unit of multi-apartment building
 - Assessment – in period of 3-5 years reduction in consumption of heat energy for 15-20%
- **Regulations on energy efficient buildings** effective from September 2012.
 - Anticipated energy consumption on an annual level for new residential buildings is 65 KWh/m²
 - , and for existing residential buildings stock in Serbia is 75 KWh/m²
 - Plans for energy recovery are 10 % of the existing residential building stock, available funds in the amount of 720 million Euro from Japanese organization JICA – Ministry of Construction Program
 - Assessment – in implementation period of 6-8 years, savings of 30-40%
- **End user education**, raising awareness on the need for rational use of energy

Conclusion



- Plant modernization made bases prerequisite for increasing efficiency of DH system for sure.
- Substation modernization provide more quality service to the end customer as well as possibility to pay according its consumption
- Data analysis and processing from SCADA data bases using special software package allows further optimization of DH system
- All these projects during previous decade make us ready to fullfil law regulations as well

SUCCESSFUL IMPROVEMENT OF CONTROL SYSTEM FOR THE PRODUCTION AND DISTRIBUTION OF HEAT ENERGY IS AN ESSENTIAL PREREQUISITE FOR INCREASING EFFICIENCY OF THE DISTRICT HEATING SYSTEM

Ms. Tatjana Nušić, Mr. Petar Vasiljević
DH “Beogradske elektrane”,
Belgrade, Serbia

t.nusic@beoelektrane.rs, p.vasiljevic@beoelektrane.rs

