Summary:

Tuzla is a city in the northeastern part of Bosnia and Herzegovina. It is the seat of the Tuzla Canton and is the economic, scientific, cultural, educational, health and tourist centre of northeast Bosnia. Preliminary results from the 2013 Census indicate that the municipality has a population of 120,441.

District Heating System of Tuzla City started in October 1983. Project to supply Tuzla City with heat energy from Tuzla Power Plant that will have combined production of electricity and heat was happened in 4 phases.

The requirements for connection to Tuzla District Heating brought of system in position that in 2005 we got to the maximum capacity and we had to do wide modernization of network pipes and heat substations.

Facts about the Tuzla district energy system

Annual heat carrying capacity: 300,000 MWth

Temperature: 130–60°C

Transmission network length: 19.6 km (2x9.8 km)

Distribution network length: 142.4 km (2x71.2 km)

Power station fuel: Coal

Number of users:

Total: 22934

Flats snd Houses: 20979

Public Institutions: 156

Commercial units: 1799

Heated area (square meters):

Total: 1718787

Flats and Houses: 1158402

Public Institutions: 220460

Commercial units: 339925

Results achieved by reengineering the Tuzla district energy system

• 30 % energy savings compared to old system before retrofit

• Capacity expanded by 36 % within the existing flow of 2,300 m3/h

• Reengineering of 98 substations: ball valves, strainers, pressure regulators, control valves, temperature and pressure sensors, safety thermostats, weather stations, electronic controllers, thermostatic radiator valves (TRVs), energy meters

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Archaeological evidence suggests that Tuzla was a rich Neolithic settlement. Being inhabited continuously for more than 6,000 years, Tuzla is one of the oldest European sustained settlements. During the period of the Roman Republic (before the area was conquered by Rome), Tuzla was called Salines. Both names came from the fact that main industry was always production of salt dug out of the mines in and around this city. Extractions of the city's salt deposits, particularly in the 20th century, have caused sections of the city center to sink. Structures in the "sinking area" either collapsed or were demolished, and there are few structures in the city that predate the 20th century, despite the fact that the city was founded over 1000 years ago.

Tuzla is the only city in Europe that has a salt lake at its center. The ancient Pannonian Sea dried up around 10 million years ago, but work by researchers and scientists has now enabled a level of saline water to be kept stable at the surface, and in 2003 the Pannonian Lake was opened.

Tuzla is located in the northeastern part of Bosnia, settled just underneath the Majevica mountain range, on the Jala River. The central zone lies in an east-west oriented plain, with residential areas in the north and south of the city located on the Ilinčica, Kicelj and Gradina Hills. It is 237 metres (778 feet) above sea level. The climate is moderate continental. There are abundant coal deposits in the region around Tuzla. 6 coal mines continue to operate around the city. Much of the coal mined in the area is used to power the Tuzla Power Plant, which is the largest power plant in Bosnia and Herzegovina.

The first idea and project of Tuzla District heating from Tuzla Power Plant was made at Tuzla Institute for Study and Projecting in 1967. That idea was realized in 1983. and District

Heating System of Tuzla City started in October 1983., after Tuzla Municipal and company Centralno grijanje d.d. Tuzla (Central Heating Tuzla completed that project and established legislation that will enable Tuzla to have continuously distribution of heat from Tuzla Power Plant as the source through District Heating Network to end users of that time. The realization of Project to supply Tuzla City with heat energy from Tuzla Power Plant that will have combined production of electricity and heat was happened in 4 phases.

1. Phase 1982-1983:
   - Installation of main heat supply pipes for Tuzla Power Plant to East Part City distribution point (K.15) dimensions from ø600 to ø250, with length 10 km, capacity of 220 MW and temperature regime 145/75°C.
   - Installation of distribution system in new eastern part of town Sjenjak in length of 3 kilometers and 16 heat substations.
   - Reconstruction of production block III (100 MW) in Power Plant in order to be a combined district heating and power unit.
   - Installation of Pump station in Tuzla Power Plant.
   - Installation of the Heat exchanging unit in Tuzla Power Plant, 4 heat exchangers steam/water with maximum power of 174 MW.
   - Chemical unit for water treatment was built with two lines for water demineralisation 2 x 90 m^3, and two lines for water softening 2 x 90 m^3/h.
2. Phase 1984-1986:
   - Installation of distribution system in four parts of town Sjenjak-2, Stupine, Usce and Old railway Station and heat substations for all buildings in those suburbs.
3. Phase 1987-1989:
   - Installation of distribution system in suburbs with obsolete fosil fuel boilers and heat substations and connection to District Heating System for all buildings in those suburbs that resulted in general the end of burning lignite coal in 41 old boilers just for building heating to that period.
4. Phase 1989-1995:
   - Connection of existing local heating networks to District Heating System.

In 2003th reconstruction of production block IV (200 MW) in Power Plant in order to be a combined district heating and power unit. The heat exchanging unit was installed and heat capacity was 220 MW. So, Centralno grijanje d.d. Tuzla is company that is main responsibility is distribution of heat energy that our company buy heat at the heat meter of Tuzla Power Plant.

Period 2008-2015 was period of the greatest number of projects and connections to Tuzla District Heating System. In that period two Hospital Centers were connected:

1. JZU UKC Tuzla – Hospital Gradina: Heat capacity installed: 10000 KW; heated area 45300 m^2 (heated area 487609 ft^2) ; emission reduction of CO_2 is around 5700 t/a.
2. JZU UKC Tuzla – Hospital Slavinovici: Heat capacity installed: 560 KW; heated area 3325 m2 (heated area 35790 ft^2) ; emission reduction of CO_2 is around 1700 t/a.
3. Connected each building with more than 4 flats to District Heating System in Tuzla.
4. Finished connection of each Primary school on District Heating System in Tuzla.
5. Tuzla City established 16 new heating zones.

The requirements for connection to Tuzla District Heating brought of system in position that in 2005 we got to the maximum capacity and we had to do wide modernization of network pipes and heat substations.

- All existing direct substations changed with indirect, now ~1,000 indirect HS.
- Implementation of SCADA system, monitoring network and heating substations, start using Termis (static) – 1st phase of digitalization.
- Energy efficiency study of all system has done.
- Termis Real Time and Temperature optimization - 2nd phase of digitalization.
- Optimization of network and heating substations, complete reconstruction of primary side.
- Refurbishment of secondary side, Heat Exchangers and circulation pumps.
- Calibrated model of DHN Tuzla.
- Possibility of making different static scenarios:
    - Reconstruction of the network and production with calculation of economics,
    - Detection of drop pressure disproportion,
    - Development and expansions of DHN Tuzla.

Determination of measurement points:

- Key points (CHP, chambers, heating substations…)
- Measurement data (SCADA, data loggers), March – April 2009.

Results of the research:

Q=2.200 m3/h, Tin=116 °C, Tout=67 °C, pin Sip=14,6 bar, P=125 MW (parameters in season 2008/2009)

Installed power: 198 MW

Reserve - excessive (-20 %): 165 MW

Reserve – work without downtime (-15 %): 143,5 MW.

Study of district heating system energy efficiency analysis of existing conditions and new improvement measures – Long term heating energy supply.

- Potential measures in regulation of public heating substations (schools and big public buildings):
- Regulation of primary side (temperature, flow, pressure) with installed power ~30 MW
- Detail calibration of network branches

Results:

- Increasing temperature difference (ΔT) – lower return temperatures:
  - 4 °C; additional capacity 10 MW
  - 7 °C; additional capacity 18 MW
- Increasing flow, Tin and pressure:
- Q=2,340 m3/h, Tin=130 °C, Tout=67 °C, pdov Sip=16,1 bar, P=171 MW (additional 6 MW)
- Additional increasing of Tout:
- Q=2,340 m3/h, Tin=130 °C, Tout=60 °C, pdov Sip=16,1 bar, P=190 MW (additional 25 MW).

After modernization it is no more cold winter mornings for the citizens of Tuzla. Since 2011, the local District Heating Company (Centralno grijanje d.d. Tuzla) has carried out a major renovation of the city's comprehensive district heating network, providing reliability of supplies, improved comfort as well as energy and cost savings. Based on thorough analysis and a long-term strategic approach, the 30 year old system is gradually transformed into a modern and smart energy system.

The available flow capacity of the existing, 30 year old system was 2,300 m^3/h, whereas the required flow to fulfill the heating demand of the connected homes, public and commercial buildings and other facilities was closer to 2,800 m^3/hour.

The shortcomings of the system were especially felt in the mornings, when the inhabitants got up to cold rooms during the winter months.

In order to maximize system efficiency, raise the level of end-user satisfaction and improve the stability of the system, the local Heating Company TPP Tuzla decided to carry out a complete renovation of the system.

Structured analysis and reengineering boost efficiency The Tuzla District Heating Company wished to create a long-term, viable solution based on thorough analyses of the current system setup, application of state-of-the-art technology and implementation of an energy management system.

When addressing capacity problems, many district heating operators resort to fast and easy solutions, for instance by installing additional circulation pumps. We chose another approach to achieve a long-term, sustainable solution. After careful analysis of the current system set-up and operational data, we opted for a step-by-step modernization and replacement of most system components, from substations to energy meters in individual homes.

The following goals were set up to succeed with the ambitious renovation project:

• Supply low-temperature district heating to existing and new buildings added to the network

• Distribute heat with minimum grid loss

• Recycle heat from low temperature sources and integrate renewables, e.g. solar and geothermal heat

• Implement a smart energy system balancing demand and supply at all times

• Ensure suitable planning, cost and motivation structures to achieve a sustainable energy system

The structured reengineering process consisted of the following, main phases: 1. Inspection of all substations that were not part of the central control system and subsequent specification of required improvement measures, for instance installation of ball valves, strainers, pressure regulators, control valves, temperature and pressure sensors, weather stations, safety thermostats and electric controllers.

2. The daily operation of substations and network was then measured to collect data that could be used for increasing capacity and efficiency of the system and potentially adding new connections and new supplies of thermal energy.

3. The measurements and subsequent analyses revealed the need to reconstruct a number of critical substations and to carry out further analysis of pipelines to avoid soiling that hampers the network efficiency. Furthermore, the analyses revealed the need to get all operators and system components into one, integrated control and management system.

4. A plan for renovation was then drawn up and the renovation commenced. A number of new control components were installed to optimize system capacity and efficiency, among others flow and temperature meters, pressure and temperature sensors, ball valves, strainers, pressure regulators, control valves, electric controllers, etc. Later, reconstruction or

replacement of heat exchangers and circulation pumps will be performed to increase capacity and efficiency even more.

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- Consulting, monitoring, measurements and data analysis to support decision-making and investment strategy.