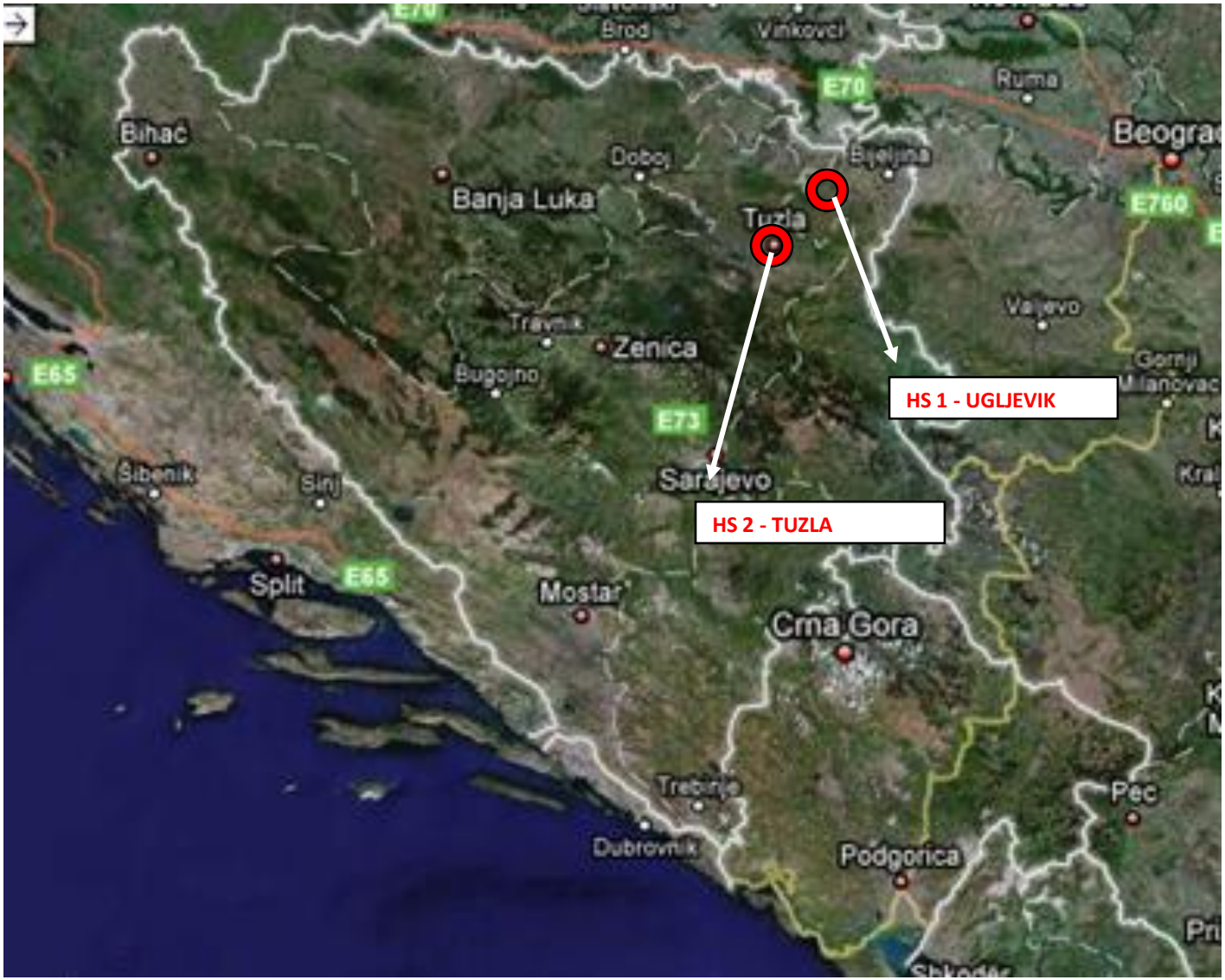
HOT SPOT
PROJECT BOSNIA AND HERZEGOVINA

Environmental monitoring in Tuzla and Ugljevik

Environmental monitoring and field surveillance training

Becici, Montenegro, 6-7.05.2009.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Pec
HS 1 - UGLJEVIK
HS 2 - TUZLA

Project sites: sub-projects for Clean up

1. *Ugljevik Mine and Thermo-Power Plant:*

   "Re-construction of facility for de-mineralization/de-carbonation processes", (waste water discharges reduction);

2. *Tuzla Town*

   "Reduction of air pollution by connecting of University Clinic Centre to the central Heating system".

Ugljevik Thermo Power Plant – Hot Spot

Problem in focus – Ugljevik site

- Capturing of huge amount of water from the river;
- Import of certain amount of chemicals from other countries;
- Weak monitoring of the process;
- Discharge of 120 t of salts into the river per year.

The following waste material is discharged from the plant for chemical preparation of water:

- Carbonate mud/slime (4%), max 54 m3/h , consisting of $CaCO_3$ and $Fe(OH)_3$ mainly, deported periodically to the landfill for carbonate mud built purposely by the Thermo Power Plant Ugljevik

- Waste water from de-mineralization; 150 m3/regen. With a large content of salts (910 g/m3-$CaCl_2$, 970 g/m3-NaCl, 797 g/m3-Na_2SO_4) through the plants for waste waters treatment, after neutralization to the pH-value 7-8.5 is dicharged into the river Mezgraja (Table 2.5)

Year	Number of regenerations	The amount of waste waters (m^3)	The amount of salts discharged in the river (t)
2003	285	42.75	114,44
2004	318	47.7	127,69
2005	279	41.85	112,03
2006	342	51.3	137,33
2007	363	54.45	145,76

Water quality analysis

The quality of water in the rivers Janja and Mezgraja measured in the period from 2003-2007 is given in tables bellow. The quality of water was also monitored/measured just before the river Janja runs into the Thermo Power Plant. This shows the quality of the river Janja without the effect of the waste waters discharged from the Thermo Power Plant, as well as the plant for de-carbonization and de-mineralization. It is raw water affected by effluents from waste waters that enter its body before the Thermo Power Plant.

Component	Unit	Janja bridge	Mezgraja	Janja down from the waste
Total hardness	^{0}dH	14.62	51.16	18.05
Carbonate hardness	^{0}dH	13.1	18.53	12.96
Ca- hardness	^{0}dH	9.6	32.25	11.51
Mg- hardness	^{0}dH	5.09	18.37	6.55
Non- carbonate hardness	^{0}dH	1.57	31.88	5.16
p-alkalinity	mmol/l	0,00	0,00	0,00
m-alkalinity	mmol/l	4.65	6.62	4.65
pH-value	-	8.02	7.98	8.09
SiO_2	mg/l	5.23	6.95	5.58
Chlorides	mg/l	7.83	11.98	14.57
Sulphates	mg/l	53.47	1068.62	176.53
Iron (total)	mg/l	0.052	0.13	0.084
Sodium	mg/l	18.2	149.94	37.43
$KMnO_4$	mg/l	13.64	22.43	15.8
Suspended material	mg/l	42.47	170.32	52.66
Evaporation residue	mg/l	287.16	1794.62	466.47
Conductivity	$\mu S/cm$	378.79	1919.14	600.28
Temperature	^{0}C	12.34	13.1	12.77
HPK	mg/l	29.92	43.59	29.65

Pollution sources impacting Janja river

Upstream of the Thermo Power Plant Ugljevik – the river Janja is expected to receive waste waters from two plants:

- The slaughter house
- the chicken farm
- Other smaller emitters
- This region of the river Janja does not have any sewage systems for the removal of municipal waste waters
  - Introduction of a physical pretreatment (to remove all solid materials, suspended materials, fats and oils)
- The Thermo Power Plant Ugljevik controls the discharge of its own waste

- It is assumed that firms upstream of TPP Ugljevik collect waste waters without any treatment, and then discharge it into the river Janja, usually by night.
- Incident in 1998 - the process of de-carbonization and de-mineralization was obstructed in chemical preparation of water , since the reactor was overwhelmed with enormous quantities of foam.
- Water quality analysis of Janja river in 1998:
  - several samples of water from the river were taken and sent it for an analysis to the Faculty of Technology and Metallurgy in Belgrade.
  - The results, were indicating that the quality of water in the river Janja had changed. Apart from this incident, there have been several more endangering the quality of the river Janja.

- In order to provide natural quality of water of the river Janja, as raw water used by the Thermo Power Plant Ugljevik and treated in the plants for de-carbonization and de-mineralization, it is necessary to:
- provide a strict control of the discharge of waste waters and materials up the stream of the location where the water is taken
- Install a suitable monitoring system - solution for this problem and facilitate the operation process of the plant for water preparation.

Water quality analysis

Water and waste water quality is monitored in the plant (certain analyses only) and Central laboratory of the Thermo Power Plant Ugljevik . The laboratory is not certified by ISO 17025, and all the analyses are done acording to procedures accepted in all the thermo power plants in the regions of Former Yugoslavia. The laboratory keeps the instructions for every analysis. The reports from the analyses are written on special forms and are sent to head engineer of the laboratory, head engineer of VPV, process engineer and environment protection engineer.

Next table review of the equipment and methods for analysis in the Central chemical laboratory of the Thermo Power Plant Ugljevik

Parameter	Method	Equipment
pH-value	electrochemical	pH-meter
conductivity	electrochemical	cundoctometer
Sulfates, iron, phosphates, silicon, copper	photometric	Spectrophotometer, colorimeter
Sodium	Flame photometric	Flame photometer
Hardness, p and m-alkality, chlorides, chemical use up of oxygen, organic substances ($KMnO_4$)	titrimetric	Laboratory glass vessels
Suspended materials, vaporization residue	gravimetric	Scales, dryers, hot plates

During the period from 2004 – 2007 the TPP Ugljevik laboratory has measured following parameters at the Janja and Mezgraja rivers:

- Total hardness,
- Carbonate hardness,
- Ca- hardness,
- Mg- hardness,
- Non- carbonate hardness,
- p-alkalinity,
- m-alkalinity,
- pH-value,
- SiO_2,
- Chlorides, Sulphates, Phosphates,
- Iron, Copper (Cu^{+2}), Sodium,
- $KMnO_4$,
- Suspended material,
- Evaporation residue,
- Conductivity,
- Temperature,
- HPK.

Results

- Waste waters from the process of de-mineralization which contain calcium and sodium salts of 145.76 t/year (the year 2007) affect the quality of water in the rivers Mezgraja, Janja and Drina.
- The average flow of water in the river Mezgraja of 0.309 m/s - the value of contamination of the water system of 14.9 g/m3, i.e.14.9 mg/l.

- Salts are not particularly toxic - effect on the water quality of the Janja can be tolerated
- reducing the amount of salts as much as possible or even eliminate completely the amount of the salts that are discharged into the river remains the primary goal.
- the emitted waste waters which contain the listed salts in average percentages of 14.9 mg/l in the river Mezgraja, are unfavourable for the aquatic life,
- reconstruction of the plant for de-carbonization and de-mineralization within chemical preparation of water in the Thermo Power Plant Ugljevik.

Environmental monitoring plan

In order to establish an efficient environmental monitoring system and for the analyses to be more complete it is necessary to :

1. apply ISO 17025,
2. to certify methods,
3. renew some apparatures and purchase new ones, which could measure other parameters (e.g. heavy metals and other):
    - automatic sampler ,
    - anion device for determining anions ,
    - atomic absorption spectrophotometer,
    - gas chromatograph,
    - apparatus for biological oxygen use-up,
    - oxymeter.

In order to have a full perception of the actual effect of the waste waters from the process of de-mineralization in the Thermo Power Plant Ugljevik on the quality of water in the rivers Mezgraja, Janja and Drina, the following programme should be implemented:

- Monitoring of the quality of water of the river Janja ,
- Simultaneous monitoring of the quality of water of the river Janja after the reception of waste waters from the Thermo Power Plant Ugljevik,
- Monitoring of the quality of water of the river Janja before it flows into the Drina,
- Monitoring of the quality of water of the river Drine before the river Janja flows into it, and
- Monitoring of the quality of water of the river Drine after the river Janja flows into it

Ugljevik Hotspot – Expected Results of the project

- Improvement of technology;
- Less water to be captured from the river;
- Savings to be made in further exploitation –and savings for economy (abt 40% less chemicals to be in use;
- Automatic monitoring on permanent basis to be applied
- Concentration of salts in Waste water to be reduced for 40% (environmental effect)

Tuzla - Hot Spot

Identified problems:

- Power Plant located near the Hospital Building and within urban zone of Tuzla;
- Only coal as energy source (CO2, SO2…, specific smell)
- Direct impact on air pollution;
- Monitoring applied but only concerning few polluters on ad hoc basis;
- Transportation, storage of coal, ash disposal;
- Efforts of Clinical Center to obtain internationally recognized certificates

Tuzla – Gradina Hospital

Environmental monitoring in Tuzla

Air quality measurements

- Monitoring of sulphur-dioxide and black smoke concentrations
- Results of the monitoring:
  - it demonstrates that average SO2 concentrations in the period between 2002 and 2005 were somewhat lower than 1990-1991.
  - the average 2007 SO2 level was significantly higher
  - the average black smoke concentrations showed a steady increase, with maximum values indicating that the legal threshold (“high level”) may have been exceed more than 7 times per year.

- In the period by 2002, measurements were conducted occasionally using analytical absorptionand gravimetric methods.
- In March 2003, an automatic air quality monitoring system has been established for the area of Tuzla Canton. 5 stationary and 1 mobile air quality monitoring stations have since been in use, each comprising 5 analyzers:

- air temperature and humidity analyzer
- global radiation analyzer
- SO2 concentration API 100A analyzer (UV fluorescence method) , EPA9 approved
- CO concentration API 300A analyzer (IR spectroscopic method), EPA approved
- NOX concentration API 200A analyzer (chemiluminescence method), EPA approved
- O3 concentration API 400 analyzer (UV photometric method), EPA approved
- PM2.5 concentration TEOM 400a analyzer (gravimetric method in accordance with EN 12341)

Conclusion:

Based on the air monitoring done in previous years, it can be concluded that:

i) Tuzla town average values of particulate matter concentrations exceeded the legal thresholds and were 2-3 times higher than the values reported for comparable size European industrial towns; and

ii) Tuzla town peak values of all the three monitored pollutants heavily exceeded the legal thresholds for an unidentified number of times, and were several times higher than peak values in comparable size European industrial towns or other selected urban areas in the EU. Although not known to what degree, these particularly high values certainly may have been reflecting on the general health of the Tuzla town population.

University Clinic Center - Gradina

The Gradina Medical Centre (Gradina Complex) is located at the eastern section of Tuzla town, on a slightly elevated hill between the Solina and Brcanska Malta neighborhoods.

There are numerous block buildings and individual residential houses in the surrounding of the Gradina Complex. The closest watercourse is the Solina stream, a tributary of the Jala River, which is at a distance of some 100 m eastwards from the Complex. No information on the Solina stream water quality has been indentified.

Air Emissions

1-day measurements of pollutant emissions from Gradina Complex heating system measured by Institute of Protection, Ecology and Education Tuzla in April 2008 (ambient temperature was 14°C, i.e. in less representative conditions),

- the concentrations of SO2 were approx. 12-23 times higher (approx. 650-1230 mg/m3),
- concentrations of NOX approx. 3-4 times higher (approx. 51-93 mg/m3),
- the PM concentrations were approx. 6-7 times lower (approx. 11-12 mg/m3) at somewhat higher exhaust gases flow (25,326 – 26,843 m3/h).

Assuming that exhaust gases from each boiler during the entire year on average contain 15 mg/m3 NOX, 700 mg/m3 SO2, 50 mg/m3 and PM total 40 mg/m3, at an average exhaust gases flow rate of 23,000 m3/h51, the average annual emissions from the heating system would be:

Around 174 t/y SO2
Around 12.5 t/y NOX
Around 9.9 t/y PMtotal

Slag and ash

- *Gradina Complex* generates approximately 1,300 m3 slag and ash per year.
- Slag and part of ash are collected under the bottom grilles of boilers, while fly ash is caught in the exhaust cyclone
- Reported coal consumption of 3,650 t/y, and the average content of incombustibles in the given coal of 26%55 mass. - the annual quantity of slag and ash generated would be 1,651 t/y or 1,719 m3/y assuming the specific gravity of slag/ash mix of 960 kg/m3
- This figure may be somewhat higher depending on burning efficiency, due to the fact that the mass of slag can contain particles of incompletely burned coal dropping through the grilles
- Assumption that between 1,300 and 1,500 m3 or 1,240 – 1,440 tonnes of slag and ash are actually collected and disposed of on an annual basis.

The collected slag and ashes are temporarily disposed of on a paved surface at the southern rim of the Gradina Complex , and from there on transported by an external contractor for further end disposal or use in civil engineering activities. However, pollutants contained in the mass of slag and ashes can be occasionally transported to unprotected soil during heavy precipitation.

Design of selected new heating systems

- MC (Gradina Complex) connection to district heating network
- The connection pipeline will have a length of 271 m in total. Insulated, corrosion protected steel/Cr/Ni and hard polyethylene pipes will be installed in ditches
- The metal pipes will be wrapped in protective polyethylene foil. Insulation materials will include polyurethane foam, bitumen and fabricated stone wool.
- Prior to their placement on pipes, external pipe surfaces will be covered with an additional protective high temperature paint layer. Ready made heat transfer station, as well as pumps will also be installed.

Based on this, coal burning for heating needs will be eliminated, however, the coal fired boilers will continue to operate at a reduced capacity for the needs of sterilization steam and hot sanitary water production until further alternatives are introduced. From environmental point of view, coal burning should ultimately be completely phased out.

Expected reduction of pollutant emissions and impacts through changes in heating system

By connecting the MC to district heating system, at least two thirds (67%) of the current coal consumption or 4,254.5 t/y will be phased out, whereas a maximum of 2,990.5 t/y coal would on average stay in use for the needs of steam and hot sanitary water provision until additional alternatives are introduced for complete coal consumption phase out.

Based on the latest heat demand estimates and taking into account the planned improved pipelines insulation, the remaining coal consumption for steam and hot sanitary water will be even lower.

Therefore, after this initial investment, equivalent reduction of at least 67% can also be expected in terms of air pollutants emission and slag generation, i.e.:

- at least 114.8 t/y less SO2
- at least 8.4 t/y less NOX
- at least 6.6 t/y less PMtotal
- at least 830.8 t/y less slag and ash (collected)

CONCLUSIONS AND RECOMMENDATIONS

Expected overall project related reduction of environmental impacts

Air quality in Tuzla area is severely affected by excessive air pollutant emissions. As a result of the initial investment related to connection of MC to district heating system for the needs of MC heating, at least **67% reduction in coal consumption** is expected to be achieved, with equivalent reduction in emissions of air pollutants and slag generation. The decrease in air emissions is expected to significantly contribute to improvement in air quality within Tuzla town.

Recommendations for follow-up

Following the above described recommendations, it is necessary to initiate activities to provide a framework for increasing energy efficiency within the hospitals` operation. For this reason, EIS recommends specific activities that should be implemented in the initial phase of system development. The recommendations refer to development of feasibility studies which are to determine the suitability of the technology in terms of its technical, economic and environmental performance. Three main activities should be initiated:

- Conduct a feasibility study of implementing energy efficiency measures
- Conduct a feasibility study of introducing renewable energy sources
- Develop and adopt internal procedures on energy management

Environmental monitoring concept

For the given air pollution source addressed by the Project (Gradina Complex heating system), considering the topography, likely prevailing wind directions, and the possible distribution patterns, the following monitoring programme is recommended:

Site	**Gradina Complex**	**Reference Values (µg/m3)59**
Monitoring points	8 points: at 50 and 100 m to N, S, E and W from Gradina Complex	SO2 : 20 NO2 : 40 PM2.5: 25 PM10: 40
Pollutants monitored	SO2, NO2, PM2.5 and PM10	
Sampling period	All pollutants: 24 h	
Frequency	1x/ year: Baseline measurements during winter 2008/2009 + Following 2 years at identical monitoring points	

- Having in mind that one mobile air quality monitoring station is already in use on the territory of Tuzla, it is recommended to approach the Tuzla Canton Ministry of Spatial Planning and Environmental Protection as the equipment owner and agree on arrangements for the proposed measurements. The Ministry staff in charge of operating and maintaining the monitoring stations (1 engineer and 1 technician) should be contracted to conduct the monitoring for the needs of MC. Having in mind that the available particulate matter analyzer is currently used only for PM2.5 monitoring, supplemental sampling head or filter allowing for PM10 measurements should be procured.

Tuzla Hot Spot – expected results

- Central heating system of the Town can satisfy needs of Clinical center during heating season (Oct. – Apr.);
- Efficient utilization of existing resources;
- Reduction of air pollution as direct benefit to environment and people;
- Elimination/significant reduction of problems caused in process of transportation, ash disposal, storage;
- Improvement of communal infrastructure
- Contribution to overall picture of Clinical centre and Town (certification process)

Thank you!