



ENERGOPROJEKT – ENTEL
BEOGRAD, Bulevar Mihaila Pupina 12
Serbia and Montenegro



SERBIA ENERGY EFFICIENCY PROJECT

ENVIRONMENTAL IMPACT ASSESSMENT FOR CONVERSION AND IMPROVEMENTS OF THE ENERGY SUPPLY SYSTEM IN CLINICAL CENTRE OF SERBIA

Final Report



Belgrade, September 2003

ENVIRONMENTAL IMPACT ASSESSMENT FOR CONVERSION AND IMPROVEMENTS OF THE ENERGY SUPPLY SYSTEM IN THE CLINICAL CENTRE OF SERBIA

CONTENTS

Executive Summary

- 1. Introduction and Background**
- 2. Site Description with Regard to the Environmental Impacts of the Existing Energy Supply System**
- 3. Review of Policy, Legal and Institutional Aspects**
 - 3.1. Applicable Air Quality and Noise Regulations
 - 3.2. Environmental Assessment Requirements
 - 3.3. Permitting Requirements
 - 3.4. Environmental and Safety Regulations for the Gas Pipeline
- 4. Identification of Potential Impacts during Construction and Operation of the Energy Supply Facilities**
 - 4.1. Main Features of the Proposed Development Project
 - 4.2. Environmental Impacts Review
- 5. Mitigation Measures during Design, Construction and Operation**
- 6. Monitoring Plan**
- 7. Institutional Responsibilities for EMP Implementation and Capacity Building Needs**
- 8. Costs of Proposed Mitigation and Monitoring Measures**
- 9. Record of Public Consultations**

Annex

Environmental Management Plan

EXECUTIVE SUMMARY

The purpose of this report is to present an integral discussion of all significant environmental issues of the project of reconstruction and improvements of the energy supply system (ESS) of the Clinical Centre of Serbia (CCS). As this project comprises an improvement of the present situation from the technical point of view, it is also important to verify its implementation from the environmental protection point of view. For that purpose, this report includes the evaluation of the environmental issues of the existing system and their comparison with the proposed solution of its improvement. It also includes the main objectives of the Environmental Management Plan (EMP) to be implemented during the project implementation and during the operation of the system.

The CCS is situated in the central zone of the capital city of Belgrade and consists of 76 buildings with the total surface of about 390.000 m². Facilities within the CCS have been developed starting from early decades of the 20th century. Consequently, the energy supply facilities have been built in that period, according to the rising needs of the CCS. Today, the energy supply system consists of 19 heat only boiler plants of which 10 are fired by coal, 5 by heavy fuel oil and 4 by light fuel oil. The total installed capacity of the boiler plants is 77 MWt and its annual fuel consumption is about 11500 tons of heavy fuel oil, 650 tons of light fuel oil and 6850 tons of coal.

Environmental impacts of such a system are substantial in the CCS area as well as in its surroundings. These impacts are the result of a large quantity of gaseous pollutants and particulate emissions into the air, generated in the process of fuel combustion, such as: 778 t/year of SO₂, 99.2 t/year of NO_x, 130 t/year of ash particles and 25 x 10⁶ m³/year of CO₂. The necessary improvements of the existing boiler plants are therefore aimed at reducing these emissions poor technical condition and accordingly to replace an insufficient, ineffective, unreliable and uneconomical way of energy supply for the CCS facilities and services. Of particular concern

The selected solution of the improvement of the ESS is the result of the comprehensive analyses carried out within the Feasibility Study aimed to select the least cost among the five alternatives of refurbishment and/or replacement of the existing boiler plants. This solution is based on the replacement of the present fuel supply by natural gas supply with closure of all the existing boiler plants and construction of a new central boiler plant including a combined heat and electricity generating (CHP) facility.

Following the proposed technical solution of the selected alternative, this EIA report includes the following main items:

- site survey and environmental impacts of the existing energy supply system ,
- review of the requirements in domain of the environmental protection according to the current regulation in Serbia and/or EU and/or WB,
- identification of potential impacts during construction and operation of the developed energy supply system,
- environmental management plan which includes: (i) mitigation measures during design, construction and operation, (ii) monitoring plan, (iii) institutional responsibilities for EMP implementation and capacity building needs, (iv) consultation with local NGOs and the project-affected groups

Respecting the results of the analyses carried out, the selected option has a number of advantages as compared to the existing one:

- replacement of coal and oil by the environmentally friendly natural gas reduces the emission of pollutants into the air,

- the closure of individual boiler plants would practically cancel emission of ash particles and would greatly reduce pollution by sulphur dioxide (from present 778 t/year to 21,2 t/year),
- emissions of nitrogen oxides would be reduced from present 99 t/year to max. 41 t/year,
- pollution problems involved by coal delivery and ash removal from the CCS area are not present exist any more,
- in a centralized plant it is more easy to optimize the firing control functions in order to maximize the fuel conversion efficiency and to minimize the production of undesirable pollutants,
- although the capacity of the new centralized plant is not significant source of CO₂ from the global heating problem point of view, it should be noted that the overall reduction of CO₂ emission from CCS will be quite significant, from the existing emission of about 25x10⁶ m³/year to approximately 14x10⁶ m³/year only,
- one central source of pollution has smaller total impact than many low intensity sources scattered throughout the CCS area, mainly due to higher stack and more favorable pollutant transport parameters, but as well as because of reduction in total fuel consumption,
- introduction of the mitigation measures for pollutant emission reduction according to relevant requirements of the current regulations additionally reduces the resultant impacts,
- conversion to gas fuel reduces the noise due to absence of coal transportation and ash removal, and minor liquid fuel transportation.

In addition, the combined production of heat and electricity maximize the fuel utilization and thus improves the overall economy as it minimizes the fuel consumption, with consequent reduction in the overall emissions to the environment.

1. INTRODUCTION AND BACKGROUND

The Clinical Center of Serbia (CCS) is the country's major, the largest and the best equipped medical institution. It is situated in the capital city of Belgrade and includes a complex of medical health care, education and administration buildings and technical support facilities, arranged in 76 buildings at the area of about 38 ha. The CCS complex is presented on the Figure 1. The existing buildings include hospitals, specialist clinics, medical high school facilities and research institutes, as well as administration, service and storage buildings, all with their specific environmental sensibility and protection requirements.

The CCS is presently facing serious problems with respect to energy supply facilities. While the majority of the public or private heat consumers in the city of Belgrade are connected to the city district heating system, operated by the municipal public company Beogradske Elektrane (BE) using mainly natural gas as fuel, the CCS is operating its own heat sources fired by heavy fuel oil (mazout), light fuel oil and coal. The energy supply systems (ESS) within CCS consists of heat supply from 19 separate boiler plants including total 72 boiler units with a variety of unit sizes.

Out of total 19 boiler plants 10 are coal fired, 5 heavy fuel oil and the rest 4 using light fuel oil. The total installed capacity of the boiler plants is about 77 MWt, and their annual consumption is 11500 tons of heavy fuel oil, 650 tons of light fuel oil and 6850 tons of coal, for which storage facilities are also provided. The major problems of the ESS are low efficiency, costly operation and maintenance, low reliability of supply and high level of environmental pollution.

Energoprojekt Entel, the local consulting engineers company with their headquarters in Belgrade, has been employed to evaluate and select the least cost alternative for the necessary improvements of the energy supply system in the CCS. The Feasibility Study has compared in details five alternatives of refurbishment of the existing boiler plants, and/or their replacement either by several new decentralized boiler plants fired by natural gas or by one central gas fired boiler plant, or by connection of the CCS consumers to the district heating network operated by the local district heating company.

The Feasibility Study has evaluated in details and compared these alternative solutions and as a result it recommended the closure of the existing boiler plants and construction of a new gas fired central boiler plant including a combined heat and electricity generating (CHP) facility. These results were presented to the local and the World Bank representatives and the recommended option was selected for implementation.

The selected option, with production of heat and electricity in a central boiler and CHP plant fired with natural gas, has a number of advantages relative to the present use of decentralized heating at individual consumer locations. First of all, combustion conditions and control functions can be optimized more easily in the large central plant to maximize fuel conversion efficiency and minimize the production of undesirable pollutants. Besides replacement of coal and oil by the environmentally friendly natural gas, a very important factor is that the present sources of pollution would be no longer scattered throughout the CCS.

The existing four-pipe heat distribution network within the CCS is suggested to be replaced by the new two-pipe (alternatively four-pipe) network, using mainly the existing channels. For a number of economic and technical reasons, the new plant is suggested to be constructed at the site of an existing boiler plant. This site is close to the major heat consumers in the CCS (at point A on figure 1), and makes it possible to continue to use the existing infrastructure (oil tanks for stand-by fueling, etc.). The preferred site location at point A is therefore considered as the reference site for the new boiler and CHP plants in all further analyses to be carried out.

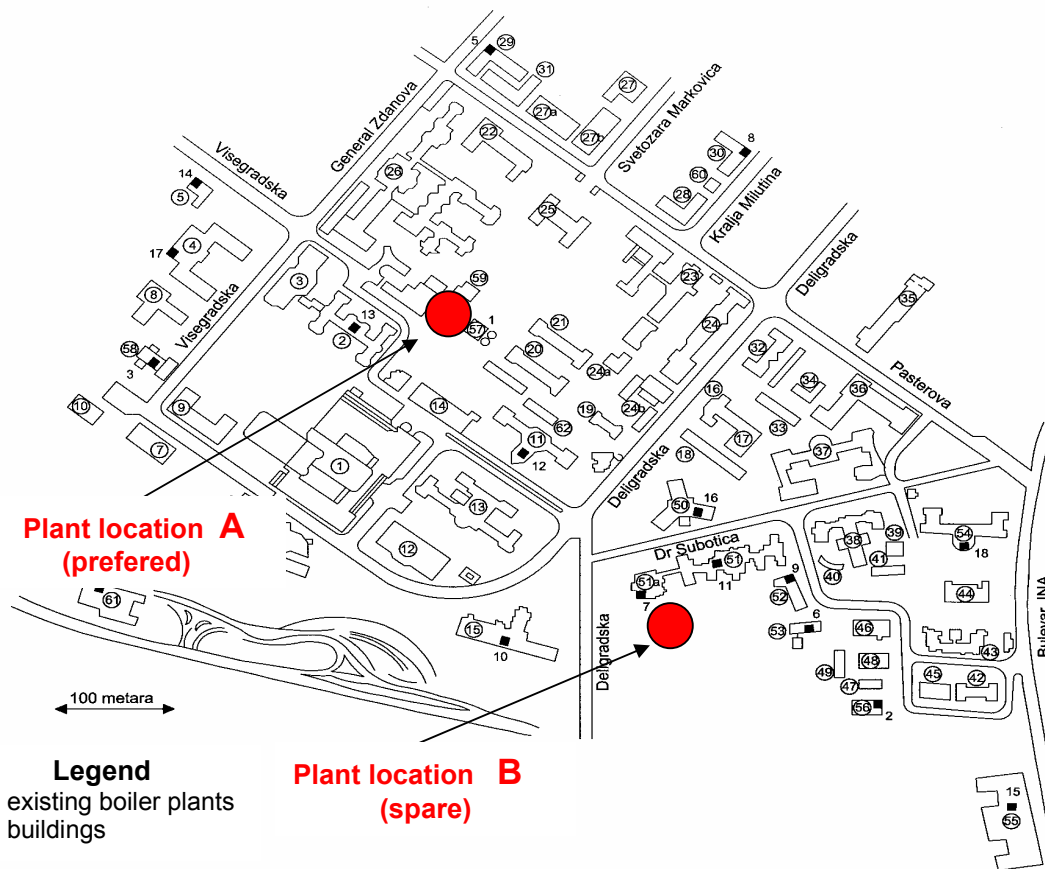


Figure 1 The layout of the CCS facilities showing location(s) of the new plant

Should for any reason other than those taken into account when selecting the suggested site location A for the new boiler and CHP plants be questioned during further development and implementation of the project, another spare site location at the edge of the CCS area (at point B on figure 1) was indicated. Obviously, if construction of the plant would be required there, all necessary adjustment of the new infrastructure would have to be made accordingly.

Although with a much larger installed capacity than the existing boiler plant at the selected site A, the overall local environmental impact is expected to be greatly reduced by the use of natural gas as the main fuel. This fact is discussed in detail in the present report, taking into account other environmental issues of the selected alternative. As the new gas pipeline may also be of concern in this respect, its environmental and safety impacts are discussed as well. Other relevant issues (right of way, land use and ownership) have also been considered when selecting the proposed route of the gas pipeline, and no obstacles have been indicated so far.

2. SITE DESCRIPTION WITH REGARD TO THE ENVIRONMENTAL IMPACTS OF THE EXISTING ENERGY SUPPLY SYSTEM

The CCS is situated in the central zone of the city, surrounded by the streets Visegradska and Resavska from the northwest, Pasterova from the northeast, Boulevard JA from the east and highway E75 from the south, covering the area of about 38 ha. This area is situated within the densely populated urban and administrative zone of the city. The other side of the highway is partly industrial zone, with smaller population density. Besides CCS facilities, the main sources of environmental pollution in this part of the city are individual heating sources, traffic and present industry facilities. This region of the city is presented on the Figure 2.

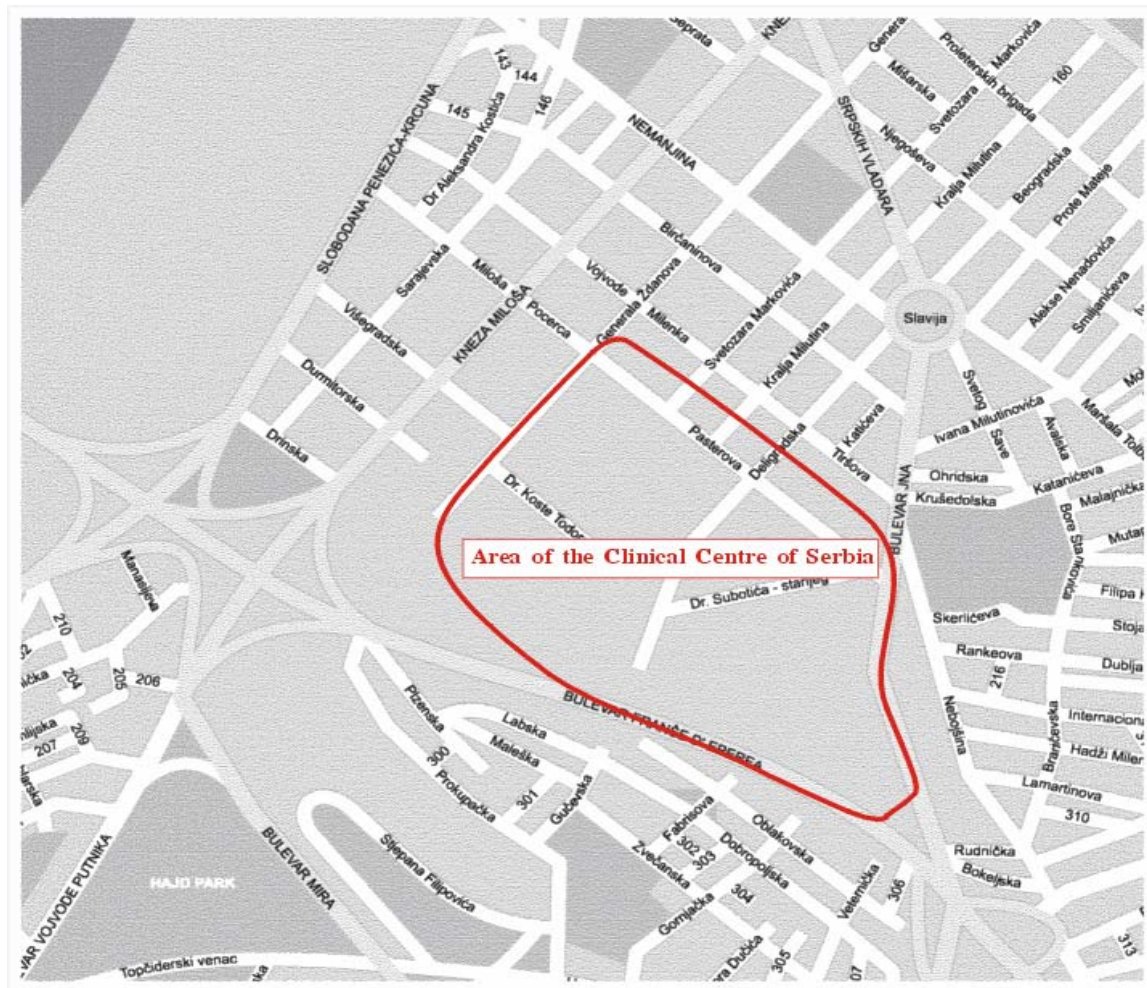


Fig.2. Layout of the CCS in the city of Belgrade

The existing energy supply is characterized by the phased construction of the heat sources following construction of the buildings of the CCS so that the energy demands were solved from individual energy sources. Nevertheless, three major local heating power plants (TEC-1, TEC-2 and VMA) fired by heavy fuel and sixteen smaller individual boiler plants (ten fired by coal and six fired by light fuel oil). Today, the CCS has 19 boiler plants, whose main characteristics are presented in the Table 1 below.

Table 1: Characteristics of the Existing Boiler Plants

Boiler Plant	Installed capacity, kW	No. of Boiler Plants/ no. of boiler units	Type of Fuel	Fuel Consumption
TEC-1	16500	1 / 3	heavy fuel oil	<ul style="list-style-type: none"> • heavy fuel oil 11500 t/year • coal 6850 t/year • light oil 645 t/year
TEC-2	18000	1 / 3	heavy fuel oil	
VMA	16800	1 / 3	heavy fuel oil	
Coal-fired plants	12500	10 / 51	coal	
Oil fired plants	10020	6 / 12	heavy&light oil	
Total	73820	19 / 72		

On the basis of the values shown above it may be concluded that the three major boiler plants cover about 70% of the total installed capacity of all 19 sources. On the other hand, the average utilization degree of these boiler plants is 0.6, while for individual boiler plants it is as high as 0.9 on the average. Depending on the actual requirements, the heat demands are also different, with specific requirements concerning the following:

- Different periods of heating during the day (8 hours, 15 hours, or 24 hours),
- Different demands as regard intensity of heating (inside temperatures 20 – 27°C),
- Meeting the sanitary hot water demands,
- Meeting the process steam demands.

The existing boiler plants are 10 to 30 years old, with out-dated control and deteriorated operating performances, characterized by a very low overall efficiency. Moreover, burning coal and fuel oil within the central zone of the city of Belgrade, the existing boiler plants are very severe sources of the air pollution, the more so as the nearest and directly endangered is just the most sensitive population inside the CCS.

From the environmental impact point of view the existing way of heat supply has many negative consequences for the following reasons:

- the existence of numerous energy sources with low efficiency has considerably higher fuel consumption that results in higher pollutant generation,
- existing mitigation measures for pollutant emissions are very poor as the result of boiler plant age,
- as each of the existing plants has its own stack, the dominant impact of the existing plant are on the local air and soil quality,
- although individual boiler plants are low-intensity pollutant sources, their unfavorable emission parameters results in the highest levels of air pollution in their close vicinity, i.e. in the CCS area,
- inadequate storage of coal and ash removal produces additional dust at the CCS area
- all waste waters are discharged into the city drainage network without any treatment.

The following discussion will present the existing levels of pollution as the result of ESS operation on the basis of major pollutant emissions.

Combustion of fuels used in each of the ESS boiler plant results in considerable emission of sulphur and nitrogen oxides and ash particles, as well as soot (as the product of incomplete combustion). The total annual emission of pollutants into the air, based to the amount of the burnt fuel and its quality, Table 2a, is given in the Table 2b.

Table 2a Chemical composition of the burnt fuel

Fuel/ Component	C	H	O	N	S	A	W
	%						
Coal	46.65	3.55	11.10	0.89	0.72	15.54	22.55
Light fuel oil	86.03	13.34	0.055	0.49	0.015	0.02	0.05
Heavy fuel oil	83.4	10	0.1	0.3	2.9	0.3	3

Table 2b.Total emissions from the existing boiler plants, t/year

Fuel	Sulphur dioxide	Nitrogen oxides**	Ash
Coal	92*	14,2	95
Light fuel oil	19	4,5	0,1
Heavy fuel oil	667	80,5	34,5
Total	778	99,2	129,6

* Sulphur emission coefficient is 0,9

** Emission factors for nitrogen oxides are taken from the Emission Inventory Techniques, UN Economic Commission. for Europe, Document no. EB.AIR/GE.1/R.38, dated June 1988

As the current regulation limits the values of the pollutant concentrations at the stack exit, these values, relative to local and EU emission limits, are shown on the Fig. 3. It have to be noted that, in the lack of emission monitoring results, the presented values are estimated on the basis of flue gas calculations. In relation to regulated emission values it can be concluded that: (i) of the ash particle emissions exceed the permitted value in the greatest extent, even up to 20 times, (ii) sulphur-dioxide emissions exceed the limit value in case of burning fuel oil, (iii) while the emissions of nitrogen oxides can be considered as satisfactory.

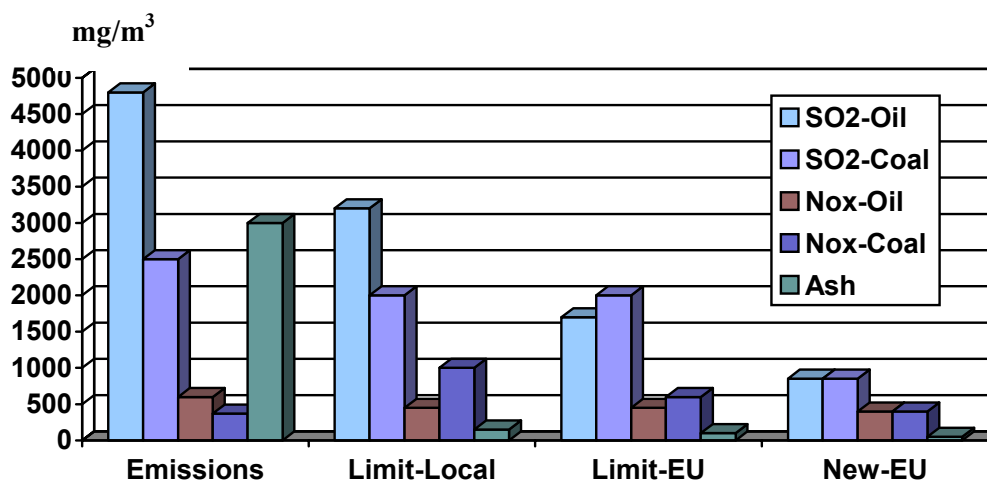


Figure 3 Present emissions relative to the local and EU emission limits

On the basis of indicated harmful impacts, it may be concluded that the area of the CCS is exposed to significant levels of air pollution, resulting primarily from ash particles and sulphur oxides emitted from the stacks of the existing boiler plants. Regarding their emission characteristics that defines their further transport in the atmosphere (flue gas flow, temperature and exit velocity, stack height), the major portion of the pollutants is deposited within the CCS area, particularly ash particles. This situation is rather unsatisfactory, especially in view of a great number of patients on medical treatment in the buildings of CCS in the immediate vicinity of these boiler plants (Institute of Cardiovascular Diseases, Institute of Hematology, Institute of Pulmonary Diseases, Clinic of Internal Medicine A).

Regarding the coal use, its transportation and storage also contribute considerably to the overall pollution, bearing in mind that its combustion generates also the total quantity of about 270 t of ash per year (part of which is emitted with flue gases through the stack), that have to be temporary stored and than removed from the CCS area. Some details that show the present situation are given on the figure 4.



Figure 4 Substation (left) and coal stock (right) as seen during the site visit

Another way to qualitatively assess the influence of the existing boiler plants operation on the air quality in this part of the city is to analyze the results of the air pollution levels measurements at the monitoring point in the Dr Subotica street (located near the building No. 39 shown on fig.1), as the part of the overall air quality monitoring program carried out in the city of Belgrade. At this point the main pollutants in the air, e.g. sulphur dioxide, soot, and total sedimentation are continuously monitored. Table 3 shows the summary results of these measurements, on the basis of mean-daily values during the winter in the last three years.

Table 3 Air quality in winter period at a measuring point in the Dr Subotica* street

Year	2000	2001	2002
Sulphur dioxide, $\mu\text{g}/\text{m}^3$	50	41	39
Soot, $\mu\text{g}/\text{m}^3$	26	29	23
Total sedimentation, $\text{mg}/\text{m}^2\text{day}$	330	417	364

* Source: Annual and monthly reports of the City Institute of Public Health, Laboratory for human ecology

The presented values indicate a high level of pollution with particles and sulphur dioxide, which are close to or above the maximal permissible annual average level (which is $50 \mu\text{g}/\text{m}^3$ as stated in Table 5), while the level of soot contamination is within tolerable limits (which is also $50 \mu\text{g}/\text{m}^3$). Related to the results obtained for the other monitoring measuring points all over the city, as shown in Table 4, it can be seen that the levels of sulphur dioxide concentrations in SCC area is convincingly highest in winter period, while in summer period these values are mainly uniform. This indicates the existence of seasonal sources of pollution in this area, which certainly include boiler plants within the CCS (especially those fired by coal, which are mainly located in the vicinity of this measuring point).

Table 4 Annual Report on Air Quality in Belgrade for the Year 2002*

Measuring point	Soot, $\mu\text{g}/\text{m}^3$			SO ₂ , $\mu\text{g}/\text{m}^3$			NOx, $\mu\text{g}/\text{m}^3$			Total sedimentation, $\text{mg}/\text{m}^2\text{day}$		
	annu.	wint.	summ.	annu.	wint.	summ.	annu.	wint.	summ.	annu.	wint.	summ.
29. novembra	57.4	77.5	36.9	10.3	15.7	4.7	35.8	37.6	33.9	235.2	354.8	56.7
Svetog Save	26.9	34.7	18.7	11.1	16.6	4.2	36.1	41.2	31.1	210.8	383.6	115.5
Milosa Pocerca	51.3	61.7	40.8	13.0	20.3	7.0	45.0	48.1	41.9	313.2	491.8	102.0
Goce Delceva	28.8	37.0	20.1	7.1	9.1	4.9	31.7	30.8	32.4	306.6	450.2	185.8
Omladinskih brigada	#	#	#	#	#	#	#	#	#	146.4	493.6	139.4
D.Z. Obrenovac	22.4	25.1	19.7	7.3	8.3	6.3	25.7	25.7	25.7	333.0	381.6	285.0
Dr. Subotica	14.6	23.1	6.2	21.9	39.4	4.3	#	#	#	221.0	364.4	77.0
Mate Vidakovica	25.0	31.4	19.0	8.5	12.8	4.5	12.1	13.1	11.3	149.4	226.2	72.6
Kraljice Jelene	22.5	30.0	15.0	7.7	9.7	5.6	17.0	20.6	13.6	186.3	223.9	148.6
Trg JNA Zemun	38.6	51.8	25.1	9.8	14.0	5.5	33.0	32.0	34.0	223.5	315.9	131.1
Blok G. Andrijanovica	15.2	19.8	10.6	6.1	8.2	3.8	14.9	18.1	11.6	224.9	351.0	98.8
Pozeska	35.4	39.4	31.0	12.3	12.4	11.2	26.0	13.8	31.9	142.3	18.6	95.0
Ljutice Bogdana	12.7	16.2	9.4	6.5	8.6	4.6	#	#	#	149.6	218.6	80.6
Ustanicka	33.3	47.8	19.8	7.1	9.8	4.6	#	#	#	#	#	#
Olge Jovanovic	12.8	15.5	10.1	6.3	8.5	4.2	#	#	#	232.1	334.4	129.8
Obilicev venac	#	#	#	#	#	#	38.9	38.7	39.1	#	#	#

Source: Annual report of the City Institute of Public Health, Laboratory for human ecology

As evident from the 2001 Statistical Yearbook of Yugoslavia, the area close to the CCS in the city of Belgrade appears to be among the most heavily polluted in Serbia and Montenegro as a whole. Table 5 presents recent measurement of air pollution by SO₂ and particulate matters at the official measuring points, from which it is evident that the country highest values are recorded at the "Vracar" point, situated in the central zone of the city, very close to the CCS, which evidently has important contribution to the overall pollution level. The mean-daily values registered there for SO₂ were the maximum $522 \mu\text{g}/\text{m}^3$ (on Dec. the 14th), and mean $79 \mu\text{g}/\text{m}^3$, while these for soot were $1575 \mu\text{g}/\text{m}^3$ (on Dec. the 30th), and $69 \mu\text{g}/\text{m}^3$, respectively. It would therefore be beneficial for the capital city of Belgrade with respect to the overall air pollution to

make the improvement of the existing boiler plants within the CCS in terms of the conversion of fuel and centralization of the sources.

Table 5 Air Quality Measurements in Serbia and Montenegro, 1998³⁾

1.17. КВАЛИТЕТ ВАЗДУХА, 1998. ³⁾							AIR QUALITY, 1998 ³⁾					
Станица ¹⁾ Station ¹⁾	Сумпор-диоксид $\mu\text{g}/\text{m}^3/24$ часа Sulphur dioxide $\mu\text{g}/\text{m}^3/24$ hours						Честице дима $\mu\text{g}/\text{m}^3/24$ часа Particulate matter $\mu\text{g}/\text{m}^3/24$ hours					
	M	datum date	\varnothing	m	datum date	uzorci ²⁾ samples ²⁾	M	datum date	\varnothing	m	datum date	uzorci ²⁾ samples ²⁾
Бар I - □ Београд-Врачар Београд - Кошут- њак Беране-□	522** 278**	14.XII 28.XII	79* 35	3 6	21.IX 16.II	348 353	1575 258	30. XII 30.XII	69* 21	3 2	29.VIII 7.IX	352 354
Ђаљево З. Градиште Зрање Кабљак Златибор	274** 154** 143 26 88	7.XII 21.XII 12.XII 5.II 22.XI	34 24 25 7 17	3 3 3 5 3	4.III 14.I 4.III 1.I 13.I	346 333 286 359 316	320 84 402 31 31	28.XII 12.II 31.XII 25.II 25.II	47 15 26 8 8	1 1 1 1 1	2.I 18.VI 6.VI 14.I 14.I	347 309 306 320 320
Каменички Вис Колашин-□ Копаноник Котор-Завод за биологију	36 52	6.II 5.IX	10 16	5 3	1.I 15.I	275 359	21	1.VIII	2	1	1.I	363
Краљево Крушевац Лесковац Лозница	51 147 78 139	16.II 13.XII 23.XII 31.XII	20 24 17 31	3 3 3 3	10.I 7.VI 8.I 7.VII	326 351 351 350	201 151 128 248	29.XII 5.I 31.XII 31.XII	29 26 16 35	2 1 1 1	18.IV 14.VI 13.IV 2.II	361 355 357 347
Неготин Никшић Ниш Пећ	. 124 . .	. 29.XII . .	. 29 . .	. 3 . .	. 8.VII . .	251 332 188	87 373 . .	31.XII 29.XII . .	17 32 . .	1 1 . .	29.I 18.IV . .	270 340 173
Пљевља Подгорица Приштина Џеница	22 . 92	22.III . 28.XII	4 . 17	3 . 3	7.IX . 4.IV	200 171 319	41 . 204	14.I . 29.XII	17 . 16	1 . 1	7.VII . 12.IV	200 186 316
Смед.Паланка Ћуприја Џичка Пожега Цетинје	87 54 133	25.XII 18.XI 22.XII	20 20 25	3 3 3	8.III 25.V 13.I	342 307 345	133 119 128	31.XII 30.XII 30.XII	17 21 25	1 2 1	13.IV 21.V 9.III	342 335 325

Извор: Савезни хидрометеоролошки завод.

* - Гранична вредност (за средњу годишњу вредност) за сумпор-диоксид и честице дима за настањена подручја је $50 \mu\text{g}/\text{m}^3$ а за ненастањена и рекреативна подручја је $30 \mu\text{g}/\text{m}^3$.

** - Гранична вредност сумпор-диоксида (за 24-часовни узорак) за настањена подручја је $150 \mu\text{g}/\text{m}^3$ а за ненастањена и рекреативна подручја је $100 \mu\text{g}/\text{m}^3$.

M = Максимална измерена вредност са првим датумом појављивања, \varnothing = средња, m = минимална измерена вредност са првим датумом појављивања.

xx Гранична вредност честица дима (за 24 - часовни узорак) за настањена подручја је $50 \mu\text{g}/\text{m}^3$, а за ненастањена и рекреативна подручја је $40 \mu\text{g}/\text{m}^3$.

□ метеоролошка станица

¹⁾ Списак станица дат на основу Правилника о утврђивању мрежа и програма рада метеоролошких станица од интереса за целу земљу који је објављен у Службеном листу СФРЈ 50/90. У овим станицама је постигнуто 75% мерења у току године.

²⁾ Једнодневни (24-часовни) узорак.

³⁾ Нема довољно мерења у 1999. години, због НАТО агресије.

Source: Federal Hydro-meteorological Institute.

* -Marginal value (for mean annual value) for sulphur dioxide and particulate matter for inhabited areas is $50 \mu\text{g}/\text{m}^3$ and for uninhabited and recreation areas $30 \mu\text{g}/\text{m}^3$.

** - Marginal value of sulphur dioxide (24 hours sample) for inhabited areas is $150 \mu\text{g}/\text{m}^3$ and for uninhabited and recreation areas is $40 \mu\text{g}/\text{m}^3$.

M = Maximal measured value on the first date of occurrence, \varnothing = mean, m = minimal measured value on the first date of occurrence.

xx Marginal value of particulate matter (24 hours sample) for inhabited areas is $50 \mu\text{g}/\text{m}^3$, and for uninhabited and recreation areas $40 \mu\text{g}/\text{m}^3$.

□ meteorological station

¹⁾ List of stations shown on the basis of Regulations on Establishment of the Networks and Programs of Meteorological Stations of country-wide interest published in the "Official journal SFRY" 50/90. In those stations 75% of measurement was completed during the year.

²⁾ One-day (24 hours) sample.

³⁾ Insufficient measurements in 1999 due to NATO aggression.

3. REVIEW OF POLICY, LEGAL AND INSTITUTIONAL ASPECTS

3.1. Environmental Quality Regulations

Environmental protection requirements and criteria for mitigation measures design to be referred are contained in the existing national and international regulations listed below:

- Regulations on ambient air quality, imission measurements methods, criteria for establishing measurement points and data collection (Official Gazette of the RS No. 54/92), defining permissible values of air pollution as in Table 6,
- Regulations on emissions limits, terms and methods of measurements and data evidence(Official Gazette of the RS No. 30/97), defining permissible values of air pollution as in Table 7,
- Directive 2001/80/EC of the European Parliament and of the COUNCIL of 23 October 2001 on the limitations of certain pollutants into the air from large combustion plants, defining permissible values of air pollution as in Table 8
- Regulations on permitted limits of noise level in the environment (Official Gazette of the RS No. 54/92), defining permissible levels of noise as in Table 9.

Table 6 Permissible imission values for inorganic matters

Pollutant	Unit of Measure	Nonresidential and recreational zones				Populated zones			
		Sampling time		x**	C98***	Sampling time		x**	C98***
		24 hrs*	1 hour			24 hrs*	1 hour		
Suphur dioxide	µg/m ³	100	150	30	150	150	350	50	350
Soot	µg/m ³	40	-	30	50	50	150	50	150
Suspended particles	µg/m ³	70	-	40	100	120	-	70	200
Nitrogen dioxide	µg/m ³	70	85	50	85	85	150	60	150
Surface ozone	µg/m ³	65	120	60	120	85	150	80	150
Carbon monoxide	mg/m ²	3	5	3	5	5	10	3	10
Total sediment matter	mg/m ² day	1	month		300	1	month		450
		1	year		100	1	year		200

* 24-hour average

** annual average

*** 98th percentage of all I daily average values measured during the year.

**Table 7. Emission limits for combustion plants up to 50 MW
(Official Gazette of the RS No. 30/97), mg/m³**

Pollutant	Type of fuel		
	Coal	Liquid fuel	Gas fuel
Particulate	150	100	5
Carbon monoxide – CO	250	250	100
Sulphur oxides, expressed as SO ₂	2000	3200	1700
Nitrogen oxides, expressed as NO _x	1000	450	350
Gaseous inorganic fluor compounds, HF	30	5	-
Gaseous inorganic chlorine compounds, CF	200	30	-

**Table 8. Permissible emission values for combustion plants up to 50 MW (thermal)
(EU Directive 2001/80/EC)**

mg/m³

Pollutant	Type of Fuel					
	Solid Fuel		Liquid Fuel		Gas Fuel	
Type of facility	I	II	I	II	I	II
Particulate	100	50	50	50	5	5
Sulphur oxides, expressed as SO ₂	2000	850	1700	850	35	35
Nitrogen oxides, expressed as NO _x	600	400	450	400	300	150

I - Existing facilities and new ones to be put in operation by November 27th, 2003

II - New facilities to be put in operation after November 27th, 2003

The noise level shall conform to the following national standard:

Table 9. Permitted noise levels in the environment, dB(A)

Ambient description		By Day	By Night
Indoors	Apartments with closed windows	40	35
	Hospitals, Clinics, Dispensaries:		
	• Patient rooms	35	30
	• Doctor's office	40	40
Settlement areas	• Operation block	35	35
	Schools, libraries	40	40
	Green areas	50	40
	School neighborhood	50	45
	Residential area	55	45
	Administrative area and along the road	65	55
	Service zone and infrastructure systems	70	60
	Industrial area, without houses	70	70
	Recreational area, outside settlements	45	35

3.2. Environmental Impact Assessment Requirements

The national environmental impact assessment requirements are prescribed by the following federal and republican environmental protection legal acts:

- Framework Law on Environmental Protection (Official Gazette of the FRY, No.19/98)
- Law on Environmental Protection (Official Gazette of the RS No. 66/91), as well as by a set of other laws, such as
- Law on planning and building (Official Gazette of the RS No. 47/03)
- Regulations on the contents and scope of the Preliminary Feasibility Study and Feasibility Study (Official Gazette of the RS No. 39/99).

Particular document that defines the format and scope of the preliminary and final environmental impact assessment reports in force is:

- Regulations on Environmental Impact Assessment of Facilities and Works (Official Gazette of the RS No. 61/92).

According to the World Bank Operational Policy (PO 4.01, OP 4.01 on Environmental Assessment), this project is classified as Category B . Therefore, the scope of EA for this category will examine potential negative and positive environmental impacts of the project and recommend measurements to prevent, minimize, mitigate or compensate expected adverse inputs and improve environmental performance.

3.3. Permitting Requirements

The existing national regulations on physical planning and building shall be applied when issuing site permit, as well as the construction and/or operation permits. The permitting requirements are particularly well defined and governed by the new Law on planning and construction, which is in force from May 13th, 2003 (Official Gazette of the RS, No. 47/03). The following permits will be required:

- Site permit
- Construction permit
- Operation permit

When applying for these permits, specific documentation will be required to support the application. It includes also the energy permit, as the new Energy Law in Serbia, that is expected to be enforced later this year, requires the energy permit to be issued first when an energy facility is to be constructed.

3.4. Environmental and Safety Regulations for the Gas Pipeline

The existing environmental and safety regulations that are governing the construction and operation of gas pipelines both on state and local levels are as listed below:

- Law on Pipeline Transport of Gaseous and Liquid Hydrocarbons (Official Gazette of the FRY No. 29/97),
- Law on transport, Distribution and Use of Natural Gas (Official Gazette of the RS No. 66/91),
- The Rules on Technical Norms for Design, Construction, Operation and Maintenance of Gas Boiler Plants (Official Gazette of the FRY No. No. 10/90),
- Decision on the Conditions and Technical Norms for Design and Construction of City Pipeline Official Gazette of the City of Belgrade No. 14/77)

Besides, the other existing regulations are to be applied such as:

- Regulations on Chemical Accidents Analysis and Management (Official Gazette of the RS No. 32/94).
- The Law on Protection at Works (Official Gazette of the RS No. 42/91 and No. 53/93),
- The Law on Fire Protection (Official Gazette of the RS No. 37/89),

4. IDENTIFICATION OF POTENTIAL IMPACTS DURING CONSTRUCTION AND OPERATION OF THE ENERGY SUPPLY FACILITIES

4.1. Main Features of the Proposed Improvement Project

According to the selected alternative, it has been anticipated the closing of all local and individual boiler plants and the construction of the new centralized boiler plant for the centralized supply of all consumers in the CCS consuming area with the heating power, SHW and the major part of the technological consumers. A minor part of the technological steam consumers in the CCS southeastern part next to the boiler plant Bulevar JA will be supplied from the separate steam boiler plant.

The construction of the new distribution network for hot water, the SHW and technological steam has been anticipated to reach all consumers, with the overall distribution network run length of around 5000 meters. The installation of 55 new substations has also been anticipated in the heating system. Heat distribution network is presented on the Figure 5.

The new central boiler plant is possible to be built on the location of the existing boiler plant in Pasterova Street (where the majority of the existing infrastructure facilities can be utilised, figure 5), or, in turn, on some other location within CCS complex anticipated capacities of the new are hot-water boilers of 3 x 14 MJ/s + 2 x 6 t/h (+ 1 x 14 MJ/s), and beside the central boiler plant, the additional small capacity boiler plant in Bulevar JA Street with the steam capacity of 2 x 2,5 t/h has been anticipated for the needs of the separate steam technological consumers.

This alternative additionally anticipates the installation of one cogenerating facility for the electric power and low-temperature heating power generation. The electric and heating capacity of the cogenerating facility has been selected based on the analyzed principal electric power needs and the annual principal heating power needs. The selected cogenerating facility comprised of the 2 MWe gas motor and the facility for the utilization of the waste heat with the heating power of 2.1 MJ/s, covers the basic part of the electric load diagram, so that in the annual operation of 8000 h it enables 80% placement of the generated electric power for its own needs and only 20% for the external network.

The conversion to the gas firing will be assured by the connection to the city natural gas network by a new common gas pipeline to be constructed from the connecting point located at the existing measuring and control station Kovac to the site of the boiler plant in the CCS, Figure 6. This gas pipeline is expected to serve not only the CCS, but also some other major consumers on the way to the CCS and possibly some after it. This is considered beneficial from the environmental impact point of view, since most of these consumers presently use coal and/or heavy fuel oil, whose replacement by natural gas will make it possible to reduce considerably the overall air pollution from outside sources. This is also of importance for the CCS, because the air pollution from the traffic surrounding its area, particularly from the highway E-75 remains to be dealt with for a long time

The stand-by fuel for the centralized source is heavy fuel oil for which the storage is possible in one or both of the existing reservoirs, Figure 7.

The fuel consumption for the presented ESS solution is summarized in the Table 10 in case with and without construction of co-generation plant.

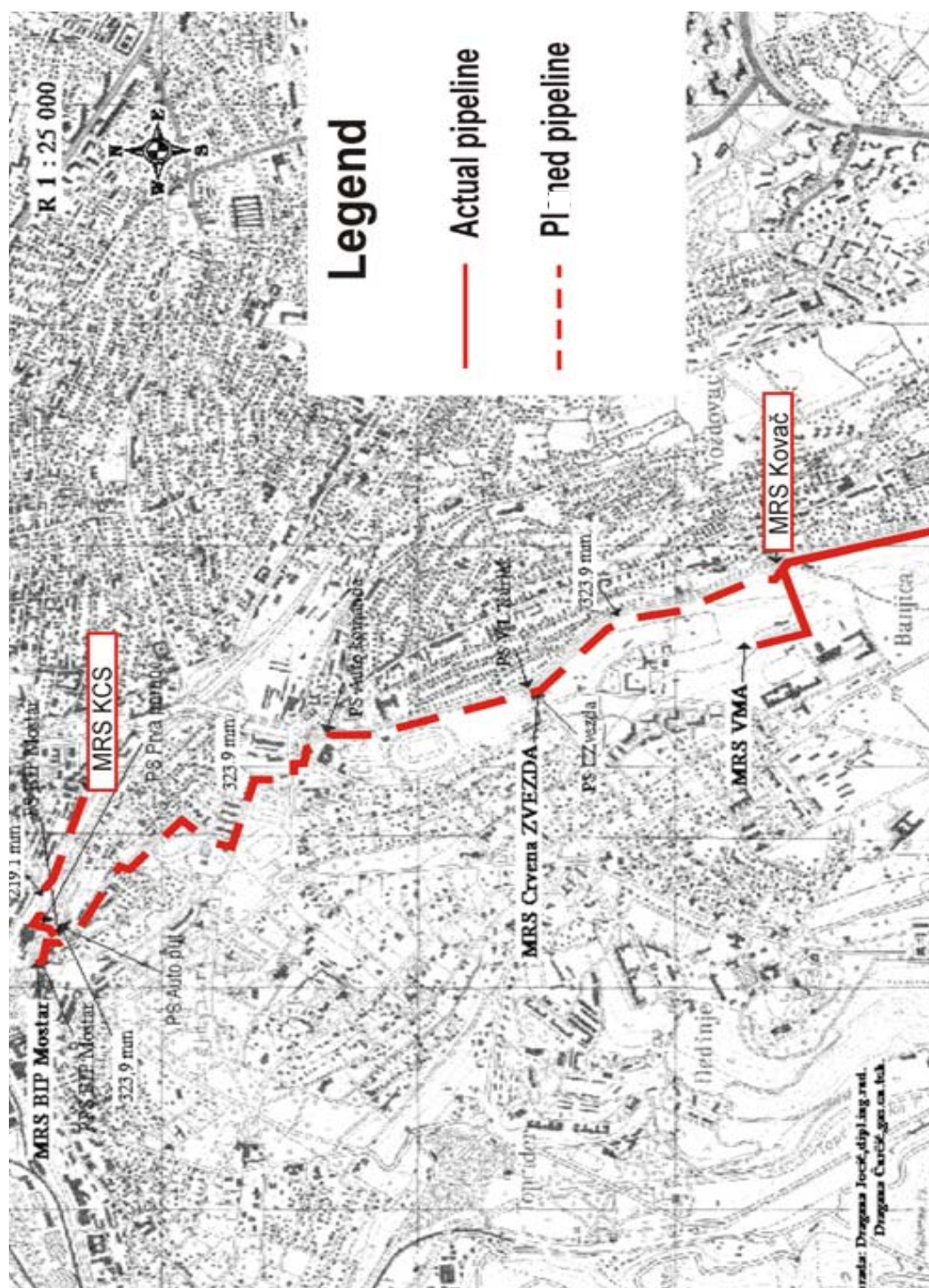


Figure 6 Natural gas pipeline pathway

Table 10. Fuel consumption balances for selected alternative

Alternative	Fuel	Fuel Oil t/year	Natural Gas 10³ m³/year	Electricity MWh/year
Centralised source			10450	
Steam & SHW		530		
Co-generation plant			12400	16000
Steam&SHW		530		



Figure 7 Existing infrastructure for the new centralized boiler plant

According to this ESS concept, its following main subsystems that could have environmental impacts are focused:

- Centralised Boiler and CHP Plant
- Local Oil Fired Steam Plant(s)
- Heat Distribution Network
- Gas Distribution Network

4.2. Environmental Impacts Review

4.2.1 Centralized Boiler and CHP Plant

The main environmental impact of centralised boiler and CHP plant is on air quality. According to fuel consumption given in Table 10, the resulting pollutant emissions are summarised in Table 11. The only serious air pollution component from burning of natural gas is nitrogen oxide (NO_x), for natural gas from Russia (which is mostly imported in Serbia) as well as the gas fuel from our national resources contain minor quantities of sulphur compounds. The chemical composition of the gas fuel is given in Table 12. Installation of low NO_x burners in the plant furnace would additionally reduce this emission, so that the overall effect is reduction of NO_x from present 99,1t/year to 38,5 t/year. With the proper design of the plant stack, the contribution of this emission to the air quality will be very small, especially compared to present situation.

Table 11. Pollutant emissions for selected alternative

Source	Fuel oil		Natural gas
	SO ₂	NO _x *	NO _x *
	t/year	t/year	t/year
Centralised source Steam, SHW	21,2	2,5	32,4
Total	21,2	2,5	32,4
Co-generation plant Steam, SHW	21,2	2,5	38,5
Total	21,2	2,5	38,5

* New boilers are assumed to be supplied with "low NO_x burners" so that NO_x Emissions are 300 mg/m³ for natural gas boilers and 400 mg/m³ for fuel oil boilers

Table 12 Natural Gas Chemical Composition

Component	Unit	Gas fuel	
		Russian	Serbian
methane, CH ₄	%	92.00	90.30
ethane, C ₂ H ₆		3.20	5.80
propane, C ₃ H ₈		0.85	0.20
n-butane, C ₄ H ₁₀		0.20	-
i-butane, C ₄ H ₁₀		0.10	-
pentane, C ₆ H ₁₄		0.05	-
nitrogen, N ₂		3.30	3.00
carbon-dioxide, CO ₂		0.30	0.70
sulphur, S	mg/Nm ³	10	
low heat value	kJ/Nm ³	36023	36250

Besides air pollution, construction and operation of boiler and co-generation plant can also be sources of noise. Bearing in mind that in the close vicinity of the plant(s) location there are noise sensitive receptors, these facilities as well as their auxiliaries must conform to the very

stringent environmental rules relating to the industrial noise abatement. The noise abatement may represent a problem, and that can be handled through standard engineering design methods, including sound insulation in the outer walls of the structure. The blower fans of the boilers, the primary source of noise pollution in heating plants, will be placed within buildings, behind the thick brick or concrete walls accompanied by mineral wool noise suppressers. Designing the plant with minimum openings reduces the noise from pumps. However, it should be noted that the capacity of the co-generation plant is rather small (2 MWe), so that the possible noise problems can be solved satisfactorily.

Some quantities of waste waters will be generated in the process of make-up water preparation: water losses in the heat distribution network are supposed to be very small (or negligible), and the capacity of steam supply is cca. 2 x 6 t/h. Although, neither their quantity nor chemical composition presents serious problem to overall pollution of water streams in Belgrade, some treatment have to be predicted.

Generation of waste waters will not be significant: the main source of waste waters will be chemical water treatment system which supplies the heat distribution network with softened water and the steam generation system with demineralised water. As the losses in this systems are considered to be very small, the need for treated water supplement will also be small. In this stage of the project the water treatment system was not quantitatively determined, so it hard to define the quantity of the waste waters generated. Qualitatively, these waters are chemically polluted and will be treated by neutralization to become pH ≈ neutral. After the treatment, they will be discharged in the city drainage network

Possible impacts coming from storage of stand-by fuel will be discussed in the following chapter.

4.2.2. Local Oil Fired Steam Plant(s)

Small amount of heat used for steam production is generated in local steam boilers by the use of heavy oil. The pollution components of the flue gas from oil fired boilers are:

- Sulphur dioxide and
- Nitrogen oxides
- Particulate (oil coke 90%, soot 1%, fly ash 9%).

The oil-fired plants are of small capacities compared to central heating plant. Following the fuel consumption given in Table 10, the resulting emissions of air pollutants are estimated in Table 11. In this table emission of particulate is considered negligible for the proper burner set-up and introduction of abatement techniques can reduce particulate emissions below 0.5 g/kg .of oil. These techniques include:

- Water-oil emulsion, with 6-7% of water added to form an emulsion in which water drops attain a size less than 5-10 micrometers and are able to collate the particulate
- Additives are added specially to reduce oil coke or/and soot, alternatively, and the oil is homogenized
- All above combined, with additions of anticorrosion chemicals

Although the solid emissions may be reduced, undesirable coatings on the heating surfaces may still be retained. If these could be removed from boilers, fuel saving of 0.5 – 3% may be achieved.

For lowering of the SO₂ emissions, it is required that the sulphur content in oil to be used shall be lower than 1.5%. NO_x appear when nitrogen in the air is oxidised during combustion, and special low-NO_x burners are applied.

Besides its major impact on air quality as a continuous source of gaseous pollutants, the specific location of the plant(s) implies the attention on heavy fuel as a potentially hazardous material, especially in case of its storage. It is envisaged that the fuel oil would be stored in the existing storage capacities near the plant. As shown on the Fig. 7, the existing storage capacities are situated in the metal-lined containers which ensure the proper protection from the leakage of fuel oil outside the storage place.

Fortunately, heavy fuel oil is not classed as a major hazardous material, nor highly flammable. Its combustion takes place when the oil is atomized in an aerosol at elevated temperatures, the conditions that occur within the boiler furnace; it is almost impossible for such conditions to occur by accident. The other characteristics of heavy fuel oil from this point of view are following:

- the maximum pour point (the temperature below which the fuel will not flow) is less than 20°C – the practical effect of high pour point is that in case of spill the oil will tend to change from liquid to near solid consistency under ambient temperatures in Belgrade in most of the year;
- the minimum flash point is usually higher than 100°C – the fuel oil cannot burn unless substantial external heat is applied to raise its temperature above ambient;
- the toxicity category is 1
- the reactivity category is 0
- the ignition category is 2
- the temperature class is 3
- rate of transportation of heavy fuel oil on the soil for which the infiltration coefficient is less than 2×10^{-5} m/s, which is the worst case from the pollution spreading point of view, (this includes sands, loamy sands, sandy loam etc.) is 0.5 cm/day – if so, in case of fuel oil spillage on soil the pollution of its deeper layers would be very slow and can be stopped effectively in time.

Small quantities of waste waters generated during the plant operation that are not seriously polluted can be discharged into the city drainage network.

4.2.3. Heat Distribution Network

Heat distribution network construction activities could lead to localised dust and noise problems. As this network is in the CCS area, these adverse impacts will be limited to the close vicinity of the place of works and can be successfully solved by their proper organisation.

In normal operation, there are no harmful environmental impacts of this pipeline.

As the pipeline is laid down under the ground, partly in concrete channels and partly on the soil, in case of its rupture hot water could leak out into the soil. The consequences of these events will not be serious, for there is no aggressive or toxic materials present in this leakage.

Waste waters from the boiler and CHP plants are managed so as to prevent any leakage to the ground waters.

4.2.4. Gas Pipeline Network

The gas pipeline route presented on figure 6 is selected according to the existing regulations. The small portion of this route from the entrance to the CCS area to the plant site satisfies the same regulatory conditions. It should be noted that the proposed gas pipeline route is not a new one, as the major portion it is in fact a continuation of the already existing route ended at the connecting point and placed along the same traffic corridor (figures 8, 9 and 10). The major part of the pipeline is laid down under the ground.

The possible adverse impacts of the gas pipeline may be expected during the phase of construction and in the phase of operation. In the phase of construction these impacts are temporary and are connected mainly with dust and noise problems, as well as traffic disruptions, since the route of the pipeline is along the main city highway. The construction activities consists mainly of making the pipeline trenches, which are not followed by serious environmental disruptions, and can be successfully solved by proper organisation of the works.

The technical solutions for using natural gas as primary fuel implies construction of high and low pressure gas pipeline from the connecting point to the site of boiler plant as the final consumer. Given the characteristics of natural gas, presented in Table 12. (the main component in gas fuel is methane which makes minimum 90% of natural gas content) pipeline as structure poses a potential risks to environment, primarily related to the possibility of an uncontrolled leakage of the gas from installations.



Figure 8: Starting point of the new gas pipeline



Figure 9: Gas pipeline route along the edge of a public forest



Figure 10 Gas pipeline route parallel to a traffic line

Table 13. gives the characteristics of methane, which is, as the major component of the gas fuel, relevant in evaluation of potential dangers.

Table 13. Physical and chemical characteristics of methane

Characteristic	Value
Chemical formula	CH ₄
Molecular mass	16,04
Density (at 0°C), kg/m ³	0,7166
Flammability limits, % <ul style="list-style-type: none"> • lower • upper 	5 15
Toxicity category	1
Ignition category	4
Reactivity category	0
Temperature class	T ₁
Temperature of self-ignition	537°C

Technical solutions and measures during transportation and stocking are taken according to the existing regulations. Nevertheless, certain uncontrolled leakage of the natural gas from installations is most frequently caused by:

- Improper dimensioning of gas pipeline network and its accessories, as well as design and construction not in compliance with applicable technical regulations and standards,
- Improper selection of equipment, pipes, measuring, regulation and safety armature,
- Poorly executed installation works, pipeline rupture due to damage or breakage, of pipeline or armature due to soil quakes and landslides,
- Leakage on threaded joints due to insufficient sealing,
- Inadequate quality of built in materials for pipes, fittings and armature,
- Failure on gas pressure regulator and/or safety valves,
- Failure on gas devices connected to gas installation,
- Insufficient ventilation of the space in which gas flow meters are located-improper handling and maintenance of gas installation and gas devices, equipment in MRSs, manholes and armature.

In order to minimize the risk from gas installations operation in the process of high and low pressure pipeline design, selection of pipeline alignment and the total construction procedure, proper care has to be taken regarding application of required measures and norms contained in current regulations and standards in this field, and especially in the Law on Pipeline Transport of Gaseous and Liquid Hydrocarbons (Official Gazette of the FRY No. 29/97), Law on transport, Distribution and Use of Natural Gas (Official Gazette of the RS No. 66/91), and the Rules on Technical Norms for Design, Construction, Operation and Maintenance of Gas Boiler Plants (Official Gazette of the FRY No. No. 10/90), Decision on the Conditions and Technical Norms for Design and Construction of City Pipeline Official Gazette of the City of Belgrade No. 14/77).

The following measures are anticipated in order to minimize the hazard probability :

- gas installation parameters have to be defined on the basis of the results of technical calculation in compliance with relevant technical regulations and standard requirements, thus preventing the pipeline rupture due to uncontrolled pressure rise,
- all joints in the installation are to be carried out with required welding and soldering technologies, by certified welders,
- pipes, fittings, armature and other equipment must be made in conformity with applicable standards, properly marked, and must possess appropriate technical documentation and factory test certificates,
- the installation should be tested for strength and impermeability,
- gas network within the structures, where consumers are installed, should be laid down with proper distances from the walls and other installations in accordance with technical regulations and standards in this field, thus ensuring professional and safe installation of pipeline, as well as prompt and easy access in case of any intervention; presence of network should be properly marked,
- gas network cannot be used indirectly or directly as safety or operating grounding, as protective conduit in high voltage electrical installations, nor as conduit or grounding for lightning rods.
- all works on the installation of gas pipeline must be carried out by professionally trained persons for this kind of work as an imperative requirement,
- the operation of gas installations must be carried out by professionally trained persons for this kind of work as an imperative requirement.

For the purpose of gas leakage detection and preventing the occurrence of explosive mixtures, during commissioning of installation and during maintenance inspections of the gas system, the control of gas concentration by a portable gas detector, is envisaged to be carrying out. Gas pressure regulators and gas flow meters as a rule are located in the facilities with appropriate ventilation. All gas devices as a rule are located in the facilities with appropriate inflow of fresh air for combustion and outflow of flue gases, in compliance with applicable technical regulations. The installation may be operated only by persons trained and authorized for this kind of work.

Particular attention is paid to the defining of the pipeline's alignment in the vicinity of building construction structures, railway lines, roads, high vegetation, etc. MRS location is also selected bearing in mind the requirements for its maintenance and operation (closeness of the road, sufficient distance to the residences or other buildings regarding noise levels and gas leakage in handling, etc.). It is important that the built in materials and equipment are of standard quality, having all the necessary quality certificates.

Bearing in mind the specificity and sensitivity of the gas fired source site as well as of the areas through which gas pipeline would pass, in the scope of further design documentation preparation it would be necessary to carry out hazard and risk assessment for the finally selected source location, all in accordance with Regulations on Chemical Accidents Analysis and Management (Official Gazette of the RS No. 32/94). This would contribute to maximal mitigation of the risk to people and material goods situated in the area of its potential impact.

5. MITIGATION MEASURES DURING DESIGN, CONSTRUCTION AND OPERATION

5.1. Mitigation Measures During Design

Mitigation measures during design are described in Annex I, Item A, attached to this Draft Report. It takes account of the following project components:

- Centralized Boiler and CHP Plant
- Local Oil Fired Steam Plant(s)
- Heat Distribution Network
- Gas Distribution Network

Necessary technical specification with respect to mitigation measures will be elaborated as part of technical design to be carried out within future activities

The time schedule will be interrelated with the overall project schedule (Project Implementation Plan).

5.2. Mitigation Measures During Construction

Mitigation measures during construction are described in Annex I, Item A, attached to this Draft Report. It takes account of the following project components:

- Centralized Boiler and CHP Plant
- Local Oil Fired Steam Plant(s)
- Heat Distribution Network
- Gas Distribution Network.

The implementation of planned mitigation measures will be included in the installation and construction contract.

The time schedule will be interrelated with the overall project schedule (Project Implementation Plan).

5.3. Mitigation Measures During Operation

Mitigation measures during operation are described in Annex I, Item A, attached to this Draft Report. It takes account of the following project components:

- Centralized Boiler and CHP Plant
- Local Oil Fired Steam Plant(s)
- Heat Distribution Network
- Gas Distribution Network

Mitigation measures implementation and control during operation will be included in operational and management practices of CCs's engineering staff.

The time schedule will be interrelated with the overall project schedule (Project Implementation Plan).

6. MONITORING PLAN

Monitoring plan is presented in details in Annex I, Item B, which is attached to this Draft Report and forms an integral part of it. It includes the following components:

- Centralized Boiler and CHP Plant
- Local Oil Fired Steam Plant(s)
- Heat Distribution Network
- Gas Distribution Network

The attached Monitoring Plan defines the following:

- What parameter is to be monitored
- Where is parameter to be monitored
- How is parameter to be monitored/ type of equipment
- When is parameter to be monitored/ frequency of measurements
- Why is the parameter to be monitored/optional
- Responsibility to install/operate measuring equipment

The time schedule will be interrelated with the overall project schedule (Project Implementation Plan).

7. INSTITUTIONAL RESPONSIBILITIES FOR EMP IMPLEMENTATION AND CAPACITY BUILDING NEEDS

7.1. Institutional Responsibilities for EMP Implementation

Institutional responsibility for the implementation of the Environmental Monitoring Plan (EMP) is described in Annex I, Item E, which is attached to this Draft Report and forms an integral part of it. Particular elements of the EMP are distributed among parties involved in different stages of project development as follows

- Consultant Services
- Equipment Purchases (including Local or International Purchase)
- Construction and Erection works
- Operation and Maintenance
- Capacity Building and Training, etc.

The time schedule will be interrelated with the overall project schedule (Project Implementation Plan).

Responsibilities for EMP implementation will be ensured by the authorized institutions and related departments within the project operation and maintenance organization and will cover:

- Responsibilities for mitigation and monitoring
- Environmental information flow (reporting—from who and to who and how often)
- Decision making chain of command for environmental management (to take action, to authorize expenditures, to shut down, etc.)

In short, how is all the monitoring data going to be used to maintain sound environmental performance—who collects the data, who analyzes it, who prepares reports, who are the reports sent to and how often, and who does that person send it to, or what does he/she do with the information—who has the authority to spend, shutdown, change operations etc

7.2. Institutional Capacity Building Needs

Institutional capacity building needs are described in Annex I, Item C, which is attached to this Draft Report and forms an integral part of it. Particular elements of the institutional capacity building to carry out EMP in different stages of project development are as listed below:

- Organizational structure and staffing
- Training (Mitigation, Monitoring, Environmental Management, and other types)
- Specialist services

The time schedule will be interrelated with the overall project schedule (Project Implementation Plan).

8. COSTS OF PROPOSED MITIGATION AND MONITORING MEASURES

8.1. Costs of Mitigation Measures

The costs of mitigation measures are within the institutional responsibility of the participants to the project. All investment costs stated in the Feasibility Study were estimated in order to meet the needs of implementation of the proposed improvements of ESS, with the main purpose to make an objective selection of the examined alternatives. Therefore, the costs of mitigation measures were not separately analyzed at this stage of the project as they are considered included in the total construction costs, since their contribution to the total costs does not influence the overall rank of the alternatives, as well as the final choice of the least-cost one. Consequently, the cost schedule is interrelated with the overall project schedule (Project Implementation Plan).

8.2. Costs of Monitoring Measures

The costs of monitoring measures are within the institutional responsibility of the participants to the project. All operation costs stated in the Feasibility Study were estimated in order to make an objective selection of the examined alternatives, and the cost of monitoring measures were not separately analyzed at this stage of the project and they are rather included in the total operating costs, as their contribution to the total amount would not influence the overall rank of the alternatives, as well as the final choice of the least-cost one. The same discussion is valid for the costs of monitoring measures that are included partly in the cost of equipment and partly in the costs of system operation. Consequently, the time schedule is interrelated with the overall project schedule (Project Implementation Plan).

9. RECORD OF PUBLIC CONSULTATIONS

9.1. Public Awareness

The preliminary consultation on the subject has been arranged with the individuals from medical, scientific and technical staff within the CCS concerning their personal views on the project solution, conversion to gas firing and on the plant site location. They appear to be generally in favor of the conversion to the gas firing, particularly so if the coal is to be replaced.

Nevertheless, major consultation with local NGOs and all other project-affected groups was carried out on September 23rd, 2003, as described in detail in annex F to this report. The consultation is believed to have met the main goal to make the NGOs and project affected groups aware of the positive environmental impact of the replacement of the existing fuelling sources (coal and fuel oil) by natural gas, as well as of the safety measures connected with the introduction of natural gas.

9.2. Preliminary Consultations

Preliminary consultations with the individuals from the project affected groups such as medical, scientific and technical staff within the CCS were held continuously during preparation of the Feasibility Study. Particular attention was to their personal views concerning environmental matters of the existing status. They all appear to be generally in favor of the conversion to the gas firing by which the coal and heavy oil are to be replaced as the main fuels. Their views are summarized as follows:

- Medical staff (Dr Ivan Jekic) is greatly in favor as their efforts to help the patients to restore their health will be easier if the air is less polluted, and their working environment free from dust during the heating season.
- Scientific staff (Professor dr Jasmina Oka) is greatly in favor of the new fuel, which practically eliminates the dust, and soot particles that presently cover the area in their laboratories and often spoil the results of their works
- The consultations with the technical staff were conducted concerning their personal views on the technical solution, conversion to gas firing and on the plant site location. The technical staff members (Engineers Music and Urosevic, and local Architect) are well aware of the benefits that bring new equipment and new fuel, both from the operational and environmental aspects. Their concerns are mainly on the plant site location, having in mind an earlier situation, when the local authorities have raised visual impact and protection of historical monuments (some are within the CCS area). From that point of view, they would prefer the site B instead of the site A, explaining their views by the expectations that the procedure to get the permit for the site A will be more difficult for them.

Major consultation with NGOs and other projected groups is presented in the Annex F.

Annex I

ENVIRONMENTAL MANAGEMENT PLAN

- A. Mitigation Plan**
- B. Monitoring Plan**
- C. Institutional Strengthening**
- D. Schedule**
- E. Institutional Arrangements**
- F. Consultation with Local NGOs
and Project-Affected Groups**

A. MITIGATION PLAN

Phase	Issue	Mitigating Measure	Institutional Responsibility	
			Installation	Operation
CB&CHP, fuel oil boiler				
Design	<ul style="list-style-type: none">Gaseous pollutantsNoiseFuel spillage	<p>Furnace design and low S-content fuel oil recommendation</p> <p>Application of the regulation requirements for noise reduction in the choice of the equipment components, sound insulation of the outer walls, placing the equipment within buildings, reduction of openings</p> <p>Application of protected basins for fuel oil reservoirs and concrete channels for fuel oil pipelines</p>		
Construction	<ul style="list-style-type: none">DustNoiseDisposal of solid materials	<p>During the dry periods sprinkle with water</p> <p>Activities will take place during the daytime and shall conform to noise ordinance and regulations. Workers will be provided with ear protection.</p> <p>All solid materials will be removed from the site and disposed at appropriate disposal areas; no hazard materials are present at the site.</p>	Chief of Construction Department	

Operation	<ul style="list-style-type: none"> Emission SO₂&NO_x, Water leakage Fuel leakage Fuel spillage 	<p>Burning of fuel oil with low S content</p> <p>Extended maintenance measures</p> <p>Extended maintenance measures</p> <p>Extended maintenance measures, arrangement of spill prevention points</p>	<p>Chief of Production & Maintenance Department Mr. Milan Music</p>
SUBSTATIONS & PIPELINES			
Design	<ul style="list-style-type: none"> Water leakage 	Proper dimensioning of the pipelines	
Construction	<ul style="list-style-type: none"> Dust Noise Disposal of solid materials 	<p>During the dry periods sprinkle with water</p> <p>Activities will take place during the daytime and shall conform to noise ordinance and regulations. Workers will be provided with ear protection</p> <p>Solid materials will be removed from the site and deposited to authorized dealers for recycle or on the proper disposal area out of the Clinical Centre; no hazard materials are present at the site.</p>	<p>Chief of Construction Department</p> <p>Chief of Construction Department</p>
Maintenance	<ul style="list-style-type: none"> Water leakage 	Extended maintenance measures	<p>Chief of Production & Maintenance Department Mr. Milan Music</p>
GAS PIPELINE			
Design	<ul style="list-style-type: none"> Gas leakage 	Following the requirements of the related regulations in pipeline dimensioning	

Construction	• Dust	During the dry period sprinkle with water	
	• Noise	Activities will take place during the daytime and shall conform to noise ordinance and regulations. Workers will be provided with ear protection	Chief of Construction Department
	▪ Disposal of solid materials	Solid materials will be removed from the site and deposited to authorized dealers for recycle or on the proper disposal area out of the city; no hazard materials are present at the site.	Chief of Construction Department
	■ Gas leakage	All works on the gas supply system are to be carried out with proper technologies by certified welders	Chief of Construction Department
		All equipment must be made according to related standards, properly marked and certified; Gas installations will be tested for strength and impermeability.	Chief of Construction Department Chief of Construction Department
Operation	▪ Gas leakage	Extended maintenance measures performed by professionally trained persons	Chief of Production & Maintenance Department Mr. Milan Music

B. MONITORING PLAN

Phase	What parameter is to be monitored	Where is parameter to be monitored	How is parameter to be monitored/ type of equipment	When is parameter to be monitored/ frequency of measurement?	Why is the parameter to be monitored/ optional?	Responsibility Installation/ Operate
CB & CHP, fuel oil boiler						
Construction	Dust	At the construction area	Visually	Dry periods – Daily basis	To prevent harmful effects to CCS patients	Chief of Construction Department
	Noise	In the CCS area –near the hospital buildings	Noise meters	During the construction activities	To prevent harmful effects to CCS patients	
	Disposal of non-hazardous materials	At the construction area	Visually	During the construction activities	To prevent pollution of the CCS area	
Operation	SO ₂	In the stack	Continuous emission gas monitoring equipment	Continuously	To prevent pollution in the CCS area and its surrounding	Chief of the Technical Production Department
	Noise	In the CCS area –near the hospital buildings	Noise meters	According to local standard (Official gazette 54/92)		
	NOx	In the stack	Continuous emission gas monitoring equipment	Continuously		
	Water& fuel spillage	Fuel and water storage and installations	Visually	Daily basis		

SUBSTATIONS AND PIPELINES						
Construction	Dust	At the construction area	Visually	Dry periods – Daily basis	To prevent harmful effects to the CCS patients	Chief of the Construction Department
	Dust	At the construction area	Visually	Dry periods – Daily basis	To prevent harmful effects to the CCS patients	
	Noise	In the CCS area –near the hospital buildings	Noise meters	During the construction activities	To prevent pollution of the CCS area	
	Disposal of non-hazardous materials	At the construction area	Visually	During the construction activities	To prevent pollution of the CCS area	Chief of Technical Production Department
Operation	Water & fuel spillage	Fuel and water storage and installations	Visually	Daily basis		
GAS PIPELINES						
Construction	Dust	At the construction area	Visually	Dry periods – Daily basis	To prevent harmful effects to CCS staff and patients	Chef of Construction Department
	Dust	At the construction area	Visually	Dry periods – Daily basis	To prevent harmful effects to CCS staff and patients	
	Noise	In the CCS area –near the hospital buildings	Noise meters	During the construction activities	To prevent pollution of the CCS area	
Operation	Disposal of non-hazardous materials	At the construction area	Visually	During the construction activities	To prevent hazardous situations in the CCS area and along the pipeline rout	Chief of Technical Production Department
	Gas leakage	Gas installation in CCS area	Visually – monitoring of gas safety equipment (manometers etc.)	Daily basis		

C. INSTITUTIONAL STRENGTHENING

There already exists a sophisticated institutional background for the implementation of such project. and for its construction and installation as well as for safe operation and maintenance. The same is valid for all mitigation and monitoring activities to be carried out during construction and installation as well as during operation of the energy supply system. Nevertheless, an institutional strengthening should be provided as well.

During the equipment purchases a detailed specification will be performed and adequate knowledge in local or international purchase processes of the key institutions and personnel involved in that process concerning:

- Type of equipment and works to be purchased
- Number and characteristics of the units
- Unit costs and total cost of equipment and works

For that purpose certain training/study tours may be organized if deemed necessary, particularly so when environmental protection measures (mitigation, monitoring, and other). This will include review of the organizational features as well to make it possible for strengthening the local organizations to be involved in the project, as well as to acquire the most adequate consultant services on the subject.

D. SCHEDULE

The schedule of the mitigation, monitoring and training activities relevant to this project is closely related to the overall Project Implementation Plan. It is therefore understood that the implementation schedule for the above mentioned activities and other measures that must be carried out as part of the project, have to be in close coordination with the particular activities provided by the project implementation schedule. For that purpose the time and all other necessary information for making the schedule of the mitigation, monitoring and training activities should be distributed as soon as they become available.

Such information will serve the project management team to define the start dates and finish dates for mitigation, monitoring and training activities from the chart for the overall project schedule. Thus, all instructions and steps needed by the staff members responsible for the mitigation, monitoring or training activities will be determined and inter-related to the other project activities in a coordinated manner.

E. INSTITUTIONAL ARRANGEMENTS

Institutional arrangements and responsibilities for mitigation and monitoring activities within this project are based on the existing institutions. All activities related to the environmental protection domain in this project development will be supported by appropriate local institutions. Environmental information flow and responsibilities for EMP implementation and organization are defined in the current regulations stated in the Chapter 3 of this report.

Responsibilities for mitigation and monitoring activities during design and construction are defined in the Law on planning and building (Official Gazette of the RS No. 47/03) within the requirements that have to be fulfilled by the consultant and construction and installation organizations. The major responsible institution will be Ministry of Building and Urban Planning, in cooperation with the Ministry of Mining and Energy, as well as the Ministry for Protection of Natural Resources and Environment. They constitute decision making chain of command for environmental management (to take action, to authorize, to stop the action, or to order corrective action in case of necessity, etc.)

Responsibilities for mitigation and monitoring measures within the organisation and control of the system in operation are defined by the regulation related to emission and imission limits such as Regulations on ambient air quality, imission measurements methods, criteria for establishing measurement points and data collection (Official Gazette of the RS No. 54/92), and Regulations on emissions limits, terms and methods of measurements and data evidence (Official Gazette of the RS No. 30/97). The responsible institutions are the Ministry of Protection of Natural resources and the Environment and the Ministry of Health. They are authorized for decision making for environmental management issues (to take action, to authorize, to shut down, or to order other corrective and preventive actions in case of necessity etc.).

The above mentioned regulations clearly define the environmental information flow and monitoring data processing (who collects the data, who analyzes it, who prepares reports, who are the reports sent to and how often, and who does that person send it to, or what does he/she do with the information—who has the authority to spend, shut-down, change operations etc). Major responsibility is with the Ministry of Protection of Natural resources and the Environment.

F. CONSULTATION WITH LOCAL NGOS AND PROJECT-AFFECTED GROUPS

Preliminary consultations with the individuals from the project affected groups such as medical, scientific and technical staff within the CCS were held continuously during preparation of the Feasibility Study, with particular attention paid to their personal views concerning environmental matters of the existing status. They all were generally in favour of the conversion to the natural gas firing by which the coal and fuel oil are suggested by the Study to be replaced. Based on the findings of the draft EIA report, major open consultation with the local NGOs and project-affected groups and related representatives of ministries responsible for health, energy, education and environmental protection was held on September 22nd 2003, in the premises of the City Assembly.

The consultative meeting was organised jointly by the CCS, Ministry of Mining and Energy and Energoprojekt Entel consulting engineers. The meeting was publicly announced in advance through several daily newspapers and by 350 informative posters exposed throughout the city, inviting the public to participate. Officials of the ministries, city authorities and several affected municipalities, as well as of international organisations were invited by official invitations. About 170 participants were present from all of the above mentioned groups and from general public.

Following the introduction to the project by the management of the CCS, the team of experts from Energoprojekt Entel carried out a presentation of the project objectives, scope and findings of the Feasibility study, and a detailed review of the comparative merits of the existing and future environmental impacts dealt with the EIA draft report. A dozen of participants took part in the discussion on various aspects of the project, all with no objection to its environmental issues. Some of the participants commented the natural gas supply and energy efficiency issues. Representatives from the Ministry of mining and energy and NIS (oil and gas company) have taken part in the discussion by giving additional explanation to the relevant questions raised by the participants and answers by the presenters from Energoprojekt Entel. There were even some comments outside the scope of the project (standards of energy efficiency in buildings in Denmark), that can be qualified as marketing of a private consultant. In summary, the meeting was an excellent occasion for public evaluation and promotion of the project with a valuable contribution of the participants that may be of use for the further development of the project (their comments on the capacity of co-generation units, etc.).

Video and printed records of this meeting (presentation, comments, questions and responses) are available in local (Serbian) language. They are attached to support this EIA final report.