TE-TO AD SKOPJE

Combined Cycle Co-Generation Power Plant Project Skopje

Environmental Assessment Report

SECTION F
ANALYSIS OF ALTERNATIVES

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Thermal Energy Plants Department

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1 Introduction

In this section, alternatives to the Skopje CCPP project shall be compared, concerning site and especially technology and design, with respect to their potential environmental impacts and suitability under local conditions.

First some remarks will be given on the situation without CCPP project and on alternative sites. Then feasible alternatives in technology for power generation from fossil fuels will be discussed and compared with the 223 MW generating Combined Cycle Power Plant Skopje:

- 223 MW fuel oil-fired conventional power unit (with FGD)

- 223 MW lignite-fired conventional power unit (with FGD)

The objective is to prove that the proposed plant technology used for the Skopje power project is the most feasible alternative, giving the lowest environmental impact, and therefore, the most suitable solution.

2 Situation without the Project

Without implementing the Skopje CCPP project an improvement of the overall Macedonian power generation situation and power supply can not be expected. With the new CCPP in operation, the load of lignite- and/or oil-fired units elsewhere will be reduced with the corresponding savings in emissions as described in Section E.

Without the new CCPP the existing district heating plant will be still in operation during winter and transition periods with heating. The negative effects of the DHP operation are mainly due to the contribution to SO_2 and particulate emissions during winter. In Section D 2.4 the strong increase of these pollution concentrations during winter has been described. With the new CCPP in operation, however, the contribution from heating drops down to zero, i. e. a substantial improvement will be reached.

Despite the locally increased annual CO_2 and NOx emission flows (due to much higher operation time of CCPP compared to DHP), the local ambient air quality as annual average will barely deteriorate. From the overall point of view (taking into consideration the savings of electricity generation) the environmental situation with the new CCPP has to be assessed better than presently

In addition to this, the positive socio-economic effects would be reduced since no additional work-force would be needed as well during plant construction and plant operation. As a further result economic growth of Skopje and Macedonia would be decelerated as additional required energy could not be provided and therefore no industrial growth can be expected.

The additional land required for the CCPP project is located in a heavy industrial area and sealed already. In that context no green land would be saved if the CCPP project would not be built. An advantage would only be that there is no need to resettle the few illegal settlers.

As a conclusion, the situation without the new CCPP Skopje cannot be considered as better from the environmental point of view.

3 Considered Alternatives

3.1 Alternatives to Site

The Skopje Combined Cycle Power Plant (CCPP) will be implemented on a site in a heavy industrial area of Skopje directly adjacent to the already existing District Heating Plant EAST. The site has been selected and approved in the course of the development of CCPP project.

Advantages of the CCPP site, which proved to be the most suitable are:

- Sound infrastructure with system of roads and railways which provide a convenient and accessible transport system
- Connection to the existing district heating system
- Excellent possibility for utilising the local river (Vardar) as a possible source of water, and cooling water supply/discharge for the project
- Interconnection with the national electricity network
- Directly located in Skopje, which is the largest power consumption centre of Macedonia.
- The site is located in a heavy industrial zone. Various industrial production plants have already been established in this zone. Sufficient qualified labour for constructing and operating the power plant project is available in the area.
- No additional green land has to be used and sealed.

Insofar an alternative site for the new CCPP as heat and power plant is out of question and could not be identified.

3.2 Alternatives to Technology

In the following, two alternative technologies for power generation from fossil fuels will be discussed and compared with the Skopje CCPP concept, particularly in connection to the environmental impact aspects:

- Generation of 223 MW by a **fuel oil-fired conventional power plant** (considering typical fuel oil)
- Generation of 223 MW by a **lignite-fired conventional power plant** (considering lignite as coal which is main fuel for Macedonian power generation)

The comparison with these alternative power generation concepts has been done taking into consideration a flue gas desulphurization system, i. e. considering only relative low SO_2 emissions.

The main data of the power plant alternatives to be compared with CCPP are summarized in the Table F- 1.

Comparison of Power Plant Alternatives				
Comparison of CCPP Skopje's Emissions with Oil- and Lignite-fired Power Plants of the same Electricity Production				
		gas-fired CCPP Skopje	oil-fired Power Plant	lignite-fired Power Plant
Specific CO2	kg/Nm3 resp. kg/kg	1.99	3.12	1.05
LHV	MJ/Nm3 resp. MJ/kg	36.0	42.0	9
Power production efficiency		51%	39%	38%
Electrical output (average)	MW	223	223	223
Needed fuel heat input	MW	438	572	587
Annual operation	h/a	8'300	8'300	8'300
Annual power production	MWh/a	1'850'900	1'850'900	1'850'900
Specific emissions				
CO2	kg/MWh	392	686	1'100
NOx	kg/MWh	0.24	1.07	1.85
SO2	kg/MWh	0	1.07	1.64
Emissions hourly				
CO2	kg/h	87'501	152'978	245'300
NOx	kg/h	53	239	413
SO2	kg/h	0	239	366
Emissions annual				
CO2	t/a	726'259	1'269'717	2'035'990
NOx	t/a	440	1'980	3'424
SO2	t/a	0	1'980	3'035
Remarks:		heat production DHP shut down	no heat prod. DHP in operation	no heat prod. DHP in operation
Assumptions lignite-fired PP:				
SO2 emission = 400mg/Nm3, i. e. with FGD		@ 6% O2		
NOx emission = 450mg/Nm3		@ 6% O2		
Assumptions oil-fired PP:				
SO2 emission = 400mg/Nm3, i. e. with FGD		@ 3% O2		
NOx emission = 400mg/Nm3		@ 3% O2		

Table F- 1: Comparison of Power Plant Alternatives

The CO_2 and pollutant emission values are lowest for the CCPP concept and increase via oil-fired plant to lignite-fired plant. The installation of a FGD has been considered for the oil- and lignite-fired alternatives. The FGD would cause additional consumption (limestone, process water) and produce additional residues (gypsum, FGD wastewater).

The potential environmental impacts are higher than for the new CCPP plant concept, because of:

- Higher CO_2 emission
- Higher NOx emission
- Higher SO_2 emission

- Higher cooling water demand
- Additional consumables
- Additional residues to be treated and to be disposed
- Higher burden to transport ways due to transport of high amounts of fuel.

Taking all these scenarios collectively clearly indicates that the potential environmental impacts to be considered regarding an oil-fired or lignite-fired power plant of the same generation capacity have to be assessed clearly higher than those for CCPP Skopje project which is based on exclusively gas-fired combined cycle technology.

Considering the expected higher expenditure, which will be incurred for the flue gas treatment, fuel transport, consumables, residue disposal etc. in connection with lower efficiency, it can also be expected that, from an economical point of view, this concepts fall below the CCPP concept and, as such, should not be considered for implementation.

Furthermore, the actual situation at site also has to be taken into consideration. It is developed and the site and associated infrastructure are suitable for the installation of combined cycle plant. The considered space for CCPP would not be sufficient for installation of a lignite or oil-fired power plant with flue gas desulphurization system, fuel storage and handling etc.

The figure below illustrates the specific emissions of the considered alternatives, clearly indicating CCPP as best solution from the environmental point of view.

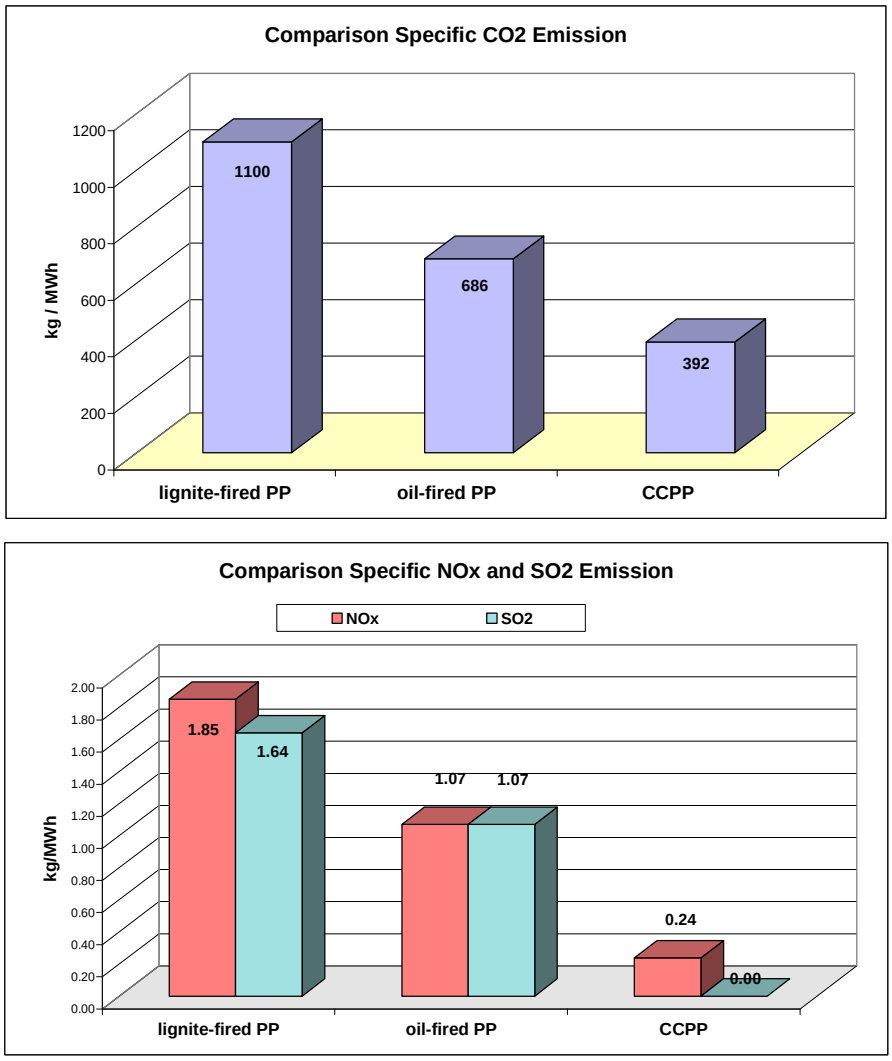

Figure F- 1: Specific Emission Data of Alternative Concepts

4 Comparison and Conclusion

The situation without the new CCPP Skopje cannot be considered as better from the environmental point of view.

Also an alternative site for the new CCPP as heat and power plant is out of question and could not be identified.

Considering all gained results, it can be assessed that the plant concept of Skopje CCPP is the most suitable technology selection for generation of 223 MW power in Skopje. This plant concept is based on modern combined cycle technology with high thermal efficiency and relatively low environmental impact.

At the same time the CCPP as power and heat generation plant will replace the heat generation in the existing DHP and thus ensure further environmental improvement with respect to SO_2 and particulate emissions in winter.