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CROSS-BOUNDARY POLLUTION DUE TO THE ACTIVITY OF A THERMAL POWER STATION

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ABSTRACT

The activity of thermal power stations of Romania has an important impact on the environment by emission of noxious substances such as: SO_2, NO_2, CO, ash. The polluting emissions are carried by the wind and reach the territories of the neighbour countries of Romania. The paper presents a study on the cross-boundary pollution due to the activity of the thermal power station of Turceni.

Keywords: thermal power station, polluting emissions, cross-boundary pollution.

INTRODUCTION

The production of electric and thermal energy constitutes an important activity for the economical development of Romania, a country in a full process of transition which is about to join to the European Union. Most of the electric energy of Romania is still produced by the thermal power stations that operate with fossil coal. From statistical data provided by Termoelectrica it is evident that although the percent of jet coal in the energy balance represents only 35 %, during its burning 70 % of the SO_2 emission is released, 48 % of the CO_2 emission and 95 % of the flying ash emission [2].

The Energetic Complex Turceni is composed of the jet coal surface mining locations of the Oltenia mining basin and a thermal power station having an installed power of 1980 MW. The Turceni station operates with 6 energetic groups of 330 MW. Each group is composed of a steam tank with a flow of 1035 t h^{-1} and a turbine having a condesation action with a nominal power of 330 MW. The fuel used by the tanks is jet coal and black oil, and for starting, natural gas is used. The Turceni station is located in the southern part of Romania, at approximately 180 km from the Bulgarian border.

A special problem that is confrounted by the Romanian energetics refers to the pollution of the environment with sulphur dioxide, nitrogen dioxide, carbon monoxide and ash [2].

Simulation of the cross-boundary pollution due to the activity of the thermal power station of Turceni

The average annual concentration of SO_2, NO_2, CO and ash pollutants, continuously measured with specialized equipment, at the smoke flues 1, 2 and 3 of the station during 2004, is presented in Tables 1, 2 and 3.

In order to analyze the cross-boundary pollution due to the activity of the thermal power station, the ISC programme for evaluating the pollutants dispersion was

Table1. Average annual concentrations of pollutants at smoke flue 1.

Pollutant	Mass flow, kg h^{-1}	Gas flow, $Nm^3\,h^{-1}$	Emission concentration, mg Nm^{-3}	Limits ON 462/93.ON 756/97, mg Nm^{-3}	
				AL	IL
SO_2	4745,1	1192305	3979,8	2000	2400
NO_x	597,5	1192305	501,2	560	800
CO	157,7	1192305	132,2	175	250
Ash	176,7	1192305	148,2	105	150

AL – Allert Limit; IL – Intervention Limit

Table 2. Average annual concentrations of pollutants at smoke flue 2.

Pollutant	Mass flow, kg h^{-1}	Gas flow, $Nm^3 h^{-1}$	Emission concentration, mg Nm^{-3}	Limits ON 462/93.ON 756/97, mg Nm^{-3} AL	IL
SO_2	4890,5	1213102	4031,4	2000	2400
NO_x	605,2	1213102	498,9	560	800
CO	188,3	1213102	155,2	175	250
Ash	148,1	1213102	122,1	105	150

AL – Allert Limit; IL – Intervention Limit

Table 3. Average annual concentrations of pollutants at the smoke flue 3.

Pollutant	Mass flow, kg h^{-1}	Gas flow, $Nm^3 h^{-1}$	Emission concentration, mg Nm^{-3}	Limits ON 462/93.ON 756/97, mg Nm^{-3} AL	IL
SO_2	4985,3	1226870	4063,0	2000	2400
Nox	629,1	1226870	512,7	560	800
CO	143,6	1226870	117,0	175	250
Powders	180,4	1226870	147,0	105	150

AL – Allert Limit; IL – Intervention Limit

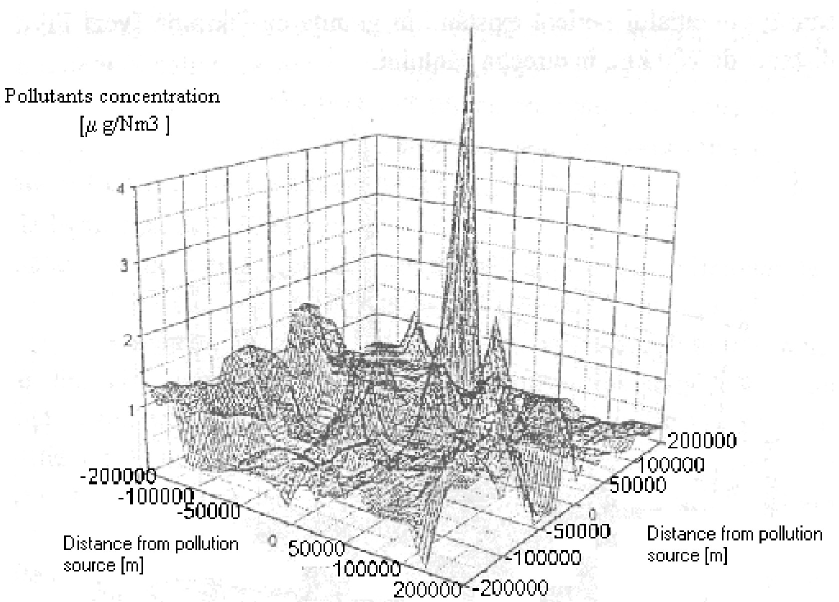

Fig. 1. The average distribution at every 24 hours of NO_2 (expressed in mg/Nm^3) emitted by CTE Turceni, on a radius of 200 km in January 2004 (cross-boundary pollution).

used. The simplified adopted hypotheses refer to the following aspects [1]:

• the emittent source keeps its infinite emission power, there are no chemical reactions;

• the wind and temperature gradients in the layer where the mixture of the pollutants with the free atmosphere takes place, are relatively constant;

• the vertical and transversal distributions in the wind direction are of a Gaussian type;

• the best results are obtained for analysis on flat areas on distances of 200 km at most;

• the stability classes refer to the stable conditions, unstable conditions as well as their limit combinations.

The European Council for the Environment Protection defined the long distance cross-boundary atmospheric pollution as follows: „the pollution whose physical source is totally or partially included in the area of the national jurisdiction of the respective state, at a distance where it is not generally possible to distinguish the contribution of individual sources or of emission sources groups "[5].

In order to analyze the cross-boundary pollution due to the Turceni station, the online measured emissions, the meteorological and topographical data of the area for January 2004 were gathered. The study was focused on three pollutants: SO_2, NO_2 and CO, input data being the emissions presented in Table 4.

RESULTS AND DISCUSSION

In Figures 1, 2 and 3 the tridimensional distribution of the nitrogen dioxide (NO_2), the carbon monoxide (CO) and the sulphur dioxide (SO_2) at an altitude of 2000 m, at distances of up to 200 km from the smoke flue 2 of Turceni station are presented.

The contributions of other pollution sources (stationary or mobile) were not taken into account in order

Table 4. Input data regarding the polluting emissions.

Stationary source	SO_2 Flow, g s^{-1}	NO_2 Flow, g s^{-1}	CO Flow, g s^{-1}	Smoke flue Height, m	Speed of burning gases, m s^{-1}	Temperature of the burning gases, [ºC]
Smoke flue 1	997,6	132,7	58,6	250	20,5	139
Smoke flue 2	1008,2	131,8	47,2	250	21,3	136
Smoke flue 3	1075,4	119,5	52,9	250	21,8	140

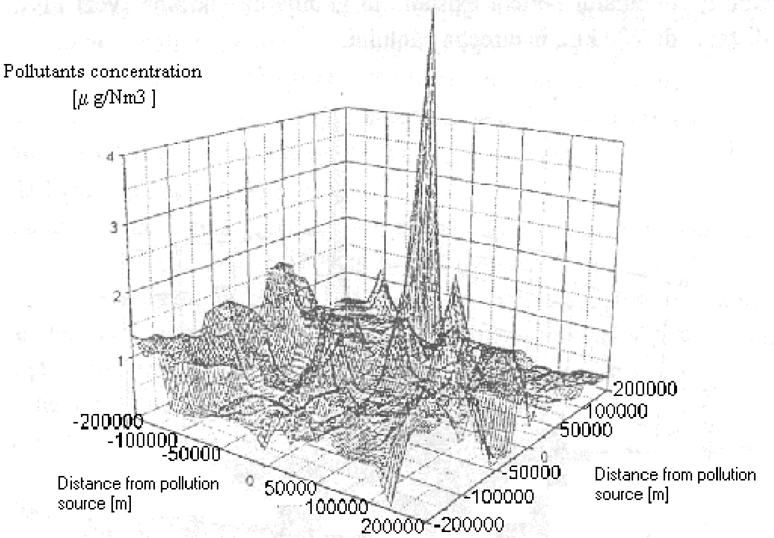

Fig. 2. The average distribution at every 24 hours of CO (expressed in mg/Nm^3) emitted by CTE Turceni, on a radius of 200 km in January 2004 (cross-boundary pollution).

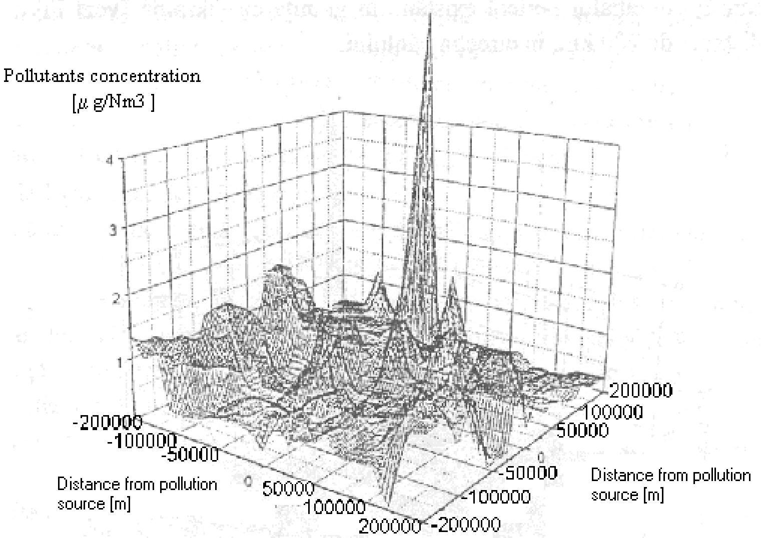

Fig. 3. The average distribution at every 24 hours of SO_2 (expressed in mg/Nm^3) emitted by CTE Turceni, on a radius of 200 km in January 2004 (cross-boundary pollution).

to show only the cross-boundary polluting mass quantity caused by the Turceni thermal station.

It is observed that the pollution as shown by the simulation, at the limit of the Bulgarian border, is a potential danger at 200 km on the wind direction.

CONCLUSIONS

In order to reduce the cross-boundary pollution due to the activity of the thermal power station of Turceni, it is compulsory to take all the technical limiting measures of the polluting emissions SO_2, NO_2, CO and ash.

The reducing of the SO_2 emissions is made by applying the injection method of calcite powder into the burning point, as a first step of desulphuration of burning gases, followed by the desulphuration of burning gases with the help of ammonia. By applying these measures, there can be obtained a reduction of up to 90 % of SO_2 emissions [6].

The reduction of NO_2 emissions can be done by organizing the burning in steps at the burners level (by using the burners poor in NOx) and by organizing the burning in steps at the level of the burning point [2].

The reducing of ash emissions can be done by continuing modernizing works of tanks electrofilters [1].

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