



BG0000193

ENERGY FORUM

September 17-19, 2000

*International Home of scientists " Fr. J. Curie"**St. Konstantine Resort - Varna**Bulgaria*

Subject Area: ENVIRONMENTAL PROBLEMS IN THE ENERGY FIELD

ENVIRONMENTAL PROTECTION-A NATIONAL AND INTERNATIONAL PROBLEM TO SOLVE

Authors: Ovidiu Apostol	- Head of Electric and Control Department Power Studies and Design Institute
Serban Iacob	- Head of I&C Workshop ISPE-ABB Power Studies and Design Institute
Roxana Marciu	- Electric Project Manager Power Studies and Design Institute
Mihaela Jedlicska	- I&C Project Manager Power Studies and Design Institute
Valentin Jemna	- I&C Project Manager Power Studies and Design Institute

1. General View

Environmental protection was taken into consideration very superficially before 1989 in Romania, because of various reasons.

A more attentive approach seems to have been introduced after this date, but, at least because of the financial difficulties, it continues to be not in the very top of the problems, although authorities and civil society recognizes its crucial importance. Steps have been made in Romania in offering facilities as are:

- customs taxes cancelled for environmental protection equipment and apparatus;
- exemption from taxes for the involved companies;
- facilities in foreign credits attiring:

One cannot ignore whatsoever some national-wide decisions due to improve the general frame:

- the Ministry of Environment establishment;
- the re-conversion of a special Institute towards environment protection and study;
- Environmental Protection Agencies in every area of the country;
- initiation of a package of laws regarding regulations concerning development under "green" conditions;
- support for imissions monitoring equipment (these efforts being often sustained from abroad);



This growth of concerns regarding the environment monitoring from the imissions point of view should attire same concerns for emissions monitoring as well.

It is well known that the Thermal Power Plants (TPP) represent one of the most important categories of pollution agents with SO_2 , NO_x , CO and dust. This is the main reason to work upon maximal reduction of their impact with the environment and to implement monitoring of the polluting emissions that these plants are evacuating in the environment.

The present paper presents two directions where for major environmental problems solutions were found by using advanced technologies, in cooperation with important specialized foreign companies:

- the thermal power plants pollution decreasing;
- the air quality monitoring in industrial hard polluting areas (as Baia -Mare city);

As the implementing of noxes reducing systems implies a large and important financial investment with major implications in the thermoelectric and electric installation, we consider that a first step to be solved is to define clearly the monitoring and reducing concepts.

2. THE PURPOSES OF POLLUTING EMISSIONS MONITORING

The Romanian Power Authority, taking into account the prospective of implementing the de-pollution primary equipment, required the fast introduction of emissions monitoring devices at the TPPs chimney.

A very important issue is to consider that main efforts for monitoring systems should be done first towards emissions monitoring, not necessarily imissions monitoring. Some years ago there have been a trend in Romania to install, for example, on the field around certain TPPs, imission monitoring systems. In our opinion this represents a very expensive solution that shows facts that are already well known in Romania; this concept has to be changed and substituted with another one - emission monitoring.

According to other countries experience, upstream the chimney the following gases concentration should be measured on every gas channel: SO_2 , O_2 , CO and CO_2 , as well as the dust concentration at every boiler.

For every item the following measurements are to be performed:

- the rated medium value at every half an hour;
- the day medium value taking into consideration the 48 every day recordings.

The limit emission values are considered normal if during a year:

- all daily medium values are not over the limit emission values;
- 97 % of the daily medium values are not over 6/5 parts of the limit emission rated values;
- any medium rated value measured at half an hour time is not over the doubled value of the emission limit values.



These conditions are in accordance with the Western Europe regulations regarding the environment protection.

The information mentioned above is very necessary for the following reasons:

- it enables to adopt certain manoeuvres due to decrease the polluting emissions, for example by improving the fossil quality;
- it enables the combustion analysis, correction in combustion automation, with favorable implications upon the fossil specific consumption;
- it offers objective documents for the analysis of the TPP pollution ratio in the area, especially for the industrial platforms, where, besides the TPP, chemical and/or cement plants may be placed.
- it might determine, in order to protect the environment, the decrease of the TPP load or even shutdown in case of hard polluting operation.

3. SOLUTIONS FOR POLLUTING EMISSION MONITORING

3.1. Fixed-mounted installation

The generalized solution for polluting elements monitoring is represented by the fixed – mounted systems. These systems consist of two main parts, as follows:

- the collecting and analysis installation
- the primary information processing

The data collecting and analysis is performed with locally placed panels in which gas – analysers are placed (combined, usually), as well as other necessary accessories as are pumps, filters, test gases recipients. Gas-analysers must issue digital outputs on a serial connection – usually unified signal 4-20mA.

As the supplying companies offer gas-analysers for each, but also for more components together, we recommend to concentrate as many as possible components on a gas-analyser – for example Hartman & Braun offers the URAS 10E gas-analyser, capable to measure all components. The devices have such qualities and such easy maintenance conditions, that this concentration of measurements does not lead to a decrease of the system availability.

The processing part of the installation consists of a computer specialized in signal processing. The signals are emitted either by gas – analysers, or are collected by other installation in boiler's area. The concentration signals are processed using a calculation program that is prepared to be standardized in our country. To be mentioned that all major companies have developed hardware systems for data processing in accordance with the European regulations ; such are: Siemens, Hartmann& Braun, Servomex, Sick. Other companies (Horiba, Junkalor) decided to integrate such dedicated systems using components from different suppliers.

We suggest using computer systems able to collect the largest possible number of input analogic and binary signals, in order to develop additional programs, besides those directly connected to emission monitoring. The computer system must necessarily be authorized by a competent organization coordinating the environment monitoring policy. Otherwise the results will not be certified by the authorities.

In what regards the number of measurement installation and computer systems, two main solutions are possible, as follows:

-Measuring installation for every boiler and for every gas channel-two solutions, as it will be presented below;

-A single measuring installation on the chimney independent of the number of boilers that are evacuating gases through that chimney.

3.2. Mobile installation

We consider the TPP installation should be completed with mobile measuring systems only if they have been provided with fixed-mounted monitoring systems. The mobile systems are used in order to check periodically the fixed systems and to substitute them during occasional interruptions. Even if these devices are provided with a small printer and are capable to edit protocols and they are TUEV authorized, their values are irrelevant in case of an authority inspection (environment agency or other authority).

The mobile installation is designed to provide the following functions:

- gas collecting;
- primary gas analysis;
- processing of the information regarding the concentration;
- editing of the information on the own display;
- information listing edition issued by own printer;
- analogical output unified signal .

In what regards the mobile gas-analysers, the range of such apparatus is more reduced. In spite of that, ISPE has a consistent documentation of mobile devices able to answer the severe conditions presented in the Technical Requirements of any customer, capable to perform simultaneous concentration measurements of SO₂, NO, CO, O₂, the environmental temperature, the flue gas temperature, the combustion ratio, the air excess coefficient.

4. MONITORING SOLUTIONS FOR THERMAL POWER PLANTS

Taking into consideration the above-mentioned assumptions, the following principles are resulting :

-one measuring installation for every boiler, with collecting points for noxes analysis on each flue gas channel;



-measuring installation of dust, placed between the two channels junction area and the chimney. Taking into consideration the practical modalities of providing the analysis device and the computer system, in the frame of the adopted general solution, the following variants are resulting:

A1- Collecting points on each channel and noxes analysis installation for each channel and a computer system used for the assembly;

A2- Collecting points on each channel and noxes analysis installation for each channel and without dedicated computer system, the processing and measurements being achieved with the TPP existing monitoring system.

B1- Collecting points on each channel and noxes analysis installation for each boiler (one for the two channels, with the possibility of automatic switch at the two collecting points) and a computer system used for the assembly;

B2- Collecting points on each channel and noxes analysis installation for each boiler (one for the two channels, with the possibility of automatic switch at the two collecting points) and the processing and measurements achieved with the TPP existing monitoring system.

The above-mentioned solutions are being applied in these last years in Romanian most important fossil power plants, in parallels with the retrofitting of electrostatic precipitators. This became one of most important activities developed in the Romanian power system in the last few years. The adopted solutions regarded both the electrical and control part, as well as the mechanical part. The new concepts applied for Turceni, Rovinari, Deva TPPs electrostatic precipitators systems are in accordance with the European standards in what concerns the dust level emitted into the atmosphere : $100\text{g}/\text{Nm}^3$.

The whole assembly is controlled either from the unit control room, or from specially built electrostatic precipitators control room with monitoring and control systems using advanced visual technologies; the whole de-dusting processed is monitored and controlled. This second solution was adopted for Rovinari TPP , using ABB process control technology – PromoVidi systems for monitoring and control of the whole de- dusting process.

5. AIR-SELF MONITORING SOLUTIONS FOR BAIJA-MARE CITY/ ROMANIA

Baia-Mare has been identified as one of the "hot-spot" polluted areas in Romania. The European Community granted through PHARE a budget to develop an efficient, real-time automatic air -self monitoring system in order to increase the knowledge of the present situation and to allow measures that are to be taken for healthy environment.

In Baia-Mare a network of measuring sites was established at two industrial facilities (Phoenix and Romplumb) for emission monitoring and an ambient air quality station. The measured data are monitored and transmitted to a central station at the Environmental Protection Agency (EPA) Baia- Mare. Different instruments installed measure the most significant pollution sulphur



dioxide ($8^{\circ}2$) and dust. The dust contains high amounts of lead (Pb).

The environmental information obtained helps the decision makers of the involved industries, EPA Baia-Mare, the Prefecture of the County Maramuresh and the local administration at Baia-Mare to develop real-time actions to reduce air pollution in Baia-Mare by controlling the industrial process to mitigate the pollution. Figure 1 presents a sketch of the operating system at Baia-Mare.

The demonstration character of the project allowed opening the environmental market. The project activities started relationships between local and foreign companies in order to establish an infrastructure for sustainable development of environmental monitoring.

The technical design of the system is opened to be extended to other detection points, to other pollutant species or to other fields in the environmental sector.

5.1 Flow of operations

The project started on February 22, 1996. In May 1996 the Consultant team Lahmeyer International (LI), Institute of Power Studies and Design (ISPE), Center of Environmental Research (ZUF) submitted an Inspection Report. This report comprised a description of the present air pollution situation in Baia-Mare and detailed model calculations from which a measuring strategy was developed. The approach was further invoked by air quality measurements from April 8 till April 19, 1996, provided with a mobile laboratory, which clarified the present air pollution load in Baia-Mare.

Based on this a technical specification was given dealing with cost estimations, technical details of proposed instrumentation and the data acquisition / telecommunication system as well as the necessary site preparations.

The technical parts to be delivered were identified as:

- System installation and integration,
- Instrumentation for two emission stations,.
- Data acquisition and telecommunication system,
- Instrumentation for ambient air quality station,
- Meteorological equipment, personal computer system.

Start of operation of the system at the local sites was settled at November 1, 1996.

The local support of EPA Baia-Mare, the support and investment of the concerned industries (Phoenix, Romplumb) and the incorporation of local suppliers for equipment (Multinet Ltd.) allowed to get a sustainable infrastructure for implementation and operation of the system.

5.2. Monitoring System

To set up the project, an air quality management concept was introduced identifying the environmental degradation at Baia-Mare with the help of air quality measurements (mobile laboratory) and numerical simulations. The technical approach introduced at Baia-Mare combines for the first time air quality measurements with emission measurements:

- One ambient air measurement station inside the residential area of Baia-Mare
- Emission measurements inside the Phoenix complex
- Emission measurements inside the Romplumb complex

The major pollutants determined on-line are sulphur dioxide (SO_2) and dust.



The air-self-monitoring system installed in Baia-Mare is designed as a two-fold system (See Attachment 1). It consists of so called user-systems at the factories of Phoenix and Romplumb. This system allows monitoring the emissions at each factory for itself. The measured data are stored at each measuring site on basis of a one-minute measuring cycle interval. Transmission of data to the central control station is arranged to work on a 1/2h-basis using the public phone net as data way. The user-system will help the facility operators to control their production process and provides information to prove the production line in order to reduce the emissions.

All measuring stations automatically display and store their own data. The measuring data from both industrial sites and the down town station are transmitted to the central control station of EPA (See Attachment 3). With the adoption of the on-line transmission of all measured data to the Environmental Protection Agency as a supervising authority, a so-called supervising system is accomplished.

Including the measured data from the ambient air station, EPA Baia-Mare has a tool to link the ambient air quality to the measured emissions in order to establish a defined source- receptor relationship.

5.3. Procedures / Benefits

The procedure itself allows continous monitoring of the major pollutant species in a hot spot polluted area.

The continuous monitoring approach allows identifying real time actions to improve the actual and the prevailing air quality situation.

The continue monitoring approach leads in the follow up to a process control of the production facilities, optimising in an economic and environmental-friendly way the production process. This also will extend the necessity of production process monitoring to a significant degree.

The continue monitoring approach is designed to allow quality assurance of the equipment and the monitored data according to the European requirements (ISO 9000, EN4500 1).

The continue monitoring approach provides transparency of the environmental impact to find the guide lines to be within the air quality standards according to the Romanian environmental law (Romanian Legislation, Volume 19, Bucharest 1996).

5.4. Technical aspects, design, equipment

The typical requirements of automated monitoring technology which were considered for the Baia-Mare-concept could be addressed as follows:

- to improve the automation in order to reduce human errors;
- to minimize the maintenance aspects;
- the quality assurance must have been passed;
- the delivering companies have to develop marketing strategies;
- in order to guarantee the service facilities;
- the service facilities should be nearby;
- the concerned organization and hardware;
- the extension of the monitoring network;
 - a. to other pollutant species;



- b. to more detection points;
- c. to impact models;
- d. to other data transfer points must be feasible.

6. Conclusions

Basically, the systems provide continuous air quality monitoring allowing process control and process optimization. Thus tracing back to sources of pollution and statistical evaluation and forecasting can be done in order to forecast the load distribution. As the system approach is modular, the process units could easily be applied at different hot spot areas (TPPs, Industrial polluting plants) coupled together in a network.

The technical specification for the sensors has to be adjusted precisely in order to assure the relevant parameters for operation and measurement range.

The integral removal of pollution is one of the major goals for environmental policies. Thus, monitoring could provide a tool to approach this goal, taking into account the financial availability and the economic progress of the environmental market.

In the present example a combination of foreign and Romanian companies was established to transfer knowledge and "know how" supporting a sustainable implementation of air quality monitoring. The enlargement of the environmental market will definitely enlarge such and similar structures supporting an environmental-friendly and economical approach.

Attachment- Diagrams according to text

Monitoring System - Baia Mare

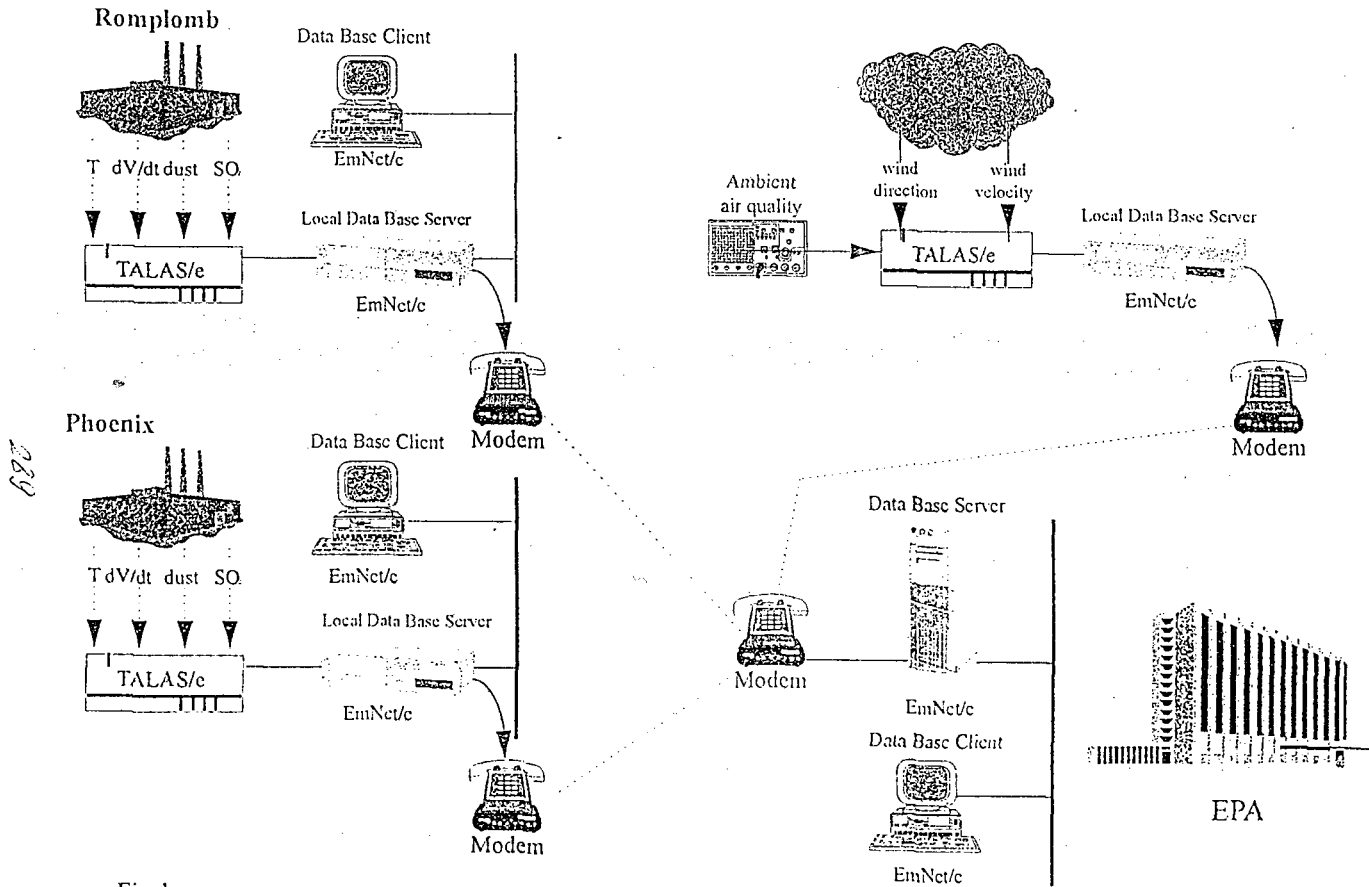
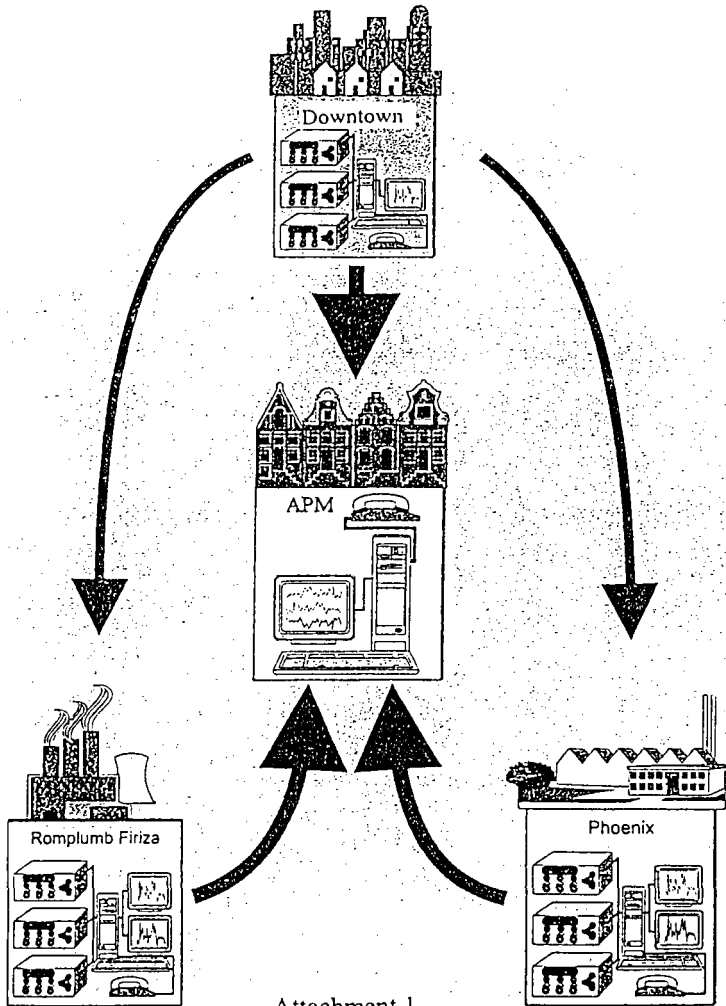
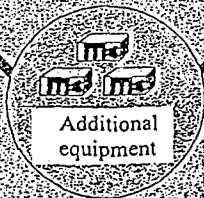
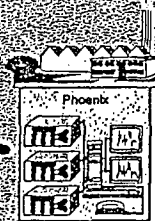
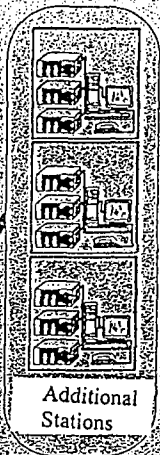
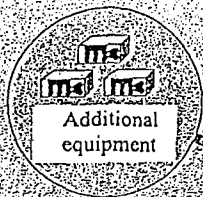


Fig.1



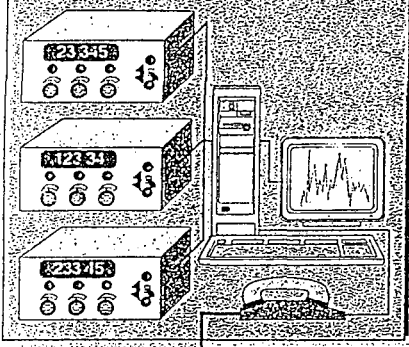
Attachment 1



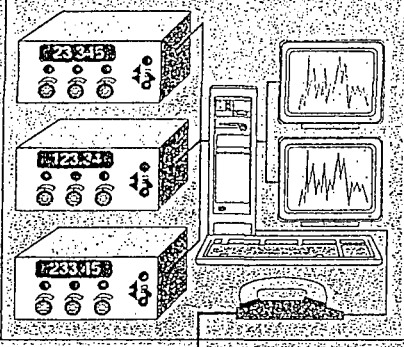
Attachment 2

Measuring network Baia-Mare

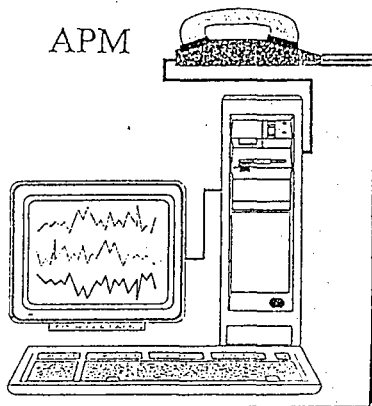
Downtown



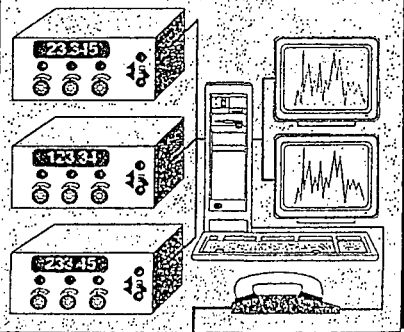
Romplumb Firiza



APM



Phoenix



Attachment 3