MACIEJ NOWICKI[*], WOJCIECH JAWORSKI[**]

A NOVEL NATION-WIDE SYSTEM FOR KEEPING RECORDS OF EMISSION AND IMMISSION OF AIR POLLUTANTS

It is expected that a computer-aided nation-wide system for keeping records of emission and immission of air pollutants will have been implemented in Poland by 1986. The system will comprise rates of emission for, and technical parameters of, all industrial plants, thermal and power generating stations and municipal point emission sources that create environmental hazards. It will also include data sets obtained from every type measurements of air pollutants. For areas where no immission measurements are conducted, actual background concentrations will be calculated in terms of mathematical models by making use of emission data bases.

The system is expected to provide complete and reliable sets of information on the actual air pollution hazards with indication of major contributing sources.

1. INTRODUCTION

The available methods of recording data on the emission and immission of air pollutants are far from being satisfactory. The central system of keeping records of emissions (supervised by the Chief Statistical Office) comprises approximately 1000 industrial plants which are considered the most troublesome. Every year, the plants in question supply information about the total emission of major air pollutants, as well as about the state of treatment devices for outlet gases (most of these being dust separators). These data are difficult to verify because of a considerable aggregation even at the moment of filling-in the questionnaire. They are also unserviceable to design engineers or town and country planning experts, as the technical para-

[*]Institute of Environmental Engineering, Technical University of Warsaw, Nowowiejska 20, 00-653 Warszawa, Poland.

meters of the emitters are lacking. Summing up, the available set of information is insufficient and difficult to verify.

The problem of collecting data on the immission of air pollutants is even more complex. Immission measurements are carried out independently by as many as four different organizations. The result is that the measuring networks overlap, and it often happens that the same air pollutant is measured by different methods yielding incomparable results. There is no central system to keep records of the measured results, and the estimates of the actual pollution levels are inconsistent.

Having these all in mind, experts   work on a unified nation-wide system for keeping records of both emission and immission of air pollutants. Work on this system was started in 1981 and will have been finished by 1986.

2. PRINCIPLES AND STRUCTURE

It is anticipated that this will be a three-stage system of collecting, processing and storage of information about emission and immission of air pollutants on the following levels: donors of data—regional bases—central base. The term 'donors of data' is used to denote industrial plants, enterprises for the sale and distribution of fuel to individual users, Commercial Centre for Oil Industry supplying liquid fuel. In the sphere of immission, the term 'donors of data' includes all institutions conducting measurements of air pollutant concentrations.

Once a year, source data will be passed to the regional, computer-aided data base. There, they will be coded, aggregated and recorded. Aggregated data should be sent to the central base (located at the Computer Centre of Płock). There, the following will be done: annual determinations will be carried out for the spatial distribution of both emission and immission of major air pollutants throughout the country, and for the dominant trends; ranking of the environmental impact exerted by individual industrial plants, and classification of exposure hazards.

Source data collection is based on the principle of inquiry.

3. GATHERING INFORMATION ON THE EMISSION OF AIR POLLUTANTS BY MAKING USE OF QUESTIONNAIRES

Industrial plants, power stations, as well as heat and power generating plants are amongst the major air pollution sources. However, keeping records of these sources is very difficult, bacause they are numerous, involve different technologies, and make use of emitters displaying various technical parameters. It is obvious that keeping records of all industrial emitters

without any exception is useless and unserviceable, as the environmental impact in a great number of instances is insignificant. Hence, there appeared the need of establishing criteria of environmental nuisance for the purpose of classification and inclusion either in a local or a nation-wide ranking list.

The basic criterion of environmental nuisance is the emission load of a given air pollutant expressed in terms of equivalent sulphur dioxide concentration. Records are kept for sources generating equivalent emission loads higher than 100 kg/h.

Another criterion of environmental nuisance is the relation between equivalent emission load and emitter height, including the rise of outlet gases. Special nomograms are available to define the boundary conditions, $H = f(E)$. If the boundary conditions are fulfilled, the emitter will be included in the records. Emitters which do not satisfy the boundary conditions are balanced concerning total annual emission.

In the system of interest, actual stacks and ventilators are recorded, as well as equivalent emitters representing a group of actual emitters displaying identical or similar height and identical or similar conditions of gas ejection into the atmospheric air. The introduction of the notion of equivalent emitters accounts for a considerable reduction of the number of actual emitters which otherwise should have been included in the records. This is of importance to the recording of very large industrial plants with numerous chimneys and ventilators. Substitution of the equivalent emitter does not influence the information on the environmental hazards and nuisance created by this type of industrial plants.

The questionnaire consists of the following sections:
1) information about the plant (name of the plant; name of the department),
2) information about the emitter (location and technical parameters),
3) data on the reducing units cooperating with the emitter (type, efficiency, availability),
4) determination of the drift coefficient for air pollutants in relation to the unit product or unit raw material typical of the technology involved,
5) determination of monthly emission of major air pollutants by making use of the drift coefficient, production volume and efficiency of reducing devices.

Knowing the monthly emissions from all emitters operated in the plant and creating environmental nuisance, it is easy to determine the overall seasonal and annual emission (there are recorded all particulate and gaseous pollutants for which standards have been established in Poland).

Keeping records of air pollutants emitted from municipal and household sources is relatively easy. The emission of interest comes from combustion of solid and liquid fuel in kitchen ranges, house heating small boiler rooms and heat producing stations. The source data to be recorded include the volume of fuel which is sold to state-controlled users, cooperatives and individual users. There are only two distributing organizations -- Village Cooperatives (solid, fuel) and Commercial Centre for Oil Industry (liquid fuel). State-controlled farms receive fuel without middlemen. The employees of certain enterprises are granted allowance of coal or coke. In all these instances the questionnaire includes only one question referring to the volume of distribu-

tion or allowance of fuel. The information is sent to the regional data base which makes use of the drift coefficients for pollutants coming from combustion in stoves and small boiler rooms to determine the rates of SO_2, NO_x, CO and C_nH_m emissions within villages and quarters of towns and cities. This information is passed to the central data base.

Another major source of emission is road traffic, i.e. motor vehicles owned either by state-controlled users or individual users. The fuel for combustion is supplied by the Commercial Centre for Oil Industry. Keeping records raises serious problems, as these sources are of a non-stationary nature in relation to time and space. Records of the fuel sold by refilling stations and fuel supply yards fail to provide reliable information on the rate and spatial distribution of emission within the area of a given town or district. Reliable are data obtained from daily, weekly and annual traffic intensity measurements. Combined with the emission coefficients for major pollutants generated individual types of vehicles travelling throughout Poland, traffic intensity data give the desired distributions of emission. But measurements of that type are carried out randomly and cover a small number of streets and roads. Hence, it is advisable to increase the measuring frequency so that the emission from road traffic be included in the emission base (appropriate indicators have been determined already). The only information available to the central base is the annual estimate of traffic emission in relation to the whole territory of Poland.

4. KEEPING RECORDS OF IMMISSION

The variety of methods for measuring the distribution of immission of particulates and gaseous pollutants made environmental scientists and engineers develop many different questionnaires for the recording of measured data. Thus, separate questionnaires are available for 1) dust deposition, 2) randomly measured particulate and gas concentrations, 3) 24-hour concentrations, 4) continuous measurements involving automatic gauges, and 5) measurements involving tracers.

Source questionnaires provide concentration values measured in the past season or year.

Statistical interpretation of measured data is carried out in the regional base where source data records are kept. Once a year, appropriately coded and aggregated, measured data are sent to the central base. The central bank will store information on the measuring devices and methods involved, which should account for their unification. One of the most important tasks to be fulfilled by both regional and central bases includes determinations of spatial distributions of the background for major air pollutants. This may be achieved by making use of the data stored in the emission base, as well as by using mathematical models of diffusion developed as one of the tasks included in the PR-8 Governmental Project. In this way, it will be possible to determine the background of pollutants the immission of which has never been measured in Poland.

5. HOW TO USE THE SYSTEM?

It is expected that regional and central authorities will be amongst the principal users of the system for keeping records of emission and immission of air pollutants. The regional base will provide information on up-to-date spatial distributions of concentrations for the most characteristic air pollutants, on the contributing emitters, as well as on the charges and fines to which the management has been sentenced for atmospheric emissions of toxic substances.

On a nation-wide scale, of particular importance may be the following: 1) determination of regions exposed to pollution, 2) determination of the state of treatment devices for industrial gases, 3) determination of trends in air pollution coming from different groups of emitters (industry, power plants, vehicles, kitchen ranges and house heating), and 4) information about the measuring apparatus and methods.

It is also assumed that the designers of industrial plants, new settlements or health resorts will become users of the system in question. Depending on the problem to be solved, the regional or central base will provide data on the emission rate and emitters which should be taken into account and, also, on the spatial differentiation of the background. Data bases will be the only legal source of information.

Work on the system in question is far advanced. Available are computer programmes (for regional bases and for the central base), as well as the questionnaires for the donors of data. Pilot-scale implementation of the system is underway. If consistent results are achieved, the system will be ready for full-scale implementation in 1986. This will be a milestone in the development of air pollution control systems, an important foundation for any organizational, managerial and technological activities contributing to the abatement of air pollution hazards to which the whole of Poland is exposed.

OGÓLNOKRAJOWY SYSTEM PRZECHOWYWANIA WYNIKÓW EMISJI I IMISJI ZANIECZYSZCZEŃ POWIETRZA

Przedstawiono nowoczesny ogólnokrajowy system komputerowy przechowywania wyników wielkości emisji i imisji zanieczyszczeń powietrza. Zostanie on wdrożony do 1986 r. System ten zawiera m.in. wielkości emisji, parametry techniczne najważniejszych zakładów przemysłowych, w tym elektrowni, które stanowią zagrożenie dla środowiska.

ÜBER DEN AUFBAU EINES NEUEN COMPUTER-GESTÜTZTEN SYSTEMS ZUR REGISTRIERUNG UND SPEICHERUNG VON DATEN BEZÜGLICH DER EMISSION UND IMMISSION VON LUFTBESCHMUTZUNG IN POLEN

Das System soll im Jahre 1986 in Betrieb gesetzt werden. Es ist vor allem auf die Registrierung und Speicherung technischer Parameter und des Emissionsausmasses aller grösseren, umweltfeindlichen Luftverschmutzungsquellen (Elektrizitätswerke, Hausöfen u. dgl.), sowie aller anderen Messwerte, die aus den Monitoring-

Netzen zugesandt werden. Wo Immission nicht bemessen wird, sollen die Hintergrundkonzentrationen mit Hilfe methematischer Diffusionsmodelle berechnet werden.

Das besprochene System soll nicht zur zuverlässige Daten über die Umweltbedrohung anschaffen, sondern auch die für diese Bedrohung verantwortlichen Verschmutzer anzeigen.

ОБЩЕГОСУДАРСТВЕННАЯ СИСТЕМА ХРАНЕНИЯ РЕЗУЛЬТАТОВ ЭМИССИИ И ИМИССИИ ЗАГРЯЗНЕНИЙ ВОЗДУХА

Представлена новейшая общегосударственная компьютерная система хранения результатов измерений величины эмиссии и имиссии загрязнений воздуха. Эта система содержит, между прочим, величины эмиссии, технические параметры важнейших промышленных предприятий, в том числе электростанций, которые приносят вред среде. Система будет внедрена до 1986 года.