AIR POLLUTION MONITORING FOR ON-LINE WARNING AND ALARM

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Abstract

The Norwegian Institute for Air Research (NILU) has been involved in the establishment of air pollution monitoring and modelling for warning and alarm systems during accidental releases and in the surroundings of industrial sites.

During the oil fires in Kuwait following the 1990-91 Gulf War, NILU was asked by the World Health Organization (WHO/UNEP) to provide and install monitoring stations for an air quality information and warning system. The installation included a data network with dedicated telephone lines connected to a surveillance centre at the Environmental Protection Department in Kuwait City. Data were transferred to the centre every 5 minutes.

On behalf of the United Nations Centre for Urgent Environmental Assistance (UNCUEA) NILU is establishing a mobile measurement platform and field laboratory for monitoring and modelling of toxic and explosive gases released after a major accident. This technology is further developed to represent part of the environmental information system (EIS) in the MEMbrain project on Major Emergency Management. The concept including on-line meteorological measurement for modelling danger zones linked to mobile gas sensors and unmanned airborne vehicle (UAV) will be presented.

1. Introduction

NILU is responsible for air quality monitoring and surveillance programmes in Norway, and represents the Central Co-ordinating Unit for the European Monitoring and Evaluation Programme (EMEP). NILU has also been involved in the establishment of air pollution monitoring and modelling for warning and alarm systems. As part of these tasks NILU has developed, established and operated air quality measurement programmes during the last 25 years.

NILU was asked by the World Health Organization (WHO) to provide and install monitoring stations for air quality in Kuwait during the oil fires following the Gulf war in 1991.

NILU is together with several co-institutes developing a complete environmental surveillance and information system (ENSIS '94) for the winter olympic games in Lillehammer.

A mobile measurement platform for monitoring, modelling, forecasting and warning during large accidents is being developed for UNCUEA. This technology will be further developed to be established as the land based environmental information system as part of the Eureka MEMbrain development project.

2. Air quality monitoring system for Kuwait

NILU was requested by the World Health Organization (WHO)/UN Environment Programme (UNEP) to provide and install monitoring stations for air quality after the Gulf war in 1991. The NILU tasks were part of the UN Inter-Agency Plan for the Gulf Region. The objectives were to combat the destruction of the environment by supporting necessary air quality information, and to inform and alarm the population of Kuwait City in case of smoke drifting into highly populated areas (Sivertsen et Berg, 1991).

NILU had also been operating air quality instruments at a Norwegian field hospital in Umm Quasr at the border between Kuwait and Iraq since mid May 1991. The installation of a monitoring

In the afternoon of 7 June 1992 the wind suddenly increased to more than 10 m/s, the temperature dropped and the PM_{10} concentration exceeded an extremely high value of 8000 µg/m³.

The UN/WHO supported installation of an air quality surveillance and warning system for Kuwait was operated at the end of the large oil fires in the area. It was not enough time and the technical facilities did not permit a complete test of the system as an operational warning system. The installations are, however, used presently in the routine surveillance of air quality in Kuwait.

3. Radioactivity alarm system for Norway

NILU has developed and installed an automatic alarm system for radioactivity in Norway, originally requested by the Ministry of Environment following the Chernobyl accident in 1986 (Berg, 1994).

A total number of 21 monitoring stations are operated all over Norway. One station is located in Russia on the Kola peninsula about 150 km east of the Norwegian border. Eleven stations are equipped with total gamma radiation detectors. The rest are radiation spectrometers measuring specific radioactive isotopes. Most of the spectrometers are located in the two most northern Counties of Norway, closest to the border of Russia (Berg, 1993).

Figure 3: The radioactivity alarm system for Norway

The detectors are connected to a NILU data logger. Data are collected automatically and transferred via telephone lines to the NILU computer centre every 3 hour. A computer programme is performing data quality controls and is calculating and presenting radioactivity levels and spectra of nuclides.

In case the total radiation or the concentrations of specific nuclides exceeds a pre-set level, an alarm is automatically tranfered to the NILU telephone or to a personal pager carried by NILU personell. The alarm levels are set for specific isotopes like Cs-137, Cs-134 and I-131. In this way it is also possible to explain the reasons and to distinguish between potential sources for radioactive releases when an alarm is issued.

If the readings are found relevant the responsible authorities are alerted and the Norwegian Nuclear Emergency Organization and the Advisory Committee for Nuclear Accidents under the Norwegian Radiation Protection Authority will be set in operation.

The NILU alarm system is very sensitive and alarms have been issued during natural occurring "high levels". This could be washout of radon daughters during storms, or strong "leakages " from the soil of similar isotopes. The spectres enable us to distinguish between "new accidents" and radon daughters, and have improved the validity of the warning system

The NILU established warning system is operated in close co-operation with the other Nordic countries, which make the system even more reliable. The experience so far is a fast response reliable warning system with a very high degree of data availability.

et al., 1993). As part of the input to the models a chemical library will be installed.

The container also include radioactivity sensors to measure total radiation levels and the level of specific nuclides.

The NILU staff participated together with the Norwegian Pollution Control Authorities and UNCUEA in Geneva in an exercise to test the communication system. A hypothetical gas tank accident in Algeria was followed and evaluated throughout 24 hours. The cloud composition and size were estimated and information and warnings were issued.

5. MEMbrain

A further development of the land based environmental information system is undertaken as part of the Eureka project MEMbrain. NILU is basing this development upon the existing experience from the work performed in the radioactive alarm system and in UNCUEA (Sivertsen, 1993).

New technologies and knowledge gained through the establishment of a complete Environmental Surveillance and Information System (ENSIS '94) developed for the Winter Olympic Games in Lillehammer, will also be used in the MEMbrain project.

The development of the land based alert and emergency system for MEMbrain will consist of three parts:

1. A measurement platform with chemical sensors, instruments for measurements of radioactivity, meteorological equipment, data transfer and storage systems and dispersion modelling capability for accidental releases and normal dispersion conditions.
2. Development and testing of dispersion models for accidental releases, transport and dispersion of gases and the consequence analysis in local scale. Routines for quality control, user interface and geographical information systems for presentation of results will be included in the development.
3. Preparing the existing radioactivity data for use in the Norwegian MEMbrain case, including demonstration of models for estimates of radioactivity on a local scale.

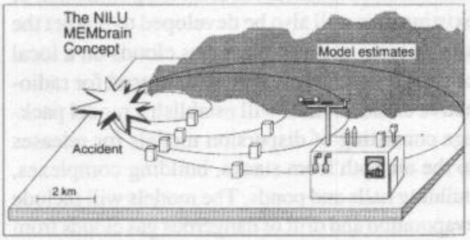

Figure 5: The MEMbrain land based environmental information system

In addition the possibilities for use of unmanned airborne vehicles (UAV) will be evaluated and reported, particularly for use in major accidents.

5.1 Measurements platforms and field laboratory

A measurement platform for mapping of the danger areas after accidents of all kinds is being developed. This platform will be equipped with mobile sampling units that can be used for mapping the gas clouds close to the accident point to submit information about the releases; release size, release type, amount and composition of the gases in question. Together with meteorological data this information will represent the input data for estimates of transport, dispersion and the size of chemical clouds following the accident. This will represent the basis for forecasting and reporting of danger areas. The meteorological data available on the platform will be used on-line as input to the models, through evaluation of appropriate scaling parameters (Gryning et al. 1987).

Equipment for tracer gas experiments can also be installed in the platform. This technique can be used for detailed mapping of leakage and dispersion patterns if required.