CURRENT MANAGEMENT APPROACHES IN THE EVENT OF RADIOLOGICAL EMERGENCIES

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ABSTRACT

Since the accident at the nuclear power plant at Chernobyl in 1986, most European countries have undertaken major efforts to implement international conventions and recommendations, develop real-time emergency response systems and upgrade early warning/monitoring networks. Despite of these improvements several areas (logistics, hardware, software) are still in need for further R & D.

THE ISSUES

The accident at the Ukrainian Chernobyl nuclear power plant on April 26, 1986, reveiled severe emergency management deficiencies in Europe in the following areas:

- lack of adequate international agreements addressing the transnational consequences of such a major nuclear accident.
- problems with the degree of comparability of information obtained at the local, regional or national levels, describing the environmental radioactive contamination situation.
- incoherent national regulations concerning trade import and export, especially food, food products and animal fodder.
- inadequate public information systems dealing with perceived fears of members of the public as well as dealing with the media.

These issues can be addressed in terms of monitoring networks and communication, emergency response systems, and international conventions and recommendations. In this paper, examples of the international and national responses to improve radiological emergency management in Europe over the last 10 years is briefly described.

MONITORING NETWORKS AND COMMUNICATION

The arrival of the Chernobyl-fallout in Western Europe in three major plumes during 26 - 30 April 1986 resulted in the upgrading of several national early warning- and environmental monitoring networks. In most countries where a large network has been established, the routine environmental monitoring mode (usually gamma dose-rate) will trigger the emergency response operating mode when elevated activities are detected, but in some cases manual operation is still used. Monitoring for atmospheric aerosols and iodine have also been considered to be part of the overall national systems.

If one takes into account the existing (and ready to be deployed) gamma dose-rate and aerosol monitoring coverage per unit population density (persons/km^2), the ten countries that rank highest in Europe are shown in Table 1. The number of stations per population density of the country can be grouped into three general categories of monitoring capabilities of > 10 stations/pop density, between 1 and 5 stations/pop density, and less than 1 stations/pop density. Finland, Spain (when the stations are deployed) and Germany fall into the category with greater than 10 stations per unit population density. Austria, Ukraine, Sweden, France and Norway fall between 1 to 5 stations and leaving Ireland and Hungary with the group of other European countries that have fewer than 1 stations per unit population density.

The density of radiation monitors is irrespective to the size of the national nuclear program (for example France and Germany compared to Austria and Norway), and these results illustrate the importance given to establishment of monitoring networks. This is important due to the relatively small distances between European States leading to the increased probability of transboundary contamination. Further standardization efforts are necessary to improve the comparability of data obtained with these systems:

- hardware: radiation detector systems; measurement conditions (height above ground, collimators, energy response, time-averaging periods, data transmission frequency), early-warning alarm-discriminator;
- analysis: quality assurance and -control of input data and data evaluation systems (e.g. system status, formal and technical compliance with standards or database, consistency between data pools).

At the IAEA (Vienna) a 24 hour-communication centre has been established for the exchange of data in standardized formats. An International Nuclear Event Scale (INES) has been devised. The seven classes of accident scenarios take into account off-site and on-site impacts, worker exposures and degradation of safety systems. It is hoped that with the use of INES misunderstandings can be avoided among all parties envolved in the management of a large scale nuclear accident.

EMERGENCY RESPONSE SYSTEMS

European capabilities for the real-time assessment of accident consequences and emergency response have improved since 1986 due to the development of computer-based support systems, such as: SPADE, MC31 and 3-DRAW for modelling atmospheric dispersion at short-range, mesoscale ($\leq$ 200 km from the source) or long range; STEP and START as feedback-models for estimating the source term and releases; EURALERT as dose assessment programme for different pathways, using data from modelling and measurements.

The RODOS project, funded by the Radiation Fission Safety Program of DGXII of the European Commission, is a major effort to integrate real-time monitoring and emergency response decision-making on a European scale. The large cooperative effort with Eastern European countries adds to the importance of this project.

Despite of these improvements several issues remain to be addressed in the future, e.g.:

- quantification of the uncertainties for the different models, particularly in view of limited respresentativeness of the data available for model validation;
- sensitivity analysis on the significance of contributing factors, such as: topography, agricultural practices or complex meteorological conditions (e.g. deposition in fog; variable wind conditions in stagnant anticyclones), gravitational settling.

INTERNATIONAL RECOMMENDATIONS AND CONVENTIONS

An essential element of confusion during the post-Chernobyl period was the heterogeneous international approach to the **limitation of the radionuclide content in foods**. A major step towards harmonization, thereby facilitating international trade, was the development of the *Codex Alimentarius Commission's guidelines* (1). It is to be noted that only 4 different values for limiting the activity concentration of 10 nuclides in all food, milk and drinking water for general consumption and for infants are used, e.g. 1000 Bq/kg for ^{134}Cs, ^{137}Cs, ^{103}Ru, ^{106}Ru, ^{89}Sr. This results in an increase of the ingestion dose for those countries with previously lower limits (e.g. for ^{137}Cs in milk in the EU: 370 Bq/kg; in Austria: 175 Bq/kg, resp. 12 Bq/kg for infants).

In the area of **early notification and mutual emergency assistance** in a nuclear accident two IAEA-Conventions reduce the shortcomings noticed after the Chernobyl accident (2,3). However, some topics of ambiguity remain, such as:

- what information about the accident is considered „relevant"? What time-period meets the request for information-supply „as soon as possible"?
- what uncertainty is acceptable in the modelling-based forecast whether a release „may occur", whether this „may result" in a transboundary contamination, which State „may be affected"?
- if the resources of a State are insufficient to respond „adequately" to a large accident, can it still refuse external assistance (because of security issues or pride), thereby increasing the radiological consequences in another State?

The issue of timely provision of relevant information about the Chernobyl accident by the former USSR and the adequacy of some European countermeasures were subject to debate. It is foreseeable that divergent interpretations of the above topics can cause further dispute in another large scale nuclear accident.

CONCLUSIONS

Major improvements have been achieved in emergency management since 1986. Nevertheless, comparability of the assessment of the radiological situation and the adequacy of countermeasures are still affected by remaining ambiguities in the interpretation of conventions, insufficient model validation for real-time assessment and lack of standardization concerning monitoring networks. Besides reducing the difficulties that can result in the application of emergency response measures, a more standardized approach would facilitate consistent communication of countermeasures and actual risks to the general public.

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Table 1: Ranking of top-ten values of a list of 19 States with early warning monitoring systems (4,5,6)

Country	No. of operating nuclear power plants	Rank $\left[\frac{\text{total no. of stations}}{\text{population density}}\right]$
Austria	0	4
Finland	4	1
France	56	7
Germany	21	3
Hungary	1	10
Ireland	0	9
Norway	0	8
Spain	9	2
Sweden	12	6
Ukraine	15	5