Chernobyl 10 yrs on. Radiological & Health Impact
OECD NEA

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Chapter VIII

LESSONS LEARNED

The accident did not affect each country in the same way and a different emphasis was placed on various aspects of the accident with particular reference to the circumstances of that country. Thus, countries remote from the accident, with no domestic nuclear power programmes or neighbouring reactors, tended to emphasise food control and information exchange as their major thrust for improvement. Whereas those countries which were contaminated by the accident, and had their own nuclear power programmes and/or reactors in neighbouring countries, drew extensive lessons from the way the accident developed and was treated. For these reasons, not all the lessons learned were applied universally with the same emphasis.

Operational aspects

The Chernobyl accident was one of a kind, and, although it highlighted deficiencies in emergency preparedness and radiation protection, it should not be seen as the reference accident for future emergency planning purposes (*Bu91*).

It was very clear from the initial reactions of the competent national authorities that they were unprepared for an accident of such magnitude and they had to make decisions, as the accident evolved, on criteria that could have been established beforehand. This also meant that too many organisations were involved in the decision-making, as no clear-cut demarcations had been agreed and established. Areas of overlapping responsibility and jurisdiction needed to be clearly established prior to any accident. A permanent infrastructure needed also to be in place and maintained for any efficient implementation of protective measures. Such an infrastructure had to include rapid communications systems, intervention teams and monitoring networks. Mobile ground monitoring teams were required, as was aerial monitoring and tracking of the plume. Many countries responded to this need by establishing such monitoring networks and reorganising their emergency response.

Logistic problems associated with intervention plans, such as stable iodine distribution (*Sc94*, *NE95a*) and evacuation obviously needed to be in place and rehearsed long before the accident, as they are too complex and time-consuming to be implemented during the short time available during the evolution of the accident. Intervention actions and the levels at which they should be introduced needed to be agreed, preferably internationally, and incorporated into the emergency plans so that they could be immediately and efficiently implemented.

The accident also demonstrated the need to include the possibility of transboundary implications in the emergency plans, as it had been shown that the radionuclide release would be elevated and the dispersion of contamination more widespread. The concern, raised by the experience of Chernobyl, that any country could be affected not only by nuclear accidents occurring on its territory but also by the consequences of accidents happening abroad, stimulated the establishment of national emergency plans in several countries.

The transboundary nature of the contamination prompted the international organisations to promote international cooperation and communication, to harmonise actions (*NE88, IA94, IC90, IC92, NE93, NE89, NE90, NE89b, WH88, WH87, IA89b, IA92, IA91a, IA89c, IA87a, IA94a, EC89a, EC89b)* and to develop international emergency exercises such as those organised by the OECD/NEA in its INEX Programme (NE95). A major accomplishment of the international community were the agreements reached on early notification in the event of a radiological accident and on assistance in radiological emergencies through international Conventions in the frame of the IAEA and the EC (*EC87, IA86b, IA86c*).

Furthermore, in order to facilitate communication with the public on the severity of nuclear accidents, the International Nuclear Event Scale INES was developed by the IAEA and the NEA and is currently adopted by a large number of countries.

The accident provided the stimulus for international agreement on food contamination moving in trade, promoted by the WHO/FAO, as there is a need to import at least some food in most countries, and governments recognised the need to assure their citizens that the food that they eat is safe. Monitoring imported food was one of the first control measures instituted and continues to be performed (*FA91, EC89c, EC93a*).

This event also clearly showed that all national governments, even those without nuclear power programmes, needed to develop emergency plans to address the problem of transboundary dispersion of radionuclides. Of necessity these plans had to be international in nature, involving the free and rapid exchange of information between countries.

It is essential that emergency plans are flexible. It would be foolish to plan for another accident similar to Chernobyl without any flexibility, as the only fact that one can be sure of is that the next severe accident will be different. Emergency planners need to distil the general principles applicable to various accidents and incorporate these into a generic plan.

The accident emphasised the need for public information and public pressure at the time clearly demonstrated this need. A large number of persons who are knowledgeable about the technique of providing information, are needed to establish a credible source of information to the public before an accident, so that clear and simple reports can be disseminated continuously in a timely and accurate form (*EC89*).

Emergency plans also need to include a process by which large numbers of people could have their exposure assessed, and those with high exposures differentiated. The accident also highlighted the need for the prior identification of central specialised medical facilities with adequate transportation to treat the more highly exposed individuals.

Refinement and clarification of international advice was needed (*Pa88*). The recommendations for intervention in an accident contained in ICRP Publication 40 were not clearly understood when they came to be applied, and the Commission reviewed this advice in Publication 63 (*IC92*). This guide placed emphasis on the averted dose as the parameter against which an intervention measure should be assessed. It was also made clear that an intervention had to be "justified" in as far as it produced more good than harm, and that where a choice existed between different protection options, "optimisation" was the mechanism to determine the choice. Emphasis was also placed on the need to integrate all protective actions in an emergency plan, and not to assess each one in isolation, as one may well influence the efficacy of another.

Scientific and technical aspects

Prior to the accident, it was felt that the flora and fauna of the environment were relatively radioresistant and this was supported by the fact that no lethal radioecological injuries were noted after the accident except in pine forests (600 ha) and small areas of birch close to the reactor. A cumulative dose of less than 5 Gy has no gross effect even in the most sensitive flora of ecological systems, but

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there are still ecological lessons to be learned especially on the siting of nuclear power reactors (*Al93*).

Plant foliar and root uptake is being studied, as are resuspension and weathering. The transfer coefficients at all stages of the pathways to human exposure are being refined. Following the accident, an assessment of the models used at thirteen sites to predict the movement of iodine-131 and caesium-137 from the atmosphere to food chains (*Ho91*) indicated that models commonly used tended to overpredict by anything up to a factor of ten. The extensive whole-body monitoring of radioactivity in persons undertaken in conjunction with the measurement of ground and food contamination allowed refinement of the accuracy of the models for human dose assessment from the exposure through different pathways. The methods and techniques to handle contamination of food, equipment and soil have been improved.

Meteorological aspects, such as the relationship between deposition and precipitation and greater deposition over high ground and mountains, have been shown to be important especially in the development of more realistic models (*NE96a*). The importance of synoptic scale weather patterns used in predictions was established, and different models have been developed to predict deposition patterns under a wide variety of weather conditions. The chemico-physical changes in the radioactive gases and aerosols transported through the atmosphere are being studied to improve the accuracy of transport models.

Other impacts of the accident on model refinement include the improvement in understanding the movement of radionuclides in soil and biota, pathways and transfer factors; the effect of rainstorms and the influence of mountains and the alignment of valleys on deposition patterns; particulate re-suspension; long range pollution transport mechanisms; and the factors which influence deposition velocities (*NE89a*, *NE96*).

Uniform methods and standards were developed for the measurement of contaminating radionuclides in environmental samples.

In the case of high exposures the importance of symptomatic and prophylactic medical and nursing procedures, such as antibiotics, anti-fungal and anti-viral agents, parenteral feeding, air sterilisation and barrier nursing was demonstrated, as were the disappointing results of bone-marrow transplantation.

In addition, the accident led to an expansion of research in nuclear safety and the management of severe nuclear accidents.

On the other hand, there is a need to set up sound epidemiological studies to investigate potential health effects, both acute and chronic. In the Chernobyl case, the lack of routinely collected data, such as cancer registry data that are reliable enough, led to difficulty in organising appropriate epidemiological investigations in timely manner. There appears to be a need for developing and maintaining a routine health surveillance system within and around nuclear facilities.

In summary, besides providing new impetus to nuclear safety research, especially on the management of severe nuclear accidents, the Chernobyl accident stimulated national authorities and experts to a radical review of their understanding of, and attitude to radiation protection and nuclear emergency issues.

This led to expand knowledge on radiation effects and their treatment and to revitalise radioecological research and monitoring programmes. emergency procedures, and criteria and methods for the information of the public.

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Moreover, a substantial role in these improvements was played by multiple international co-operation initiatives, including revision and rationalisation of radiation protection criteria for the management of accident consequences, as well as reinforcement or creation of international communication and assistance mechanisms to cope with the transboundary implications of potential nuclear accidents.