IAEA technical assistance in support of contamination monitoring following the Chernobyl accident

Over the past 5 years, countries have requested a range of services

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The radiological impact of the Chernobyl nuclear plant accident in April 1986 was not limited to the Soviet Union, but was felt widely in the northern hemisphere. As a result, national authorities in many countries took steps to safeguard public health. A number of them asked the IAEA to support their efforts, and over the past 5 years various national and regional technical assistance projects have been established.

This article presents an overview of the type of assistance that was requested, and takes a closer look at the situation in selected IAEA Member States. Case histories of Turkey and Iceland are presented in some detail since they reflect two typical, yet different situations. On the one hand, Turkey was significantly affected by the Chernobyl accident, since the fallout seriously affected the wholesomeness of a number of food products or feedstuffs, with a strongly negative impact on the national economy. Iceland, on the other hand, was little affected directly; however, the authorities realized that they had no established infrastructure to control the level of radioactivity in agricultural produce or seafood, rendering them unable to certify a satisfactory radiohygienic quality vis-à-vis either their own population or their trading partners.

General problems

In the wake of the Chernobyl accident, countries were faced with two main problems: (1) what actions they had to take immediately and in the months following the accident — the acute period, and (2) what long-term activities would be necessary, firstly to follow up and, secondly, to be prepared for any other such eventuality in the future. This was the case even in countries where no fallout occurred, since public concerns made it necessary for national authorities to establish radiological controls on imports of food and other products that derived from contaminated areas.

The first problem requires the capability to determine intervention levels (the levels of contamination at which authorities will take protective actions), to measure radioactivity, and to compare the results against the intervention levels. The second problem, namely long-term activities, involves continued monitoring to follow the decay of radioactivity; and the establishment of an early warning system to automatically signal national authorities when any unusual change in the pattern of the radiation background occurs.

In its post-Chernobyl assessment of national needs and capabilities, the IAEA found that a relatively large number of its Member States in the developing world have neither an established environmental monitoring programme nor laboratories that can undertake radioactivity measurements in support of a sample collection network. In many cases, this is because they have limited applications of radioactive sources.

The case of Turkey

Turkey was one of the first countries to be significantly affected by radioactive precipitation originating from the Chernobyl accident. Shortly afterwards, Turkish authorities noted an increase in radioactivity levels of various plants, domestic animals, and food

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products, especially in the northeast of the country, near the Black Sea. As early as May 1986, they requested the IAEA's advice on how to strengthen their environmental and other monitoring capabilities to allow them to meet the requirements of the emergency.

An Agency mission visited the country to assess radiation protection activities. It noted that neither the existing measurement capabilities nor the manpower were adequate to handle the increased number of samples that would need to be analysed. The mission recommended upgrading the laboratory of the Turkish Atomic Energy Authority (TAEA) in Ankara and instituting a training programme so that personnel would be able to undertake environmental monitoring and routine control of food samples. As part of the upgrading, the Agency provided a high-sensitivity semiconductor system so that the contamination measurements could be done with the necessary accuracy and speed.

An environmental monitoring programme was established in Turkey at three levels. Measurements were to be made at (1) the well equipped facilities of TAEA in Ankara and Istanbul, which were able to provide detailed radiocontamination analyses, using sensitive equipment; (2) units in a number of cities using less sophisticated gamma spectrometry and portable monitors to provide quick, though less detailed, monitoring data (at Izmir, Giresun, and three towns that are focal points for the food export trade); and (3) several sites using sensitive dose-rate meters to monitor atmospheric contamination, including any radioactive precipitation.

Apart from monitoring food products for local consumption, foodstuffs intended for export were controlled — for example, tea, meat, milk products, nuts, and hay. The equipment to measure radioactivity in food was made available to factories involved in food production, since the ability to guarantee the radiohygienic quality of exported food had a direct impact on the national economy. In addition, routine analysis of radioactivity in the Black Sea was strengthened. To support this programme, an alpha measurement system was developed at the Ankara Nuclear Research and Training Centre based on the use of a silicon surface-barrier detector.

Since several different laboratories participated in determining levels of radioactivity in the environment and food (for example, eight were involved in measurements on tea), a national intercomparison exercise was organized to provide the quality control necessary to guarantee comparability of data.

In 1987, Turkish authorities also approached the IAEA for advice on specific issues regarding disposal of the contaminated tea collected in 1986. The level of measured contamination, which ranged from 12 kilo-becquerel per kilogram (kBq/kg) to more than 50 kBq/kg, rendered the tea unsuitable for consumption, and it had been put into safe temporary storage. It was estimated that the stored tea contained several tens of curies of caesium and it was recognized that it represented a radiation protection problem. Careful study by IAEA experts indicated that very wide dispersion of the tea to obtain a low areal concentration and shallow ground burial were acceptable and safe disposal procedures if undertaken under controlled conditions.

The amount of radioactive contamination measured in tea from the northeast part of the country suggested that it would also be important to monitor for internal contamination large groups of the Turkish population, especially persons from that area. No such monitoring had been carried out in Turkey previously. Since tea consumption is very high in Turkey, amounting to a few litres of highly concentrated infusion per person daily, this mode of ingestion was recognized to be a critical pathway for internal contamination with radioactive caesium.

A locally made whole-body counter was installed in the Department of Radiobiology at the Cekmece Nuclear Research and Training Centre in Istanbul specifically for monitoring caesium radionuclides. Then, in early 1988, two additional, sophisticated whole-body counting systems were installed by the TAEA, one at the Ankara Nuclear Research and Training Center and one at the Cekmece Nuclear Research and Training Centre, to increase the capability for whole-body radioactivity monitoring. At the same time, a mobile whole-body monitoring laboratory equipped with two additional counters already was being operated by the Cekmece Centre.

The Agency provided expert services to advise and train the staff on internal contamination monitoring and dose assessment, while advice was also given on procedures for calibrating the whole-body counters and for interpreting the measured data. A large number of whole-body radioactivity measurements were performed using these counters and values of up to 20 kBq per person were reported.

Early warning network. Parallel to radioactivity measurements in people and foodstuffs, Turkish authorities planned to establish, as part of the national environmental radioactivity monitoring programme, an early warning monitoring network. In support of this, a new IAEA technical assistance project was requested and established. The Agency assisted the TAEA in obtaining technical information from other countries affected by the Chernobyl accident and arranged for two Turkish specialists to visit Poland to study the monitoring system established there. Information was also provided on monitoring equipment available on the market. As a result, the authorities decided to install a number of Geiger-Mueller detectors and to develop their own computerized EWERMS (early warning environmental radiation monitoring system). The Agency contributed to its establishment by providing various items of equipment, including nine personal computers.

The system comprises eleven microprocessor-based "intelligent" radiation monitors together with the associated detectors, printers, alarm units, and accessories. The individual local stations distributed along the Turkish borders are linked directly to the TAEA's Ankara Centre by telephone line. In this "real-time" system, the data is automatically logged, transferred to the central station at Ankara, analysed on line, and printed out. As part of the system, dose-rate meters with a sensitivity below 1 millirem per hour were installed at 10 national sites in 1987. The number of sites has since been enlarged. The monitoring stations are now in routine operation; the computer software being developed with IAEA assistance will serve as the "heart" of the early warning system and will commence trials in mid-1991.

The case of Iceland

Iceland had no regular environmental monitoring programme at the time of the Chernobyl accident. With a view to obtaining expert advice, the Ministry of Foreign Affairs invited the IAEA to send a mission to study the status of radiological protection in the country. The mission concluded that, while knowledge and understanding of the various aspects of radiation safety was good, the activities being undertaken were limited in scope and inadequate under the special circumstances to assess radioactivity in the environment, in the food chain, and in food, whether imported or locally produced for internal consumption or export. It was also noted that it would be of value to modernize the monitoring system for radiation workers.

With manpower available for specialized training, a comprehensive programme of activities was initiated at the National Institute for Radiation Protection at Reykjavik, supported through a project established in 1987 under the IAEA's technical co-operation programme. The main emphasis was on establishing gamma spectrometry for analysis of environmental samples. Spectrometry equipment was provided, as was a thermoluminescence dosimetry system for personnel monitoring. IAEA experts advised on the various aspects of monitoring food and environmental radioactivity, including interpreting the results and certifying the wholesomeness of food products.

In August 1989, a regular programme of monitoring that covered measurements of radioactivity in soil, plants, and local agricultural produce was established by the National Institute for Radiation Protection in co-operation with the Institute for Agricultural Research and the National Centre for Food Control.

In Iceland, fish and fish products are not only important in daily diets but are also a major source of export revenue. Hence, the Directorate for Shipping in collaboration with the Oceanographic Institute, the Fisheries Research Laboratories, and the Meteorological Institute set up a programme to monitor radioactivity in air, rainwater, sea water, fish, and bladder wrack. This programme, complementary to the one of the National Institute for Radiation Protection, is also receiving IAEA support.

National activities foresee establishing an early warning environmental radiation monitoring system. It would be similar to that already established in the Nordic countries, which were the first to provide any national authority with a warning of the increase in environmental radioactivity that was subsequently traced to Chernobyl.

Middle East countries

In the Middle East, some countries reported problems, specifically in regard to controlling food contamination and monitoring the environment. Even though precipitation from the radioactive plume of the Chernobyl accident was rather negligible in these countries, concerns were raised about exposures through the food chain, since many of these countries rely heavily on both imported foodstuffs for human consumption and feed for animals. As in the case of Iceland, appropriate radiation protection infrastructures were lacking.

In 1987, a "sub-regional" IAEA technical co-operation project was formulated following a co-ordination meeting in Amman with representatives of the countries concerned. The meeting identified specific needs and priorities based on national inputs, reports from

IAEA Radiation Protection Advisory Teams (RAPATs), project requests, and IAEA evaluations.

The project comprises the following principal activities:

- Elaboration of relevant national standards, including intervention levels;
- Establishment of local national laboratory facilities capable of measuring contamination in environmental samples and foodstuffs;
- Training in methodologies for sample collection and preparation for measurement;
- Establishment of national networks for monitoring radioactivity in the environment, including automatic EWERMS;
- Establishment of national programmes to measure natural radiation levels;
- Training in absorbed dose calculation for critical population groups;
- Manpower development for the above tasks.

In 1989, following the recommendations of RAPAT missions, a further, broader-based regional project was established. Its particular objective was to reinforce activities of the national regulatory body in the respective countries, especially with regard to the practical aspects of radiation protection, and to promote co-operation among these bodies. Achievements under these projects to date can be briefly summarized as follows:

- There has been significant progress in upgrading national radiation safety service capabilities.
- Derived intervention levels, based on local data concerning food and water consumption, were established.
- There has been a marked improvement in the availability and standard of gamma spectrometry (food and environmental samples) and of thermoluminescence dosimetry used for environmental control.
- Several intercomparison exercises were conducted in support of quality control as applied to measurements.
- EWERMS have been or are being set up.
- Eleven regional training courses and workshops were devoted to environmental monitoring and control, and six were conducted on the practical aspects of radiation protection, mostly related to strengthening national radiation protection infrastructures (over 200 participants received training).

Mutual co-operation and consolidation of efforts at various sub-regional levels have already shown benefits in terms of better identification of common problems and possible collaborative approaches to solving them. An example is the series of intercomparison measurements on environmental and food samples which are of practical importance in countries of the region. The first was organized using standardized milk samples, with the IAEA's Seibersdorf Laboratories as the focal point. The second used samples prepared by the participating countries; the Syrian Atomic Energy Commission's laboratory in Damascus was selected as the focal point. These intercomparisons are essential for quality control of these necessarily sensitive radiation measurements. They further serve to improve local capabilities in the participating countries, as well as collaboration among them.

As noted earlier, the IAEA is helping to set up EWERMS in certain countries of the region. Equipment developed in Poland was selected for use in the field stations. Telephone, telex, and radio transmission systems are being considered for the transmission of data over the national networks. In a joint effort involving the countries, the IAEA's Seibersdorf Laboratories, and the suppliers of the equipment, a computerized EWERMS has been developed and demonstrated at a workshop in March/April 1990 in Damascus. Iraq, Jordan, Syrian Arab Republic, and United Arab Emirates are the initial beneficiaries. Cyprus and the Islamic Republic of Iran have expressed their interest, and they will be establishing such networks with IAEA technical assistance under national projects.

However, looking at the status of radiation safety in many of the Middle East countries, it was noted that the problems reported with establishment and implementation of radiation protection activities were mainly a result of the shortage of qualified local manpower. Many of the countries rely heavily on expatriate personnel, which does not provide a sufficient guarantee for the future, particularly in the event of an accident or an emergency. Consequently, where manpower is lacking, training for duties at all levels must be recognized as a task of the highest priority. Other tasks include setting up appropriate environmental surveillance, organization of emergency planning and preparedness, perhaps on a sub-regional basis, and adherence to the IAEA *Convention on Early Notification of a Nuclear Accident* and the *Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.*

Requests from other countries

Following the Chernobyl accident, Greece sought and received assistance to improve its national environmental radioactivity monitoring network, and was provided with some equipment for alpha and beta monitoring. In Hungary, the environmental radiation telemetry system is being extended to cover the whole country using the field stations of the Hungarian Meteorological Service. Poland sought assistance to establish an EWERMS using the field monitors they have developed.

Since 1987, Portugal has received Agency assistance to establish a nation-wide scheme to assess individual and collective population doses. Through a bilateral arrangement, an EWERMS is also being set up there. In the Republic of Korea, it was decided to extend the environmental monitoring programme in response to public concerns following the Chernobyl accident.

In Yugoslavia, different institutes in the individual republics take responsibility for various aspects of radiological protection. The IAEA has supported the upgrading of environmental measurement laboratories and the establishment of a new ecological laboratory. This laboratory has a mobile unit designed for detecting and analysing pollution caused by radioactive substances, as well as by specific chemical and biological ones.

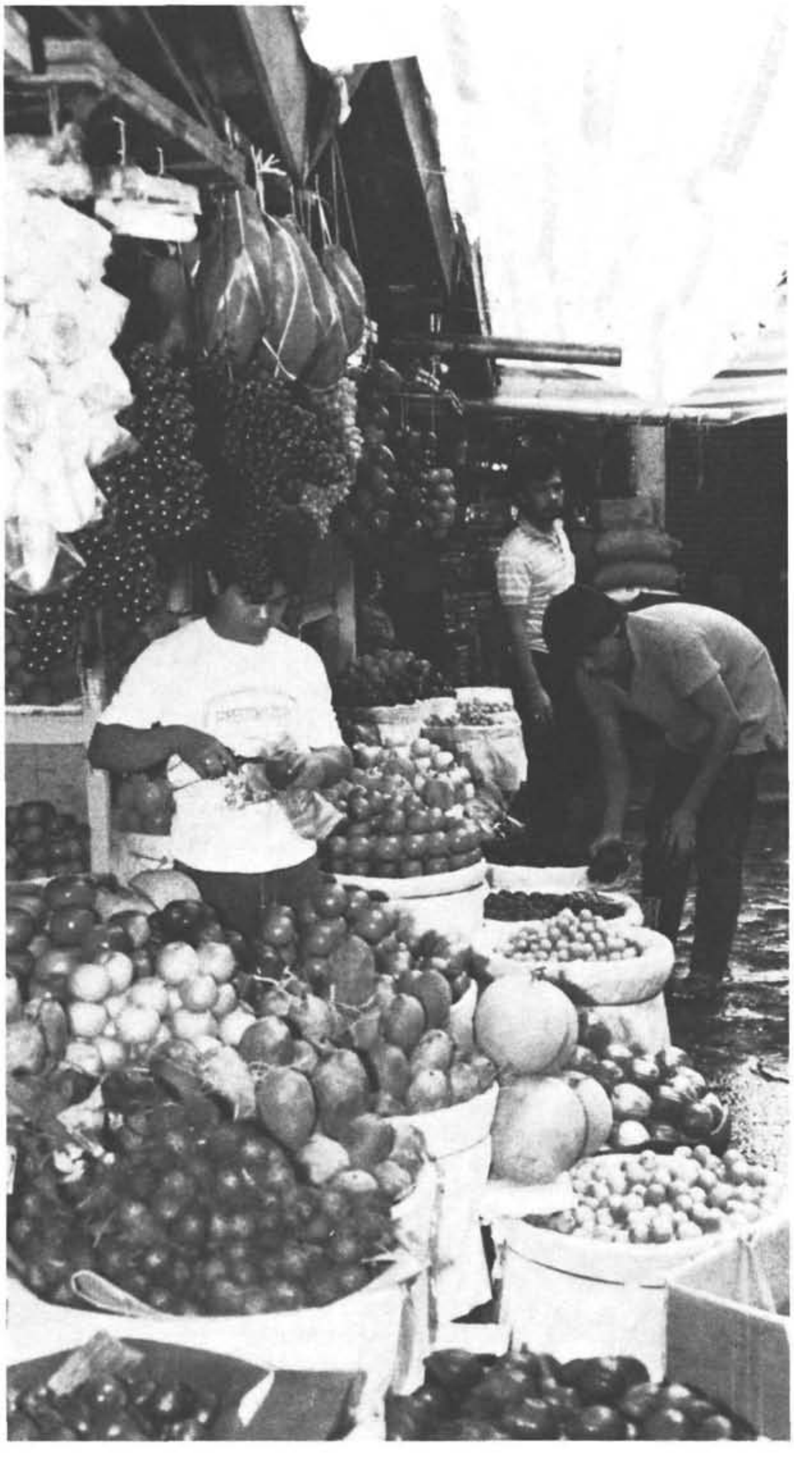
Many countries sought IAEA assistance to either analyse or help them analyse food samples, mostly for checking imported food items for radioactivity. Among these countries were Morocco, Saudi Arabia, Singapore, and Venezuela. Tunisia had both personnel and equipment available for undertaking such studies, but received expert assistance to define a reproducible protocol to determine radioactivity in milk. Ghana, the Libyan Arab Jamahiriya, and Zambia requested analyses of imported foodstuffs; samples were sent to the Seibersdorf Laboratories, which did the analysis.

Other areas of interest for which several countries sought IAEA support were monitoring of radioactive body burdens in members of the public using whole-body counters, and setting up mobile emergency monitoring teams that would also undertake routine environmental surveys.

Changing national perspectives

The Chernobyl accident brought about a change in national perspectives, especially as they relate to public health and radiological safety. More and more countries have become aware of the need to have an organized radiological protection programme, even those that use radiation sources in medicine, industry, or other fields to a limited extent.

The IAEA has been able to respond to national requests for assistance largely through its established technical co-operation programme. It has become an important catalyst for building up both the confidence and capabilities of radiation protection authorities in many countries.



Monitoring the environment to assess levels of radioactivity in the air, soil, plants, and food became necessary in many countries after the Chernobyl accident in 1986, and many national authorities sought support from the IAEA.