POLAND

The first four weeks

by Zbigniew Jaworowski

A 700-fold increase of air activity and a 10-fold increase of ambient gamma dose rate were observed in Poland in the early morning on Monday, 28 April 1986, at one of the 140 permanent stations of the Service of Measurements of Radioactive Contaminations (SPSP) in Mikolajki, in the northeastern part of the country.

In accordance with the "Instructions of the SPSP" these exceptional readings were immediately transmitted by telephone to the Central Laboratory for Radiological Protection in Warsaw (CLOR), which is a co-ordinating centre for the SPSP system throughout the country. The station in Mikolajki changed its mode of operation from its normal state into an emergency one, i.e., from one replacement of aerosol filter a day — followed by radioactivity measurements after one hour and then after 120 hours — into one replacement every two hours and immediate measurement of activity. Together with the gamma dose rate readings these measurements were reported every two hours. The first information on findings in Mikolajki reached CLOR at about 9 a.m. on 28 April, and soon afterwards similar information arrived from several other SPSP air- and dose-rate monitoring stations in northern Poland and in Warsaw. At 10 a.m. on the same day, CLOR initiated the emergency operation in 24 stations, and beginning on the morning of 29 April, in all 140 stations of the SPSP system.

During the morning hours on Monday, 28 April, a large number of reports started to reach CLOR and a six-person operational group was formed to analyse incoming information. In the afternoon of the same day, a similar group was formed at the National Atomic Energy Agency. From the gamma spectrometric analysis of an air filter collected at 13:00 hours in Warsaw, it was clear that the composition of radionuclides in the air was typical of a reactor fission rather than of a nuclear explosion, with the radioiodines and tellurium-132 contributing about 80 per cent of the activity. At 20:00 hours, the group prepared the first preliminary report on the radiological situation in the country for the President of the National Atomic Energy Agency, and at 21:00 hours, a second one.

Gross beta activity concentrations in air measured during this Monday afternoon in northern and central Poland were: e.g., in Mikolajki 550 becquerel per cubic metre (Bq/m^3) (i.e. 15 000 times higher than the two earlier days), in Gdynia 170 Bq/m^3, in Warsaw 87 Bq/m^3, and in Poznan 0.79 Bq/m^3. Gamma dose rates ranged in these locations between 0.1 to 2.5 milliroentgen per hour (mR/h) (this last value was corrected later to 0.45 milliroentgen per hour (mR/h)). At that time, the station in southern Poland did not report any large increase of gross beta activity in the air, except for the meteorological observatory at Sniezka Mt. (altitude of 1602 metres), located in the southwestern part of the country, where an activity of 1.8 Bq/m^3 was measured. However, a southward trend in radioactivity migration was already identified on this Monday evening.

Because the values of initial deposition of activity indicated that radioiodines in milk might reach concentrations above the intervention level (1000 becquerel per litre), the National Atomic Energy Agency recommended, at 1:40 p.m. on 29 April, that from that day on, all over the country, the consumption of milk from cows fed with green fodder be banned, and that this milk should be used uniquely after industrial processing. The Agency also recommended that the cows should stay in the barns and not be fed with green fodder. Distribution of pre-accident powdered milk was recommended for children up to 3 years of age, and consumption of green vegetables, meat, and fish with activity levels above 5000 becquerel per kilogram was proposed for prohibition. The Agency recommended that in 11 northern and central voivodities, stable iodine be distributed to all children up to the age of 16. These recommendations were accepted by the Governmental Commission for Assessment of Nuclear Radiation and Prophylactic Measures, which was formed early in the morning of Tuesday, 29 April. The Governmental Commission, taking into account the changing meteorological situation, contamination by emissions from the Chernobyl reactor, and also socio-psychological factors, decided that stable iodine had to be distributed all over the country to children up to the age of 16.

The Ministry of Health and Social Welfare took over the responsibility for stable iodine prophylaxis. It decided that a single dose of iodine should be administered in a solution (2 gram per kilojoule + 1 gram per joule per 100 gram distilled water). Children up to 1 year of age were administered 15 milligrams (mg) of iodine, from 2 to 6 years 30 mg, and from 7 to 16 years 60 mg.

Administration of stable iodine was started on the evening of 29 April in the Bialystok region and, on 30 April, throughout the rest of the country. It was estimated that about 10 million children and youngsters, i.e. 98 per cent of the population group up to 16 years, received prophylactic doses of stable iodine. In addition, several million adults received this treatment, although this was not recommended by the authorities. Stable iodine prophylaxis at such a scale was a difficult task. Its fast and efficient implementation was enabled by the decision to administer the iodine in dissolved form, which was prepared and distributed by each of the 3348 pharmacies in the country. The iodine solution was distributed also by hospitals, schools, nurseries, etc.

According to a preliminary estimation, the average external gamma radiation-dose received by the inhabitants of about 50% of Poland was 0.15 millisievert and 0.44 millisievert in the highly contaminated regions (approximately 25% of the country.) Thyroid doses were measured in approximately 1200 persons. The average dose commitment is tentatively estimated as ranging from 1 to 10 millisievert. In a limited number of cases, in highly contaminated regions, thyroid doses measured in adults were about 100 millisievert and in children about 800 millisievert. The highest thyroid dose found in an adult was 230 millisievert. These high doses were found among persons who consumed highly contaminated milk from cows grazing in pastures.

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The Chernobyl emergency was a serious test for the Polish radiation monitoring system. It demonstrated that its size is sufficient to stand up to that type of challenge. From the first days of the emergency our laboratory had the opportunity to exchange information with similar institutions in other countries and with the IAEA, which, in our opinion, assumed the role of an international information centre. Due to these emergency events we were able to compare both radioactivity levels and projections in Poland with those in other countries. This was most useful and reassuring.

Safety in global nuclear energy systems would be strengthened if an IAEA centre were established to serve as a focal point in a worldwide system for early notification, warning, and assessment of potential environmental consequences of radiological accidents. The task of the centre might also be to process and co-ordinate requests for assistance, to increase national capabilities, and to provide immediate consultation by top-level experts in the nuclear safety and radiological protection fields.

It also seems that there is a need to establish internationally acceptable intervention levels of radiation doses and derived intervention levels of radionuclides in the environment and in foodstuffs, in the event of large-scale radiological emergencies leading to transboundary and long-term contamination.

System overview

The Service of Measurements of Radioactive Contaminations (SPSP) is composed of various types of stations, more or less homogeneously distributed over the country. They belong to several ministries: 49 stations to the Ministry of Environmental Protection and Natural Resources; 39 stations to the Ministry of Health and Social Welfare; 30 stations to the Ministry of Agriculture, Forestry, and Food Management; 11 stations to the Ministry of Construction, Area and Communal Management; two stations to the Ministry of Foreign Trade; three stations to the National Atomic Energy Agency, and six stations to various scientific institutions. All these stations are equipped by the Central Laboratory for Radiological Protection (CLOR) with basic radiation measuring instrumentation, their personnel is systematically trained, and work is controlled by CLOR. The stations report their measurements directly to CLOR but they are administered, and their work is sponsored by, their respective ministries.

Nine of the SPSP stations are situated at synoptic meteorological sites and, under normal conditions, perform continuous air sampling and measurement of gross beta activity. At these stations the gamma dose rates are measured and registered continuously. Other stations collect samples of total deposition, milk, meat, agricultural products, grass, soil surface, tap water, and liquid effluents from industrial installations. Under normal conditions, gross beta activity is identified in these samples, at intervals ranging from one measurement per month to one per year, depending on the type of samples.

All SPSP stations are equipped with a basic radiation measurement set, ZAPKS-1, (Polish made) for continuous gamma dose rate counting (detection range of the scintillation counter is 0.01 milliroentgen per hour to 100 roentgen per hour, with graphic registering of results and signalization of a preset emergency level). For beta counting of environmental samples, they are equipped with a plastic scintillation counter in a lead castle. Four other types of Geiger-Müller and scintillation counters also are used by the majority of the stations. The 10 stations which control the activity in milk are equipped to measure iodine-131 concentration by a quick radiochemical method. During the Chernobyl emergency, simple gamma measurements of liquid milk also were performed.

Under normal conditions, concentrations of cerium-144, caesium-137, strontium-90, and of other man-made and natural radionuclides in environmental samples, foodstuff, and in human tissues are determined by radiochemical methods by CLOR and in 10 other stations.

Gamma spectrometric measurements of environmental samples are performed routinely by CLOR. During the Chernobyl emergency, five other institutes joined their gamma spectrometric capacities to the SPSP system. Analysis of tritium is routinely performed in two different institutes, and of carbon-14 in one institute. Activity levels in the population are measured by two whole-body counters and by radiochemical analyses of post-mortem material. Simple gamma measurements with hand-held scintillation counters, for emergency measurements of internal contamination with iodine-131, also are available. Stationary thyroid counters are in operation at CLOR and in two other institutions.

Vertical profiles of activity concentrations in the troposphere and stratosphere over Poland are routinely measured on a monthly basis at 0, 3, 6, 9, 12 and 15 kilometre altitudes. For these measurements air samples are collected by airplanes and the radionuclides are determined by radiochemical analysis and gamma spectrometry. During the Chernobyl emergency, monitoring of the vertical distribution of activity was initiated over eastern Poland on 29 April and carried out daily until 2 May; later, at intervals depending on the meteorological situation. In addition, beginning on the evening of 28 April, the airborne teams from CLOR and from the Armed Forces monitored dose rate, ground deposition, and thyroid accumulation of radioiodine all over the country.

In emergency situations, the SPSP stations report their coded monitoring results to CLOR by telex, telegramme, or telephone every two hours. The 18 numbers-per-measurement code saves time in transmission of information.

This organization is expected to ensure quick warning in case of radioactive contamination of large areas, rapid estimation of radiation exposure of the population, and readiness for immediate change in the whole SPSP system, from its normal operation of monitoring into an emergency one. It seems that during the Chernobyl emergency, the SPSP system fulfilled these expectations. (The accompanying table illustrates the monitoring capacity of the system.)

Poland's SPSP system: Sampling sites and samples measured between 28 April and 31 May, 1986

Type of sample	Number of sampling sites	Number of measurements
Total deposition	67	1374
Soil	79	1172
Grass	93	1481
Surface water	126	1416
Tap water	70	839
Vegetables	186	2456
Milk	193	2393
Meat	36	515
Fish	19	144
Eggs	11	122
High altitude aerosols	—	50
Ground-level aerosols	9	3670