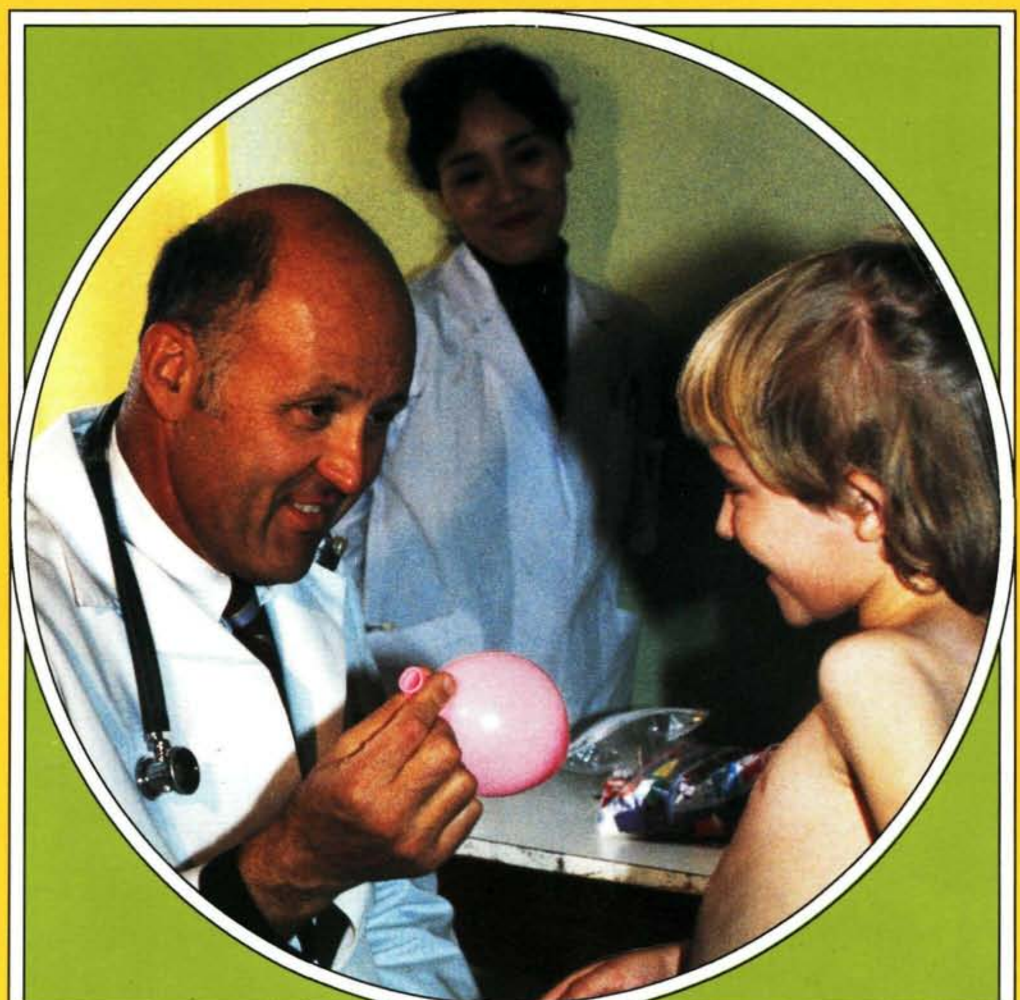
THE INTERNATIONAL CHERNOBYL PROJECT

ASSESSMENT OF RADIOLOGICAL CONSEQUENCES AND EVALUATION OF PROTECTIVE MEASURES

SUMMARY BROCHURE



Cover photo: Project team doctors during children's medical examination
(Credit: Mouchkin, IAEA)

THE INTERNATIONAL CHERNOBYL PROJECT

ASSESSMENT OF RADIOLOGICAL CONSEQUENCES AND EVALUATION OF PROTECTIVE MEASURES

SUMMARY BROCHURE

Introduction

On April 26, 1986 a major reactor accident occurred at the Chernobyl Nuclear Power Plant. This caused acute radiation injuries and deaths among plant workers and firemen. It also led to radiation exposure to thousands of persons involved in rescue and clean-up operations. There was severe radioactive contamination in the area, resulting in the evacuation of people from a 30-km zone around the power plant. It became clear over the months following the accident that radioactive contamination of varying severity had also occurred in extensive areas of the UkrSSR, BSSR and RSFSR up to hundreds of kilometers from the site.

Information about the severity and significance of this contamination was often sparse and uneven; public opinion was uncertain and even many doctors were not sure how to interpret information that did become available. As a result, there was a loss of confidence in the information and in the countermeasures recommended.

The Government of the USSR sought international assistance in tackling the problem. The World Health Organization (WHO) sent a team of experts in June 1989 as did the League of Red Cross and Red Crescent Societies, in early 1990.

The WHO concluded among other things that ''scientists who are not well versed in radiation effects have attributed various biological and health effects to radiation exposure. These changes cannot be attributed to radiation exposure, especially when the normal incidence is unknown, and are much more likely to be due to psychological factors and stress. Attributing these effects to radiation not only increases the psychological pressure in the population and provokes additional stress-related health problems, it also undermines confidence in the competence of the radiation specialists''. The League of Red Cross and Red Crescent Societies made similar observations.

In October 1989, the Government of the USSR formally requested the International Atomic Energy Agency (IAEA) to co-ordinate "an international experts' assessment of the concept which the USSR has evolved to enable the population to live safely in areas affected by radioactive contamination following the Chernobyl accident, and an evaluation of the effectiveness of the steps taken in these areas to safeguard the health of the population".

As a result, an international project was launched in the spring of 1990. An independent "International Advisory Committee" of 19 members was set up under the chairmanship of Dr. Itsuzo Shigematsu from Japan — Dr. Shigematsu is the Director of the Radiation Effects Research Foundation in Hiroshima, which, ever since 1950, has monitored and analysed the health situation of atomic bomb survivors in Japan, the largest population ever exposed to high doses of radiation. The other scientists on the Committee came from ten countries and five international organizations. The expertise encompassed, among other disciplines, medicine, radiopathology, radiation protection, nutrition, radio-epidemiology and psychology.

The most active phase of the project ran from May 1990 until the end of that year. About 200 independent experts from 23 countries and 7 international organizations were involved, and 50 scientific missions visited the USSR. Laboratories in several countries, including Austria, France, and the USA, helped to analyse and evaluate collected material.

The goals of the project were to examine assessments of the radiological and health situation in areas of the USSR affected by the Chernobyl accident, and to evaluate measures to protect the population. The purpose of this brochure is to present a summary of the main results. The project was directed at the welfare of those people still living in contaminated areas. The radiation health effects for people already evacuated (from the 30-km zone) were not considered except for some of these people which have resettled in the areas under review. Also excluded were the large numbers involved in emergency clean-up operations (called "liquidators") who were brought into the region temporarily. The health of these people, some of whom may have been exposed to high levels of radiation, reportedly is being monitored in the USSR and also may be the object of future international work.

The international project, carried out in co-operation with local authorities, deliberately selected a number of settlements in the contaminated areas of concern to perform the necessary surveys. Some of the settlements were located in areas with relatively high soil surface contamination, while other settlements were chosen in areas of relatively low soil surface contamination, but with potential for high radiation doses to the people living there. Other settlements were selected outside the contaminated areas of concern for purposes of comparison.

The surveyed contaminated settlements were:

Bragin	**Daleta**	**Gden**
Gomel	**Khojniki**	**Komrin**
Korchevka	**Korma**	**Malozhin**
Michul'nya	**Mikulichi**	**Milcha**
Narodichi	**Novoe Mesto**	**Novozybkov**
Novye Babovichi	**Ovruch**	**Polesskoe**
Rakitnoe	**Savenki**	**Savichi**
Slovechno	**Staroe Vasil'kovo**	**Starye Babovichi**
Svyatsk	**Veprin**	**Zhatka**
Zlynka		

The surveyed settlements for comparison purposes were:

Chemer	**Khodosy**	**Kirovsk**
Krasilovka	**Surazh**	**Trokovichi**
Unecha		

The project received the full support of the USSR Government and the Governments of the BSSR, the RSFSR and the UkrSSR. Assistance took various forms, including the participation of local scientists in cross-checking, extensive discussions with scientists involved in the project, and in the collection and preparation of field samples as well as medical examinations of the population, especially children, in the affected areas. There were open and frank conversations with authorities, scientists, and particularly local citizens that added to the international experts' understanding of the situation.

The numbers of examinations and other such activities reported later in this brochure give some idea of the extensive nature of the international effort deployed within the limits that were set for the project. The agreed method of operation was to concentrate on direct study of the environment and of the population in those more highly contaminated areas that were still inhabited (with suitable comparative studies in areas of low contamination). In parallel with these detailed independent sampling studies, a general evaluation was made of existing Soviet methodology and findings.

A short account of the risks of radiation and radioactivity can be found in the penultimate section of this brochure to help set in focus some of the presented information.

Radiation exposure of the population

If the distribution of radioactive substances in the environment is given, the radiation exposure (''dose'') of the population may be assessed. However, this assessment is by no means simple. Nor is there a straightforward, uniform relationship between ground contamination and radiation dose. The dose to the population includes the external gamma radiation dose as well as the internal dose received by eating food containing radioactive materials.

Different physical data are used in calculating external dose. Additional important data are biological ''transfer factors'' influencing the movement of elements from the ground through food into the human body. Finally, people's living conditions are important for assessing doses, such as housing, time spent outdoors, and diet. There are complex mathematical calculations which take all this into account. They always entail certain assumptions and may be designed to give either conservative or realistic results.

Certain checks can be made by direct measurements and this was done during the project. People can be equipped with dosimeter badges which, if carried at all times, record the radiation dose they receive externally. Also, by means of devices called "whole body counters", people can be monitored for the amount of caesium they have absorbed within their bodies. This provides an effective way of measuring their internal dose. Because of the nature of the work involved, such checks can be made only on representative samples of the affected population.

The project concentrated on examining data for significant radioactive elements that can affect human health such as caesium, strontium and iodine. A number of representative settlements in contaminated regions were selected for independent radiation dose assessment. Some 8000 personal dosimeters were distributed to residents of seven such settlements and were carried for two months. The dosimeters were then sent to France for evaluation.

Independent whole body counting of radiocaesium levels was done by project teams on more than 9000 people in nine settlements. Comparisons between project and USSR whole body counting facilities and data were made. Finally, independent calculations of past and future doses were made for the surveyed settlements using internationally accepted calculation methods and starting from average values for deposition of radioactivity in the soil. Since the radioactive iodine from the fallout emissions had totally decayed long before the project began, it was not possible to do independent measurements of this element for verification purposes. Because the thyroid gland concentrates iodine coming into the body, radioactive iodine can give a significant dose to that organ. Doses to the thyroid were reported on the basis of some early direct thyroid measurements as well as assumptions about iodine intake. For the seven contaminated settlements specifically studied by the project team, average radioactive iodine thyroid doses for children reported by the USSR varied widely.

Conclusions

- The USSR procedure for estimating radiation doses was assessed as being scientifically sound. Methodologies used in the USSR were intended to, and did, overestimate the doses actually received.
- The external dose to people from radionuclides deposited on the ground is generally the most significant contribution to total dose, especially in the areas where food restrictions are in force.
- Of the dosimeters worn for two months by inhabitants of the highly contaminated areas, only 10 percent registered exposures above the minimum detection limit of 0.2 mSv. This corresponds to 1.2 mSv per year which is a typical dose an individual would receive from the natural environment.
- The whole body counting of radiocaesium generally indicated lower contents of that element in peoples' bodies than would be calculated using theoretical models based on transfer from the environment, intakes from food, and metabolism. This is true for USSR models as well as for international ones. Comparing whole body counting with basic model calculations produced results in the USSR similar to those seen in other countries.
- Independent calculations of past and future doses, based on average deposition results for the surveyed settlements, gave doses lower by a factor of 2–3 than the USSR estimates for the same villages.

	Project results	**USSR officially reported**
External Dose	**60–130 mSv**	**80–160 mSv**
Internal Dose (caesium)	**20– 30 mSv**	**60–230 mSv**
Total (including strontium)	**80–160 mSv**	**150–400 mSv**

The health situation

The nature of the biological effects which can be caused by ionizing radiation and a necessarily brief account of human health effects are outlined later in this brochure. That account is confined to direct physical effects. However, in the case of Chernobyl, as in many other radiological incidents, psychological effects have predominated.

The nature of these effects is complicated and it is wrong to dismiss them as irrational or to label them as ''radiophobia''. Many factors contribute to the development of this widespread public response. Among other things, there may be the historical association with nuclear bombs, or a lack of openness in the past on the part of governments, or the absence of intelligible explanations by scientists. It is noteworthy that some negative psychological responses were found in the populations of both ''contaminated'' and ''uncontaminated'' settlements studied by the project. Such effects are real and understandable, particularly in a mainly rural population whose work and recreation are closely interwoven with the land where restrictions may have had to be imposed by the authorities. Even physicians and others who might be looked to for guidance have often been confused. The result is that rumors multiply, fears increase, and any health problem is quickly attributed to a nuclear cause. Uncorroborated narratives may become commonly held wisdom and unverifiable statistical data may be accepted with insufficient scrutiny.

To address these problems, the international project set about reviewing the health situation reported by key medical centres and institutes in the Soviet Union. Subsequently, seven representative settlements of high contamination were selected for detailed independent health examination by the project medical teams. Six control settlements with the same socio-economic structure, but with insignificant contamination, were similarly examined.

Settlements Surveyed			
"Contaminated"		***"Uncontaminated"***	
Bragin	**}BSSR**	**Khodosy**	**}BSSR**
Korma		**Kirovsk**	
Veprin			
Novozybkov	**}RSFSR**	**Surazh**	**}RSFSR**
Zlynka		**Unecha**	
Narodichi	**}UkrSSR**	**Chemer**	**}UkrSSR**
Polesskoe		**Trokovichi**	

The individuals to be examined were selected according to a statistical sampling scheme giving a representative distribution of age groups. As many as 250 people were examined in each settlement. The examination focused on disorders that had been reported or that might be expected. In addition to direct clinical examination, samples were taken and sent to the USA and Japan for laboratory analysis.

In any detailed clinical study of a particular population, some health disorders are bound to be detected due to the better documentation and closer scrutiny such a detailed study entails. This makes careful comparison with a similar population outside the contaminated area even more critical and rules out reference to pre-existing national or regional statistics.

Results of the health study

- There were significant non-radiation related health disorders in the population of both the contaminated and the non-contaminated settlements studied, but no health disorders that could be attributed directly to radiation.

- The accident had, and continues to have, considerable psychological consequences such as anxiety and uncertainty, which extended beyond the contaminated area. These consequences were compounded by the socio-economic and political changes in the USSR.

- The USSR data that were examined did not indicate a substantial increase in incidence of leukemia or cancer or hereditary effects. However, the data were not detailed enough to exclude a slight increase in the incidence of some tumor types. The adequately performed USSR studies, for their part, have not substantiated any of the reported health effects alleged to be due to radiation.

- Many of the clinical investigations by the USSR were done poorly, producing confusing or contradictory results. The reasons included inadequate equipment, lack of scientific information, and a shortage of well trained specialists. However, a number of USSR clinical studies were carefully and competently performed, and the international project was able to substantiate these studies in most cases.

- The children examined (mostly 2, 5 and 10 years old) were found to be generally healthy. The field studies indicated that a considerable number of adults in both the contaminated and the comparative settlements had substantial medical problems of a general nature.

- Diet appeared to be limited in range, but adequate. No significant differences in reported eating habits were found between the contaminated settlements studied and the uncontaminated. No detrimental effects on growth due to voluntary or official dietary restrictions imposed as a result of the accident were found. There was no evidence of differences in thyroid function between contaminated and comparison regions.

- The intake of iodine in the regions was found to be at the low end of the acceptable range. Most of the dietary components were found to be adequate. Vitamin intake, however, was not examined.

- Dietary intake of toxic elements (lead, cadmium, mercury) was low in comparison with those reported from many other countries and was well below the maximum tolerable intake levels specified by international organizations.

- Blood lead levels were found to be well within the normal range. Thus, no support was found for believing that the large quantity of lead dropped on the reactor to help control the accident had been widely dispersed in the atmosphere in vapor form and created a health hazard for the population at large.

- Review of USSR data indicated that reported cancer incidence had been rising for the last decade. The rise started before the Chernobyl accident occurred and has continued at the same rate since the accident. The project members could not judge whether the rise is due to improved detection and diagnosis or to other causes.

- The data did not show a marked increase in leukemia or thyroid tumors since the accident. However, owing to limitations in the statistical methods, the possibility of a slight increase in the incidence of these disorders cannot be excluded. Nor can the later development of increased numbers of cases after longer latent periods be excluded.

- There was no evidence from special eye examinations of radiation induced cataracts in the general population.

- High blood pressure was common among adults, but no differences were observed between the contaminated and the comparable settlements. Both resembled figures available for Moscow and Leningrad.

- Review of USSR data for settlements in the contaminated areas of concern, as well as for the three affected republics as a whole indicated relatively high infant and perinatal mortality levels. These levels existed before the accident and appeared to be decreasing.

- No statistically significant evidence was found of an increase in the incidence of foetal anomalies as a result of radiation exposure.

While the data were not detailed enough to exclude the possibility of an increase in some tumor types, it is emphasized that, on the basis of the doses estimated by the project and using internationally accepted risk estimates, future increases over the natural incidence of all cancers or hereditary effects would be difficult to discern, even with well designed long-term epidemiological studies. There remains a possibility of a statistically detectable increase in the incidence of thyroid tumors at a later date. Some general recommendations in the field of preventive medicine and for further investigations were also made by the project team.

Measures to protect the population

Over the years, internationally recognized standards have been developed to limit exposures of the public to ionizing radiation from nuclear facilities of all kinds. These criteria can be met by incorporating particular features into the design of such facilities, and arranging for them to be sited and operated under rules and conditions to ensure compliance with the necessary standards. In general, by efficient pre-planning, even the most rigorous limits can be respected at a reasonably low cost.

The situation is different when, for any reason or combination of reasons, the pre-planned design and operational control measures fail and an accident occurs. The existing criteria no longer apply since the system has broken down and a new approach has to be adopted. The objective is to avert, as far as practicable, exposure to people in the area from future radiation doses. This limitation must be achieved through various methods, all of which may have some negative effects or costs of a health, socio-economic, psychological or political nature.

Many possible actions may be considered. Some are quite simple. If there is a minor radioactive release, people may be advised to stay inside their homes and keep windows and doors shut. At the other extreme, whole areas of land or entire towns may have to be evacuated and large quantities of food excluded from human consumption.

It is over-simplistic to assume that all measures which would reduce future dose are beneficial and therefore should always be fully implemented. For example, one of the measures to be reconsidered is that of resettling people elsewhere. Moving people to an area of lower radioactive contamination will probably reduce dose. Since future dose is considered to have a proportional effect on future levels of risk, relocation should reduce the risk of long-term radiation effects. However, it is known that the stress of extensive changes in lifestyle can have very serious psycho-social and even physical effects on people. A balance must be struck between potential reduction in dose and possible harm that might be avoided on the one hand and the possible detrimental and disruptive effects of the resettlement. The calculation of future dose avoidance, either by relocation or by food restrictions, is also not straightforward; single measurements of ground contamination do not translate into predictions of future dose because of factors such as the interaction of deposited materials with soils of different natures.

Many actions had to be taken quickly in the early days after the accident. Stable iodine tablets were issued, evacuations organized, and food restrictions imposed based on the best judgement that could be made on the available information. There is the opportunity now for longer reflection. As part of that process, a number of ''decision conferences'' were held towards the end of this international project with decision makers in the Republics and at All Union levels in the USSR to enable the issues addressed to be spelled out clearly and to clarify and summarize for the project the socio-economic and political factors that influenced the decision-making process in the affected Republics.

Comments by the project teams

The unprecedented nature and scale of the Chernobyl accident obliged the responsible authorities to respond to a situation that had not been planned for. Thus, many early actions had to be improvised. The project teams were not able to investigate in detail many actions taken by the authorities owing to the complexity of the event. In those cases in which project teams were able to assess these actions, it was found that the general response of the authorities had been broadly reasonable and consistent with internationally established guidelines which prevailed at the time of the accident. Some measures could doubtless have been better taken or could have been more timely, but these need to be seen in the context of the overall response. It is all too easy, with the benefit of hindsight, to criticize actions which had to be carried out in response to a pressing situation.

The international advisory committee stated that the protective measures taken or planned for the longer term, albeit well intentioned, generally exceed what would have been strictly necessary from a radiological protection viewpoint. The relocation and food restrictions could have been less extensive. The extent to which such measures were implemented was not justified on radiological protection grounds. However, any relaxation of the current policy would almost certainly be counterproductive in view of the present high levels of stress and anxiety among inhabitants of the contaminated areas and people's present expectations. It is recognized, however, that there are many social and political factors to be taken into consideration and the final decision must rest with the responsible authorities. In any case, future modifications introduced should not lead to more restrictive criteria.

More specific comments included the observation that the relaxation of the criteria for food consumption should be considered as a preferable alternative to relocation when overall health, social and economic effects are taken into account. Continuing restrictions on the consumption of domestically produced food in the contaminated areas of concern imply, for some people, a serious deterioration in the quality of life. This may be remedied only by relocation to areas where an attempt can be made to resume the previous way of life if feasible. The relatively low cut-off levels adopted for food stuff restrictions may have exacerbated these problems. The study also found that the international confusion and misunderstanding about the appropriate level for such restrictions made matters much more difficult for the authorities. Clearer guidance is obviously necessary for the future.

Among more detailed findings in the report was a recommendation to improve the quality and quantity of information to the public. In particular, factors that may influence the acceptability to the local population of continuing to live in settlements in the contaminated areas of concern should be further identified and analyzed.

More realistic and comprehensive information should be provided to the public on comparative levels of dose and risk. These risks should be compared with risks experienced in everyday life and with risks from other environmental contaminants such as radon and industrial pollutant emissions commonly found near large cities.

Environmental contamination

From a biological point of view, as noted earlier, the most significant radioactive substances in the emissions from the accident were iodine, caesium, strontium, and plutonium.

Different problems arise with different radioactive substances. Radioactive iodine is short-lived and practically had disappeared some weeks after the accident. Its significance is due to the fact that, if inhaled or ingested, it accumulates in the thyroid gland, where it may deliver large radiation doses as it decays. The doses may result in impaired thyroid function and, many years after the exposure, in thyroid cancer. The difficulty about radioiodine is that its original distribution can no longer be measured but must be inferred.

Caesium is the element that clearly dominates the long term radiological situation after the Chernobyl accident. Due to its penetrating radiation, caesium deposited on the ground may give an external dose. It may also enter the food chain and give an internal dose. It is eliminated metabolically in a matter of months. Caesium is relatively easy to measure.

Plutonium and strontium, on the other hand, present difficulties in measurement; but there is relatively little strontium in the fallout and it does not give a dose unless ingested or inhaled. Very little plutonium travelled far from the reactor site, and because of its chemical stability, it does not find its way easily into food chains.

Measurements and assessments carried out under the project provided general corroboration of the level of surface contamination for caesium reported in the official maps that were made available to the project in the USSR. Analytical results from a limited set of soil samples obtained by the project teams, near the evacuated zone, corresponded to the surface contamination estimates for plutonium. However, project results were lower in the case of strontium.

The concentration of radionuclides measured in drinking water and, in most cases, in food from the areas investigated, were significantly below guideline levels for radionuclide contamination in food moving in international trade and in many cases were actually below the limit of detection. The analytical capabilities of Soviet laboratories appeared to be adequate. The range of performance of the Soviet laboratories that participated in the intercomparison exercise was broad, but similar to that found in previous international comparison exercises. The few problems identified, including the tendency to overestimate strontium, did not significantly affect the use of data for purposes of making conservative dose assessments.

The extensive surface water sampling programmes in the USSR are adequate. Certain problems during sampling and analytical procedures could result in the possible overestimation of the concentration of radionuclides in water.

Insufficient information was available to evaluate air sampling equipment and procedures. Although the relative contribution to radiation doses of some resuspension of radioactive materials in the air (as dust) is believed to be minor, it should be noted that the occurrence of such airborne resuspension, particularly during agricultural activities or dry periods, cannot be excluded.

Rapid screening and sophisticated techniques used locally for monitoring commercially available food from production to consumption appeared to be satisfactory. The relevant instrument calibration technique could not be evaluated sufficiently by the project owing to the lack of detailed technical information.

The radioactive contamination of food samples was found to be in most cases below the levels established by the responsible authorities for specific countermeasures in the settlements surveyed. In some settlements, milk from individual farms and food collected in contravention of official recommendations could be contaminated above these levels.

Some technical recommendations about analytical methods used by Soviet scientists were made and, in particular, it was felt by the Committee that there should be fuller participation in the future with international intercomparison programmes and intercalibration exercises.

Radiation units and biological effects

We meet radiation everywhere in nature. Naturally occurring radioactive elements in the ground emit radiation which gives an external dose. Some of these elements enter food chains and can enter the human body, resulting in an internal dose. In addition, there is constant exposure to radiation from space (cosmic radiation). This is collectively described as "background radiation".

A number of units are used to express quantities of radiation absorbed by the body or amounts of radioactivity deposited on the ground or existing in a cloud. These units have been expressed differently over the years and each has its own precise physical description. For the purposes of this booklet, the most recently agreed international units have been employed although their detailed scientific descriptions are not addressed.

The most useful in this context is the unit of effective dose — the sievert*. In the present context, the millisievert (mSv) is often employed. That equals 1/1000th (1×10^{-3}) of a sievert. The following notes put the size of this unit in perspective.

The total natural background dose varies a great deal. The average is about 1 to 2 mSv per year, but values several times higher are not uncommon. In some areas, the natural background dose is more than 60 times the global average. It has not been possible to find a relation between natural radiation dose and adverse health effects. Natural radiation background and its variations therefore may serve as an indicator of what doses may be considered to be acceptable.

The naturally occurring radioactive radon gas from the ground is sometimes trapped and concentrated in buildings. Where houses are well insulated, doses from radon in homes may exceed the natural background dose many times. Doses of radon of more than 10 mSv per year are not uncommon, and they are levels at which controls must be exercised.

Sources of information on biological effects

Man-made sources of radiation have been in existence since the turn of the century. Radiation doses have since been administered to patients as a contribution to medical diagnosis and therapy. These doses are variable, but in most developed countries they represent a significant amount of the additional radiation already received over and above that from the natural background. As an example, one chest X ray may give about 1/50th of 1 mSv (0.02 mSv). Other procedures such as fluoroscopy will give considerably higher doses and patients treated by radiotherapy may be given doses many times higher than that.

* *The older unit was the rem. 1 sievert (Sv) = 100 rem.*

Before effective radiation protection practices were generally adopted, certain occupational groups such as hospital radiologists received high doses, and eventually showed deviations from normal health patterns that could be attributed to radiation.

The most comprehensive experience of the health effects of high doses of radiation stems from the atomic bombing, in 1945, of the Japanese cities of Hiroshima and Nagasaki. These irradiated groups and many more have been monitored for health effects over many decades. Additionally, there have been extensive programmes of other types of biological research. As a result, there is considerable knowledge as to what kinds of health effects may occur and what doses may produce them. There is also information about how long after exposure these effects may appear.

All these facts are kept under constant review by permanent international bodies of scientists which continually assess radiation risks in the light of existing and new knowledge and experience. Among these bodies is the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the International Commission on Radiological Protection (ICRP).

If the whole body is exposed to a very high level of radiation, death may occur within a matter of days or weeks. Other effects such as local skin burns and sterility can occur if only part of the body is heavily irradiated. If, however, the exposure is more spread out in time, the effects are less severe.

In the case of the population studied by the project, such acute effects were not to be expected nor were they found.

The table below lists the principal harmful radiation effects, the condition for their occurrence and the source of information about them.

The most important late effect of radiation is cancer, which is always serious and often fatal. Tumors appear after what is called the ''latent period'', which is normally several years. The higher the exposure, the greater the risk of an individual subsequently developing cancer, but only a relatively small number of people exposed will contract cancer because of this. It is important to recall that cancer also has many causes. The situation is analogous to smoking, where those who smoke most run the highest risk of lung cancer, but not all of them will contract it. Cancer is a very common disease; something like 1 in every 4 or 5 deaths is attributable to it. Therefore, unless the number of new cancers caused by the excess of radiation is large, it may be difficult to be certain that they are actually attributable to radiation. It is for that reason that very careful statistical studies have been recommended in various parts of the report.

Condition	Circumstances	Source
Acute radiation effects	1 Sv+ (1000 mSv+) dose	Human data from accidents Hiroshima and Nagasaki Biological studies
Late radiation effects — cancer — genetic effects	Any exposure Risk proportional to dose	Human experience Biological studies
Developmental changes	Irradiation of embryo manifested after birth	Limited human data

Conclusion

The International Chernobyl Project was the largest multinational interdisciplinary venture ever undertaken in the field of radiological protection. Even with limited objectives, it was a huge logistical task; the necessity of a tight schedule added to the burden. Scientists from many lands gave freely of their time and skill. Government institutions, organizations, and commercial companies provided equipment and supplies, without which some major parts of the work could not have been carried out. There also were extensive assistance and contributions from many authorities at the All-Union and Republic levels in the USSR and from the scientists, experts, technical, and administrative staff of the affected Republics who co-operated with the visiting project teams.

The International Advisory Committee, responsible for the project, is of the opinion that the project represents a much needed international humanitarian and scientific response to the needs of the authorities and the people of the USSR who were affected by the Chernobyl accident.

For the future, lessons have been learned by every country in the world which will help in formulating and strengthening radiological protection policies and in the public presentation and understanding of these policies.

Future scientific studies being planned and co-ordinated on an international scale will contribute to fuller understanding of the effects of contamination and radiation exposure and thence to the improved protection of all peoples worldwide.

Note: This brochure gives only a brief account of the large volume of data gathered during the project and of considered opinions by doctors and scientists who undertook the work. The International Atomic Energy Agency in Vienna, which co-ordinated the project, can provide additional information on request.

Comments from Member States

It should be emphasized that the study's conclusions regarding the absence of direct effects on the population examined during the study agreed completely with those reached by a group of WHO experts. Moreover, as regards longer-term effects, the study complemented a thorough assessment already carried out by UNSCEAR.

Argentina

The study provided considerable reassurance for the exposed populations that radiation from the accident had not been a widespread cause of mortality and morbidity, as many had feared.

Australia

The scientific competence and professionalism of the experts from a number of countries who had participated in the Project was deeply gratifying. The Project had shown that the world community was capable of carrying out far-reaching research requiring experience and knowledge in a wide range of areas.

Byelorussian Soviet Socialist Republic

The project is the first step in extensive future work, particularly the appraisal, prognosis and preservation of the health of the population.

Chile

The high-calibre scientific studies will greatly assist, not only those directly affected by the accident, but the entire international community.

China

The project had been a success ... carried out carefully and scientifically, and the conclusions were reliable; that should put a stop to rumours and unrealistic assertions.

Egypt

The public should be informed of the results, in order that the negative effects of the accident and its consequences for the utilization of nuclear energy in many countries might be diminished.

France

As to follow-up, the project should, as far as possible, be extended to cover those who had been evacuated and the ''liquidators''.

Germany

Germany has full confidence in the professional quality of the work done.

India

The scientific information generated by the project should be published soon in the form of an easy-to-read brochure, so as to inform the public and decision-makers all over the world correctly and thereby help in clearing the doubts raised by adverse publicity.

Indonesia

The conclusions and recommendations were of value to regulatory authorities, medical institutes and other organizations concerned with food controls and safety assessments.

Philippines

The conclusions and recommendations constitute an important body of knowledge that would be useful to both the Agency and Governments in drawing up future safety measures.

USSR

The fact that the opinions of conference participants differed greatly was not to be deplored: only through the clash of opposing views could the truth be found.

USA

The United States considers the project to be an important contribution to the study of the Chernobyl accident.

Comments from project participants

B.W. Wachholz, National Cancer Institute, USA

It is commendable that the Government of the USSR not only requested but invited the international community to look over their shoulder to evaluate, to review, to criticize, to conclude, to recommend. That in itself is almost unprecedented in an accident of this nature.

B.G. Bennett, U.N. Scientific Committee on the Effects of Atomic Radiation

It is common practice (to overestimate doses). It is something that scientists would do to make sure that they do not underestimate the doses. This is important to provide adequate radiological protection of the people. But the danger in doing that is that you take protective measures which are excessively stringent and you expect health effects which are exaggerated. This is what must be kept in perspective. You must estimate doses as realistically as possible. You must use the best, most realistic estimate of doses to make your judgement about relocation, evacuation, and estimated health effects that might occur eventually from these doses.

T.R. Lee, University of St. Andrews, Scotland

The consequences of relocation depend upon the length of time for which people have expected it, their preparedness, whether it is to favourable circumstances or unfavourable circumstances, whether it is voluntary or involuntary and so on. However, the sheer disruption effect for elderly people can take its toll.

J. Jovanovich, University of Manitoba, Canada

I think we should just not forget that we do live in a real world and that there are other technologies that are worse for the health of populations that nuclear power, including the Chernobyl accident.

P. Hedemann Jensen, Risø National Laboratory, Denmark

There had not been, certainly for the people at large, enough understanding of what might go on. And there was clearly a need for much public discussion, not in the heat of an accident, but before an accident, with what one might call local liaison committees, so that the risks are all explained, so that emergency procedures are understood, and all be exercised, so that it does not come out of a clear blue sky, at some terrible time in the morning, that people know that there has been planning for this, that something can be done about it and that something is being done about it.

F. Steinhäusler, Austria

I do not think it helps the people in the settlements to state repeatedly, against the facts of measurements, that food is contaminated, that it is poisoned, or that water cannot be drunk, when the measurements clearly indicate, that in most of the water measurements for instance, we could not even detect any radioactivity. Not because we used unsuitable equipment, but because there is not any.

P. Waight, World Health Organization

Before the initiation of the Chernobyl Project, the World Health Organization sent a team of experts to the Soviet Union in June 1989 which concluded that scientists who are not well versed in radiation effects have attributed various biological and health effects to radiation exposure. These changes cannot be attributed to radiation exposure, especially when the normal incidence is unknown, and are much more likely to be due to psychological factors and stress. Attributing these effects to radiation, not only increases the psychological pressure in the population and provokes additional stress-related health problems, it also undermines confidence in the competence of the radiation specialists.

F.A. Mettler, The University of New Mexico, USA

There certainly may be health effects worth studying in the future. We need organized studies with appropriate control groups and the best dosimetry available... . We must use uniform methodology in these studies, not only amongst Soviet investigators, but among international investigators, if we hope to get useful data out of it.

INTERNATIONAL ATOMIC ENERGY AGENCY

PRINTED BY THE IAEA IN AUSTRIA, AUGUST 1991
91-03254 · IAEA/PI/A32E