ANNEX IV

(1) Radiation Emergency Medical Preparedness and Assistance Network (REMPAN) at International Level

Guennadi N. Souchkevitch
World Health Organization, Geneva, Switzerland

Introduction

Up to now about 380 major radiation accidents have happened. Nuclear weapons are still present and being produced. At least 1950 nuclear tests have been performed during the last 50 years and still continues. At present 430 Nuclear Power Plants are in operation and 55 under construction. The largest nuclear accident to date occurred on the 26 April 1986 at the Chernobyl Nuclear Power Plant in Ukraine. This accident resulted in acute radiation sickness of 134 and cost the life of 30 workers at the reactor site. It also created the potential to adversely affect the health of about 5 million people residing in territories where ^{137}Cs soil contamination density is higher than 37 kBq/m^2. In addition about 800,000 accident recovery workers who participated in clean-up operations and were exposed to radiation, are needed in medical care and regular medical examinations.

There are not many guaranties that humanity will not meet with other major nuclear accidents in future. Due to widespread of radioactive fallout, such accidents are not bordered by an affected country. Therefore, international efforts to establish worldwide cooperation in the field of radiation emergency medical preparedness and assistance appeared reasonable. This activity should be regarded as part of the overall system for radiation safety and protection.

Contribution of International Organizations

The international system related to REMPAN activities consists different governmental and nongovernmental organizations. The following five boards within the United Nations Organization provide the major contribution in the development of REMPAN at international level:

- **International Atomic Energy Agency (IAEA)**
- **World Health Organization (WHO)**
- **United Nations Scientific Committee on Effects of Atomic Radiation (UNSCEAR)**
- **International Labour Organization (ILO)**
- **Food and Agriculture Organization (FAO)**

The IAEA plays a central role in the development of general strategy and standards in the establishment of radiation emergency preparedness and assistance at international and national levels.

Specific tasks of WHO in the family of UN Organizations are to address those problems which lie within the competence of health authorities and/or are directly relevant to the medical community in Member States. These problems include the preparedness of medical services for handling radiation emergencies and practices in diagnosis, treatment and follow-up of overexposed persons.

UNSCEAR provides international community with scientific information on health effects of radiation on human beings which is taken into consideration by relevant authorities at international and national levels in the development and implementation of radiation countermeasures, radiation standards, intervention levels, further radiobiological research, etc.

ILO participates in the development of radiation standards for occupational groups of population; and FAO for food and food products.

The International system compiled of UN specialized agencies and contributed to radiation emergency preparedness and assistance would not be finalized without mentioning of International Committee on Radiation Protection (ICRP). This Committee having been a non-governmental organization develops recommendations on radiation protection which serve as a basis for relevant international and national recommendations and guidelines.

In addition to the above-mentioned worldwide acting institutions, there are also regional organizations which do much work in the improvement of interstate cooperation in the field of radiation emergency medical preparedness and assistance. Among them there are, for example, Committee of European Community (CEC), Nuclear Energy Agency (NEA) of the Organization of Economical Cooperation and Development (OECD) and Pan American Health Organization (PAHO).

The international efforts to cooperate in radiological emergencies have been strengthened by the adoption of two Conventions - the Early Notification Convention and the Convention on Assistance in the case of a Nuclear Accident on Radiological Emergency. At present time about 75 States and Organizations became parties of each of these Conventions.

The major recent event in the international system of radiation safety was the development and publication of the new International Basic Safety Standards for Protection of Radiation Sources *(1)*.. This work was jointly sponsored by FAO, IAEA, ILO, NEA, PAHO and WHO. The new standards are considerably more comprehensive than the previous standards and cover the basic responsibilities and obligations for the protection of people and the safety of sources in all fields of application. Specific requirements apply to public, occupational and medical exposure, to the safety of sources and to intervention in accidental and chronic situations *(2)*. The management of accident situations outlined in the standards are based on the ICRP principles for planning and deciding interventions for cope with a radiological emergency. The principles are as follows:

- All possible efforts should be made to prevent serious deterministic health effects;

- The intervention should be justified, in the sense that introduction of the protective measure should achieve more good than harm;

- The levels at which the intervention is introduced and at which it is later withdrawn should be optimized, so that the protective measure will produce a maximum net benefit.

The main criterion for deciding on an intervention is the mean individual dose which is expected to be avoided by the intervention *(3)*

Dose levels at which intervention is expected to be undertaken under any circumstances (be justified) are given in Tables 1 and 2 *(1)*.

Table 1. Intervention level of dose for acute exposure

Organ or tissue	Projected absorbed dose (Gy) to the organ or tissue in less than 2 days
Whole body (bone marrow)	1
Lung	6
Skin	3
Thyroid	5
Lens of the eye	2
Gonads	3

Note:	The possibility of deterministic effects for doses greater than about 0 1 Gy (delivered over less than two days) to the foetus should be taken into account in considering justification and optimization of actual intervention levels for immediate protective action.

Table 2. Intervention level of dose rate for chronic exposure

Organ or tissue	Equivalent dose rate ($Sv.a^{-1}$)
Gonads	0.2
Lens of the eye	0.1
Bone marrow	0.4

Intervention levels in emergency exposure situations are expressed in terms of avertable dose, i.e. a protective action is indicated if the dose that can be averted is greater than the corresponding intervention level. The standards provide the values which can be taken as starting points for the judgement required for decisions to select levels for emergency exposure situations. These values have been developed by IAEA *(3)* and summarized in Table 3.

Table 3. Recommended generic intervention levels for urgent protective measures

Protective action	Generic intervention level (dose avertable by the protective action)
Sheltering	10 mSv in a period of no more than two days
Temporary evacuation	50 mSv in a period of no more than one week
Iodine prophylaxis	100 mSv (absorbed dose due to radioiodine)

The recommended quantity for the administration of stable iodine is shown in Table 4 *(4, 5)*:

Table 4. Quantity for the administration of stble iodine

Age Groups	Potassium iodide (mg)	Potassium iodate (mg)	Equivalent mass of iodine (mg)
Adults (including pregnant and lactating women) and adolescents aged 13-16 years	130	170	100
Children aged:			
birth - 1 month	15	20	12.5
1 month - 3 years	30-35	40-45	25
3 years - 12 years	65	85	50

The recommended generic action levels for foodstuffs are presented in Table 5 *(1, 4)*.

Table 5. Generic action levels for foodstuffs

Radionuclides	Food destined for general consumption (kBq/kg)	Milk, infant food and drinking water (kBq/kg)
Cs-134, Cs-137, Ru-103, Ru-106, Sr-89	1	1
I-131		0.1
Sr-90	0.1	
Am-241, Pu-238, Pu-239	0.01	0.001

It is noted that levels given in Table 5 apply to situations where alternative food supplies are readily available. Where food supplies are scarce, higher levels can apply *(4)*.

The generic optimized intervention levels recommended for temporary relocation and permanent resettlement are given in Table 6.

Table 6. Recommended generic intervention levels for temporary relocation and permanent resettlement *(1, 4)*

Actions	Avertable dose
Initiating temporary relocation	30 mSv in a month
Terminating temporary relocation	10 mSv in a month
Permanent relocation	1 Sv in lifetime

Several additional examples are given below to illustrate international cooperation in the field of radiation emergency preparedness and assistance. Thus, the IAEA organizes periodic external communication exercises involving Member States and other international organizations.

The first international conference "Radiation and Society: Comprehending Radiation Risk" organized by IAEA was held in Paris in 1994. One of the conclusions of the conference was that further efforts were needed to promote a proper understanding of radiation risk as compared with other types of risk.

Two major multipartner projects have been established by the CEC. One of them is the Eurogrid database project which is aimed at the collection and analysis of data in order to assess individual and collective doses and of economical aspects of an accidental release of radionuclides in Europe.

The second project is dealing with the decision aiding techniques. 18 European institutes deal with the development of an integrated an comprehensive real-time-on-line decision support system (RODOS) for nuclear emergencies in Europe *(6)*. In addition, CEC has been developing activities aimed at reconstruction of doses in the post-accident period, improvement of diagnosis and treatment of radiation victims, harmonization of education and training in radiation protection (the European Radiation Protection Education and Training Programme-ERPET).

WHO's contributions

WHO's efforts aimed at the improvement of worldwide medical preparedness and assistance in a case of a radiological accident, include measures to:

(1) Strengthen international cooperation;
(2) Provide the assistance for better functioning of national radiation emergency medical services;
(3) Establish international network of specialized institutions capable in providing medical care and assistance for any affected country.

In 1988, WHO took a decision to accede to Convention on early notification of a nuclear accident and to Convention on assistance in the case of a nuclear accident or radiological emergency.

The WHO plan for radiation emergency medical preparedness and assistance is reflected in the Emergency Notification and Assistance Technical Operations Manual (ENATOM) developed by IAEA as a guide for State Parties to the Conventions.

The WHO function under the Early Notification Convention entails the obligation to notify IAEA of its competent authorities and contact points. In accordance with the Assistance Convention, WHO is one of the appropriate international intergovernmental organizations which may be called for assistance. The request may come directly to WHO (to WHO Headquarters or to a WHO Regional Office) or through IAEA. For the promotion of radiation emergency medical preparedness and for practical assistance and advice to countries in a case of overexposure from any source of radiation, WHO has established 8 Collaborating Centres: in France (International Centre for Radiopathology, Paris), in the USA (Centre for Radiation Emergency Assistance, Oak Ridge), in Russian Federation (Centre for Medical Radiation Pathology, St Petersburg), in Australia (Centre for Radiation Protection and Radiation Emergency Medical Assistance, Melbourne), in Argentina (Centre for the Response to Ionizing Radiation Emergencies, Buenos Aires), in Brazil (Centre for Radiation Protection and Medical Preparedness for Radiation Accidents, Rio de Janeiro), in Germany (Centre for Radiation Emergency Medical Preparedness and Assistance, Ulm) and in Japan (Centre for Radiation Effects on Humans, Hiroshima).

The WHO Collaborating Centres have formed the Radiation Emergency Medical Preparedness and Assistance Network (REMPAN). This network serves as a focal point for advice, training and possible medical care of radiation injuries. Up to now five REMPAN meetings have been held in order to up date knowledge about health effects of radiation injuries, develop methodology related to organizational aspects of REMPAN. Since the last meeting of REMPAN held in Paris, December 1994, the positive decision of WHO/WPRO has been taken to nominate the Institute of Medical Radiology, Beijing, China, as a WHO Collaborating Centre within REMPAN. The same decision was made by WHO/EURO concerning the Urals Research Centre for Radiation Medicine, Chelyabinsk, Russian Federation. In addition, two new WHO Collaborating Centres with terms of reference related closely to REMPAN activities have recently been established in the Russian Federation. One of them is the WHO Collaborating Centre for Research and Training on Radiation Epidemiology in Medical Radiological Research Centre, Obninsk and the other WHO Collaborating Centre for Treatment and Rehabilitation of Accident Recovery Workers of Nuclear and other Disasters in the All-Russian Centre on Ecological Medicine, St Petersburg, Russian Federation.

In a case of a radiation accident, the Collaborating Centres will provide a team for on-site emergency treatment; a survey team for rapid external radiation monitoring and/or contamination surveys with appropriate equipment; transportation of patients; facilities and staff for medical supervision and treatment.

Following the recommendations of the Paris meeting of REMPAN, the proposal for funding a five-year project related to further development of Radiation Emergency Medical Preparedness and Assistance has been developed by WHO/Headquarters and the first steps for resource mobilization have been taken.

The alleviation of the Chernobyl consequences: practical and scientific aspects of international cooperation

The international cooperation in providing the assistance to affected countries has been successfully revealed in a case of the Chernobyl accident.

In addition to humanitarian assistance coordinated within UN system by the Department of Humanitarian Affairs, many international organizations have initiated programmes in order to investigate medical consequences of the accident.

The IAEA was one of the first Agencies to be involved in addressing the technical problems of the Chernobyl accident in 1986. In 1989, it was asked by the Government of the former USSR to coordinate an international assessment of the radiological consequences of the accident and of the criteria used for protection of the population. This became the International Chernobyl Project and involved over 200 scientists and experts from over 23 countries and seven international organizations including WHO and CEC. Dr Itsuzo Shigematsu was the Chairman of the International Advisory Committee of the International Chernobyl Project.

Several Chernobyl projects have been carried out by CEC. These projects have been implemented by groups from CIS and the CEC as partnerships between Eastern and Western research institutions and hospitals in order to increase training of CIS scientists; provide financial support to CIS institutes for allocating staff to the joint projects; introduce new technology and training of the medical specialists; improve the local infrastructure and create a regional research facility in Belarus, Russian Federation and Ukraine.

Big contribution to the minimization of the health effects of the Chernobyl accident has been made by UNESCO, the International Federation of Red Cross and Red Crescent Societies and many non-governmental organizations. Among the last ones the Sasakawa Memorial Health Foundation should be particularly emphasized.

In response to the Chernobyl accident, WHO has established in 1991 the International Programme on the Health Effects of the Chernobyl Accident (IPHECA). The Programme is financed solely through extrabudgetary resources. The World Health Assembly has called upon Member States to provide financial and other support for IPHECA. The Director-General has also issued calls for extra-budgetary support. In addition, the UN General Assembly has also requested Member States and intergovernmental funding agencies to provide support to the population in the affected regions. As a result of such international activity, over US$20 million have been received for the programme. The major contribution has been made by Japan. The pilot phase of IPHECA came to an end in 1994. Main results obtained within the programme have shown dramatic increase of childhood thyroid cancer in radiocontaminated territories and especially in the most affected areas of Gomel oblast of Belarus. Prior to the accident in 1986, the annual incidence of childhood thyroid cancer in Belarus, Russian Federation and Ukraine was about 1 per million. In 1994, the annual incidence of childhood thyroid cancer in Belarus was 34 per million children and in Gomel region 100 per million children, i.e. a hundred fold increase over the rates before the accident. In Ukraine, an approximate ten fold increase of the annual incidence of thyroid cancer was registered in compare with the period before the accident. In Bryansk and Kaluga regions of the Russian Federation, the incidence of thyroid cancer increased to 22 cases per million children (0.5 per million before the accident).

In the course of implementing the IPHECA Haematology Project it was not shown changes in leukemia morbidity which could be linked to radiation effects. However, the specialized registries will prove useful for further investigations. Plans have been made to continue detection and registration of cases and to use approaches such as case-control studies to identify possible relationships between disease risk and individual exposure dose.

During the pilot phase of IPHECA, work was conducted on detecting cases of mental retardation and other brain dysfunctions in the children exposed *in-utero* due to the Chernobyl accident. On the basis of these investigations it is impossible to arrive at any definite conclusions about relationships between an increase in the number of mentally retarded children and the ionizing radiation factor due to the Chernobyl accident.

A practically identical incidence of diseases of the oral mucosa, periodontal and dental tissues was detected among the residents examined within IPHECA from the contaminated (>555 kBq/m^2) and clean regions of Belarus.

IPHECA has contributed significantly to the improvement of diagnostic and therapeutic capabilities of the three affected countries. The health studies have been an essential contribution to the assessment of the impact of the accident, and allowing for the development of realistic plans for emergency preparedness and response to similar future events. In 1994, the Management Committee of IPHECA supported new activities within the programme, i.e. investigation of health status of the Chernobyl accident recovery workers, dose reconstruction and thyroid diseases on a regular basis. In addition, the Committee recommended that a guideline document be prepared on public health action following nuclear accidents. These activities are in progress.

They include, for instance, the preparation of protocols for the "Accident recovery workers" project and "Dosimetry" project and the establishment of the network of WHO collaborating centres in order to investigate in depth the cause of the increased incidence of thyroid cancer in children. This network includes centres located in Belarus, Japan, France, Germany, Italy, Switzerland and Great Britain. However, in order to carry out these activities perfectly, additional financial support is extremely needed. From the pragmatic, scientific and moral point of view, failure to exploit the unique Chernobyl situation to increase our knowledge of the long-term effects of radiation would be intolerable.

In order to make the post-accident studies more available for specialists, IAEA, CEC and WHO agreed to organize a series of conferences which will summarize data obtained up to 10th anniversary of the Chernobyl tragedy. This series will start by the WHO Conference on Health Consequences of the Chernobyl and Other Radiological Accidents which will be held in Geneva from 20 to 23 November 1995. It will continue by the CEC "First International Conference of the European Union, Belarus, the Russian Federation and Ukraine on the consequences of the Chernobyl accident," Minsk, 18-23 March 1996. The last but not the least, the Joint WHO/IAEA/CEC Conference "One decade after Chernobyl: Summing up the Radiological Consequences" will finalize the series in Vienna, 9-12 April 1996. Needless to say that proceedings of these conferences and results of discussions will serve as valuable sources of information for further development and improvement of the international radiation emergency medical preparedness and assistance network.

References

1. Safety Standards. International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, Safety Series No. 115-1, IAEA, Vienna 1994.

2. International Atomic Energy Agency, The Annual Report for 1994, GOV/2794, April 1995.

3. Radiation Protection, Today and Tomorrow. OECD Nuclear Energy Agency, 1994.

4. Safety Guides. Intervention Criteria in a Nuclear or Radiation Emergency, Safety Series No 109. IAEA, Vienna 1994.

5. Guidelines for Iodine Prophylaxis following Nuclear Accidents. Environmental Health No 35, World Health Organization.

6. Fifth Coordination Meeting of WHO Collaborating Centres in Radiation Emergency Medical Preparedness and Assistance, WHO/EHG/95.02

(2) SPEEDI and WSPEEDI: Emergency Response Systems for Real-time Prediction of Local and Global Impacts Due to Nuclear Accident

Masamichi Chino, Ph.D.
Japan Atomic Energy Research Institute
Tokai-mura, Naka-gun, Ibaraki-ken, Japan

I. Introduction

The establishment of a full-scale off-site countermeasure programme in Japan against accidental releases of radioactivity was initiated by the TMI-2 reactor accident in the United States in March 1979. After the accident, the Japanese government immediately built up a national scale support programme for local governments who are responsible for taking public protective actions against radiological emergencies. At the same time, the Japan Nuclear Safety Commission designed a project to develop technology to assist experts of national and local emergency headquarters in assessing the environmental impact of accidental releases. This project yielded several results, e.g., an aerial survey system, a computer-based dose prediction system SPEEDI (System for Prediction of Environmental Emergency Dose Information), etc In particular, SPEEDI is now available for the real-time prediction of atmospheric dispersion of radionuclides in local emergency situations

Although an off-site countermeasure programme against a domestic local range accident has been established by local and national governments, the task of designing a concrete national scale countermeasure programme against overseas accidents still remain However, after the Chernobyl accident, a new technical capability WSPEEDI (Worldwide version of SPEEDI) has been developed to predict the radiological impacts on the Japanese people of a nuclear accident in a neighbouring country.

II. SPEEDI (System for Prediction of Environmental Emergency Dose Information)

Japanese nuclear power plants are located in coastal areas with hills and mountains. Because such complex topography results in high variable wind and turbulence patterns, models for accurate predictions must take explicit account of the terrain. For this purpose, a three-dimensional mass consistent model WIND04 for providing terrain-induced wind fields and a particle diffusion model PRWDA for atmospheric dispersion of radionuclides have been developed for the local scale (10-100 km radius of a plant site) These models take account of the complex source, terrain condition, and non-uniform and non-steady atmospheres. Furthermore CIDE has been developed to estimate external and internal doses due to radioactive cloud.

WIND04/PRWDA, the combination of models, has been applied to data sets from a series of field tracer experiments on the seacoast with flat terrain, isolated conical mountain regions, and mountain-valley areas. The comparison between the measured and the calculated results showed that the accuracy is a factor of 10 for 50 % of sampler and 2 for flat terrain near the seacoast. Diagnostic model, like WIND04, cannot achieve extremely high accuracy in complex terrain, but the possibility of large error is small owing to the synthesis of observations in the computational area. It is important for real-time emergency response models to retain some level of accuracy constantly under any situation.

For easy operation of computational models in emergency situations, the SPEEDI models are systematized in combination with the databases, conversational software and graphic software. The input data are divided into two types, i.e., time-dependent data and invariant data. Time-dependent data like meteorological and release information are expected to be input in real-time from a data communications network and a keyboard, respectively. Invariant data are extracted from the database which contains geographical data for all the Japanese sites, site data, physical constants relating to radionuclides and isotopic composition data. Calculated results of wind fields, airborne concentrations, deposition levels, external dose and internal dose by inhalation are output in the form of wind vectors or contours superimposed on a map.

In practice, a nationwide data communications network that links the Science and Technology Agency (STA), 14 relevant local governments, the Japan Weather Association and the SPEEDI centre has been established by the Nuclear Safety Technology Centre (NUSTEC) under contract to STA. The local governments normally deploy several automated monitoring posts around sites. The meteorological and radiological data from the posts are telemetered to the monitoring centres of the local governments. In routine work, the SPEEDI network acquires meteorological and radiation monitoring data around the sites from the monitoring centres of the 14 local governments together with nationwide AMeDAS (Automated Meteorological Data Acquisition System) meteorological data from the Japan Weather Association. Meteorological data, which are available from five to ten stations in a local range, are input to SPEEDI. During an emergency, STA initiates SPEEDI and provides the SPEEDI centre with initial information on accidental releases through the network or other communication links such as facsimile. SPEEDI performs predictions based on source information, on-line meteorological data, and geographical and nuclear databases. Calculations are carried out by a vector processor for quick response. The results are transmitted to the national and local emergency headquarters via the network. Although both the monitoring data acquired and the results predicted by SPEEDI are provided to the national emergency headquarters, SPEEDI has, at this stage, no numerical technique to increase reliability of the predictions by integrating the monitoring data.

III. WSPEEDI (Worldwide version of SPEEDI)

The Chernobyl nuclear reactor accident in 1986 necessitated the expansion of the computational area of SPEEDI to evaluate long range transport of airborne radioactivity due to a severe nuclear accident in a foreign country. In response to this requirement, several points of the models of SPEEDI are improved for long range transport, e.g., the consideration of the Earth's curvature, up/down flows induced by low/high pressure systems and the distribution of precipitation for wet deposition.

The models are combined with worldwide geographical and meteorological databases, conversational software and graphics. Worldwide geographical data are based on the US Navy Global 10 minute Elevation Data provided by the National Centre of Atmospheric Research of the United States. While SPEEDI has the database for each nuclear plant site, WSPEEDI has a master database that records worldwide geographical data. Because the area of concern will depend on the location and scale of the accident, WSPEEDI has a preprocessing function to extract the geographical and meteorological data for the relevant region from the master database. With regard to meteorological data, the Japan Meteorological Agency routinely releases analysed and forecast meteorological data in the global scale, called GPV. Thus, a computer connection with the Japan Weather Association, which is in charge of distributing GPV data, is established to acquire GPV twice daily. WSPEEDI outputs the same graphic forms as SPEEDI, but the map projection is selected in accordance with the region of interest.

IV. International Cooperative Studies

A variety of long range atmospheric transport models have been developed in different countries for application during emergencies, but their performance can only be estimated with much difficulty, because it is extremely hard for single institution to establish experimental databases for verification of long-range transport models. On these background, three international organizations, the European Commission (EC), the International Atomic Energy Agency (IAEA), and the World Meteorological Organization (WMO) sponsored two international model validation studies, called ATMES (Atmospheric Transport Model Evaluation Study) and ETEX (European Tracer Experiment). Regarding ATMES, performed during the period from 1986 to 1991, the Chernobyl accident data have been used retrospectively for model validations. Although ATMES was highly successful, the uncertainty associated with source term and monitoring procedures was also pointed out. Moreover, it was difficult to evaluate how well the models, used by ATMES participants, would respond to the near real-time predictions against an accidental release of radioactive materials. For these reasons, a follow-up international programme ETEX has been agreed by the three ATMES sponsors, involving experimental studies of the long-range atmospheric transport over the European continent, to produce databases and to evaluate predictions capability. The experiments and related near real-time simulations by the models of the ETEX participants were conducted in Autumn 1994. WSPEEDI was one of participants in both programmes, ATMES and ETEX.

The simulations of WSPEEDI for ATMES revealed the following behaviour of the radioactive cloud:

- The radioactivity released in the earlier hours of 26 April, 1986 was transported to Scandinavian countries until the end of April.
- The radioactivity released during the period from the afternoon of 26 April to the morning of 27 April was transported to Central and Western Europe until 30 April.
  After that it was transported northward.
- The radioactivity released from the afternoon of 27 April to 3 May was transported to the east or south of Chernobyl, which covered Ukraine, Romania, Bulgaria, Yugoslavia, Greece and Turkey.
- The radioactivity released on 4 and 5 May was first transported to the southwest of Chernobyl and was finally transported to the north, covering Central and Northern Europe.

The compared results of prediction with monitoring data showed that the transport of radioactivity from Chernobyl over Europe was qualitatively explained well by calculations.

The ETEX experiment was carried out twice, 23 to 26 Oct. (Run 1) and 14 to 17 Nov. (Run 2), 1994. An atmospheric tracer gas, perfluoromethlcyclohexane (PMCH), was released from Rennes, France. Participants in the project, 25 institutions from 21 countries, were informed of the precise occurrence, location and characteristics of the release, e g , the time and duration of release and exact source strength, only at the time of the release by facsimile and a computer mailing system(E-mail) via INTERNET. The task of the participants was to acquire the necessary meteorological information, calculate the cloud evolution for the next 60 hours, and transmit the predicted results as soon as possible to the ETEX evaluation team, located at JRC-Ispra. The participant s could update their predictions every 12 hours when they could acquire new meteorological data The evaluation includes not only the differences between forecast and experimental data but also the timeliness of response, the behaviour of communication lines and the quality of the emergency response system as a whole. The near real-time operation tests of WSPEEDI by participating ETEX, carried out twice, could accomplish all the tasks required by the ETEX evaluation team. Therefore, it could be verified that WSPEEDI has sufficient capability to respond to an accidental release of radionuclides from nuclear installations abroad, although it may not be valid that a presumed operation procedure, like this ETEX simulation, can be possible when information might be entangled during a real accident.

V. Summary

Two types of computerized system to predict the environmental impacts due to nuclear accident have been developed.

SPEEDI, which was developed for local range assessment, is in practice already involved in the national scale countermeasure programme against domestic nuclear accidents. This system has a nationwide data communications network which provides data acquisition and transmission of predicted results on off-site contamination for the local and national emergency headquarters. By coupling SPEEDI with monitoring systems, it is expected that more reliable information from the national emergency headquarters will be provided to its local counterparts.

With regard to overseas accidents, WSPEEDI, which is worldwide version of SPEEDI, has been developed to estimate the long range transport of radionuclides and deposition on the ground surface. WSPEEDI is now close to being fully operational Data communications network with the same type of systems in different countries will be constructed to exchange predicted results in real-time during nuclear emergency.