The Chernobyl Radionuclear Event: Ukrainian Soviet Socialist Republic 1986

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26 April 1986 is marked with the most serious radio nuclear accident in the history of the nuclear industry that has left short and long term effects behind. Many people were exposed to external or internal radiation that caused acute or chronic illnesses. The economic and psycho-social status of hundreds of thousand of people declined. Several countries were affected by the fallout and the environment was also influenced. Since coming into force, IHR (2005) has provided the world with a global framework for preventing, detecting, assessing and providing a coordinated response to events that may constitute a public health emergency of international concern (PHEIC). This document examines the accident and application of IHR (2005) on similar situation.

Group 4
Collective
Report

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Executive summary

On April 26th, 1986, in the result of the erroneous testing during the routine maintenance of the reactor number 4 of the nuclear power plant at Chernobyl in Ukraine, two severe explosions occurred that led to massive releases of radioactive materials into the atmosphere, which were later on deposited over countries in Europe, but especially over large areas in Belarus, Russian Federation and Ukraine. This accident formed the most serious accident in the history of nuclear industry and is the only registered level 7 event on the International Nuclear Event Scale (INES).

Lack of rational and well-organized monitoring and response measures on event and environment from the beginning of the Chernobyl radio nuclear emergency caused short and long term negative effects in the health and welfare of populations within the contaminated areas.

Deficient contingency planning, lack of transparency, limitations of the regulations and highly centralized management of the accident caused a significant damage to the health and well-being of exposed populations as well as the environment.

This document is the final draft of the comprehensive document on the event and discusses the deficiencies in preparedness and response to the accident. It also examines application of the IHR (2005) to the accident if it was to happen after IHR (2005) came into force.

I. Human health risk assessment

The Chernobyl Power Complex is lying about 130 km north of Kiev, Ukraine, about 20 km south of the border of Belarus. It consisted of four nuclear reactors of the RBMK-1000 design. The nuclear power station lies 15 kilometers to the northwest of the actual Chernobyl town (around 7 km from Belarus), which had about 14,000 populations during the accident). Three kilometers northwest of the reactors is the city of Pripyat that has been built for the workers of the plant. The Pripyat and the Dniepr Rivers flow past the nuclear power station on their way to the Kiev Reservoir and Black sea in the south. The power plant is located within 20 km from the Belarus in the North.

Hazard identification

Radioactive materials usually release alpha particles, which are the nuclei of helium, beta particles, which are quickly moving electrons or positrons, or gamma rays. Alpha and beta particles can often be stopped by a piece of paper or a sheet of aluminum, respectively. They cause most damage when they are emitted inside the human body. Gamma rays are less ionizing than either alpha or beta particles, and protection against gammas requires thicker shielding.

However, the amount of damage done to matter (especially living tissue) by ionizing radiation is more closely related to the amount of energy deposited. This is called the absorbed dose. The gray (Gy), with units J/kg, is the unit of absorbed dose, which represents the amount of radiation required to deposit 1 joule of energy in 1 kilogram of any kind of matter.
Equal doses of different types or energies of radiation cause different amounts of damage to living tissue. For example, 1 Gy of alpha radiation causes about 20 times as much damage as 1 Gy of X-rays.

Therefore the equivalent dose was defined to give an approximate measure of the biological effect of radiation. It is calculated by multiplying the absorbed dose by a weighting factor W_R which is different for each type of radiation. The Sievert (Sv) is the unit of equivalent dose. It is the dose of a given type of radiation in Gy that has the same biological effect on a human as 1 Gy of X-rays or gamma radiation[1].

Some of the radionuclides of concern after a nuclear accident include cobalt-60, caesium-137, iodine-131 and strontium-90. ^{131}I decays with a half-life of 8.02 days, while ^{137}Cs and ^{90}Sr have half-lives of 30,07 and 28,78 years and both emit beta and gamma.

Tones of fuel, containing highly radioactive materials (fission products), were ejected from the reactor along with a portion of the graphite moderator, which was also radioactive. The releases of ^{131}I and ^{137}Cs were the most important and estimated to have been 1,760 and 85 PBq respectively, over a 10-day period.

Hazard characterization

Acute Radiation Syndrome (ARS) is a form of damage to organ tissue caused by excessive exposure to ionizing radiation in a short period, though this also has occurred with long term exposure. Nausea and vomiting are usually the main symptoms. In addition to the symptoms of mild exposure, fever, hair loss, infections, bloody vomit and stools, and poor wound healing are seen with moderate exposure Very severe (5.5–8 Gy of radiation) exposure is followed by the onset of nausea and vomiting in less than 30 minutes followed by the appearance of dizziness, disorientation, and low blood pressure in addition to the symptoms of lower levels of exposure. Severe exposure is fatal about 50% of the time.

A chronic radiation exposure can also increase the probability of developing some other diseases, mainly cancer, tumors and genetic damage. Cancers associated with high dose exposure include leukemia (a malignancy of blood cells), thyroid, breast, bladder, colon, liver, lung, esophagus, ovarian, multiple myeloma, and stomach cancers. These are referred to as the stochastic effects of radiation, and are not included in the term radiation sickness.

Exposure assessment

Exposure to ionizing radiation was external and internal:

- External exposure is an exposure, which occurs when the radioactive source remains outside the organism exposed. It can result from either exposure to radio nuclides at the site area or to radio nuclides that have been transported from the site to other locations in the environment. External exposure was the main source of exposure immediately after the incident. People were getting the direct external irradiation from Gamma rays and there was also contact radiation from radioactive fallout on the skin and clothes

[1] The effective dose is measured in Sievert (Sv, and is dependent on 3 factors: 1 - the amount of ionizing radiation energy absorbed, 2 - the type of radiation and 3 - the susceptibility of various organs and tissues to radiation damage. For most exposures from Chernobyl accident absorbed doses are similar to effective doses (1Gy is equal to 1 Sv). People were exposed to high levels of radioactive iodine (^{131}I) with high effective doses. Individual thyroid doses ranged from few tens of mGy to several tens of Gy.

- Internal exposure may also occur if radioactive isotopes are present in the environment. Both inhalation and ingestion have to be taken into account.

Risk characterization

The release and transmission of radioactive materials caused 30 deaths, within a few days or weeks, among the power plant employees and firemen (including 28 with acute radiation syndrome) and brought about the evacuation, in 1986, of around 116,000 people from areas surrounding the reactor and the relocation, after 1986, of about 220,000 people from Belarus, the Russian Federation and Ukraine. A number of 600 emergency workers have received the highest dose during the emergency (accident), out of which 134 cases reported as Acute Radiation Sickness.

The total number of deaths already attributable to Chernobyl or expected in the future over the lifetime of emergency workers and local residents in the most contaminated areas is estimated to be about 4000. This includes some 50 emergency workers, who died of acute radiation syndrome and nine children who died of thyroid cancer, and an estimated total of 3940 deaths from radiation-induced cancer and leukemia among the 200 000 emergency workers from 1986-1987, 116 000 evacuees and 270 000 residents of the most contaminated areas (total about 600 000). These three major cohorts were subjected to higher doses of radiation amongst all the people exposed to Chernobyl radiation.

Globally, the main health consequences of exposure to radioactive materials among the exposed population were as follows:

- Acute radiation syndrome (ARS) and death occurred among plant workers, firemen as well as radiation exposure among thousands of people involved in rescue clean-up procedures. 134 liquidators, who had received high doses, contracted ARS. Among 200 hospitalized cases, 30 persons died due to ARS in 1986 within a few days to weeks (28 persons were firemen and power plant employees).
- Thyroid cancer: By 1995, 5000 cases have been diagnosed. The incidence of thyroid cancer has risen significantly among those who were under 18 years of age at the time of the accident and lived in the most contaminated areas. The reason was: release of high levels of radioactive Iodine in the early days after the accident that was concentrated radioactive iodine in the milk of caws consumed by children. The effect of this Iodine was exacerbated by the underlying iodine deficiency in the area (causes more of the radioactive iodine to be accumulated in the thyroid)
- Leukemia and non-thyroid solid Cancers: doubling of the incidence of leukemia among the most highly exposed Chernobyl liquidators has been documented. But no such increase has been clearly demonstrated among children or adults residents in any of the contaminated areas. Further studies are necessary to clarify this point.
- Cataracts, cardio-vascular diseases and reproductive and congenital effects: although these conditions have been shown rising among the exposed populations, however, more studies are required to show the evidence.

Alongside radiation-induced deaths and diseases, there has been an increase in psychological disorders, especially among accident recovery workers and people living in the highly contaminated areas. These disorders were not a consequence of radiation, but a consequence from the stress of losing their properties, evacuation, the lack of information given after the accident and the stress of knowing that their health and their children's health could be affected. Fear of radiation exposure lead to raised number of health disorders: headaches, chest pains, intestinal disorders, sleep disturbances, loss of concentration.

A social stigma with a designation of the affected population as “victims” rather than “survivors” lead to feelings of hopelessness and lack of control over their future and synergistically contributed to the deterioration of mental health status of the affected population.

Lack of physical and emotional well-being, loss of economic stability due to relocation, high level of stress, anxiety have led to excessive use of tobacco and alcohol.

After the accident the worst contaminated areas started economically, socially and politically declining. The typical features have been: poverty, unemployment and low living standards in the affected areas, immigration of skilled, educated and younger workers to outside the area leaving old population with few skills needed for economic recovery in the region, and low investment of the private sector in the area.

The affected areas could not evolve industrially or agriculturally because of strict rules that were introduced. The few products made were hard to sell or export because people were aware that it had come from the Ukraine and so were scared of being affected, this caused a further economic decline. Socially people have been limited on their activities making everyday life very difficult.

II. Event and environmental monitoring and response measures evaluation

Paucity of document supported that there were rational and well-organized monitoring and response measures on event and environment from the beginning in the Chernobyl radio nuclear emergency. Therefore, the baselines of the health status and environmental situation could not be defined at the start and followed up thereafter. Information about the severity and significance of the 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. International assistance became possible in 1989 when the Government of the USSR finally sought some alternatives in tackling the problem.

Immediate response measures (event management)

The immediate measures that were implemented to mitigate the event impact included the following:

- Evacuation of people from a 30-km zone around the power plant (116,000 people in the spring and summer of 1986 and another 230,000 in 1987)

- Rescue clean-up procedures by 600,000 people in a 30-km zone around the reactor. There were two main groups for mitigation of the accident, the first group acted during the accident itself (emergency workers like firemen) ant the second one acted after the accident (recovery operation workers). Their main task was decontamination of the reactor block, reactor site and roads, and the town built for the reactor personnel. This response measure was completed by 1990
- A sarcophagus built to contain the radioactive dust spread form the damaged reactor

It appears clearly that the response measures, rather than proactive and based upon a contingency plan, appeared reactive and of limited professionalism, and probably resulted in even more catastrophes and long-term negative consequences. On the spot of the accident, many firemen added to their considerable doses by staying on call on site.

It should be mentioned that these workers who were exposed to radiation should have been required to wear dosimeters so they can keep a record of their exposure, to verify that it is below legally prescribed limits. Indeed ionizing radiation remains undetectable by the senses, and the damage it causes to the body is cumulative, related to the total dose received.

On fighting graphite fires, flying helicopters while dumping materials over the reactor caused additional destruction of the standing structures, spread the contamination, and probably led to a further release of radio nuclides a week later.

It should be highlighted that it was 23 days after the accident that distribution of iodine preparations started with the intention to prevent the absorption of radioactive iodine by the thyroid; however, the greatest proportion of radioactive iodine had already been released in the first ten days following the accident that made the effectiveness of the action questionable. Normally iodine preparation should be given to the population before the radionuclides release, as a mean to saturate the thyroid and protect it from its contamination with radioactive iodine.

Environmental monitoring

Deposition of radio nuclides was extensive over Belarus, the Russian Federation and the Ukraine with other European and northern hemisphere countries received radiation deposition and occurred mainly during the first 10 days. Extensive environmental monitoring and studies have been conducted since the event. Secondary contamination resulting from cleanup, decontamination efforts and containment at the site has resulted in significant amounts of nuclear waste.

Radioactive waste management

Generally the dismantling of nuclear facilities generates radioactive waste that presents large variations:

- In activity level, for instance between waste originating from containment envelopes and waste resulting from the reactor core itself;
- In bulk and weight, for instance, between concrete rubble and huge metal components, such as reactor vessels;
- In gross waste volume, for instance between concrete waste from containment envelopes and waste resulting from filtration systems.

Depending on their physical and radiological characteristics, maintenance and operational waste will be directed towards different waste management processes:

- direct disposal of the waste
- prior processing for decreasing the activity level of the nuclear wastes.

In this case, taken into account the amount of radioactivity, it is likely that only a direct disposal of the waste on site would have been feasible. This process should have respected the following steps:

- identification of adapted suitable sites for disposal (identification of soils that are not permeable for preventing any groundwater contamination for example);
- identification of quantitative and radiological inventories of waste;
- definition of packaging specifications of waste (metal drum, concrete sarcophagus…).

But much of this waste is unprotected throughout areas of the old Soviet Union and remains an ongoing potential environmental and health hazard. The Chernobyl Exclusion Zone (CEZ) is the most contaminated environment and human activity has been severely limited within this zone.

Soil, groundwater and aquatic systems monitoring

^{137}C has been used to map the deposition of the soil surface because it is easy to measure and is significant radiological contaminant; the provisional minimum contaminant level is 37kBq/m^2. An atlas of this deposition (64 TBq) covering all of Europe was published and shows the most heavily affected areas with Belarus, Russian Federation and the Ukraine having depositions of 23%, 30% and 18% respectively. Wet deposition has resulted in areas with higher concentrations (e.g. from roofs to the ground).

Today, there is concern about contamination of the soil with strontium-90 and caesium-137, which have half-lives of about 30 years. Indeed, the highest levels of caesium-137 and strontium-90 are found in the surface layers of the soil where they are absorbed by plants, insects and mushrooms, entering the local food supply. Therefore restriction orders remain in place in the production, transportation and consumption of food contaminated by Chernobyl fallout. As of 2009 in the UK, they remain in place on 369 farms covering 200,000 sheep, which are still subject to inspection which may lead to them being prohibited from entering the human food chain because of contamination arising from the accident. In parts of certain countries of Western Europe, restrictions are in place on stock animals (boar, deer, reindeer…) in natural and near-natural environments, as well as on mushrooms.

Groundwater was not badly affected by the Chernobyl accident since iodine with short half-life decayed away long before they could affect groundwater supplies, and longer-lived radio nuclides such as Cs and Sr were adsorbed to surface soils before they could transfer to groundwater. However, significant transfers of radionuclides to groundwater may occur from waste disposal sites in the exclusion zone around Chernobyl. Runoff by rain into rivers and groundwater has been demonstrated to be negligible, except in case of floods.

In conclusion of this section, it should be pointed out that extensive studies of aquatic systems including river water, open and closed lakes, biota and marine environments has been conducted since the event:

- Bioaccumulation in freshwater fish continues with slow decline
- Marine environment has relatively low levels of contamination
- Water monitoring continues along major waterways

Food and agriculture

Contamination of food, primarily milk and meat, with ^{131}I was the immediate concern following the accident; however due to its rapid decay, few samples were collected. Modeling using ^{129}I has provided better estimates of the deposition of ^{131}I. Cesium and Iodine are environmentally mobile and transfer to foodstuffs. However, the authorities started monitoring of milk and drinking water in the contaminated zone as of 1 May 1986.

Short Term agricultural impacts:

- Milk production – uptake by grazing dairy cows of ^{131}I plants surfaces led to contaminated milk. Peak periods of ^{131}I that exceeded national standards were from late April – early May 1986.
- Leafy vegetables – uptake from atmospheric contamination
- Grazing of ruminants – contaminated soil and pastureland as well as feed has contaminated ruminants in northern hemisphere – sheep in uplands UK, reindeer meat

Long term agricultural impacts:

- Plant uptake is dependent on variables including soil type, competition from other elements
- Slow decrease in concentration since the event; ^{137}C should decrease (30 yr half-life)
- Potential increase in concentrations if changes in water table or current management.
- Most agricultural food products are now less than national action levels
- Limited areas with high radionuclide contamination or poor soils have higher than acceptable concentrations.

For the longer term, radiocaesium, present in milk, meat and some plant foods, remains the most significant concern for internal human exposure, but, with the exception of a few areas, concentrations fall within safe levels. Therefore, a global and long-term monitoring of radio nuclides in the environment is still necessary. Some scientists fear that radioactivity will affect the local population for the next several generations. The main source of elimination is predicted to be natural decay of caesium-137 to stable barium-137. Future activities should include:

- Ongoing mapping of ^{137}C of eastern Europe to complete mapping

- Long term monitoring of ^{137}C and ^{90}Sr in agricultural vegetable and animal products
- An integrated waste management program within the exclusion zone is necessary.

Event monitoring (Epidemiological Studies)

Epidemiological studies have been hampered in the former Soviet Union by a lack of funds, an infrastructure with little or no experience in chronic disease epidemiology (differences in the intensity and method of follow-up between exposed populations and the population with which they are compared), poor communication facilities and an immediate public health problem with many dimensions. Emphasis has been placed on screening rather than on well-designed epidemiological studies. International efforts to organize epidemiological studies have been slowed by some of the same factors, especially the lack of a suitable scientific infrastructure. In addition, the work of World Health Organization and the European Commission in strengthening the epidemiological research infrastructure in Russia, Ukraine and Belarus is laying the basis for major advances in these countries' ability to carry out epidemiological studies of all kinds.

Thyroid cancer, birth defects, increase in cardiovascular related conditions were among the diseases reported as consequence of exposure to the nuclear fallout from the Chernobyl event. Comparing the exposed populations from the Chernobyl case to the victims of the atomic catastrophic event in Japan, the incidence of health consequences for the Japan exposed population sharply increased in a relatively short period of time. But the exposure from the Chernobyl took a longer period of time. For example, scientific studies documented that incidence rate of thyroid cancer in children and adults exposed to nucleid as result of the Chernobyl accident increased sharply over time from 1986-2002 (Jacob et al, 2005).

As radioactive elements (Plutonium, Strontium, and Cesium) normally take a long time (up to 30 years) to be degraded, there is a need to have well designed longitudinal epidemiologic studies to better document the consequence of the Chernobyl case. Perhaps studies that employ both a retrospective and prospective approaches would be a better approach for comparison purposes in order to better account for the background exposures of other events which was noted as difficult to decipher in some of the epidemiologic studies carried out to date. In addition, close monitoring of workers who received from ARS and other highly exposed emergency workers should continue, as well as focused screening of children exposed to radioiodine for thyroid cancer and highly exposed clean-up workers for non-thyroid cancers. Regardless the adopted strategies, these studies require significant resources to be allocated for establishing chronic disease surveillance for tracking the exposed as well as following up the inhabitants in the area.

The long term result of radiation in humans is a variety of chronic diseases. Obviously and as the chronic diseases have many extrinsic and intrinsic factors in common, correlation of the condition with the radiation risk factor would be very difficult. Surveillance of these chronic health effects of Chernobyl require standardization of determinants, risk factors, diagnosis, interventions and outcomes, for which it is hard to find a blue print. Nevertheless, some current literature suggest that Chernobyl, in the Ukraine, continues to feature in the top ten, still polluted by radioactive dust released by the incident in 1986 and since then, more than 4000 cases of thyroid cancer have been diagnosed in children, and incidence of

skin lesions and breast cancer has increased in the surrounding region[2]. Circulation of views of this kind shows that there is still a huge gap in evidence and a need for establishment of a kind of surveillance for chronic diseases. It could be a system similar to the WHO Non Communicable Disease Stepwise Surveillance (STEPS) with regular surveys (that might suffer from ethical issues surrounding screening of cancers that have no treatment) or based on the risk prediction models developed from studies of other populations exposed to radiation in other settings, particularly the studies of the atomic bomb survivors in Japan[3].

To respond to the need for evidence and with the support of the European Commission, an international group of experts and advisors formed the project "ARCH: Agenda for Research on Chernobyl Health" to review the health consequences of exposure to radiation from the Chernobyl accident and provide advice on the studies needed to be carried out in the future. ARCH has outlined a reasoned long term plan for research into the health consequences of radiation from the Chernobyl accident in its Strategic Research Agenda (SRA)[4]. The SRA proposes long-term funding support to proposals on the Chernobyl Health Effects Research Foundation, similar to the action taken to create the Radiation Effects Research Foundation some years after the atomic bomb exposures in Japan, together with a series of individual studies covering the main health consequences. This includes the ongoing thyroid cancer problem, the reported rise in breast cancer, inherited molecular-genetic alterations, and various cancers, cataracts and other non-cancer diseases in liquidators and in the general exposed population. Long-term studies of already existing groups with known radiation doses would provide invaluable information on the life-time risks of both external and internal exposure. The ARCH project is coordinated by the WHO IARC and is funded by the EC EURATOM Programme**.**

IAEA has enlisted the studies and the programs such as cancer and congenital anomalies registries that need to be implemented by the engaged countries[5]. The document contains the areas that need to be monitored regularly.

III. Communication

The Chernobyl radionuclear event happened in a system of information control. Problem-solving errors, such as overconfidence, preoccupation and over-focus and horizontal flight were identified delaying the communication in response to the emergency. In addition, the responsible authority was not prepared to keep people informed, and the firefighting and emergency workers were not informed of the risk they encountered. The first reaction of the Governmental authorities was to hide the accident both from the general public and from the rest of the world. It was not until April 28, two days after the disastrous

[2] Annual report 2007, Dirty Thirty: The Blacksmith Institute accessed on http://oncology.thelancet.com Vol 8 November 2007

[3] The Cancer Burden from Chernobyl in Europe, IARC Press Release No. 168, 20 April 2006; accessed on http://www.iarc.fr/en/media-centre/pr/2006/pr168.html

[4] http://arch.iarc.fr/documents/ARCH_SRA.pdf

[5] Chernobyl's Legacy: Health, Environmental and Socio-economic Impacts and Recommendations to the Governments of Belarus, the Russian Federation and Ukraine; The Chernobyl Forum: 2003–2005, Second revised version: pp 45-48.

event and after other countries reported radioactivity in atmosphere, did USSR acknowledge the accident.

Losing Public Trust

Miscommunication led to widespread loss of confidence and trust in general to the Government and to a large extent affected the public health measures thereafter. 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.

Delayed International Assistance

The communication on the decisions made or actions taken was delayed and consequently also affected the involvement of WHO and other international organizations in the assessment of the effects of the accident and in provision of assistance to the country for mitigating the effects of the disaster. The WHO ever 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, but also undermines confidence in the competence of the radiation specialists". The League of Red Cross and Red Crescent Societies made similar observations.

Multiple stakeholders' negotiation and international assistance

International assistance became possible in 1989 when the Government of the USSR finally sought some alternatives 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 Government of the USSR, in October 1989, formally requested the International Atomic Energy Agency (IAEA) to coordinate "an international expert's" assessment of the concept and the measures that the USSR evolved and took after the event. As a result, an international project was launched in the spring of 1990 with an independent "International Advisory Committee" of 19 members set up under the chairmanship of Dr. Itsuzo Shigematsu with experts from disciplines like medicine, radiopathology, radiation protection, nutrition, radioepidemiology and psychology, among other disciplines. Following that in May 1990, 200 independent experts from 23 countries and 7 international organizations in the form of 50 scientific missions visited the USSR.

On Sep. 5, 2005, WHO, IAEA, and UNDP jointly hosted a press release, "Chernobyl: the true scale of the accident"-- 20 Years Later a UN Report Provides Definitive Answers and Ways to Repair Lives. In the press release, transparency with facts was addressed, collaboration with solutions was stressed, and the true scale of the accident's consequences was presented. And most importantly, the press release was jointly held by independent and professional parties with an open attitude to the accident and hope to move forward reassured. Besides, recommendations called for targeting information to specific audiences through re-alignment and reframing issues. Answers to longstanding questions were provides as a supplement for further reference.

UNDP assumed responsibility for UN-wide coordination of Chernobyl issues in 2004. UNDP established a platform for international cooperation on Chernobyl. UNDP and UN Action Plan for Chernobyl, "A unified message of hope for Chernobyl-affected communities" was one of the key communications. On the message, in line with a shift in strategy from humanitarian assistance to development aid information issues, policy advice, and community development were addressed. On April 24 2009, UN agencies marked Chernobyl anniversary with launch of US $ 2.5-million project aiming to translate the latest scientific information on the consequences of the accident into sound practical advice for residents of the affected territories. A return to normal life as a realistic prospect for people living in the affected territories was the message once again delivered.

So far, in the Chernobyl radionuclear event, among others, international organizations such as WHO, IAEA, WTO, ICAO, IATA, FAO, and ILO, and relevant international networks, such as GOARN, ChemiNet, and REMPAN are all concerned to achieve the objective of protecting and promoting global public health security. Furthermore, a substantial array of intergovernmental organizations and non-governmental organizations whose mandates include global health security concerns are involved.

Accurate information not sufficiently delivered to the people

For people most affected by the accident, provision of sound, accurate information can assist with the healing process. Poverty, lifestyle diseases and mental health problems could even pose a far greater threat than the radiation exposure per se. There was no targeting information to specific audiences, community leaders and health care workers, neither along with a broader strategy that could promote healthy lifestyles as well as information about how to reduce internal and external radiation exposures.

The authoritative scientific findings should be translated into plain non-specialist language accessible to all people to help dispel widespread misconception and fears and fight the stigma that afflicted the region. Moreover, the main challenge consists in defining creative ways to disseminate information, especially to population living in rural areas, in a way that induces people to change their behavior. Targeting information to specific audiences, including community leaders, health care workers, and teachers, should be taken into consideration to propagate accurate and practical advices. Other resources may be exploited to provide local residents with practical advice on health risks and healthy lifestyles. Mass media, internet-equipped information centers in rural areas, and small-scale community infrastructure projects could be good options aiming at improving living conditions and promoting self-reliance.

Cross border negotiation and other countries' reaction

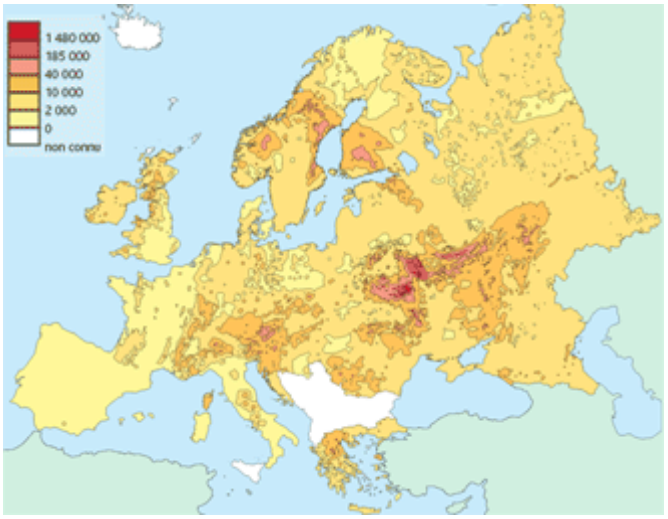
Radioactive materials released after the accident rose into the air up to 1200 meters. Volatile materials and gas were transported over large distances by the mass of air. A radioactive cloud was then created and has circulated across the large part of Europe between 26th April and 6th May 1986.

A dynamic modelisation across Europe of this radioactive cloud is available at the following address: *http://www.irsn.fr/FR/popup/Pages/tchernobyl_video_nuage.aspx*

This cloud was progressively diluted when it moved away from Chernobyl. Therefore 3 countries received about 60% of the total radioactivity emitted: Ukraine, Belarus and Russia.

The particulate matters contained in the cloud finally fell out. This fallout implies exclusively Cs137.

Figure 1: ^{137}Cs fallout in Europe in May 1986 (in Bq/m²)



Few, if any, records documented the cross border negotiation for the Chernobyl radionuclear event and the possible international collaboration and cooperation for monitoring and response measures.

In fact, there was no mechanism for coordinating the measures to take after this accident across Europe. As a result, a large variety of measures has been taken by EU countries. A compilation of them are as follows:

- monitoring of the Cesium and Strontium radionuclides in the environment and foods to assess the impact of countermeasure remedial actions;
- better information to the people regarding radioactive contamination in certain food products, appropriate food preparation methods to reduce radionuclide intake;
- restriction of harvesting some wild food products in some areas;
- to focus efforts and resources in high contamination areas;
- to focus assistance programs on highly contaminated areas and shift away from those that foster victim and dependency mentality;
- application of some agricultural countermeasures;
- avoidance of mushrooms, berries and hunted meat in the forest and mountain areas with high absorption of high Cesium e.g. in the arctic and sub-arctic areas;
- avoidance of fish consumption hunted from lakes with high Cesium concentrations e.g. in Germany and Scandinavia;

- removing contaminated pasture grasses form from animal diets and monitoring milk for radiation level;
- treatment of land and for fodder crops with the aid of Cesium binders;
- restriction of access to some forest areas in Scandinavia for harvesting food products and firewood.

It should be highlighted that some restriction orders remain in place in the production, transportation and consumption of food contaminated by Chernobyl fallout. As of 2009 in the UK, they remain in place on 369 farms covering 200,000 sheep, which are still subject to inspection which may lead to them being prohibited from entering the human food chain because of contamination arising from the accident. In parts of certain countries of Western Europe, restrictions are in place on stock animals (boar, deer, reindeer…) in natural and near-natural environments, as well as on mushrooms.

However, a controversy reached also a country like France, when the government claimed that the radioactive cloud had stopped at the Italian border. Therefore, while some kinds of food (mushrooms in particular) were prohibited in Italy because of radioactivity, the French authorities took no such measures, in an attempt to appease the population's fears. Today, lawsuits have been filed against “X”, considering that the French government had not adequately informed the population of the risks linked to the Chernobyl radioactive fallout.

Further reflection upon the Chernobyl radionuclear event

Communication is one of the core capacities of emergency management. Proactive communication of real and potential risk is the basic principle. Public health communication networks and strategies shall be practiced as daily routine. Communication plans and strategies for emergencies shall adapt to specific challenges and be open, clear, and transparent. To identify and be ready for media activities for the firsts 24-72 hours under extreme time pressure will be anticipated. Timely and accurate information provided at local, national, and international levels shall be in line with the guidelines to build trust, announce early, be transparent, understand the public, assess the media needs, and plan/prepare a communication strategy beforehand. Reflected upon the Chernobyl radionuclear event, people did not witness any communication merits as described above.

IV. Public health governance and responsibilities

Right to health

Conventions and charters of human rights reflect the relationship between the duty bearers and the right holders. The holders claim their rights from the bearers and the bearers are obliged to fulfill their responsibilities towards the holders.

According to the WHO constitution, health is one of the fundamental rights of every human being, which highlights the role of the states authorities in responding to health needs of their population in the context of human rights. This does not limit to the domestic population but also to the travelers and other international communities.

The General Comment on the Right to Health, adopted in 2000 by the UN Committee on Economic, Social and Cultural Rights, specifies four elements to the right to health:

- Availability of health services
- Accessibility of health services with four criteria:
    - Non-discriminatory
    - Physical accessibility
    - Economical affordability
    - Information accessibility
- Acceptability
- Quality

There are times that the duty bearers have to apply some restrictions (such as isolation of a patient). In such instances a key factor in determining if the necessary protections exist when rights are restricted is that each one of the five criteria of the Siracusa Principles must be met, but should be of a limited duration and subject to review and appeal. The Siracusa principles are:

- The restriction is provided for and carried out in accordance with the law;
- The restriction is in the interest of a legitimate objective of general interest;
- The restriction is strictly necessary in a democratic society to achieve the objective;
- There are no less intrusive and restrictive means available to reach the same objective;
- The restriction is based on scientific evidence and not drafted or imposed arbitrarily i.e. in an unreasonable or otherwise discriminatory manner.

Interpretative principles relating to specific limitation clauses in the public health domain provides that public health may be invoked as a ground for limiting certain rights in order to allow a state to take measures dealing with a serious threat to the health of the population or individual members of the population. These measures must be specifically aimed at preventing disease or injury or providing care for the sick and injured. Also, due regard shall be had to the international health regulations of the World Health Organization. In addition, the principles on public safety refer to the meaning as protection against danger to the safety of persons, to their life or physical integrity, or serious damage to their property[6].

However, what occurred in Chernobyl showed a number of human rights violations by the responders at the central level, although the evacuation could be interpreted as the limitations in the benefit of the public, it never happened in time and with this spirit. This is well highlighted when a group of elderly decided to resume their previous lives in the contaminated areas due to forces of poor living conditions and the central and local governments did not apply these limitations. Lack of access to the right information by the population at risk that exposed them to contaminated food and environment, late distribution of Iodine to children that exposed them to the risk of thyroid cancer and finally lack of transparent dissemination of the dimensions of the accident to the neighboring countries and international organizations are examples among others.

[6] Accessed on the Internet at: http://www.unhcr.org/refworld/docid/4672bc122.html

Few documents provide the evidence that any competent authority or authorities received some notifications, recognized the emergency, issued alert, and responded accordingly in the very beginning moments of the incident. The response measures were not based upon a contingency plan and appeared reactive, chaotic and of limited professionalism that delayed implementation of the right approaches. This may have resulted in deeper catastrophes and long-term negative consequences.

The Chernobyl radionuclear event happened in a system of information control. The firefighters, liquidators and emergency workers were even not informed of the risk they encountered. People living in the affected areas were forced to leave their homes.

As the basic rights of the affected population were neglected, the social stigma with a designation of the affected population as “victims” rather than “survivors” had lead to feelings of helplessness and lack of control over their future, or otherwise, the affected population might be shunned by local residents because the evacuees were provided with new houses and pensions. There is not sufficient evidence that the affected population has been discriminated against by prospective employers.

Continued distribution of contaminated milk to the families and its consumption by children could be directly resulted from lack of knowledge on the consequences or direct violation of the right of the people to know the risks to protect themselves.

Added to this, is the deployment of soldiers and liquidators without any suitable Personal Protective Equipment was an evident violation to their basic rights.

Who was in charge & how the event was handled by authorities?

The accident triggered by a test taking the advantage of a shutdown of Unit 4 reactor for routine maintenance on 25 April 1986. Unfortunately, this test was carried out without a proper exchange of information and coordination between the team in charge of the test and the personnel in charge of the operation and safety of the nuclear reactor i.e. the people responsible for testing did not comply with the established Standard Operating Procedures (SOP). According to an assessment report of the Nuclear Energy Agency (NEA), the Chernobyl accident was the product of a lack of "safety culture".

Thus, there was not one cause of this accident, but several. In summary, the following causes led to the accident:

- Design fault in the RBMK-1000 reactor
- A violation of standard procedures (No compliance with the SOPs)
- Breakdown of communication between the reactor personnel
- Lack of safety culture

Another concern was the containment procedures after the accident, which may have resulted in further contamination of atmosphere, soil and underground water sources due to spreading of radio nuclides, melting of reactor fuel rods and graphite. The chronological relation between the events and the response to the incident is shown in table I (see Annex I).

The secretive Soviet state was slow to act. Soviet bureaucracy debated whether to evacuate nearby cities, and how much land should be evacuated. They were slow in their response, slow to evacuate, and slow to inform the world of the disaster. It took over 36 hours before authorities began to evacuate nearby residents. Two days later, the nightly news (the fourth story) reported that one of the reactors was "damaged." All these drawbacks indicate that there was no contingency plan maybe due to neglect or kind of overconfidence to engineering system of the former USSR.

The resettlement and rehabilitation programs launched in soviet conditions proved unsustainable after 1991 and funding for projects declined, leaving many projects unfinished and abandoned and many of the promised benefits underfunded.

The strategy applied by UNDP and the affected states would be to apply a holistic "area-based development" approach aimed at restoring a sense of community self-reliance by showing local residents that they hold the key to their own recovery to empower community-based efforts across the region.

What hierarchical management was used?

In reality, besides many problems in the Soviet nuclear power industry, the atmosphere created by bureaucracy and hierarchy of a system like the Soviet created many barriers against effective legislation before the accident and timely notification, investigation, reporting and action following the accident.

Health system and community dynamics

It took over 36 hours before authorities began to evacuate nearby residents. The health system was not well prepared for monitoring the public health event. No one was aware of the risk of contamination of the food, water, animals and animal products, fish and the environment. The risk was not recognized by the health system and had not been communicated with the people in an efficient manner. This resulted in consumption of contaminated milk and other food and feed in the affected zone without any knowledge of methods for preventing the internal routs of irradiation.

There were no specific contingency or any other risk reduction plans for the affected population. Specifically the people at risk (such as pregnant women, children and young adults, elderly, firefighters and liquidators, farmers) had not any kind of specific protective programs. Furthermore, there is always a group of people more vulnerable than the others who suffer most during an emergency.

Vulnerable Population is the people who cannot comfortably or safely access and use the standard resources offered in disaster preparedness, relief and recovery. They may include people with sensory impairments (blind, deaf, hard-of-hearing); cognitive disorders; mobility limitations; non natives/expatriates with limited language comprehension; as well as people who are geographically or culturally isolated, medically or chemically dependent, or homeless7. There is not sufficient information available on the demographic information on the unaccompanied children, single women, pregnant women, woman-headed households, impoverished elderly people and people with disabilities. However,

[7] Yale Center for Public Health preparedness: http://info.med.yale.edu/eph/ycphp/glossary.html#vp

with the short and long term consequences of the incident it would be far that an identical support program for the vulnerable population is implemented.

The reports show that a group of elderly people have returned to their homes in the affected zone to resume their normal life. This could be recognized as a proxy of the extent and quality of social support programs in place.

Local, national and international regulations norms and their application

At the country level

At a more general level the governments of affected countries should have entered into force rules, regulations and guidelines to make sure that all capacities including the surveillance for radiation/nuclear risks, notification, investigation, reporting and action following a tentative radio/nuclear accident were in place. If done, effective legislation and coordination could facilitate all these activities following the accident.

The affected governments must have reviewed, re-aligned or redesigned the rehabilitative programs away from dependency and replaced them with the initiatives that encouraged opportunity, supported local development, and given people confidence in their futures.

The contingency plans, even if in place, have not been followed. One major reason could be lack of know-how of the local authorities that mainly is the result of absence of simulation exercises. This is quite comprehendible through the repeated errors in decision making and containment of the risk during and after the incident. Same is also applicable to the authorities at the central level for decision making and evaluation of the situation.

Chernobyl rehabilitative programs should have been refocused on more targeted benefits, elimination of unnecessary benefits in less contaminated areas, improving primary health care, support for safe food production techniques and encouragement for investment and private sector development, including small and medium-sized enterprises.

Cross-border & International

Cross-border linkages were not established well with other affected countries following the accident, although many countries in Scandinavia, Germany, France, England and Netherlands were affected by radionuclear dusts.

The international support to the accident came quite late and in the beginning was not effective. First of all, this was because of the late formal request from the USSR Government. It was only in 1989 that the assistance was requested from the WHO and IAEA. Besides, at the time of the accident there were no international conventions that would support arranging and providing global response. The following conventions were adopted only after the Chernobyl accident in 1986:

- The convention on Assistance in Case of a Nuclear Accident or Radiological Emergency
- The convention on Early Notification of a Nuclear Accident (Emergency Conventions)

The authorities at the other countries made responses e.g. Sheep in certain mainland areas of the UK contracted levels of radioactivity above the standard safety limits where sheep farming is the primary land use. A regulation was come into power to restrict the movement and sale of the sheep in the restricted areas. A management system known as "Mark and Release" operates in the restricted area under which any farmer wishing to move sheep out of the restricted area, could have them monitored for radio cesium. Those sheep that pass the test were allowed to enter the food chain.

One of the reasons for this lack of international cooperation might have been that, when the Chernobyl accident occurred, no appropriate international conventions were in place to manage the event, in terms of global response or of public health. For instance, the IAEA Convention on Early Notification of a Nuclear Accident was only adopted in 1986 following the Chernobyl nuclear plant accident. During the Chernobyl disaster notification to the IAEA delayed by 3 years and its not indicated if there were notifications from the USSR to the neighboring countries that were at risk.

In addition former IHR (1969) didn't allow WHO to provide recommendations and support to a State Party that didn't request it officially.

V. The event in the context of IHR

Since the Chernobyl accident, the nuclear sector has developed or strengthened the regulations and the tools to reinforce the prevention or the preparedness of such an accident, under the supervision of IAEA. A New Safe Confinement (NSC) with a 100 y service life covering over the existing sarcophagus (Shelter) as a longer-term solution[8]. The construction of the NSC will enable the dismantlement of the current Shelter, removal of highly radioactive, fuel-containing materials from Unit 4, and eventual decommissioning of the damaged reactor. More radioactive waste will be generated during NSC construction, possible Shelter dismantling, removal of fuel-containing materials, and decommissioning of Unit 4.

Meanwhile, the IHR (2005) entered into force and provides a framework for prevention, detection, notification and response to radio-nuclear events in a country especially if there is a risk of trans-boundary contamination/ health implications following the event.

Therefore, nowadays, in case the accident happened when the IHR (2005) was in force, the country should have established a capable IHR NFP with adequate and clear Terms of Reference, enabling laws and national partnerships, especially with the nuclear sector. These are required for a swift surveillance and response to any event. The NFP would have developed, in collaboration with all stakeholders, preparedness plans at different levels.

[8] Radioactive waste management and environmental contamination issues at the Chernobyl site accessed through http://www.ncbi.nlm.nih.gov/pubmed/18049220

Core capacities

Since coming into force, IHR (2005) has provided the world with a global framework for preventing, detecting, assessing and providing a coordinated response to events that may constitute a public health emergency of international concern (PHEIC). To ensure appropriate and timely management of public health risks, effective national core capacities as well as international and intersectoral collaboration in compliance with the IHR (2005) should be in place by the NFP and enabling mechanisms provided to it.

The core capacities are not listed or defined in the IHR (2005) as are presented in literature; however, they have been identified through consensus among a group of technical experts from Member States, technical institutions and WHO expert technical group. The core capacities are 8 in number and are listed below:

1. Legislation, Policy & Financing
2. Coordination & NFP Communications
3. Surveillance
4. Response
5. Preparedness
6. Risk Communication
7. Human Resource Capacity
8. Laboratory

Also, the public health security is in constant threat by certain hazards either deliberate or accidental. Theses threats include:

9. Infectious Disease Hazards
10. Zoonotic Events
11. Food Safety Events
12. Chemical Events
13. Radiological and nuclear Events

Nonetheless, those Core Capacities that have been directly listed in Annex IA mandates the States Parties to meet minimum core capacities for reinforcement or setting up an alert and response mechanism for use in case of PHEIC:

- Surveillance, reporting, notification, verification, response and collaboration activities;
- Activities concerning designated airports, ports and ground crossings

Theses capacities are listed in three levels (community or primary public health response level, intermediate public health response level and at the national level) in a way that each level has a supervisory and supportive role over its lower level and involves the stakeholders and partners at their own levels.

Articles 5, 13, 19, 20 and 21 oblige the state Parties to develop, strengthen and maintain certain capacities as specified in Annex 1 of the Regulations. Also as provided in Annex 1 of the Regulations,

States Parties and WHO shall support assessments, planning and implementation processes of the core capacities.

In summary, here is a summary of national level activities that could have helped to facilitate the intersectoral surveillance and response to nuclear events if the IHR core capacities were already in place at the time:

a) Communication mechanism between the Atomic Energy ministry and the IHR NFP
   - A national law should make it mandatory that all radio-nuclear events are immediately notified to the national atomic energy committee and the country's IHR National Focal Point (NFP).
b) Incorporation of radio-nuclear events surveillance into the national event based surveillance system
   - Surveillance of radio-nuclear events should be included into existing surveillance systems and into the national event based surveillance system to ensure that the events are detected on time.
c) Role of an multi-sectoral committee in responding to the radio-nuclear event
   - The IHR (2005) also requires that a multi-sectoral committee is available at the national level to coordinate and monitor response to radio-nuclear events.
   - There should be a national multidisciplinary rapid response team with capacity to investigate and respond to radio-nuclear events.
d) Stockpiles of supplies, antidotes, specimen collection kits, Personal Protective Equipment (PPE) for responding to radio-nuclear events.
   - Vital supplies, drugs, PPE should be available for initial response to radio-nuclear events.
e) Case management: including designated clinics, case management guidelines, and staff trained in management of cases.
f) Laboratory capacity for analyzing radio-nuclear contamination
   - There should be capacity for analyzing radio-nuclear contamination or alternatively; shipment address of an international collaborating laboratory where such specimen can be shipped for laboratory analysis

IHR and Human health risk assessment

In case the accident happened when the new IHR was in force, the IHR NFP had to be immediately informed on that. The latter had to activate the IHR decision instrument for the assessment and notification of events that may constitute a PHEIC. The situation, in spite of its obvious danger and threat to public health, should have been anyway analyzed applying four questions on PHEIC:

1. Is the public health impact of the event serious? And the answer would be "yes", as there was a spread of dangerous hazardous materials that had contaminated a population and large geographical area.

   The external assistance was needed to detect, investigate, respond and control the event, as at that time in the USSR there were inadequate human, financial, material and technical resources (including stocks of non radioactive iodine, medicines, protective equipment, decontamination equipment, etc.)

2. Is the event unusual or unexpected? And the answer would be "yes", as the explosion was unexpected.

3. Is there a significant risk of international spread? The answer would again be “yes”, as there was an environmental contamination that had the potential to spread across international borders.
4. Is there a significant risk of international travel or trade restrictions? As it was clear that the radioactive substances were going to enter the food chain through contaminated water, soils and grass, in a longer run it was going to have implications on trade leading to various restrictions.

Thus, scanning the Chernobyl accident through these questions, the accident had to be classified as PHEIC and immediately the information had to be reported to the WHO. Moreover, following the requirements of the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency and the Convention on Early Notification of a Nuclear Accident (Emergency Conventions), the event had to be reported in a special form to IAEA.

One of the core capacities of the IHR (2005) is preparedness. It includes development of preparedness plans for response to the emergencies (PHEIC) at the national, provincial and local levels with an all hazard approach. Hazard mapping, resource mapping, stockpiling of resources and capacity to support operations at the intermediate and local community/primary response levels during a public health emergency are among the requirements.

One contingency plan that had to be developed for Chernobyl nuclear power station from its construction and updated regularly, as this type of sites always pose a serious risk to public health and environment (in case of an accident). And for example among the first actions to be taken in case of accident and emission of radionuclides the plan had to prescribe the distribution of the iodine to the affected population, especially considering that in that geographic area there was an endemic iodine-deficiency. Again following that contingency plan the stock of iodine had to be created and established in one of the nearest health facilities or any other relevant place identified for that purpose. The plan had to clearly identify what is the maximum possible time for the accident liquidators to spend in that area, and distance on which the workers could approach the source of explosion. A set of standard operation procedures had to be developed and put in place for all stages of the accident response and liquidation, which would help to lessen the number of the affected people and mitigate the health effects of the ionizing radiation.

Health impact assessment had to be done alongside with assessment of the accident as a PHEIC, The characteristics of the hazardous substances had to be once again determined (as they could have varied depending on the scale of the damage to the nuclear power plant), the exposure pathways had to be clarified.

Population data should have been analyzed to estimate the total number of residents in the affected territory, as well as identify the most vulnerable groups, such as children, elderly people, lower socioeconomic classes. Vulnerability assessment of that groups as well as emergency responders had to be done. This information had to be used to estimate the likely number and type of casualties, and delayed effects from acute exposures, and effects of secondary contamination (i.e. of soil and water). The health impact assessment had to include an estimate of the sheltering and evacuation requirements and the capacity of the emergency services to support them.

The number and type of estimated casualties had to be translated into the resources required to respond adequately to a potential incident.

Communication strategy had to be in place and be immediately activated as soon as the accident has occurred. The case study of the Chernobyl accident described that free of radiation exposure lead to raised number of health disorders: headaches, chest pains, intestinal disorders, sleep disturbances, loss of concentration. Lack of physical and emotional well-being, loss of economic stability due to relocation, high level of stress, anxiety have led to excessive use of tobacco and alcohol. Proper information campaign and work with the affected population could have helped to avoid these complications.

Not as an immediate measure, but for being better prepared for the long term consequences of the accident, as well as have more evidence-based information, appropriate epidemiological studies could have been initiated to follow the exposed population. These studies would help to identify potential chronic conditions related to the accident and offer necessary treatment if necessary. Additional objectives of an epidemiological study are to: (a) provide information regarding the probability of health effects; (b) delineate the exposure-dose/health-effect relationship; and (d) contribute to the database of public health and radiological information.

Effects on International travel and trade

As this event constitutes a PHEIC, the root cause for occurrence must be determined. The intent underlying the occurrence of the event should be established. A thorough investigation is needed to consider all possibilities. Is this event an accident or a potential for terrorist attacks, including the potential for terrorists to attack public transportation systems and other tourist infrastructure in respected countries? Proper assessment of the case is necessary for an appropriate needed response.

Currently under IHR 2005, the member states were required specific capacities for public health action including for surveillance and response, for airports, ports and (ground crossings) and other supporting capacities.

The Chernobyl event which caused migration may impose health measures applicable to international travelers. Immediate clinical treatment of the victims of the radio-nuclear exposure must be done. The patients shall be screened or placed in a less invasive and intrusive medical examination that would achieve public health objective, or to diagnose the extent of exposure. Eventually, banking of epidemiological data is necessary for further reference and studies. This is developing the capacity to detect events involving disease or death above expected levels for the particular time and place in all areas within the territory of the state party. There should be the capacity to report all available essential information immediately to the appropriate level of health care response.

Support to travelers at POE

1. Ensure safety and security at ports, airports and ground crossings. Clear the threat of terrorism
2. Advise the traveler to avoid Civil Unrest or Political Tension

Travel and transport, Points of Entry

Development of core capacities at POE

- Assessment, designation and certification
- Development of plans for implementation
- Promotion of multi-sectoral collaboration and coordination for prevention, surveillance and response
- Development of emergency contingency plans for POE
- Test routine measures and emergency contingency plans
- Develop national legislation for travel and transport issues
- Develop training tools and support for training programmes

Core capacity requirements for Designated Ports and Airports of entry

(Points of Entry- POE), Article 19, 20, and 21

1. Shall designate ports and airports for developing capacities Annex 1b
2. May designate ground crossings for developing capacities Annex 1b (Volume and frequency of international traffic and public health risks)
3. States parties sharing common borders should consider:
    - Bilateral and multilateral agreements
    - Joint designation of adjacent ground crossing for capacities Annex 1b
4. Identify competent authority for each designated Points of Entry
5. WHO certification for Ports and Airports
    - Under request of State Party WHO may arrange to certify it

Need to develop procedures and guidelines by WHO support to travellers at POE

It is just a question of travel restriction to the contaminated area and information of travelers coming from this area… No more because we are not in a process of communicable disease.

Crime

Due to some mental and psychological imbalance brought about by the disaster, travellers are potential targets for robbery, mugging and pick pocketing. Crime levels are higher at night and in or near bars and hotels catering for foreigners. Drink spiking, with the intention of robbing the victim while incapacitated, has been reported. Some travellers have been robbed when travelling by train. There have also been reports of harassment, mistreatment and extortion by police or other local officials.

Communication

Reflecting upon the Chernobyl radionuclear event, what shall we do under IHR implementation today in terms of communication?

Under the IHR capacity building requirements for surveillance and response, risk communication for public health emergencies includes the range of communication capacities required through the

preparedness, response and recovery phases of a serious public health event to encourage informed decision making, positive behaviour change and the maintenance of trust. Through the process of public health emergency communication, assessment, coordination, transparency, and learning to listen shall be practiced. Proactive communication and first announcement of real or potential risks shall be exploited as the event comes up. Analysis of the stakeholders, including the affected, the public, the interested (including the mass media), and the influential parties and their concerns shall be made in advance and updated as the event goes on. Therefore, target messages shall be addressed to the questions and concerns of important stakeholders to ensure public security, protect human rights, and dissolve ethical dilemma. If all these were done in a transparent and open line of communication, the extent to which public trust was heightened during the Chernobyl event, could have been lessened.

According to the IHR, National IHR Focal Point (NFP) shall be accessible at all times for communications with the WHO IHR Contact Point. NFP shall send to WHO IHR Contact Point urgent communications, disseminate information to, and consolidate input from, relevant sectors of the administration of the State Party, including those responsible for surveillance and reporting, points of entry, public health services, clinics and hospitals and other government departments. WHO shall collect information regarding events through its surveillance activities and assess their potential to cause international (disease) spread and possible interference with international traffic. Therefore, the international communities could be informed of an event like the Chernobyl radionuclear accident from the start.

Under the Early Notification Convention, the IAEA is the designated international organization that is officially notified by the accident or affected country and provided with relevant information about the accident. WHO, as well as other cooperating international organizations, are notified and provided with further relevant information through the IAEA. WHO helps establish a link between the country making the request and the Radiation Emergency Medical Preparedness and Assistance Network (REMPAN) assisting center(s) and Regional Offices, keeping all REMPAN centers informed about the details of the accident and progress in its management.

The State Party shall assess events occurring within its territory by using the decision instrument in Annex 2. The State Party shall notify WHO, by the most efficient means of communication available, by way of the National IHR Focal Point, and within 24 hours of assessment of public health information, of all events which may constitute a public health emergency of international concern within its territory in accordance with the decision instrument, as well as any health measure implemented in response to those events. If the notification received by WHO involves the competency of the International Atomic Energy Agency (IAEA), WHO shall immediately notify the IAEA. Therefore, the IAEA could also be informed of the event through WHO.

Following a notification, the State Party shall continue to communicate to WHO timely, accurate and sufficiently detailed public health information available to it on the notified event, where possible including case definitions, laboratory results, source and type of the risk, number of cases and deaths, conditions affecting the spread of the disease and the health measures employed; and report, when necessary, the difficulties faced and support needed in responding to the potential public health emergency of international concern. For an event like the Chernobyl radionuclear accident, capacity

surge shall be required to monitor on and respond to the event. Professional capacity can be recruited from IAEA, REMPAN, and the international communities as required.

Even in the case of events not requiring notification as provided in Article 6, in particular those events for which there is insufficient information available to complete the decision instrument, the State Party may nevertheless keep WHO advised thereof through the National IHR Focal Point and consult with WHO on appropriate health measures. The State Party in whose territory the event has occurred may request WHO assistance to assess any epidemiological evidence obtained by that State Party.

WHO may take into account reports from sources other than notifications or consultations and shall assess these reports according to established epidemiological principles and then communicate information on the event to the State Party in whose territory the event is allegedly occurring. States Parties shall, as far as practicable, inform WHO within 24 hours of receipt of evidence of a public health risk identified outside their territory that may cause international disease spread. Thereon, WHO could still take actions in pursuit of the pertinent Articles.

WHO shall request verification from the State Party of reports from sources other than notifications or consultations of events which may constitute a public health emergency of international concern allegedly occurring in the State's territory. In such cases, WHO shall inform the State Party concerned regarding the reports it is seeking to verify. When requested by WHO, the State Party shall verify and provide: (a) within 24 hours, an initial reply to, or acknowledgement of, the request from WHO; (b) within 24 hours, available public health information on the status of events referred to in WHO's request; and (c) information to WHO in the context of an assessment under Article 6, including relevant information as described in that Article. When WHO receives information of an event that may constitute a public health emergency of international concern, it shall offer to collaborate with the State Party concerned in assessing the potential for international disease spread, possible interference with international traffic and the adequacy of control measures. Such activities may include collaboration with other standard-setting organizations and the offer to mobilize international assistance in order to support the national authorities in conducting and coordinating on-site assessments. When requested by the State Party, WHO shall provide information supporting such an offer. If the State Party does not accept the offer of collaboration, WHO may, when justified by the magnitude of the public health risk, share with other States Parties the information available to it, whilst encouraging the State Party to accept the offer of collaboration by WHO, taking into account the views of the State Party.

WHO shall send to all States Parties and, as appropriate, to relevant intergovernmental organizations, as soon as possible and by the most efficient means available, in confidence, such public health information which it has received and which is necessary to enable States Parties to respond to a public health risk. WHO should communicate information to other States Parties that might help them in preventing the occurrence of similar incidents. WHO shall use information received for verification, assessment and assistance purposes under these Regulations. WHO shall consult with the State Party in whose territory the event is occurring as to its intent to make information available. When information received by WHO is made available to States Parties in accordance with these Regulations, WHO may also make it available to the public if other information about the same event has already become

publicly available and there is a need for the dissemination of authoritative and independent information.

At the request of the State Party, WHO shall collaborate in the response to public health risks and other events by providing technical guidance and assistance and by assessing the effectiveness of the control measures in place, including the mobilization of international teams of experts for on-site assistance, when necessary. If WHO, in consultation with the States Parties concerned as provided in Article 12, determines that a public health emergency of international concern is occurring, it may offer further assistance to the State Party, including an assessment of the severity of the international risk and the adequacy of control measures. Such collaboration may include the offer to mobilize international assistance in order to support the national authorities in conducting and coordinating on-site assessments. When requested by the State Party, WHO shall provide information supporting such an offer. When requested, WHO shall provide appropriate guidance and assistance to other States Parties affected or threatened by the public health emergency of international concern. In cases in which notification or verification of, or response to, an event is primarily within the competence of other intergovernmental organizations or international bodies, WHO shall coordinate its activities with such organizations or bodies in order to ensure the application of adequate measures for the protection of public health.

States Parties shall undertake to collaborate with each other, to the extent possible, in: (a) the detection and assessment of, and response to, events as provided under these Regulations; (b) the provision or facilitation of technical cooperation and logistical support, particularly in the development, strengthening and maintenance of the public health capacities required under these Regulations; (c) the mobilization of financial resources to facilitate implementation of their obligations under these Regulations; and (d) the formulation of proposed laws and other legal and administrative provisions for the implementation of these Regulations. WHO shall collaborate with States Parties, upon request, to the extent possible. Collaboration under this Article may be implemented through multiple channels, including bilaterally, through regional networks and the WHO regional offices, and through intergovernmental organizations and international bodies.

Public Health Governance

In the era of IHR2005, all capacities including the surveillance for radiation/nuclear risks, notification, investigation, reporting and action following a tentative accident should be in place plus effective legislation and coordination to facilitate all these activities.

Public health and safety is the goal of the IHR. Similarly the IAEA has a few conventions that are intended to respond to nuclear related events. For example, the Convention on Early Notification of a Nuclear Accident (Emergency Convention) is set up to commit states parties to notify IAEA of any accident related to nuclear event. In doing so, IAEA has obligations to do certain things in response to the accident. Also, the convention on assistance in the Case of Nuclear Accident or Radiological Emergency is also in place. However, this particular Convention is not legally binding on members; it's only binding on the work of IAEA in its own work and on IAEA's work with member states. In addition,

these two Conventions under the IAEA are not that clear cut in terms of what a member state should do; whereas, the revised IHR clearly states the role and function of WHO and member states.

The Emergency Convention, mentioned above, establishes requirements for international notification and information exchange in the case of a “transnational emergency”, i.e. a nuclear or radiological emergency of actual, potentially perceived radiological significance for more than one State.

At national level, IHR NFP is the main Center in charge in management of preparedness and public health response the nuclear/radiation emergencies at the national level in the country affected.

At the international level the main coordinating agency for an international response is first the IAEA and secondly, WHO.

WHO is a full party of the conventions on Early Notification of a Nuclear Accident and is an assistant to IAEA and the involved country in preparing and response to a nuclear accident or radiation emergency. Emergency public health support and medical support for the radiation exposed individuals is performed through a specialized WHO-affiliated network called REMPAN (Radiation Emergency Medical Preparedness and Assistance Network). This network is activated following notification a nuclear/radiation accident or even a single victim with severe overexposure). REMPAN is composed of 40 medical and research institutes specializing in diagnosis, monitoring, dosimetry, treatment and long-term follow-up of radiation injuries, ARS, internal contamination and other radiation pathologies. It is the main WHO mechanism to prepare and assist countries in notification, public health and medical responses to nuclear/radiation emergencies. Other important role players in providing a response are:

- FAO
- NEA (Nuclear Energy Agency)
- OECD (Organization of Economic Cooperation and Development) in the developed countries
- UN OHCA (The United Nations Office for the Coordination of Humanitarian Affairs)
- WMO (World Meteorological Organization)
- UNDP
- UNICEF

The Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency and the Convention on Early Notification of a Nuclear Accident (Emergency Conventions) were adopted only after the Chernobyl accident in 1986. These are the prime legal instruments that establish an international framework to facilitate the exchange of information and the prompt provision of assistance in the event of a nuclear accident or radiological emergency. They place specific obligations on the Parties and the IAEA, with the aim of minimizing consequences for health, property and the environment.

A public health event like the Chernobyl radio/nuclear event definitely fulfilled the criteria of a PHEIC. Once happened, it surely goes up to at least the national level, regional and cross-border collaboration and negotiation will be indicated, and international assistance can be of great value considering constraints in containment and mitigation capacities.

Such an event involves the regulating authority together with the collaborating authorities and sectors, from local to national levels, regional and international bodies. More than the consideration of assistance when indicated, timely information sharing with the international society deems as a responsibility .Effective international assistance, when requested, should be rapidly provided to control the public health threats at their source. Effective event management can protect international health security.

Reviewing the Chernobyl radionuclear event actually reminded us of the role and importance of national and international legislation, regulations, guidelines for governments/sectors in managing an emergency. Platforms and networks should be established as a daily routine. Capacity building and contingency plans and simulation activities should be in place as part of the preparedness.

Information flow and command flow need to be defined and streamlined. Public health events shall be detected early, reactions should be appropriate and based on well-founded human health risk assessments.

Acknowledgement

This report is the first draft of the group four's collective report. It has been prepared by active participation and contribution of the team members of Group 4. The team convened 3 teleconferences through which divided the work among the members and discussed the format and consensus on the current draft document. The list of team members and their roles are provided below:

- DANIELYANY Elizabeth: Human health risk assessment
- PAUX Thierry: Event and environmental monitoring and response measures evaluation
- HO Bin-Shenq (facilitator) and MARCUS Samo: Communication
- HEMMATI Payman: Public health governance and responsibilities
- VASQUEZ Maria Vicenta Rosario: Potential impact of this event on international transport, travel and trade
- MAFI Ali R (Rapporteur): Potential relevant core capacities for preparedness to respond to this event under IHR

ANNEX I

Table 1: Chronology of the events and response to the Chernobyl incident: 26 April 1986 to 16 September 1986

Event	Response
April 26 1986 Two severe explosions occurred. Massive releases of radioactive materials into the atmosphere	
	April 26 1986 An explosion in the machine hall could have led to the destruction of all four Chernobyl reactors only averted by spraying nitrogen at the last minute. Four of the eight people who did this died shortly
26 April to 4 May 1986: Most radiation released in the first 10 days, First south and southeast(winds) directly to Kiev (3 million population), Then northwest to Sweden	Estimated 75% of total released radiation contaminates Belarus
	27 April (Sunday) A radius of 10 km around the plant (cities of Pripyat and Yanov) evacuated ("for three days") (50.000 people) to the town of Poliske (50 km west coincidently wind is blowing in that direction too The government in Moscow is warned.
28 April (Monday) Forsmark in Sweden identified radioactivity	**28 April (Monday)** Radio Moscow broadcasts a Tass' statement about an accident at the Chernobyl and casualties.
	28 April (Monday) 30 minutes later West European news agencies reporting an "incident in Ukrainian reactor"

	29 April (Tuesday) A powerful American reconnaissance satellite provided photos of reactor showing the roof blown off and still smoking although The first Soviet photos censored by removal of the smoke
	Polish authorities distribute iodine tablets in the north-east of the country to protect infants and children against thyroid cancer
	1 May Parades on the May 1st in Kiev and the Belarussian capital Minsk to emphasize "normal situation" However, the Soviet Communists bureaucrats immediately after the accident removed their children from threatened areas while assuring others that everything was normal
Material thrown on the plant does not completely extinguish the fire and generates a temperature rise creating a new danger i.e. melting the hot core into the cement then in the water reservoir underneath. A steam explosion would follow	
	6 May **The first extensive report in Pravda:** - schools in Gomel and Kiev closed **Kiev radio eleven days late** warned not to eat leafy vegetables, to stay indoors amap, keep children & pregnant women indoors, avoid fresh vegetables and milk, don't drink rain water and wash the clothes and shoes every time come in
	9 May – IAEA: Moscow started to encapsulate the reactor, pouring concrete under the reactor to prevent reaching groundwater
	14 May After 18 day delay, Gorbachev speaks for the first time publicly insisted there was no cover-up: He declared his desire for

	"serious cooperation" with the IAEA, four specific proposals: An international regime for safe development of nuclear energy, A conference in Vienna to discuss "complex questions", an increased role and scope for IAEA, safe development of "peaceful nuclear activities, involving WHO & UNEP. These proposals suggested that Gorbachev was broadening the scope of the accident to PHEIC
A 30 kilometer zone around the reactor designated for evacuation (90.000 people)	**23 May** A committee orders the distribution of iodine preparations. Such prophylaxis is of no medical value. As Radioactive iodine has already accumulated in the thyroid of the contaminated
	15 June Almost the complete management team of the reactor has been dismissed for 'irresponsibility and lack of control' who will be brought on trial a year later based on Pravda
	Demonstrations by Estonian military reservists forcibly conscripted Chernobyl for clean-up labour. In November reports claim 12 people were executed
	18 July 1986 The Minister of Energy forbade his civil servants from telling the truth about Chernobyl to the media
16 September: The disaster will cost UK Pounds 200 billion economic damage, a senior Moscow official disclosed.	**20 September** - The Soviet Union paid already US$3 billion, mainly for relocation, compensation and loss of power