IMPORTANCE OF INTERNATIONAL COOPERATION FOR EMERGENCY PREPAREDNESS

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Abstract:
The paper contains a brief review of reactor accidents and their consequences. The bilateral, regional and interregional agreements on early exchange of information and mutual assistance in case of a nuclear and radiological accident are presented in a table and discussed. The international projects in emergency preparedness are briefly outlined and the situation in the field of emergency preparedness in Slovenia is given for the comparison.

I. Introduction

A severe nuclear accident has universal and global character. We are all in the same world and a potential nuclear accident could affect all the hemisphere, bearing in mind that the winds blow from the equator to the north or to the south, therefore there is a very little mixing between the air masses of the northern and southern hemisphere.

A little bit of historical overview is necessary to put into perspective the issue of the international cooperation in the field of emergency preparedness. This is not meant as a thorough description of all important events in the history of nuclear industry, but rather events were selected by the importance to emphasize the need for the cooperation on the national basis and on the international as well.

On 29th September,1957, a major accident occurred with nuclear waste at military plant in Kyshtim in the Ural, former Soviet Union. The accident was a chemical explosion in high level waste due to failure of cooling system of the concrete storage tank. The principal radioactive components were Cs-134, Zr-95 and Ru-106 together with 5% Sr-90. The radioactive plume affected area approximately 9 km wide and 300 km long. The contribution to the exposure was external from the ground, and internal due to contaminated food and inhalation. After a year the exposure was mainly internal due to Sr-90. Over a few years a total 10 000 people were evacuated. The doses received by the evacuated people were in the range from 23 to 520 mSv [1].

In October, 1957, the accident in Windscale plutonium production reactor occurred when the shut-down core exceeded safe temperature during Wigner annealing and fuel elements overheated, thus a fire started. The irradiation of graphite blocks produces dimensional changes which can lead to channel blockages. Routine annealing was necessary to counteract this blockage. The cooling with carbon dioxide was not successful, thus the fire was extinguished with water, although it presented two hazards (hydrogen-oxygen explosion and possible criticality hazard). About 20 000 Ci of I-131 was released [1], which produced contamination of grassland. The maximum activity in milk was 0.8 microCi/litre. No evacuation took place.

On March 22, 1975, a major fire occurred at Browns Ferry NPP near Decatur, Alabama, USA. The fire, which was set off by a technician using a lighted candle to conduct the search for the air leaks. The fire burned for over seven

hours and nearly disabled the safety equipment of one of the two affected units. This event nearly led to a core damage and was a blow to the public image of nuclear power. The accident clearly showed the possibility of "common mode" failures, in which a single event could initiate a chain of events. There were no release and no evacuation.

The final report of Reactor Safety Study, WASH-1400, was issued in October 1975. The Reactor Safety Study attempted to make a realistic estimate of the potential effects of LWR accidents on the public health and safety. One BWR, Peach Bottom Unit 2, and one PWR, Surry Unit 1, were analysed in detail. In the study thousands of the possible core melt sequences were assessed for their occurrence probabilities. The consequences of such accident sequences were then estimated to complete the risk assessment. The Reactor Safety Study indicated that risks to the public from potential LWR accidents were small compared to other risks (i. e. fires, explosions, dam failures, earthquakes, tornadoes, etc.).

On March 28, 1979, an accident at Unit 2 of the Three Mile Island NPP near Harrisburg, Pennsylvania, USA, demonstrated that the nuclear accident can happen. As a result of a series of mechanical failures and human errors, the accident uncovered the reactor's core and melted about half of it. Of the 66 million Ci of I-131 in the reactor at the time of accident, only about 15 Ci escaped to the environment [2] . Uncertainty about the causes of the accident, confusion about how to deal with it and contradictory information about the levels of danger made utility and government authorities appear incompetent and deceptive. Two days after the onset of the accident (long term cooling was restored at that time) the Governor of Pennsylvania issued two recommendations: initially for sheltering in the 10 miles (16 km) radius, and later for closing schools and evacuating pregnant women and pre-school children within 5 miles (8 km). Despite the limited evacuation, these recommendations led to spontaneous evacuation of 144 000 persons from 50 000 households. The investigations conducted after the accident strongly criticized the NRC, the utility, the nuclear industry and the reactor operators. The investigators concluded that human factor contributed more to the accident than the nuclear steam supply system and that the major health consequences were on the mental health of the people living in the region.

Given the confusion and uncertainty experienced during the TMI-2 accident the steps were taken to upgrade emergency preparedness and planning. New rules and guidelines were developed, emergency response personnel from industry, government authorities and local organizations received extensive training and were evaluated by periodic drills.

Although not many licensing actions rose opposition, the two licensing cases, which triggered widely publicized debates, were Seabrook in New Hampshire, USA, and Shoreham on Long Island, New York, USA, which happened after the TMI-2 accident. In both cases the issue was emergency planning. After the TMI accident the NRC passed the rule to improve emergency planning, that required each nuclear utility to come up with a plan for evacuating the population within a ten mile radius of its plant in the event of a reactor accident. The NRC expected cooperation between federal, state and local government officials to upgrade emergency plans, and did not anticipate that state and local governments would try to prevent the operation of nuclear plants by refusing to participate in emergency preparations. For the Shoreham NPP New York state officials claimed that it would be impossible to evacuate Long Island if Shoreham suffered a major accident. The state refused to join emergency planning or drills. The NRC granted Shoreham a low-power operating licence, but the state and the utility agreed not to operate the plant in return for the concessions from the state.

The Seabrook plant is located in New Hampshire, but the ten mile emergency planning zone extends into Massachusetts. As a result of Chernobyl accident Massachusetts authorities decided not to cooperate with emergency planning efforts for Seabrook. The NRC adopted a "realism rule", which was based on the premise that in real emergency the state and local governments would make every effort to protect public health and safety. Therefore, in cases in which state or local officials declined to participate in emergency planning, the NRC and FEMA (Federal Emergency Management Agency) would review and evaluate the plans developed by the utility. On that basis the NRC issued an operating license for the Seabrook.

On April 26, 1986, in unit 4 of the Chernobyl NPP in the Ukraine a strong explosion destroyed the reactor, blew the top off and spread a large amount of radioactive materials in the environment. The nuclear critics pointed to Chernobyl as the prime example of the hazards of nuclear power. The Chernobyl accident has shown that a large scale accident has transboundary effect and there is a need for a strong international cooperation.

There is another type of emergencies, which do not directly jeopardize the general public, but could be extremely dangerous to the operating staff. These are accidents in research facilities, where especially in the 50's more than ten criticality accidents happened. An example of this emergency is accident at Institute of Nuclear Science in Vin_a near Belgrade, Yugoslavia [3]. On 15 October six persons were present in the reactor room, four of them observing electronic gear in the reactor pit and two were at the control panel at floor level on the edge of the pit. During the power excursion the reactor was in power surge for about 4 min with a reactor period of 10 s, as estimated by physicists from Vin_a. Longer period could not have generated the estimated energy, and the limited supply of heavy water did not allow shorter period. Of the six persons in the reactor room, the five persons indicated exposure above the lethal range and they received bone marrow transfusions. The sixth patient received only conventional treatment. One who received the highest dose did not survive the acute phase of the illness, but the others recovered.

II. Bilateral and multilateral agreements in connection to nuclear emergency

It was soon realized that the nuclear accidents could have transboundary effects, but quite some of the accidents had to happen before some nuclear emergency issues were resolved in the international level, i. e. the agreements between the countries on early notification and mutual assistance in case of a nuclear emergency were put into force.

II.a Bilateral agreements

A brief review [4] of the existing bilateral agreements reveals that a vast majority of the agreements related to notification of nuclear accident and emergency assistance had been agreed and signed after the TMI (1979) and Chernobyl (1986) accident. The Table I contains a list of bilateral agreements, which are divided into two sections:

(a) prompt notification of a nuclear accident and the exchange of information,

(b) mutual assistance between the countries concerned.

The Table I shows that only one agreement on early notification in case of an accident has been signed before the TMI-2 accident and five of them were signed before the Chernobyl accident. It is obvious that after Chernobyl the interest for bilateral

Table I: List of bilateral agreements

a) on Early Notification of a Nuclear Accident and on the Exchange of Information Relating to Nuclear Facilities

Year	Parties concerned	Post TMI	Post Chernobyl
1978	Germany - Switzerland	No	No
18.10.1979	France - Switzerland	Yes	No
1981	France - Germany	Yes	No
1982	Austria - Czechoslovakia	Yes	No
1983	France - Luxembourg	Yes	No

21.10.1986	Denmark - Sweden	Yes	Yes
21.10.1986	Norway - Sweden	Yes	Yes
Dec, 1986	Argentina-Brazil (*)	Yes	Yes
1987	Austria - Hungary (*)	Yes	Yes
1987	Denmark - Finland	Yes	Yes
1987	Denmark - German Dem. Rep.	Yes	Yes
1987	Denmark - Poland	Yes	Yes
1987	Denmark - USSR	Yes	Yes
1987	Denmark - UK	Yes	Yes
1987	Finland - Norway	Yes	Yes
1987	Finland - Sweden	Yes	Yes
1987	Finland - USSR	Yes	Yes
1987	German Dem. Rep. - Germany	Yes	Yes
1987	Norway - German Dem. Rep.	Yes	Yes
1987	Norway - UK	Yes	Yes
1988	Austria - German Dem. Rep.	Yes	Yes
1988	Austria - USSR	Yes	Yes
1988	German Dem. Rep. - Spain	Yes	Yes
1988	Netherlands - UK	Yes	Yes
1988	Sweden - USSR	Yes	Yes
1989	German Dem. Rep. - Sweden	Yes	Yes
1992	Finland - Germany	Yes	Yes
1993	Poland - Ukraine	Yes	Yes
1995	Poland - Russia	Yes	Yes
1995	Poland - Lithuania	Yes	Yes
1995	Hungary - Slovenia	Yes	Yes

b) on Mutual Assistance

Year	Parties concerned	Post TMI	Post Chernobyl
1977	France - Germany	No	No
1978	Germany - Luxembourg	No	No
1980	Belgium - Germany	Yes	No

1984	Germany - Switzerland	Yes	No
1985	Denmark - Germany	Yes	No
Dec, 1986	Argentina - Brazil (*)	Yes	Yes
1987	Austria - Hungary	Yes	Yes
1988	France - Luxembourg	Yes	Yes

(*) this agreement comprises prompt notification and mutual assistance in the event of nuclear accidents and radiological emergencies.

agreements substantially increased in nordic countries, which were first affected by the radioactive plume. The Chernobyl accident actually triggered the most of the agreements related to early notification in case of a nuclear accident. The 1987 was the most successful year in term of bilateral agreements on early notification - twelve of them were signed that year.

In the area of "mutual assistance" agreements situation is a little bit different: two agreements have been signed before the TMI-2 accident, three agreements between the Chernobyl and the TMI-2 accident. The only bilateral agreement which had been agreed between non-European countries were between Argentina and Brazil, which covers both early notification and mutual assistance. There are substantially less bilateral agreements on mutual assistance than on early notification (31 versus 8).

II. b Multilateral agreements

Regional:

Beside bilateral agreements the multilateral agreements are extremely important, because multilateral agreements cover much larger area, introduce unification in the information exchange and stimulates the cooperation between many countries in the field of emergency preparedness. There are two regional agreements:

(b) Nordic Mutual Emergency Assistance Agreement in Connection with Radiation Accidents (1963) [5]

(a) a Council of the European Communities passed a Decision of 14 December 1987 on Community Arrangements for the early Exchange of Information in the Event of a Radiological Emergency [6]. In the Article 5 of this decision a provision is made for a detailed procedures for the transmission of information, thus this forms a legal basis for the ECURIE system.

Interregional:

The need to create a framework for reporting and mutual assistance in nuclear accidents after the TMI accident boosted the IAEA to issue Guidelines for Mutual Emergency Assistance Arrangements in Connection with a Nuclear Accident or Radiological Emergency, and Guidelines on Reportable Events, Integrated Planning and Information Exchange in a Transboundary Release of Radioactive Materials. In February 1982 the IAEA Board of Governors adopted a resolution in which it requested the Director General to convene a group of experts, open to all Member states, to study the most appropriate means of responding to the need for mutual assistance in connection with nuclear accidents. The group of experts was convened by the Director General the same year in July. The group of experts recommended the prompt development of a single set of provisions that could be applied in emergency assistance and could:

(a) serve as a model for the negotiation of bilateral or regional agreements, which are to be encouraged,

(b) be readily agreed between a requesting and an assisting state at the time of nuclear emergency.

One of the recommendations of the group of experts on nuclear safety co-operation and mutual emergency assistance which met in June 1982 was related to the need for prior arrangements among the states to cope with the transboundary aspects of a nuclear emergency. Consideration of these needs was done by the group of experts in May 1984. This expert group developed Guidelines on Reportable Events, Integrated Planning and Information Exchange in a Transboundary Release of Radioactive Material. These guidelines could serve for bilateral and multilateral agreements among neighbouring states wishing to co-ordinate their response to any emergency which may involve transboundary radiological release.

Unfortunately when the Chernobyl accident occurred the above described work was not finished, therefore no legally binding convention was in force. The Chernobyl accelerated the process that two conventions, which regulate notification of nuclear accident and emergency assistance, came into force in the end of 1986. The Convention on Early Notification of a Nuclear Accident [7] seeks to assure through a notification procedure that any nuclear accident with possible transboundary effects be brought to the attention of Member states that they take protective measures. Based on this convention EMERCOM system was established by the IAEA. The provisions of this convention have not been yet invoked. The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency [8] establishes an international framework to facilitate prompt provision of assistance in the event of a nuclear accident or a radiological emergency. States have agreed to co-operate in case of a nuclear accident or radiological emergency in order to minimize its consequences and protect life, property and the environment. This convention was invoked by Brazil in the radiological accident in Goiania in September 1987.

Convention on Nuclear Safety requires from the member countries to write up the emergency plans and provide the data about the potential accident. This convention is binding even for the non-nuclear countries with requesting them to have emergency plans in case of a nuclear emergency developed.

Slovenia ratified both conventions ([7], [8]) with notification of succession of the documents, which former Yugoslavia had ratified. The notification was given to the IAEA in 1992 and the succession has started since the declaration of Slovenia as an independent state. Slovenia has bilateral agreement with Hungary on the early exchange of information in the event of a radiological emergency, which was signed in 1995. A bilateral agreement similar as that with Hungary was signed with Austria and prepared with Croatia. The negotiations to sign up a bilateral agreement are underway with Italy.

III. Other projects related to emergency preparedness

The international co-operation on the field of emergency preparedness had recently become extremely important. There have been launched quite a few projects in this area, which involve many countries across the Europe and in the world.

In October 1995 the OECD/NEA invited all member countries and East and Central European Countries to participate in the INEX-2 (International Nuclear EXercise) series of exercises. In each region one accident-host country integrates the exercise objectives into a national exercise, and this will form the core of INEX-2. Following the scenario in the accident-host country, border countries and far-field countries will participate simultaneously, activating their own emergency organization and existing bilateral and multilateral notification and communication agreements. The concept of communication during the exercise is the separation of the domestic part from the international part:

- the exercise is designed as the national exercise and all communications for the national part are the same as would be in case of the national exercise,
- the exercise direction serves as the link between the national and international part: all communication to

the international participants goes through the exercise direction. The international players can not directly communicate with the players in the accident-host country.

There are four national exercises on the schedule of INEX-2. Two have already been organized (the Swiss exercise in November, 1996, with 30 participating countries, and the Finnish exercise in April, 1997, with 28 participating countries) and two are still to be performed (in Canada in April, 1998, and in Hungary in November, 1998).

The basic objectives of the INEX-2 exercises, which are common to all exercises, are:

- real-time exchange of information (for the most of participating countries the IAEA EMERCON notification is used, and for EU countries ECURIE system),
- decision making in real time and with limited data,
- public information (press releases, public briefings, press conferences).

In 1995 the ECHO (European Commission Humanitarian Organization) started the project to provide the assistance in the Off-Site Emergency Preparedness (OSEP project) in the East and Central European countries. The first phase of the project, which was finished by the end of 1995, was to perform a study to assess the level of off-site emergency preparedness in the countries, which expressed the readiness to accept the assistance. Some of the countries received the assistance in equipment, but for the most of the participating countries, the training of the personnel, responsible for the emergency preparedness, is foreseen. The project is still under way and its duration has not been known yet.

The IAEA has extensive program to improve and harmonize the emergency preparedness in the international level:

- in 1994 the IAEA issued Intervention Criteria in a Nuclear or Radiation Emergency [9] to provide guidance on radiation protection criteria for use in planning and preparedness for response to nuclear accidents or radiological emergencies
- two TECDOCs were issued, which cover method for the development of emergency response preparedness for nuclear or radiological accidents (TECDOC-953) and generic assessment procedures for determining protective actions during a reactor accident (TECDOC-955),
- In October 1997 the representatives of the countries in the European region who met in Vienna have outlined the Memorandum of Understanding and Work Plan in the field of harmonization of nuclear emergency preparedness. Memorandum of Understanding is used to launch the IAEA Regional Technical Co-operation Project RER/9/050. The purposes of this project are to define means of notification and communication, determine joint approach for the classification of nuclear accidents, develop detailed procedures or methods for assessing reactor accidents, coherent approach to public information. To address the purposes of the project a "Project steering group" composed of representatives of national competent authorities will be established. The "Project steering group" and the IAEA secretariat will monitor the implementation of "Work Plan". The "Work Plan" comprises: evaluation of existing national plans, implementation of accident classification based on plant conditions in national emergency plans, establishment of effective communication between the countries, review and revision of procedures for environmental monitoring, strategy and mechanisms for public information.

IV. Conclusions

It is pretty straight forward that the need for international cooperation in emergency preparedness is extremely important. The reasons which support the above premise are:

- the influence of a serious nuclear accident is transboundary, which does not only mean that the radioactive plume passes on the territory of a foreign country, but also there are consequences related to trade, travel, contamination of food, medical assistance, mental distress, etc.
- internationalization of a nuclear emergency through public media is almost inevitable,

- nuclear accident could pose a serious blow to the nuclear industry, therefore the international nuclear industry itself is interested in good emergency preparedness in order to minimize the consequences of a potential accident,
- so far, there has not been too many nuclear accidents, therefore the expertise on accidents is concentrated in the leading countries in nuclear technology. The less developed countries would have to seek the assistance at more developed ones even in the knowledge, how to prepare emergency plans and how to assess the development of a potential accident,
- the vast number of bilateral and multilateral conventions in this field is definitely a proof for internationalization of nuclear emergencies.

Convention on Nuclear Safety gives further momentum for the international cooperation in emergency preparedness through the preparatory work for national reports and Review Conference in 1999.

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