EMERGENCY PREPAREDNESS IN SWEDEN AFTER NUCLEAR SAFETY IMPROVEMENTS AND THE CHERNOBYL ACCIDENT

Jan Olof Snihs and B Åke Persson
Swedish National Institute of Radiation Protection, Stockholm, Sweden

THE NUCLEAR POWER SITUATION IN SWEDEN

In Sweden there are 12 power reactors distributed at four sites, four at Ringhals, two at Barsebäck, three at Forsmark and three at Simpevarp (Oskarshamn). Nine are BWR (Asea Atom) and three PWR (Westinghouse, at Ringhals). The total installed capacity is about 10 GWe. After the TMI accident 1979 there was a referendum in 1980 about the nuclear future in Sweden. As a consequence of that it was decided to terminate nuclear power in year 2010, at the latest. The order and rate of closing the reactors should depend on energy demands and alternative energy sources as well as on nuclear safety and radiation protection aspects. After Chernobyl it has been further decided to consider the possibility of closing two of the reactors already in the middle of the 1990's.

THE EMERGENCY PREPAREDNESS IN SWEDEN UP TO CHERNOBYL

The dimension and shape of the emergency plans were mainly formed with nuclear accidents at Swedish nuclear power plants in mind. The four affected county administration authorities are responsible for the local planning and for the actions taken in an emergency situation. At the National Institute of Radiation Protection (NIRP) there is a special advisory group with experts on radiation protection, reactor safety, radiobiology, meteorology etc to give advice to the local authority. The advisory group collects information on releases, contamination and exposure rates, on weather conditions and other dispersion parameters in order to assess consequences and trends. The group works very closely with the Swedish Nuclear Inspectorate which assesses the technical safety aspects.

The emergency planning area around each nuclear power plant is divided into circular zones with graded emergency planning. The central alert zone extends to 5-10 km, the inner emergency zone to 12-15 km and the radiation measurement zone to about 50 km from the plant.

In the radiation measurement zone measurements by mobile instruments have been prepared to be made along several specified routes. Measurements will be made by the local fire brigade teams. Booklets with information have been distributed to the farmers within this zone. In the inner emergency zone furthermore there are plans for evacuation, there is a network of permanent measurement sites with TLD, iodine tablets have been given in advance to each household and an alert system for telephone alarm signals will reach each home. An information booklet is also

given to each family. In the central alert zone furthermore there is a permanent system with sirens for outdoors alarms.

The emergency plan is triggered into action at one of three levels

a) information; something has happened at the plant that requires special information to the authorities and the public. The safety systems are intact.

b) increased preparedness; something has happened at the plant that is or can be of significance for the safety of the reactor and there is a threat or indication of releases of radioactive material above normal releases. The essential safety systems are intact. The responsible authorities will put the emergency organisation into operation, inform the public and make ready all preparations for further actions (if needed).

c) accident alarm; something has happened at the plant that requires countermeasures outside the plant, abnormal, significant releases are expected, occurring or have occurred, the reactor safety systems do not operate satisfactorily. The alarm system will be activated and the local and central emergency organisations will operate in full.

The levels given above are specified in technical terms in the control room of respective reactor. The general guidance given to the public in the neighbourhood of the plant in case of an accident is to go indoors, close windows and ventilation and listen to the radio for further information and advice. Iodine tablets would probably be used at a rather low level of radioactive iodine release whilst evacuation would only be undertaken in a very serious accidental situation. Evacuation is not warranted below 10 mSv but would be urgent above 100 mSv and no evacuation should occur during releases. The reference doses are those obtained if evacuation is not made. To keep authorities and others in the organisation for emergency preparedness alert, education and exercises are performed at a regular basis, e g a large exercise each four years for each site including all personnel concerned at the site and the local and central authorities.

IMPROVED NUCLEAR SAFETY AND SYSTEMS FOR MITIGATING THE CONSEQUENCES OF AN ACCIDENT

By continual efforts, including technical and administrative means, nuclear safety is improved all the time. By a governmental decision in 1981, the reactors at Barsebäck (in the south of Sweden) have been connected to a large filter system, "Filtra", containing 10 000 m3 of stone, to enable the containment to be vented in case of a serious accidental situation with disfunctioning safety systems and an uncontrolled, increasing pressure in the containment. "Filtra" has been in place and ready for operation since 1985. By accident management and the filtering effect of "Filtra" the expected releases of particulate aerosols will be reduced by a factor of about 1000, and doses warranting evacuation will occur only within close distances up to a few kilometres from the reactor. Because of the large volume of "Filtra", there will also be a considerable delay in the

release of noble gases from the containment leaving more time (several hours) for planning and for carrying out the necessary protective actions.

By the governmental decision in 1981, also the other reactors shall have similar filtering systems with the same requirement on filtering efficiency. They are required to be in place in 1988 at the latest. These filter systems will be of the water-scrubber-type.

LESSONS LEARNED FROM THE CHERNOBYL ACCIDENT AS REGARDS MEASURES AFTER AN ACCIDENT

The major conclusions from the experience of the events in Sweden after the Chernobyl accident are:

- The need of personnel was much higher than planned, because of the prolonged release, the large geographical distribution of the contamination and the extraordinary need of information to the public, between authorities and to the Government.
- Preplanned information, the systems and means for rapid information and the number of qualified informers were quite insufficient. The message given in the information was sometimes contradictory and ambigous, leading to unnecessary anxiety.
- The need of measurements of land contamination, on milk and foodstuffs, on vehicles, on people, etc was much greater than made possible by initially available resources and organisation.
- The alarm functions were insufficient. In Sweden, the first alarm signals came from routine measurements on personnel at the Forsmark power station in the morning of 28 April 1986.
- The responsibility of the various authorities was unclear in this type of situation, when the whole country was contaminated. Because of this NIRP voluntarily took the initial responsibility in many questions belonging to other authorities' jurisdiction such as food restrictions, recommendations on farming, etc. However,these problems were in practice solved within a week or two.
- The wide geographical distribution of released radioactive materials created a lot of international problems that were not planned for, e g as regards information, tourism, trade, transport, intervention levels etc.

CHANGED EMERGENCY PLANNING

Since the Chernobyl accident there have already been several governmental decisions on immediate improvements of the emergency planning and special investigations have been initiated on further appropriate changes of the planning in general and in detail. Since these investigations are still in progress the final result might in some part be slightly different than that reported here.

- The extent and ambition level of emergency planning in counties with nuclear power plants will not change significantly. There are a few additional sirens for outdoor alarms to get a better areal coverage. The level of education and frequency of exercises are quite appropriate.

- There will be emergency planning in all the 24 counties in Sweden although not (with one exemption) to the same extent as in those with nuclear power plants.
- The early warning system will be improved. Since many years there are 25 stationary ionization chambers geographically distributed in Sweden which continuously measure the gamma radiation from air and ground. The number of these will be increased 20-100 % and they will give an automatic alarm to NIRP at a significantly increased radiation level. The number of automatic air-samplers will be increased to about 10 and give automatic warning signals.
- The strategy for measurements will be as follows: In the area outside nuclear power plants 6-8 stationary measuring points in every 60 degrees sector are given in advance distributed out to a distance of about 50 km from the plant. Before and during the release gamma measurements (from about 1 μGy/h) and airsampling are made at the points which are within a 60 degree sector in the wind direction. The reason for using pre-determined measuring points is to obtain an organisation that operates automatically and will identify the plume passage and the limits of the influenced sector area. When the release has ceased the ground contamination is measured along given routes as previously planned. At a distance of 10-20 km there might be continuously measuring gamma instruments recording the average ambient dose equivalent for every 10 minutes. At sea outside the coast limited measurements might be made on a vessel moving in wind direction at a few nautical miles distance. Measurements from airplanes are made to map the ground contamination over large areas. Hand instruments at every municipal and county administration authority (in total about 400) are used to meet local requirements on measurements and information but also to complement the assessment of ground contamination. Milk is measured at dairies by their own staff and measurements on food and water at special qualified laboratories. The possibilities to analyse Pu and hot-particles will be improved.
- The communication system between central and local authorities will be improved by telefax, telex etc.
- The information system will be much improved by an enlarged staff of informers in preparedness, preplanned principles and means for information of the public, manuals to central and local authorities with basic data and guidance how to handle emergency situations, improved medical information, improved education on radiation matters in schools etc. Information will mainly be given by local authorities and backed up by the central authorities on general matters and recommendations.

In conclusion, the emergency preparedness will be much improved particularly to be able to handle a large land contamination from accidents in Sweden or abroad. The extra costs are of the order of 10 milj US $ the first year and 1-2 milj US $ per year the following years including research and development. As has been pointed out above, a large part of the emergency planning is motivated by the risk of an accident at some of the about 100 nuclear power reactors in other European countries and is thus independent of the existence of Swedish nuclear power.