Implications of the Chernobyl Accident for Protective Action Guidance

Charles W. Miller
Andrea J. Pepper

Division of Planning and Analysis
Office of Nuclear Facility Safety
Illinois Department of Nuclear Safety

The accident that occurred at Unit 4 of the nuclear power station at Chernobyl in the Union of Soviet Socialist Republics on April 26, 1986, was the worst accident in the history of nuclear power. Thirty-one workers and emergency personnel died and more than 200 site personnel were hospitalized as a result of this event. Approximately 135,000 persons within 30 km around the reactor were evacuated, and radioactive debris was spread throughout the Northern Hemisphere. There was much public concern generated around the world, and an increased risk of fatal cancer in the world's population is possible as a result of exposure to Chernobyl fallout (USNRC, 1987a).

Since the time the Chernobyl accident occurred, many authoritative studies have been published, e.g. USNRC, 1987a. In these studies, differences in design between commercial U.S. reactors and the RBMK pressure-tube reactor at Chernobyl have been emphasized, e.g. USNRC, 1987b. While significant differences in design do exist between these reactors, we believe there are still significant lessons to be learned from the Chernobyl accident for U.S. reactors. The purpose of this paper is to summarize some of the major lessons to be learned related to protective action guidance.

The Illinois Department of Nuclear Safety (IDNS) has identified three areas related to protective action guidance for food and water where implications can be drawn from Chernobyl for the U.S.: (1) uniformity of Protective Action Guides (PAGs), (2) incompleteness of U.S. PAGs, and (3) international communications. Following the Chernobyl accident, a variety of protective actions were undertaken by various nations. Furthermore, these actions were initiated, modified, and terminated at different times in different places and, in some instances, were applied on a local or regional basis rather than a national basis (Goldman et al., 1987). One result of this differing application of PAGs was the generation of considerable confusion among decision-makers and the public, between and within countries, regarding appropriate levels of response. For example, one country may have considered a product acceptable for consumption while another country reported that the same level of contamination in the same product was too high for consumption. An accident in the U.S. could lead to similar discrepancies between States, and between the U.S. and other nations. Therefore, more emphasis must be given to both interstate and international cooperation in the development of PAGs. These guides should be developed using similar contamination action levels and applying consistent dose assessment methodologies. We recognize, however, that in the U.S. each State is responsible for protecting the health and safety of its citizens. Therefore, some differences between PAGs for different States may exist. Through workshops such as this one, though, the federal government can supply leadership to minimize differences in PAGs both within the U.S. and between the U.S. and other nations.

PAGs have been developed in the U.S. for both the plume pathway (USEPA, 1989) and for the food pathway (USDA, 1982). However, the PAGs for the food pathway, which were developed by the Food and Drug Administration, specifically do not cover drinking water because drinking water standards fall within the Environmental Protection Agency's (EPA) area of responsibility. The EPA has not issued PAGs for drinking water, but it did issue response levels for radioactivity in finished drinking water during the Three Mile Island accident (USFDA, 1983). During the aftermath of the Chernobyl accident, PAGs for drinking water sources were applied, e.g. in the Soviet Union (USSR, 1986). The EPA should move quickly to provide the States with practical guidance for drinking water. This workshop is designed to be a step in that direction, but it is only the first step. When this workshop is finished, EPA must use the information gained from this meeting to move forward with this guidance.

As mentioned earlier, radioactive debris from the Chernobyl accident was spread throughout the Northern Hemisphere. Small, but measurable, quantities of fallout were even found in Illinois. Measurements of environmental concentrations and estimates of dose were made by many different organizations in many different places. One very noticeable difference in these values was the units used to report them. The U.S. continues to use traditional units of measurement for radiation quantities, e.g. 7 curies for amount of radioactivity and rems for dose, while most of the rest of the world appears to be adopting the new SI units of measurement, e.g. becquerels for amount of radioactivity and sieverts for dose. This difference has the potential for creating great confusion when radiological information is exchanged across international borders. We, like many U.S. health physicists, do not like some aspects of the SI system. It appears, however, that our objections have not been heard in the international community, and that SI units are here to stay. If that is the case, EPA should take the lead to help the U.S. move to SI units. All future PAG values, including those that result from this workshop and its subsequent proceedings, should be published in both traditional and SI units. All States and other federal agencies should also begin moving to SI units. One outcome of the Chernobyl accident has been a renewed commitment to international cooperation in the area of reactor safety and accident notification. Adoption of a universally-accepted set of radiation measuring units will enhance this process.

There is one other area where the Chernobyl accident can be of assistance in utilizing PAGs. Mathematical models are an integral part of the PAG implementation process. For example, intervention levels for radionuclide concentrations in food and water are derived from PAG dose limits using environmental transport and dosimetry models. The process of testing model predictions with suitable data is known as model validation. The extensive amount of data developed from monitoring Chernobyl fallout provides an independent data set that can be used to test, or validate, the models used in dose assessment, including those used with PAGs (Richmond et al., 1988). International programs are being developed to test models using Chernobyl data, e.g., Hoffman and Deming, 1988. U.S. participation and support for these efforts, however, has been minimal. EPA, and possibly other agencies of the federal government, should take the lead to increase U.S.

participation in these model validation efforts. The information gained from this effort should be reflected in federal guidance and shared with the States in a timely fashion.

Although significantly different in design from the Soviet RBMK, release rates similar to the Chernobyl accident have been postulated for U.S. reactors (USAEC, 1975). As a result, it is important that persons and organizations responsible for protecting the public in the event of a severe reactor accident learn as much as possible from the Chernobyl experience. The preceding paragraphs summarize some of the lessons related to water and food chain contamination that we believe can be learned from Chernobyl. Through participation in this workshop, as well as other activities, IDNS is actively seeking to apply all the knowledge we can gain from Chernobyl to protecting the health and safety of the citizens of Illinois.

REFERENCES

1. GOLDMAN, M., CATLIN, R.J., ANSPAUGH, L., CUDDIHY, R.G., DAVIS, W.E., FABRIKANT, J.I., HULL, A.P., LANGE, R., ROBERTSON, D., SCHLENKER, R., AND WARMAN, E. 1987. "Health and Environmental Consequences of the Chernobyl Nuclear Power Plant Accident." DOE/ER-0332.

2. HOFFMAN, F.O., AND DEMING, E.J. 1988. The Use of Chernobyl Data for Model Validation" in "Proceedings of the ANS Topical Meeting on Emergency Response - Planning, Technologies, and Implementation," Charleston, South Carolina, September 26-28. CONF-880913.

3. RICHMOND, C.R., HOFFMAN, F.O., BLAYLOCK, B.G., ECKERMAN, K.F., LESSLIE, P.A., MILLER, C.W., NG, Y.C., AND TILL, J.E. 1988. "The Potential Use of Chernobyl Fallout Data to Test and Evaluate the Predictions of Environmental Radiological Assessment Models." ORNL-6466.

4. U.S. ENVIRONMENTAL PROTECTION AGENCY. 1989. "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents." EPA/520/1-75-001 (Draft).

5. U.S. FOOD AND DRUG ADMINISTRATION. 1982. "Accidental Radioactive Contamination of Human Foods and Animal Feeds." Federal Register, Vol. 47, No. 205, pp. 47073-47083.

6. U.S. FOOD AND DRUG ADMINISTRATION. 1983. "Preparedness and Response in Radiation Accidents." FDA 83-8211.

7. U.S. NUCLEAR REGULATORY COMMISSION. 1987a. "Report on the Accident at the Chernobyl Nuclear Power Station." NUREG1250, Rev. 1.

8. U.S. NUCLEAR REGULATORY COMMISSION. 1987b. "Implications of the Accident at Chernobyl for Safety Regulation at Commercial Nuclear Power Plants in the United States." NUREG-1251 (Draft for Comment).

9. U.S.S.R. STATE COMMITTEE ON THE UTILIZATION OF ATOMIC ENERGY. 1986. "The Accident at the Chernobyl Nuclear Power Plant and Its Consequences." International Atomic Energy Agency.

10. U.S. ATOMIC ENERGY COMMISSION. 1975. "Reactor Safety Study: An Assessment of Risks in U.S. Commercial Nuclear Power Plants." WASH-1400.