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The Role of the United States Food Safety and Inspection Service After the Chernobyl Accident

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The Food Safety and Inspection Service (FSIS) of the United States Department of Agriculture (USDA) inspects domestic and imported meat and poultry food products to assure the public that they are safe, wholesome, not economically adulterated and properly labeled. The Service also monitors the activities of meat and poultry plants and related activities in allied industries, and establishes standards and approves labels for meat and poultry products. As part of its responsibility, shortly after the Chernobyl accident occurred, FSIS developed a plan to assess this accident's impact on domestically produced and imported meat and poultry.

The events leading to the accident at the Chernobyl plant began on Friday morning, April 25, 1986, entered a stage of crisis with an explosion at 1:23 a.m. on April 26, and over the subsequent week to 10 days released the largest quantity of radioactive material ever freed in one technological accident [1]. The distribution of radioactive materials from Chernobyl occurred in the following manner [2]:

- After 2 days the lower-level particles (surface to 1.5 km) moved towards Scandinavia.
- After 4 days the lower-level cloud was still over Scandinavia with parts moving into Western Europe. Mid-level (1.5 - 4.5 km) was moving toward the Mid-East and upper level (4.5 - 8 km) was moving toward Siberia.
- After 6 days the upper-level cloud was approaching Japan.
- After 10 days part of the upper-level cloud was over the U.S.

The Chernobyl fallout was transmitted through the troposphere, and fell out in a relatively short period. In contrast, the bulk of weapons testing fallout came down through the stratosphere, where aerosols have residence times of 1 to 5 years [1].

The accident at Chernobyl demonstrated that accidental releases of radioactive substances into the environment can contaminate large geographical areas. The possibility, although improbable, of future accidental releases cannot be ruled out; therefore it is incumbent on the international community to be prepared to measure environmental radioactivity in the event of an accident.

One aspect of being prepared after any nuclear accident where radioactivity is released into the environment, public health authorities must introduce measures to restrict the radiation doses received by members of the public to minimize the risks of adverse effects. Measures must be taken to minimize the incorporation of radionuclides into food produced in areas where there is ground contamination. Control measures over food could exist for months or even years.

In addition to the predicted physical health consequences of irradiation, considerable psychological effects may constitute a significant public health and political problem. The level of anxiety generated by the possible contamination of food or the environment may not be related to the level of exposure. Psychological stress or even hysteria may be exhibited where radiation is low or insignificant. These effects can be attributed to: 1. The association of nuclear accidents with the explosion of a nuclear bomb; 2. The inability of the human senses to detect ionizing radiation; and 3. Inadequate and often conflicting information concerning the accident. Adequate planning for dealing with the potential emotional and psychological problems is an essential component of emergency preparedness [3].

Most authorities agree that the single most important aspect of emergency response is the communication system. Experience has shown that when any major accident occurs - not just those involving radioactivity - the normal communication system is usually not adequate, and therefore a reliable, alternative system of communication for emergencies will be needed and must be available. [3] An advisory group of multidisciplinary technical experts, which is organized in advance can make decisions and communicate with local professionals to substantially minimize radiation contamination of populations and their food, feed, and water supplies. Pre-planned communications will enhance evaluations of the exposure pathways during all three phases of a nuclear accident to more adequately apply the proper protective measures.

In evaluating any disaster situation, including those involving radiation and radioactive materials, it is important to place the specific situation in perspective to other risks. Actions taken to control radioactively contaminated foods should be appropriate to the likely risk. Special care must be taken to assure that counter-measures do not result in new and greater risks. If certain food products are to be removed from the market because of low level radioactive contamination e.g., well within the safe standards established by the international community, it is important that the nutritional status of the population is not thereby compromised.

Although preliminary monitoring results will become available soon after an accident, they will be difficult to evaluate fully. Initially, monitoring will be directed towards identifying higher levels of contamination in order to specify areas in which further countermeasures will need to be considered. It is important for monitoring to be undertaken well outside the areas of concern to provide data to the responsible authorities to take the appropriate actions.

Three phases of a nuclear accident have been identified. The early, intermediate, and late or recovery phases are generally accepted as being common to all nuclear accident scenarios. Although these phases cannot be represented by precise periods, and may overlap, they provide a useful framework within which one can intervene with countermeasures.

The actual countermeasures used in a specific situation depend on the level of radioactive contamination, the availability of radionuclides in the contamination, and intervention levels used for the different food products. Derived intervention levels can be determined (once intervention levels of dose have been set) from knowledge of physiological and metabolic processes in human beings, of the distribution of radionuclides in the body after intake, and of the resulting radiation doses to various body organs [4].

After the Chernobyl accident FSIS and the Food and Drug Administration (FDA) met to establish intervention levels for food, because derived intervention levels for meat and poultry in the United States had never been officially adopted. The FSIS derived intervention levels for meat and poultry were established by using the FDA's "Accidental Radioactive Contamination of Human Food and Animal Feeds; Recommendations for State and Local Agencies" [5]. At that time, FSIS and FDA agreed that meat and poultry could be separated from food items under FDA's regulatory control with respect to potential food contamination from the radioactive fallout. Meat and poultry composed a readily discernible and easily segregated subset of all food items. The radionuclide intervention levels that were established were based on a 5 mSv projected dose commitment to the whole body, bone marrow, or any organ other than the thyroid.

This intervention level was based, in part, upon the expectation that the major contributors of radiation to imported meat and poultry will be cesium-134 (half-life of 2.1 years) and cesium-137 (half-life of 30 years). In addition, it was not expected that iodine-131 (half-life of 8 days) would contribute radioactive levels of any practical concern. The calculation of the intervention level took into consideration the total intake of activity from radionuclides and the average daily consumption of meat and poultry. In calculating this response level, FSIS used data for U.S. consumption of meat and poultry which represented 13 percent of total food intake. Other derived intervention levels, such as the one developed by WHO, use the total average daily consumption of all foods [4]. This information was not available to FSIS at the time of the accident.

On May 16, 1986, FSIS officially set a total cesium (cesium-134 plus cesium-137) intervention level of 2,775 Becquerels per kilogram (Bq/kg) and 56 Bq/kg of iodine-131 for meat and poultry. On May 28, 1986, FSIS began collecting samples of meat and poultry products imported into the U.S. from 14 European countries. The criteria for selecting samples included the best available information concerning the geographic distribution of the fallout, types of products being imported and the level of contamination of the products as determined by scintillation survey instruments used by FSIS inspectors at the seven ports of entry. The samples were collected in response to significant readings on the instruments and subsequently sent to the laboratory. Initially, the following five radionuclides were measured in the laboratory: Cesium-134, Cesium-137, Strontium-89, Strontium-90, and Iodine-131.

By October of 1986, 366 of 815 samples exceeded background levels for total cesium. Iodine and strontium results were not practically distinguishable from background radiation levels. However, only, five countries had any samples with results greater than 37 Bq/kg for total cesium:

Belgium, Hungary, Poland, Romania, and Sweden. Only Romania had values greater than 185 Bq/kg, with the highest reading of 794 Bq/kg. The sample data collected and information on agricultural practices in the exporting countries indicated that the occurrence of these two cesium radionuclides in meat and poultry may continue for an extended period. Six months following the release of radioactivity, FSIS determined that the intervention level of 2,775 Bq/kg needed to be reassessed.

The FDA 1982 guidelines are for short-term protective actions in an accident resulting in radioactive contamination of human food or animal feeds, and not for long-term, continuous exposure applications [5]. They state that the duration of the recommended protective actions should not exceed 1 or 2 months. However, evaluating the public health consequences of food contamination, even on a preliminary basis, requires a period of some length following the accident to assess or reassess all the available pertinent information. These protective action guides consider the types of contamination which might occur after such an event, the half-lives of resulting radioactive substances, and the biological pathways for human exposure.

The FSIS initial intervention level of 2,775 Bq/kg for total cesium was established at one-tenth of the emergency Protective Action Guides (PAGs) [5]. in specific situations, and where justified, lower projected doses than the PAGs can be established. Another important consideration in establishing the FSIS intervention level was that the FDA guidelines did not consider perceived risks in developing the PAG values. Such risks involve a high degree of subjectivity and could cast doubt on the validity of the scientific evaluations. In the opinion of FSIS, protective actions had to address the nature of the situation, the availability of resources, and the impact of these actions.

The FDA guidelines provided FSIS, by virtue of its immediate knowledge of its operations, the basis for developing intervention levels to meet the particular needs of the Agency. Therefore FSIS determined that the initial intervention level of 2775 Bq/kg needed to be lowered to meet the criteria of good public health practices.

Since the 2775 Bq/kg intervention level was established using the emergency PAG, it therefore seemed appropriate to employ a more conservative margin of safety of two orders of magnitude, i.e., 100, relative to the emergency PAGs. This yielded a new intervention level for total cesium of 277 Bq/kg. However, the Agency obtained some preliminary data from a 1986 study that indicated a lower rate of meat consumption in the United States [6]. Consequently, a lower consumption rate resulted in a higher intervention level. In October 1986 FSIS adopted a 370 Bq/kg response level for total cesium to harmonize U.S. intervention levels for all food items.

The highest total cesium levels had occurred by April 1987, for each of the 14 European countries [7]. However, on June 3, 1987 a sample of beef extract from Brazil was taken by an FSIS inspector who noticed, on routine inspection, that a large container of beef extract caused an unusually high reading on his scintillation survey instrument. An adequate sample for analysis was sent to the laboratory. The sample contained 481 Bq/kg and 168 Bq/kg of cesium 137 and 134, respectively. The total cesium of 649 Bq/kg, exceeded the FSIS response level of 370 Bq/kg. The cesium 137/134 ratio of 2.86, indicated a strong probability that the beef used in the product was from Chernobyl contaminated animals [7]. The Brazilian plant that produced the beef extract, stated that the meat used to produce the extract may have been imported from three European countries: Poland, Ireland, or Denmark.

Based on the result of this sample, FSIS started a sampling program to determine the cesium levels in: 1) all non-distributed Brazilian beef extract products in the U.S., 2) all Brazilian beef extract entering the U.S., and 3) all products exported to the U.S. by the Brazilian plant. Two out of the 60 beef extract samples exceeded the FSIS 370 Bq/kg intervention level. Subsequently, the contaminated product was prevented from entering U.S. commerce. A total of 122 samples of Brazilian beef products were taken during a four month period. In August 1987, FSIS stopped routine sampling of Brazilian product. Thereafter, samples were collected only when the inspector obtained a significant response on the scintillation survey instrument. Since all of these samples contained relatively low levels of cesium 134 and 137, a definite response of the instrument was in all probability due to the presence potassium 40, which is concentrated in beef extract.

By October 1988, most of the samples contained cesium levels that were indistinguishable from background. Therefore, FSIS discontinued taking samples of product from European countries exporting meat and poultry products to the U.S. The Agency determined that any public health benefit of continuing the program was offset by cost consideration and resources that could be reprogrammed to other high priority areas.

In total, FSIS analyzed 6195 samples of imported meat products from 14 European countries. 3701 samples of the 6195 were above background [Table I]. The highest values found were not necessarily from those countries with the largest number of samples above background.

In summary, the following actions were taken by FSIS after the Chernobyl accident:

- Set a realistic intervention level using United States interim protective action guidelines (PAGs).
- Calculated the intervention levels by using both the maximum intake of radionuclide activity allowed and food consumption data.
- Monitored, sampled, and tested imported meat and poultry products for five radionuclides.
- Periodically assessed and revised the intervention levels based on good public health practices
- Continued to evaluate and assess the ongoing regulatory activities.

Subsequent to these actions, "Derived Intervention Levels for Radionuclides in Food" was published by the World Health Organization [4]. Also a joint FAO/WHO recommendation to the Codex Alimentarius Commission to control foods in international trade that have been accidentally contaminated with radionuclides may soon help harmonization of intervention levels. "The goal is to provide a system that can be uniformly and simply applied by government authorities and yet one that achieves a level of public health protection to the individual that is more than adequate in the event of a nuclear accident". [8] Codex represents a worldwide search for compromise and consensus based on science. Food Safety Officials have been instrumental in setting many of these guidelines; they supervise radiological monitoring of much of the food in international trade and food consumed in each nation; and they will continue to be more important in orchestrating new activities for the benefit of all nations.

TABLE I: EUROPEAN SAMPLES ANALYZED FOR CESIUM 134 AND 137

COUNTRY NAME	NUMBER OF SAMPLES	RESULTS ABOVE BACKGROUND	HIGHEST TOTAL CESIUM Bq/kg*
BELGIUM	224	177	51 (9/86)
CZECHOSLOVAKIA	63	59	42 (1/87)
DENMARK	1820	348	26 (3/*87)
FINLAND	274	241	71 (1/87)
FRANCE	239	15	<1 (1/87)
GERMANY	57	20	7 (3/87)
HUNGARY	307	269	3 (4/87)
NETHERLANDS	99	20	5 (11/86)
POLAND	849	749	115 (8/86)
ROMANIA	1425	1376	1043 (10/86)
SWEDEN	571	229	83 (10/86)
SWITZERLAND	68	36	165 (12/86)
YUGOSLAVIA	188	157	86 (3/87)
TOTAL	6195	3701	

Note: Numbers may change slightly pending final audit of data.

* Total cesium is the sum of cesium -134 and cesium -137.

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