

Introduction

Nuclear power facilities are integral to energy production in the United State. With an abundance of safety protocols in place in the nuclear industry, a radiation emergency is extremely unlikely to occur. Nevertheless, all citizens should have an understanding of the potential effects of radiation contamination as part of the general disaster preparedness planning.

Preservation of human life and safety is the highest priority in any disaster

Domestic animals, such a livestock and poultry production animals, are important to humans, both as economic and societal resources. Agricultural businesses provide vast amounts of products critical to our economy and well-being.

This guide has been written to provide information about radiation emergencies for farmers who raise animals or grow crops for food, as well as for food processors and distributors, especially for those located within 50 miles of a nuclear power plant in an area called the Ingestion Exposure Pathway. It describes some actions that may be recommended in a radiological event to protect farmers, their animals and crops and to ensure food safety.



Knowledge of these actions can help those in the agricultural community develop preparedness plans. Should a radiation emergency ever occur, improved readiness and good judgment will be critical for making rational response decisions to minimize agricultural losses.

Keep this guide in a convenient location where you can refer to it quickly and use it to supplement other available preparedness plans and guidance.

Radiation Basics

→ Description of Radiation

Although radiation is invisible, tasteless and odorless to our senses, we are constantly exposed to radiation that naturally exists in the environment. Radiation has been described as energy in motion. All things are made up of atoms, which, in turn, are made up of smaller units called protons, electrons and neutrons. Atoms break apart continuously and, as they do, energy is released. This energy, in the form of tiny particles, waves or rays, is radiation. Ionizing radiation occurs when charged particles, called ions, are produced. Examples of ionizing radiation are alpha, beta and gamma radiation and x-rays.

Background radiation is what we are exposed to from the air, soil, water, rocks and manufactured consumer products including food, watches, televisions, medical procedures and building materials. These sources (especially medical procedures) account for more than half of the exposure we receive. Levels of background radiation vary between locations depending on factors such as elevation and soil composition. We are also exposed to radiation from materials used in medicine to diagnose and treat disease.

From radiological research, scientists have studied the potential effects of radiation on humans and have developed standardized guidelines for safe exposure levels, measured in millirems (mrem) and/or Sieverts and milliseiverts. According to estimates, our normal average yearly doses of background radiation levels (more than 600 mrem) cause us no harm.

Radiation from nuclear plant operation is strictly controlled within the plant. Outside a plant, meters continuously monitor radiation levels around nuclear power plants to ensure safety. People who live nearby receive only about one additional mrem per year from normal plant operation.

→ Contamination from Radiation

We can be exposed to radiation and not become contaminated. Contamination occurs when radioactive particles become attached to surfaces including those of people, animals, water, food, plants, soil, equipment and other objects.

- Being contaminated, however, does not necessarily mean a dangerous exposure to radiation has occurred.
- Contamination does not necessarily lead to ill effects.
- Contaminated surfaces may be able to undergo decontamination processes.
- External contamination may be easier to remove than internal contamination.

→ Radiation and Health

A big concern is that radiation will collect in our bodies and potentially cause injury or illness such as cancer or genetic changes. It is important to remember that neither exposure nor contamination necessarily increases the risk of damaging health effects.

Minor cell injuries caused by inhalation or ingestion of small and infrequent amounts of radiation would likely be repaired by normal cell repair processes that take place all the time. A very large radiation dose may damage too many cells too fast for the body to repair or replace them.

These are some factors that may determine adverse health effects of radiation:

- Type and amount of radiation introduced
- Duration of the radioactive introduction (long-term exposure may be more significant)
- Organs that are exposed (such as thyroid, muscle and bones)
- Time radioactive materials remain in the body
- General health of the person affected

→ Internal Contamination

People can become internally contaminated by breathing radioactive materials from the air or by ingesting contaminated food or water. Our body could be successful at eliminating and expelling some inhaled radioactive particles but if these materials persist, lung and other sensitive surrounding tissues could be damaged.

In the event of a release from a nuclear power plant, radioactive materials are carried by the wind and deposited on land, crops, livestock, food and water supplies. Without protective actions in place, we could consume contaminated food. Animals that are produced for food can become internally contaminated in the same way as humans by eating or drinking radioactively contaminated food. If radioactive material is absorbed into their bodies, it could be passed along the food chain through the eggs, meat or dairy products, such as milk.

Plants produced for food can also be internally contaminated by absorbing radioactive materials from soil or water.

Food Chain Example

Land, crops, livestock, food products and water supplies contaminated with radioactive materials above established safe levels would be considered adulterated and unsafe for use as potential food sources.

In a radiation emergency, it will be important to protect agricultural food sources as much as possible to reduce the chance of contaminating part of the food chain and endangering the public.

Emergency Planning

→ Emergency Planning and Management

Emergency preparedness personnel from nuclear power plants and from all levels of government work together continuously to protect against the threat of a possible radiation accident. Detailed emergency plans from each plant and affected counties are continuously reviewed, revised as needed and shared with citizens living or working near nuclear facilities.

State and local governments, with support from the Federal government and utilities, develop plans that include a plume emergency planning zone with a radius of 10 miles from the plant and an ingestion pathway zone within a radius of 50 miles from the plant.

Learn about the emergency plans that have been established in your area by your state and local government at www.ready.gov/today.

In the unlikely occurrence of an emergency event, staff from nuclear power plants as well as from county, state and federal government agencies will be coordinating assistance to citizens. Protection of lives and property will be foremost in the response effort. The power plant will coordinate the onsite response for their location.

Federal agencies and other emergency response organizations will be sending trained responders, equipment and radiation experts. Additionally, various nongovernmental organizations will be called upon for assistance.

→ Planning Zones

Emergency Planning Zone (10 mile radius from nuclear power plant)

Plans designate two areas for emergency planning around a nuclear power plant. The first area, approximately 10 miles in radius from the plant, is known as the plume exposure pathway Emergency Planning Zone (EPZ). People who live or work in this area regularly receive information and guidance from the plant and the county. If your farm or agricultural facility is within the 10-mile EPZ, you should become familiar with this guidance.

Within the 10-mile EPZ, you may be advised to go inside, stay inside; shelter-in-place; evacuate the area; and/or stay tuned for further instructions.

If radioiodine has been released from the plant, public health officials may also advise people in the vicinity of the plant to take potassium iodine (KI) that was distributed for use in advance or during this kind of emergency. Potential for direct exposure to radioactivity would be most likely during the early period when the radioactive materials are first released. If your farm or facility is within the 10-mile EPZ, your first concern should be for you

and your family. Do not take time to implement protective for farm animals or products as this might jeopardize your personal safety.

Numerous methods will be used to warn the public in the 10-mile EPZ. These may include siren, emergency vehicle loudspeakers and predetermined tone signals from emergency radios and the Emergency Alert System (EAS). If an alert signal is heard, immediately turn on your radio or TV for information and instruction.

Ingestion Pathway Zone (50-mile radius from nuclear power plant)

The other designated zone, out to approximately 50 miles in radius from the plant, is the Ingestion Pathway Zone (IPZ). This area is where individuals could become indirectly exposed to radiation from inhaling radioactive contaminants or through the consumption of contaminated milk, fruits and vegetables, water and other food products. Planning for the IPZ is focused on the agricultural community (farmers, food processors and distributors).

There will be coverage of the event in all news media. Information will change at least daily when local, state and federal officials deliver updates to communications specialists who will release it in regularly scheduled advisories. Guidance, in the form of protective actions, will be offered to everyone living, working or responding in potentially affected areas. Protective actions will depend on the extent of any released radiation and the impacts the proposed actions would have on the health and well-being of citizens and the economy. Basic actions to limit exposure, such as by sheltering, increasing distance and reducing exposure time, may be suggested.

Protective actions intended specifically for farmers, food producers and distributors will be provided by state agencies assisting with the response. A toll-free information call center will be setup to handle citizen's questions.

Protective Actions

Emergency managers are prepared to quickly notify and advise those in the agricultural community with suggestions of protective actions they may take following a nuclear power plant accident. Some of the actions will be precautionary, designed to limit radiation exposure – in other words, actions to take before radioactive materials have spread to your farm or facility. Some will be geared toward specific commodity groups, such as dairy farmers.

Recommended protective actions for agriculture will focus on the need to reduce contamination and prevent public consumption of adulterated food, milk and water. Humane care of animals must also be considered. You should respond quickly to protective actions but remain calm. Follow all advised procedures until you are told it is safe to resume normal activities.

Various factors would determine whether a radiation plume would affect your farm or facility:

- The type and amount of radioactive materials released
- The distance of your facility from the plant
- The wind direction and strength
- Rainfall at the time of release

In a radiation accident, follow these general recommendations:

- Remain calm.
- Tune in to your local news.
- Follow protective action instructions that are specific for your area.
- Find your plan and follow it.

Remember the basic ways to limit contamination by radioactive materials:

- Shielding the body (includes seeking shelter indoors or wearing protective outer garments)
- Staying a safe distance from contaminated areas
- Reducing time in contaminated areas

→ Protective Actions and Legal Restrictions

Restrictions will be initially imposed on a broad geographic area until the extent of the release is known. These include movement restrictions for animals and agricultural commodities to prevent transport of potentially contaminated products. This could occur at a farm, facility or in transport. Cargo enroute to processors may be returned to its origination. Food control areas and/or checkpoints may be established where products will be sampled for radiation. Products determined as contaminated or adulterated will be subject to official quarantine or embargo and forbidden from entering commerce. Products officially determined to be safe may be marketable.

Access into restricted areas (re-entry) must be arranged by official permission from local law enforcement. All protective actions and legal restrictions must be based on established standards for radiation protection and safety. Protective decisions should weight the need for short-term trade restrictions to protect public health against the balance of maintaining export and trade that is critical to our state economy. Misunderstandings about the risk of radiation exposure, such as overreaction when no harm has occurred, could lead to hasty decisions that are more damaging than good.

→ Sampling in the IPZ

Some protective actions will be site-specific, based on assessments from sampling in suspected contaminated areas. Radiation experts, scientists and trained personnel from the nuclear plant, local, state and federal agencies will be dispatched as radiation monitoring sampling teams. Samples may be taken at farms, processing plants, food distribution carriers and food control checkpoints. Sampling teams will collect samples for transport to a radiological laboratory for analysis. Data from these assessments will be analyzed to determine the amount of radioactive materials and the spread of contamination. Specific protective actions can then be determined.

Agriculture samples might include:

- Air, water and feed
- Animal feces and blood
- Swabs from animals and from surfaces inside animal housing buildings
- Pasture, leaf, soil, crops (tobacco, soybean, corn, peanuts, cotton, hay)
- Meat, eggs, milk
- Containers from water boiling plants and food distribution facilities
- Swabs from products, equipment and surfaces of food processing facilities

Safe limit for radioactive materials in food are based on guidelines set by the Food and Drug Administration (FDA) to prevent contaminated items from entering the food chain. Like federal guidelines set for total body exposure from radiation, these limits are conservative. This means that protective measures may be put into place way before actual harmful limits are reached. The limits are set to ensure food safety and to enhance consumer confidence.

All radiation sampling team members will wear protective outer clothing. Each will receive and wear a dosimeter, which measure how much total radiation they are exposed to during the workday. Additionally, they will carry communications equipment so they can share information quickly. Strict protocols and training concerning how to maintain sample chain of custody, as well as biosecurity procedures, will be followed when team members enter and leave any agricultural site.

→ **Food Control Areas and Checkpoints**

If Food Control areas or checkpoints are setup and agricultural products will be sample there, adulterated products will be condemned and will remain under official control until disposal. Control area limits will be revised whenever new assessments of the extent of radioactive contamination are known.

Only when these controls are lifted can normal farming and food processing activities be resumed.

Re-Entry Priorities: Human Life Safety!

...followed by incident stabilization, humane animal care, recovery of critical infrastructure and services.

Re-entry will allow farmers to milk, water and feed farm animals, replenish supplied and take care of other essential tasks. Official escorts may be provided. Farmers must follow emergency worker rules while in the restricted area. Those who re-enter must understand and accept that they will be exposed to low levels of radiation, though not at levels expected to cause ill effects. Protective clothing and dosimeter badges must be worn.

Pre-entry training will include information about open routes, safety measures and guidelines for radiation exposure and protection. Time limits for the length of the stay will be based either on a set number of hours or a maximum allowable dose. A decontamination process may be performed upon exiting.

→ **Restricted Access and Re-Entry Permission**

For obvious safety reasons, there will be restricted access into certain areas that have been defined as contaminated – probably those within 10 miles of the nuclear power plant, which received direct exposure and deposition of radioactive materials. When conditions allow, recovery efforts will begin in these areas. Local law enforcement and emergency management officials will implement controls to manage re-entry at access points. Access will be permitted only to emergency workers, radiation monitoring teams and certain others and only for limited amounts of time. Farmers whose property had been under an evacuation order may seek re-entry. Broadcasted information will advise farmers about designated re-entry points and how to obtain official re-entry passes or permits. Completion and submission of certification forms will be necessary.

Farm animals will continue to need daily care during this post-emergency phase of response.

Personal Protection

Various factors would determine whether a radiation plume would affect your farm or facility:

- The type and amount of radioactive materials released
- The distance of your facility from the plant
- The wind direction and strength
- Rainfall at the time of the release

Again, in a radiation accident, follow these general recommendations:

- Remain calm
- Tune in to your local news
- Follow protective action instructions that are specific for your area
- Find your plan and follow it

Also, don't forget the basic ways to limit contamination by radioactive materials:

- Shielding the body (includes seeking shelter indoors or wearing protective outer garments)
- Staying a safe distance from contaminated areas
- Reducing time in contaminated areas

When outside, always wear protective outer garments. These garments should be similar to what you would wear to apply pesticides and should cover all of your body. Disposable Tyvek coveralls may be provided but until that time you should wear the following:

- Long sleeved shirt and long pants,
- Coveralls,
- Rubber gloves,
- Cap or hat,
- Socks and shoes,
- Rubber boots or other shoe covers,
- Bandana, dust mask or other protective face cover.

Avoid farm duties such as plowing, disking, digging, baling, burning, or mowing that stir up soil and could re-suspend radioactive materials. Remove outerwear:

- Before entering the barn to care for your animals and
- Before entering your home.

Ideally, devise a place where your outer garments can be hung or stored where you can access them each time you go outside. Follow advice of radiation control specialists about safe disposition of this outer wear:

- How to wash it; and
- How to dispose of it.

After completing your outside activities, follow these steps:

- Remove outer garments,
- Shower, and
- Wash your hands before eating.

Do not consume farm products such as milk, produce or eggs until you are advised they are safe or until they are tested. If you choose to eat certain produce items that have been determined likely to be safe, wash them first -- away from your kitchen, separate from other food items and while wearing rubber gloves. Canned or packaged items and those in the freezer before the emergency event are safe to consume.

Livestock

→ Farm Animals

It will not be practical to evacuate farm animals in a radiation emergency in most cases nor will people likely be asked to evacuate their farms. This section is intended for farmers who do not evacuate. It is unlikely that a radiation release will directly cause the death or illness of any animals, but sickness and deaths could possibly occur due to sudden feeding and husbandry changes imposed on livestock and poultry because of the event. If any animals are found sick or dead, contact your veterinarian to assist with diagnosis and treatment. When notified that a release of radioactive materials has occurred, there are protective actions you can take to protect your animals from exposure.

The highest priority for your protective actions should be for milk-producing animals – lactating dairy cows and goats. Radioactivity can appear in milk in three days if an animal ingests contaminated forage, feed, or water.

Radiation sampling teams will be dispatched to animal production sites as soon as possible. Monitoring and testing may determine that your farm has not received radiation levels of any concern. In the meantime here are some steps that can be followed:

- Remove livestock from pastures and do not allow further grazing (especially dairy animals)
- Shelter animals indoors if possible
- Feed only protected feed
- Offer only protected water
- Protect remaining feed and water sources

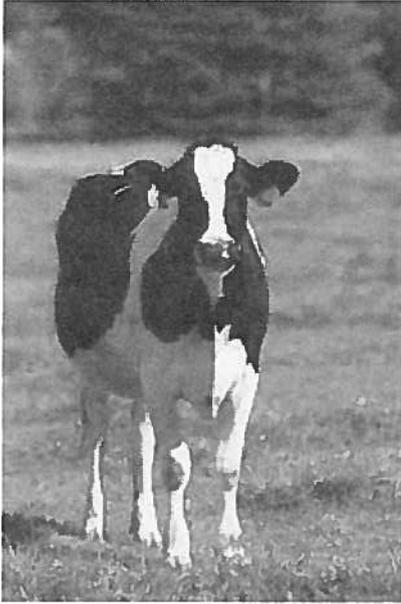


If at all possible move animals off pastures where they could ingest radioactive particles from the release. Do not let them graze until you are told that the pasture in your area is safe. If space is limited and grazing can't be avoided, lactating dairy animals should be given the highest priority to remove from pastures. For those animals who must continue to graze, add protected feed to their rations so that they eat less from grazing.

→ Sheltering Livestock

Since farm animals will not usually be evacuated during a radiation emergency, sheltering is the most effective way to reduce their exposure to radioactive particles deposited from the plume. Provide shelter that offers as much protection as possible from outside air and rainwater which may contain radioactive materials. A totally enclosed structure is best, but other protected areas can be used. Farm buildings such as barns, milking parlors, machine sheds, garages, corn cribs, swine buildings or poultry buildings can be adapted for use. Depending on building construction, some structures provide more shielding than others -- with concrete or masonry, stone, or metal best.

Producers with large numbers of animals will probably find it difficult to provide shelter for all of them.



Priority for shelter should be given first to milk-producing animals to prevent internal contamination from ingested radiation that could pass on to humans in milk.

There will likely be many other types of livestock, as well as poultry, on the farm. Farmers will need to evaluate their egg-producing poultry, breeding stock and other animals to prioritize shelter decisions.

An ideal indoor shelter site would have these characteristics:

- Constructed at least partly of heavy materials that provide shielding
- Doors, windows and curtains that close
- Enough space to prevent overcrowding
- Adequate ventilation.

Although open buildings such as pole barns or loafing sheds would provide less protection, any sheltering is better than none. Open areas could be blocked off with concrete blocks, earth, hay, sacks, plastic sheeting, or other materials.

Whether you can provide adequate space will influence decisions about how many animals to move indoors. See chart on page 18: **GUIDELINES FOR SPACING REQUIREMENTS FOR FARM ANIMALS IN SHELTERS DURING DISASTERS**

Ensuring adequate air flow and ventilation will be critical for animal health. Animals crowded together with limited air flow can overheat beyond recovery or can suffocate. Use of a ventilation system could, however, bring radioactive materials into the shelter, defeating the purpose of preventing exposure to possibly contaminated air from outside. This presents a challenge/balancing act.

It is believed that animals in these sheltered buildings would be harmed less from exposure to small amounts of radioactive particles entering via ventilation systems than they would be from overcrowding and overheating. These steps could be implemented into your ventilation processes to reduce exposure:

- Modify ventilation temporarily until the plume has passed -- use filters over air intake surfaces; turn on misters or low volume sprinklers; maintain on recirculated air
- Keep fans on low speed.

Wait for official testing and analysis that pastures are safe before allowing animals back outdoors to graze.

Animals that are normally raised indoors, such as swine and poultry, should remain in those farm buildings and be sheltered in place. Protected feed and water should be offered. In swine barns, uncontaminated water should be used for flushing under floor slats, using lagoon water as a last resort.

Animals that Need to Remain Outdoors

You may have some animals that must remain outside because of limited building options and/or because of their behavioral traits that would not be conducive to living indoors closer together.

Examples of outdoor shelter options: range-type animals could be placed closer together in an outdoor pen or into “natural” outdoor shelters such as densely wooded areas, ravines, bridge underpasses, or culverts to limit their exposure; or onto paved surfaces, parking area or other places where forage is not available. As much as possible, outdoor animals should be prevented from contacting radioactive forage, feed and water. Their outdoor lots and feed and water troughs can be watered down to reduce the stir-up of dust.



Livestock and poultry raised outdoors and remaining outdoors will be monitored and will be involved in official sampling for radioactive contamination.

→ Feeding Livestock

Ideally you will have a supply of stored, protected feed, before and after the event. Only offer silage, concentrates and hay that have not been stored in the open and possibly exposed to radioactive materials.

Types of protected feed include these:

- Feed that had been stored in a building
- Feed in a protected self-feeder
- Grain stored in grain elevators, covered bins or other containers
- Hay stored in a barn or covered shed
- Ensilage stored in a covered silo or trench
- Hay bales covered by a barrier such as a plastic tarpaulin.



In order to conserve limited feed supplies, temporarily offer reduced rations to your animals. In a worst case scenario with no protected feed available, most animals will survive for short periods on water alone. Any feed deprivation period should be followed by a gradual increase in rations as recommended by veterinarians providing guidance at the time of the event. One example might be to begin with feeding one-half normal feed the first day and increase by a pound per day per animal until back to normal amounts fed.

Notify your county emergency managers if you need to request emergency supplies of animal feed or water. Emergency supplies will be distributed as quickly as possible to affected areas.

If hay bales stored in the open must be used, use hay from the side away from the wind direction first. Being sure to wear personal protective equipment to avoid inhalation of re-suspended radionuclides, remove the outer layer of the bales and use the inner layers. (You could continue to store the outer layers until they have been monitored for radioactivity, then discard them if determined to be contaminated.)

See chart on page 19: **GUIDELINES FOR SHORT-TERM DIETARY REQUIREMENTS FOR FARM ANIMALS DURING DISASTERS**

Offer only protected water

For animals sheltered indoors, provide water from uncontaminated sources. Wells, tanks, cisterns or springs that have been covered should be considered safe sources.

Prevent outdoor animals from drinking from open sources such as ponds or lakes.

Protect Remaining Feed and Water Sources

Stacks of hay and other animal feed sources stored in the open should be protected from radioactive particle fallout by covering with a plastic tarpaulin or other impervious shield. See Feed only Protected Feed section on page xx for other recommendations.

When notified of a possible radiation release, cover standing water in containers such as troughs, barrels and open tanks right away. If water storage containers are connected to fill pipes that collect surface runoff from roofs or drainage fields, disconnect or close these and any other intake valves that could introduce contaminated water. Use this water first before adding other water and do not add water to these containers unless you know it has come from a protected source. Use protected self-waterers when able.

Protected water sources include covered or deep wells and underground springs. Although contamination could potentially move through porous soil or sand, underground water sources should be safe. Surface water may be contaminated from airborne material; do not use water from open ponds, rivers or streams until officially tested and cleared as safe. If notified that a radioactive plume has passed, drain and rinse and refill any open water troughs with uncontaminated water and repeat whenever dust is re-suspended from the ground. Public and private water sources will be sampled for contamination.

→ Other Animals

Bees

Managed honey bees are maintained in hive boxes. Young bees work inside the hive and will be more protected from radiological fallout than older, foraging bees. Exposure risk is higher if a radiation release occurs during daylight hours since foraging bees will be out of the hive, whereas at night all bees remain in the hive.

If there is time when notified of a radiation release, here are some protective actions for your bees:

- Close off the hive to prevent bees from foraging and contamination of the entire hive
- Feed uncontaminated sugar water, honey, pollen and nutritional supplements, as needed
- Move hives and beekeeping equipment to sheltered areas such as barns, garages or outside areas of dense vegetation.



Sampling teams will test bee hives, honey and wax in areas where radioactivity has been detected. Analysis of the data will determine recommendations. Honey should not be consumed and must not be shipped or sold until officially cleared for commerce. Contaminated hives and hive products will be treated as radioactive waste. In a worst-case scenario, it may be recommended that you destroy and dispose of affected hives or combs.



Horses

Horses are considered livestock but are not considered a part of the food chain. Horses should be removed from pastures as soon as possible, placed in sheltered areas and fed uncontaminated hay, feed and water. It is highly unlikely they will become sufficiently contaminated in the short run to adversely affect their health.

Fish and Wildlife

At least initially it will be recommended not to hunt or fish or to consume game in affected areas in the 50-mile Ingestion Pathway Zone. Samples of water, fish, other marine life and wildlife may be analyzed. Until laboratory data is analyzed, protective action recommendations may be broad since wildlife has unrestricted access and may have had extended contact time with contaminated food and water. Alternatively, guidance may be more liberal in specific locations where very low levels of radioactivity have been detected. Because it is expected that large bodies of water will dilute radioactive particles that were deposited, fish could potentially be caught and released for recreational purposes.

Service Animals and Pets

Service animals will be allowed to stay with their owners. Protective action recommendations for pets will be found in separate evacuation and mass care guidance.

Crops-Farms

This section focuses on your farm. Suggested protective action recommendations for food products derived from crops are in the Food Commodities section on page 13.

Contaminated soil will not be as urgent a concern in the initial days after a radiation accident as human safety or even production animal health and dairy product safety. However, an early priority in the agricultural community will be the evaluation of crops to determine whether contamination has occurred. As soon as feasible, radiation sampling teams will visit your farm to test your soil and crops.

Stay safe. After the radiation release is announced, follow the guidance on page 7 about wearing protective outer clothing when outside and about eliminating any field activities that would stir up soil.

General protective action recommendations for crop farmers will be based on factors that influence the amount of radiation expected to be deposited on or taken up by the plants. Some factors influencing recommendations are these: type and amount of radioactive materials; crop type; crop growth stage; soil composition and weather. With general recommendations and from sampling data from your site, officials will advise you about any special harvesting and disposition protocols for your crops and for the use of your land.

Financial compensation may be available for losses directly related to a radiation event (see pages 16-17). After the emergency has passed and before you irrigate your crops, be aware that contaminated dust may have accumulated in exposed irrigation canals. Flush the system away from your crops before irrigating.

DO NOT MOVE OR SELL ANY CROPS UNTIL THEY HAVE BEEN OFFICIALLY TESTED AND RELEASED FOR MARKETING. See page 5-6 for information about possible Food Control Checkpoints.

The following are examples of protective action recommendations that may be provided to crop farmers:

- Ripe fruits and vegetables may be lost if harvesting poses risk of personal contamination. In time, some crops could be quickly harvested and covered to protect them before possible contamination.
- Many standing crops may be grown to maturity. It is believed that pasture and forage plants retain only small amounts of deposited radioactive particles since exposure to wind and rain will likely drop contamination to safe levels before harvesting.
- Contaminated grains allowed to grow to maturity may only need milling or polishing or careful removal of contaminated layers to remove contamination. However, numerous grains can be pressed for oil which can remove up to 99% of radioactivity in the product. Some very slightly contaminated grains may be used for methanol production.
- Root vegetables such as potatoes, carrots and turnips are likely protected from surface contamination by the soil and may be considered safe after peeling.
- Timber products such as logs, firewood and Christmas trees will be included in sampling protocols and should not be moved or sold until determined to be free of contamination.
- Crop handling techniques such as delayed harvesting and salvage, storage, dehydration, canning or freezing may be suggested that would allow time for radioactive decay. Contaminated and uncontaminated crop products should be stored separately.



Officials will provide instructions for crops, soil or products that are determined to be too highly contaminated for any purpose. These will be removed and treated as radioactive waste to be moved to pre-determined sites for destruction, disposal or long-term storage.



Long-term soil management strategies may be implemented to reduce contamination until normal farming activities can be resumed. These include the following:

- Keeping land unproductive and idle for a specific period of time
- Deep plowing the soil to move radioactive materials below plant root level
- Substituting alternative non-agriculture uses of the land
- Planting non-food crops such as cotton or flax
- Planting oil seeds.

Food Commodities

Protective actions for food safety will be implemented based on safe levels of radiation in food recommended by federal radiation authorities.

In a worst-case radiation event scenario, your farm may suffer economic loss. This could be due to irreparable damage to your commodities from radioactivity. Another reason marketability could be lost would stem from public fear. Radiation monitoring and scientific data to ensure safety of farm products will be promoted whenever possible to promote public confidence in the agricultural community.

DO NOT MOVE OR SELL ANY FOOD PRODUCTS UNTIL THEY HAVE BEEN OFFICIALLY TESTED AND RELEASED FOR MARKETING. See page 5-6 for information about possible Food Control Checkpoints

➔ **Milk**

Radioactive materials, if taken internally by dairy animals, can appear in fresh whole milk within three days of a release. See guidance on page 8-9 about moving dairy animals indoors to avoid grazing on contaminated pasture or drinking water from contaminated sources.

Milk is the most critical product in the 50-mile Ingestion Pathway Zone. Commercial dairies and milk processing plants will be checked early.



Fresh milk is an important nutritional food. It is a perishable product with a relatively short shelf life compared to many other agricultural products. Early sampling of milk within the potentially affected area will help to protect dairy consumers, especially children who are the largest group of milk consumers and who may be more sensitive to radiation than adults.

Milk should be safe for use if it is obtained from dairy animals that did not ingest contaminated radioactive materials. Procedures such as ultrahigh temperature pasteurization followed by freezing and storing of milk products and/or production of cheese, butter or concentrated dry milk may also be recommended to produce safe dairy products. All dairy products intended for commerce must be sampled and analyzed and officially approved for marketing before they are moved or sold.

➔ **Meat and Poultry**

Production animals should not be used for food until it has been officially determined that they did not receive internal contamination and are safe for consumption. They should not be moved until that time or until other decisions about disposition are made. Instructions will be provided to animal producers about handling animals that are potentially contaminated (see Decontamination and Disposal on page 15).

➔ **Eggs**

Poultry housed indoors and given protected food and water are not likely to produce contaminated eggs. Egg consumption is discouraged if adulteration is suspected. If confirmed, disposal will be recommended or ordered. Eggs must not be moved or sold until officially cleared for marketing purposes.



➔ **Aquaculture**

Fish hatcheries and aquaculture farm sites will be visited by radiation sampling teams to determine whether contamination has occurred. Water from ponds or tanks where fish are raised will be tested. Product determined by laboratory analysis to be safe may continue to be harvested.

➔ **Crops**



See examples of protective action recommendations for crop farmers on pages 12-13.

After a radiation event, the best advice may be disposal of potentially contaminated produce; however, consumer tips may circulate about removal of surface contamination for safe consumption. Methods such as scrubbing, milling and polishing; removal of skins, leaves, pods or shells; or salvage steps such as storage, dehydration, canning or freezing must be officially sanctioned before products thus treated can be sold.

→ Food in Transit/Distribution

Food distributors must comply with official embargoes and with official radiation sampling for contamination before products can be allowed to be returned to commerce.

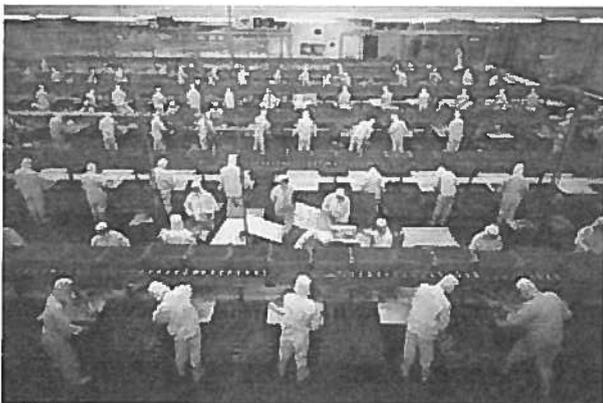
These protective action recommendations may reduce radiation exposure to products in warehouses:

- Keep windows, door and vents closed.
- Turn off all air intake systems including ventilation, air conditioning, vacuum and compressed air.
- Limit vehicle, employee and visitor traffic – restrict entry and exit access to prevent contamination.
- Monitor all incoming products since contamination could occur during transit.
- Decontaminate buildings, trucks and equipment as necessary.

Food products that were canned or bottled and stored in areas that were not exposed to radioactive materials should be safe to eat. Likewise, foods stored in airtight freezers or refrigerators would not be expected to be contaminated, nor would foods in cartons or other finished packaging.

Outer food packaging and outer containers can be washed or discarded.

→ Food Manufacturing and Processing



Radiation sampling teams will visit food manufacturing and processing facilities as soon as possible. In the meantime, owners of these businesses in the Ingestion Pathway Zone must cease operation. They must comply with embargoes and may not reopen production lines nor ship or sell their products until they receive official laboratory results that their facility and products are free from radiation contamination and suitable for commerce.

Recommendations listed above under the Food in Transit or in Distribution Facilities section can be followed to reduce product contamination and loss.

Decontamination and Disposal

→ Decontamination

Some items may be able to be decontaminated. Following decontamination the item may be re-sampled. Radiation scientists and subject matter experts have set some “clean” goals for radiation levels following decontamination; higher levels may be approved for use at the time of an actual radiation emergency.

Radioactive materials can be removed from outer surfaces by proper washing techniques. Internal contamination may be persistent and therefore may cause long-term exposure.

Research is underway to determine the best methods for decontamination of production animals that have been in areas exposed to radiation. Some of the current research seeks to determine if radioactive particles on animal hides can be removed using soap and uncontaminated water.

During an event, radiation monitors will be used to evaluate animals. Instructions for decontamination will be provided, some on a case by case basis, depending on the features of the radiation release and the animals

affected. Do not undertake livestock-washing procedures unless following the guidance of radiation experts at the time of the event to include which personal protective equipment to employ. Methods to control, collect and dispose of effluent must also be considered.

Removing internal contamination from production animals is more of a challenge, although some promising methods are being studied.

[Note: methods to clear animals of contamination do not include administration of potassium iodine (KI). Administration of KI ingestion must be timed to protect the thyroid gland from radioactive iodine and has no effect if given at other times. Pet owners should never administer KI to their pets unless under a veterinary prescription and dispensed by their veterinarian; the protective dose of KI for pets has not been established.] Official guidance for decontamination procedures for crops, food, buildings and equipment will be offered.

→ Disposal

It is possible that some items may be able to be placed in temporary storage until radioactivity has been reduced to acceptable levels. However, retention of these products may increase the length of time that trade restrictions are imposed on the affected area. If it is determined that a product cannot be sold or consumed, government officials will provide information about disposal of contaminated items. These may be collected, treated as radioactive waste and moved to pre-determined sites for destruction, disposal or long-term storage.

Recovery and Compensation

→ Recovery

Radiation exposure will be greatest in the hours and days after an emergency release. After that, radioactive materials will decay at a predictable rate with the passage of time.

Even though some issues within the Ingestion Pathway Zone may pose long term problems, recovery is definitely possible and is the goal! Recovery in a radiation incident can be defined as processes to ensure acceptable levels of environmental radiation are achieved that allow a return to normal day-to-day living.

You should not resume your previous unrestricted activities at your farm, processing or distribution site until officials have notified you that radioactive materials at your site are reduced to allowable limits.

→ Compensation

To assist in recovery, financial compensation may be available to the agriculture community for financial losses directly related to a radiation accident. All nuclear power plant operators contribute to an insurance liability coverage fund which is administered by American Nuclear Insurers (ANI).

Be sure to complete and maintain detailed paperwork about all losses that you experience.

These are examples of the types of losses that may be eligible:

- Loss of income due to official embargoes and product condemnations
- Property damages
- Living expenses if ordered to evacuate such as food, temporary lodging, mileage
- Lost wages
- Bodily injury
- Emergency medical equipment

Within 48 hours ANI, with collaboration with local agencies, will open and staff claim centers where insurance claims will be processed. Locations for these offices, along with information about types of assistance programs and how to file claims will be provided via public service announcements.

Be Prepared

Here are some things you can do now to prepare for a possible radiation event:

- Keep this guide where you can refer to it
- Plan to shelter your farm animals if ever needed
- Determine how to quickly obtain protected feed and water for your farm animals
- Consider maintaining protected supplies of forage, feed and water that are rotated frequently
- Plan how to quickly cover outside feed and water supplies
- Consider possible methods for storing or processing milk if ever needed
- Introduce yourself to local emergency managers so that they are aware of your operation
- Stay calm -- this will allow you to make good decisions in an emergency situation.

Guidelines for Spacing Requirements for Farm Animals in Shelters during Disasters

Adapted from *Guide for the Care and Use of Agricultural Animals in Research and Teaching*, Federation of Animal Science Societies, 3rd Edition, January, 2010

Estimates to assist planning for temporary sheltering of animals indoors in emergency situations

| ANIMALS | SQUARE FEET FOR SHORT (24–36 HOUR) PERIOD | SQUARE FEET FOR LONGER (2-10 DAYS) PERIOD |
|-------------------------|---|---|
| Cattle | | |
| ~400 pound calf | 15/animal | 25/animal |
| ~1200 pound adult | 20/animal | 35/animal |
| Cow with calf | 40/unit | 70/unit |
| Swine | | |
| ~ 150 pound hog | 5/animal | 8/animal |
| ~ 450 pound sow or boar | 14/animal | 18/animal |
| Sow with litter | 30/unit | 35/unit |
| Sheep | | |
| Ewe | 8/animal | 12/animal |
| Ewe with lambs | 10/unit | 15/unit |
| Poultry | | |
| Broilers | 0.8/animal | 1.5/animal |
| Laying Hens | 0.6/animal | 1/animal |
| Turkeys | 2/animal | 5/animal |

Guidelines for Short-Term Dietary Requirements for Farm Animals during Disasters

Adapted from Emergency Management Institute, IS-010, Animal Disasters, Module A, Unit 8 – May, 1998

Rations for maintenance, not production – for specific amount and type of feeds, consult your veterinarian

| ANIMALS | Amount of water per day (higher amounts apply to summer months) | Amount of feed per day |
|-----------------------|--|-------------------------------|
| Dairy Cows | | |
| In Production | 7-9 gal | 20 lb hay |
| Dry cows | 7-9 gal | 8-12 lb hay |
| Heifers | 3-6 gal | 8-12 lb hay |
| Cow with calf | 8-9 gal | 12-18 lb legume hay |
| Calf (400 lb) | 4-6 gal | 8-12 lb legume hay |
| Swine | | |
| Brood sow with litter | 4 gal | 8 lb grain |
| Brood sow (pregnant) | 3 gal | 2 lb grain |
| Gilt or boar | 1 gal | 3 lb grain |
| Sheep | | |
| Ewe with lamb | 1 gal | 5 lb hay |
| Ewe (dry) | 3 qt | 3 lb hay |
| Weanling lamb | 2 qt | 3 lb hay |
| Poultry | | |
| Layers | 5 gal/100 birds | 17 lb/100 birds |
| Broilers | 5 gal/100 birds | 10 lb/100 birds |
| Turkeys | 12 gal/100 birds | 40 lb/100 birds |
| Horses | | |
| All | 1 qt/animal | As needed dry food |

Resources

Fact Sheet on Safety and Security Improvements at Nuclear Plants, US Nuclear Regulatory Commission:
<http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/safety-security.html>

Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies, Center for Devices and Radiological Health, Food and Drug Administration:
<http://www.fda.gov/downloads/MedicalDevices/DeviceRegulationandGuidance/GuidanceDocuments/UCM094513.pdf>

Radiation Protection, US Environmental Protection Agency:
http://www.epa.gov/rpdweb00/understand/health_effects.html

South Carolina Operational Radiological Emergency Response Plan (SCORERP), South Carolina Emergency Management Division: <http://www.scemd.org/planandprepare/disasters/nuclear-power-plants>

This guide was prepared by Clemson University Livestock-Poultry Health in consultation with USDA Veterinary Services and with assistance from Clemson Regulatory Services and Clemson Cooperative Extension. It replaces the 1998 "Agriculture and Nuclear Power in South Carolina" brochure.

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