

**ANNEX 7**  
**(INGESTION EXPOSURE PATHWAY ZONE)**  
**TO THE SOUTH CAROLINA OPERATIONAL RADIOLOGICAL EMERGENCY**  
**RESPONSE PLAN)**

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**I. INTRODUCTION**

- A. The Ingestion Exposure Pathway Zone (IPZ) is a geographical area, approximately 50 miles in radius surrounding a commercial Nuclear Power Plant (NPP), in which it has been estimated the health and safety of the general public could be adversely affected through the ingestion of water or food from that area which has been contaminated through exposure to radiation primarily from the deposition of radioisotopes after a radiological accident. The duration of such exposures could range in length from hours to months.
- B. The IPZ is designed to mitigate contamination of the human food chain by a radiological accident at an NPP. The Ingestion Pathway is characterized by radionuclides being deposited on surfaces, potentially contaminating water supplies and foodstuffs (i.e. milk, meats, other livestock, poultry, fish, fruit, vegetation, eggs, tea, grains, honey, soft drinks, shellfish, mature produce, etc.).

**II. PURPOSE**

- A. Identify the responsible agencies and actions taken to protect people and animals from ingesting contaminated foodstuffs and water resulting from a release of radioactive materials from a NPP within or in close proximity to the state of South Carolina.
- B. Address the responsibilities and processes taken to identify radioactive contaminated foodstuffs, water and animals resulting from a release of radioactive materials from a Nuclear Power Plant (NPP) within or in close proximity to the state of South Carolina.

**III. SITUATION**

- A. Although the IPZ generally does not present the direct or immediate threat that is characterized in the 10-mile Plume Exposure Pathway Emergency Planning Zone (EPZ), preventive protective actions (i.e. covering water sources, providing dairy cows with stored feed, etc.) should be initiated as soon as a danger is recognized.
- B. Internal contamination through ingestion of contaminated materials presents a unique challenge from external contamination, in that radioactive materials can continue to expose individuals to unacceptable levels of contamination as long as it remains in the body. Once absorbed or taken up into human organs, the radioactive materials can be difficult or impossible to eliminate in the short term.
- C. Ingestion of radionuclides is a longer term problem than external exposure because radionuclides from the soil may be taken up by vegetables, fruit trees, and grains, potentially contaminating future harvests. Thorough sampling and monitoring

procedures are necessary to ensure that appropriate Protective Action Decisions (PAD) can be made.

#### **IV. ASSUMPTIONS**

- A. Most of the radiological particulate released to the environment from a significant NPP incident would be deposited within 50 miles.
- B. Projected contamination will not exceed Protective Action Guide (PAG) levels beyond the IPZ.

#### **V. CONCEPT OF OPERATIONS**

##### **A. General**

- 1. Health risk to the public will be averted by limiting the radiation dose received as a result of consumption of accidentally contaminated food by:
  - a) Setting limits, called Derived Intervention Levels (DILs) on the radionuclide activity concentration permitted in human food, and
  - b) Taking protective actions to reduce the amount of contamination.
- 2. Preventive/precautionary protective actions are taken to either avoid or reduce the contamination of food, milk, or water and to isolate food to prevent its introduction into commerce. Protection of dairy animals and surveillance of fresh milk supplies and feed for dairies will command the highest priority early in the IPZ response.
- 3. All human consumption foodstuffs (e.g., milk, meats, other livestock, poultry, fish, vegetation, eggs, tea, grains, honey, soft drinks, shellfish, mature produce, etc.) including potable/non-potable water, will be sampled by priority for radioactive contamination in the IPZ.
- 4. For effective emergency response in the IPZ, samples of milk, food or water will be obtained from all areas that may be contaminated.
- 5. Following a radiological release, the impact on the IPZ will not be known until sample collection and analysis is completed. Once these samples have been analyzed, final protective measures will be determined and implemented.

##### **B. Field Monitoring & Sampling**

- 1. South Carolina Department of Health and Environmental Control (SCDHEC) is responsible for implementation of all radiological field monitoring and sampling activities in South Carolina in accordance with procedures contained in the South Carolina Technical Radiological

Emergency Response Plan (SCTRERP) and the South Carolina Standard Technical Radiological Operating Procedures (SCSTROP).

2. ESF-10 (Hazardous Materials) is responsible for coordination of all field monitoring and sampling activities in South Carolina, which includes staff from SCDHEC, the South Carolina Department of Agriculture (SCDA), Clemson University Cooperative Extension Services (CUCES), augmented by staff from Southern Mutual Radiological Assistance Plan (SMRAP) states, the National Guard Civil Support Teams (CST), U.S. Environmental Protection Agency, (EPA) Department of Energy (DOE) Radiological Assistance Program (RAP) Teams, and Federal Radiological Monitoring and Assessment Center (FRMAC) to accomplish this mission
3. Each respective agency identified will maintain state and local staff rosters.
4. Additional information on sampling procedures and priorities are available in Appendices I and II of the SCTRERP and the SCSTROP.

C. Derived Intervention Levels (DILs)

1. DILs are established by the U. S. Food and Drug Administration (FDA) and provide a large margin of safety for the public because each DIL is set according to a conservatively safe scenario for the most vulnerable group of individuals.
2. DILs are limits on the concentrations permitted in human food distributed in commerce.
3. DILs apply during the first year after an accident.
4. If there is concern that food will be significantly contaminated beyond the first year, the long-term circumstances need to be evaluated to determine whether the DILs should be continued or if other guidance may be more applicable.
5. For further guidance see the FDA's Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations for State and Local Agencies.

D. Protective Actions

1. Protective actions would be initiated subject to evaluation of the situation and would continue until, in the absence of actions, the concentrations remain below the DILs. Protective actions can be taken to:
  - a) Avoid or limit, through precautionary measures, the amount of contamination that could become incorporated in human food and animal feeds, or

- b) Delay or limit consumption of human food and animal feeds suspected of being contaminated until concentrations of contamination has been determined, or
  - c) Reduce the amount of contamination in human food and animal feeds.
2. Protective actions prior to confirmation of contamination
- a) Simple precautionary actions
    - (1) Actions to avoid or reduce the potential for contamination of food and animal feeds, including:
      - (a) Covering exposed products
      - (b) Moving animals to shelter
      - (c) Corralling livestock and providing protected feed and water
    - (2) Should only be considered prior to the arrival of contamination and should be implemented so as to avoid placing in jeopardy persons implementing the action
  - b) Temporary embargoes to prevent the introduction into commerce of food which is likely to be contaminated
    - (1) Because there is potential for negative impact on the community, justification for this action must be significant.
    - (2) Should be issued only upon declaration of a GE and if predictions of the extent and magnitude of the off-site contamination are persuasive.
3. Protective actions for foods confirmed to be contaminated and the contamination equals or exceeds the DILs.
- a) Temporary embargoes to prevent the introduction into commerce until measurements confirm that concentrations are below DILs.
  - b) Normal food production and processing actions that reduce the amount of contamination in or on food to below the DILs, including:
    - (1) Milk
      - (a) Withholding of contaminated milk from the market to allow short-lived radionuclide to decay. This may

be achieved by storage of frozen concentrated milk or milk products.

- (b) Storage for prolonged times at reduced temperatures provided ultra-high temperature pasteurization techniques are employed for processing.
- (c) Diversion of fluid milk for production of dry whole milk, butter, or evaporated milk.

(2) Fruits and Vegetables

- (a) Washing, brushing, scrubbing or peeling fruits and vegetables to remove surface contamination.
- (b) Preservation by canning, freezing, and dehydration, or storage to permit radioactive decay of short-lived radionuclide.

(3) Grains

Permitting grain to grow to maturity, with subsequent milling and polishing to remove most of the radioactive contamination.

(4) Other food products

Processing to remove surface contamination.

(5) Animal Feed Other Than Pasture

- (a) For hay and silage fed to lactating cows, the concentration should not exceed that equivalent to the recommendation for pasture.
- (b) Increase non-contaminated mineral calcium to a maximum.

4. Protective actions for soil, water, and animal feed

a) Soil

Examples of land management practices to reduce contamination include:

- (1) Idling (i.e., non-use of the land)
- (2) Removal and proper disposal of soil
- (3) Alternating types of crops

- (4) Deep plowing
  - (5) Liming to limit absorption of specific radioactive substances by crops
  - a) Water
    - (1) Covering and/or closing intakes to water supplies (i.e. open wells, rain barrels, tanks, etc.).
    - (2) Increasing flow rates in rivers and/or streams to transport and dilute radionuclides.
  - a) Animal feed
    - (1) Substitution of contaminated water with uncontaminated water.
    - (2) Removal of lactating dairy animals and meat animals from contaminated feeds and pasture with substitution of uncontaminated feed.
    - (3) Corralling livestock in uncontaminated areas.
  - 5. Ultimately, protective actions for food, water, and other related products will be incident specific and determined by State and local officials with assistance from the growers, producers, and manufacturers.
  - 6. SCDHEC will make Protective Action Recommendations (PARs) to protect the public from the ingestion of radioactively contaminated food or water.
    - a) PARs will be based on the analysis of field samples of air, soil, milk, water and vegetation within the IPZ. Environmental sampling will be directed at determining limits of the area of radiological impact (i.e., the "Plume") and determining the level of contamination of food, milk and water within and adjacent to the plume area.
    - b) SCDHEC will direct environmental sampling to define the limits of the area of radiological deposition and to begin defining levels of radioactive contamination in milk, foodstuffs, meat, other livestock, poultry and water.
- E. Actions by Phase
- 1. Early or Emergency Phase
    - a) Implementation of protective actions by the public and agricultural community within the IPZ typically begins during the Early or Emergency Phase of off-site response operations, with

precautionary protective actions for livestock and dairy cattle, and may continue well into the Late or Recovery Phase.

- b) SCEMD will coordinate the production and distribution of emergency information for the agricultural community.
- c) SCDHEC, in coordination with appropriate State agencies, will consider and recommend protective actions including but not limited to:
  - (1) Removing animals from pasture and placing on stored feed and water
  - (2) Curtailment of hunting and fishing
  - (3) Covering wells or shutting down surface water intakes for public water supplies
  - (4) Quarantine, embargo, or disposal of food or animals

## 2. Intermediate Phase

### a) General

- (1) Prior to this Phase, protective actions would have been implemented based upon plume and ingestion pathway exposure guidelines.
- (2) IPZ protective actions will be recommended by SCDHEC, SCDA, Clemson University Cooperative Extension Services (CUCES) and other concerned agencies.
- (3) Most ingestion PADs will still be in effect at the beginning of the Intermediate Phase. Therefore, most ingestion response operations which occurred during the Early or Emergency Phase will continue to apply.
- (4) SCDHEC will continually coordinate the evaluation of the impacted area.

### b) Radiological Assessment

- (1) The assessment of the IPZ is accomplished by the analysis of radiological monitoring data from air, milk, soil, vegetation and water samples and direct radiation measurements.
- (2) Ingestion estimate summed with whole body external dose calculations will be used for estimation of first and

subsequent year whole body and inhalation exposures and skin beta dose conversion factors for a one-year exposure.

- (3) ESF-17 will coordinate the investigation of long-term agricultural land management practices (e.g., soil removal, crop rotation, tillage, etc.) that reduce future contamination of feed and food crops.
  - (4) ESF-17 will coordinate the identification of long-term impacts on livestock, poultry and related food products.
  - (5) SCDNR will coordinate the identification of long-term impacts on the area's indigenous wildlife.
  - (6) ESF-17, in coordination with appropriate state and federal agencies, will recommend appropriate measures to reduce or eliminate the effects of contamination to food and water.
- c) SCDA and CUCES will establish Food Control Points co-located with the traffic/access control points.
- (1) The Food Control Points will operate under the technical direction of SCDA in coordination with the impacted county. They will be used to restrict the flow of all livestock, poultry, foodstuffs and commercial products from a restricted zone.
  - (2) Food control staff will perform direct radiation surveys of all items leaving the controlled area to ensure all non-commercial items (personnel, pets, household items, etc.) leaving a controlled area meet the established State acceptable contamination release limits.

3. Late or Recovery Phase

- a) Actions will normally be a continuation of those initiated during the Early or Emergency Phase and/or the Intermediate Phase.
- b) The following actions will be a coordinated effort among local, state and federal partners; however, SCDHEC, CULPH, CUCES and SCDA will have primary responsibility for providing guidance and recommendations:
  - (1) Implementation of recommended long-term agricultural land management practices that reduce future contamination of feed and food crops.

- (2) Implementation of recommended long-term storage or disposal of contaminated foodstuffs or water.
- (3) Dissemination of extensive public information by various media to provide recovery instructions, to include, but not limited to, decontaminating foodstuffs, caring for livestock, and personal precautions.
- (4) Development and implementation of a decontamination and restoration plan to include agricultural properties and disposal of contaminated animals.
- (5) Identification of the time for final relaxation of PADs and other restrictions on the production, processing, distribution, and consumption of human food, animal feed, and water in the affected area.

## VI. ORGANIZATION AND ASSIGNMENT OF RESPONSIBILITIES

### A. South Carolina Emergency Management Division

1. Coordinates radiological emergency response operations to protect the public from the ingestion of contaminated food and water resulting from an NPP incident.
2. Participate in the PAD process for human food, animal feed and water.
3. Based on analysis from SCDHEC that the ingestion impact of the event is likely to extend beyond the 10-mile EPZ, notify the impacted counties and request a limited activation of their EOCs for emergency management, public information, and rumor control purposes.
4. Inform the affected counties that the incident is likely to have an impact on individuals, local governments, human food, animal feed, and water in their counties and that State personnel will contact food producers, processors, and distributors in their counties to collect samples.
5. Inform the counties periodically of the progress of the sampling process, the potential impact of the incident, and the protective actions being recommended.
6. In consultation with appropriate State agencies, adjacent states and federal agencies where appropriate, coordinate the development of protective actions and mitigation techniques, for humans, human food, livestock, poultry, animal feed, surface waters, public water supplies, fish and wildlife in the affected area and their periodic revision, throughout the term of the event.

7. In coordination with SCDHEC, SCDA, CULPH, CUCES and DNR, jointly develop public information advisories to local governments concerning actions they should take to protect the public in the affected area.
8. Coordinate the emergency printing and distribution of ingestion pathway public information brochures for the affected area.
9. Coordinate the development of ingestion-related information from State agencies for use at the JIC and media center.
10. Provide ingestion status updates through JIC news statements and/or directly to county emergency management officials for distribution to the local media.
11. Coordinate with the SC Department of Commerce for the compilation of information on the physical and economic impact of the incident with local, State, and federal agencies.
12. Coordinate with federal, State, and local agencies to determine the time for final relaxation of PADs and other restrictions on the production, processing, distribution, and consumption of human food, animal feed, and water in the affected area and disseminate this information to the public.

**B. South Carolina Department of Health and Environmental Control**

1. Lead State agency for directing the assessment of the radiological impact of an NPP incident within the IPZ.
2. Initiate actions to protect the public from the ingestion of contaminated foods
3. Participate in the PAD-making process for human food production, animal feed and water.
4. Coordinate radiological monitoring, sample collection and analysis, dose assessment, and dose projection.
5. Coordinate IPZ assessment activities with the FRMAC when federal agencies arrive on the scene.
6. Based upon dose assessment results and initial PARs, jointly consult with SCDA, CUCES, CULPH, DNR, adjacent states and federal agencies where appropriate, on the development and recommendation of protective actions for human food, livestock, poultry, animal feed, surface waters, public water supplies, fish, and wildlife in the affected area and their periodic revision throughout the term of the event.

7. Identify the need for additional field monitoring, sample collection, and sample analysis resources, request assistance from the FRMAC and/or other states and utilities as needed, and coordinate all sampling activities.
8. Develop and coordinate a sampling plan for collection, analysis, and evaluation of environmental samples.
9. In coordination with SCEMD, SCDA, CUCES, CULPH and DNR, jointly develop instructions or advisories to local governments, businesses, and industries to protect the public in the affected area.
10. Respond to inquiries from decision makers relating to ingestion hazards.
11. Assist with the development of information for Public Information Officers and media contacts regarding the public health impacts of ingestion of contaminated food or water and SCDHEC's anticipated long-term IPZ responsibilities and response efforts.
12. Coordinate with federal, state, and local agencies to identify the time for final relaxation of PADs and other restrictions on the production, processing, distribution, and consumption of human food, animal feed, and water in the affected area.
13. Request SCDA to evaluate, implement, and coordinate food control points in conjunction with Traffic Control Points.

C. South Carolina Department of Agriculture

1. Initiate actions to protect the public from the ingestion of contaminated foods.
2. Participate in the PAD-making process for human food and animal feed.
3. Upon request, provide SCDHEC and other state agencies with information about the IPZ needed to initiate ingestion-sampling activities. This information shall include the location of farmers markets and other food producers, food processors, and distributors.
4. At the request and direction of SCDHEC, activate sampling personnel to assist with sampling at specified locations within the IPZ. These activities will be coordinated with CUCES when possible.
5. Continually assess and update the SERT on:
  - a) Condition of the human food, livestock-poultry and animal feed supply in the IPZ

- b) Status of production (e.g., state of the growing season, crop maturation dates, perishability, impact of processing, supply of locally stored feed, access to and cost of outside feed sources, etc.)
  - c) The implications of short- and long-term protective actions on the above examples.
- 6. For those areas of agency responsibility, monitor the implementation of PADs by State and local government agencies, agricultural, business, industrial, volunteer organizations, and the general public. Provide periodic briefings to ESF-10 (Hazardous Materials).
  - 7. If the event persists, coordinate with appropriate federal agencies to identify outside sources of animal feed and assist local farmers with re-supply.
  - 8. Assist with the development of ingestion related information for the JIC, the media, local officials and the public. This information should focus on PADs relating to human food or animal feed.
  - 9. Coordinate jointly with federal, State, and local agencies to identify the time for final relaxation of PADs and other restrictions on the production, processing, distribution, and consumption of human food, animal feed, and water in the affected area.
  - 10. Coordinate with SCDHEC, CULPH, and CUCES to provide periodic information on the status of the incident and offsite response efforts to State and federal elected officials who represent the affected area.
  - 11. Coordinate the establishment of food control points at or near Traffic Control Points.

D. Clemson University Livestock - Poultry Health

- 1. Initiate actions to protect the public from the ingestion of contaminated foods.
- 2. Participate in the PAD making process for human food produced from animals and products of animals raised for food.
- 3. Upon request of SCDHEC, provide SCDHEC and other state agencies with information about the IPZ needed to initiate ingestion-sampling activities.
- 4. Participate in the incident assessment process by providing information on the condition of human food supply in the IPZ, the status of production (e.g., impact of processing, etc.) and the implications of short and long-term protective actions on these.
- 5. Issue stop movement orders on animals and animal products as needed.

6. Provide subject matter expertise regarding animal health and disease issues as well as disposition of animals and animal products, to include condemnation and disposal when indicated.
7. Assist with the development of ingestion related information for the JIC, media, local officials, and the public. This information should focus on PADs relating to animals raised for food and their products.
8. **Coordinate** with **SCDHEC**, CUCES and SCDA to provide periodic information of the status of the incident and offsite response efforts to State and federal elected officials who represent the affected area.
9. **Coordinate** jointly with federal, state, and local agencies to identify the time for final relaxation of PADs and other restrictions on the production, processing, distribution and consumption of animals raised for food and their products in the affected area.

E. Clemson University Cooperative Extension Service

1. Initiate actions to protect the public from the ingestion of contaminated foods.
2. **Participate** in the PAD-making process for human food and animal feed.
3. At the request and direction of the **SCDHEC**, activate sampling personnel to assist with sampling at specified locations within the IPZ beyond 10 miles of the NPP.
4. Continually assess and update the SEOC on:
  - (a) Condition of the human food and animal feed supply in the IPZ
  - (b) Status of production (e.g., stage of the growing season, crop maturation dates, perishability, impact of processing, supply of locally stored feed, access to and cost of outside feed sources, etc.)
  - (c) Implications of short- and long-term protective actions on these.
5. For those areas of agency responsibility, monitor the implementation of PADs by State and local government agencies, agricultural, business, industrial, volunteer organizations, and the general public. Provide periodic briefings to **SCDHEC**.
6. If the emergency persists, work with appropriate federal agencies to identify outside sources of animal feed and assist local farmers with re-supply.
7. Assist **SCDHEC** and SCEMD with the development of ingestion-related information for the JIC, the media, local officials, and the public. This

information should focus on PADs relating to human food, animal feed, or farm animals.

8. **Coordinate** with **SCDHEC** and SCDA to provide periodic information of the status of the incident and offsite response efforts to State and federal elected officials who represent the affected area.
9. **Coordinate** jointly with federal, state, and local agencies to identify the time for final relaxation of PADs and other restrictions on the production, processing, distribution, and consumption of human food, animal feed, and water in the affected area.

F. South Carolina Department of Natural Resources

1. Initiate actions to protect the public from the ingestion of contaminated wildlife (i.e. deer, fish, and other game harvested for food).
2. **Participate** in the PAD making process for human food and water.
3. Upon request, provide SCDHEC and other state agencies with information about the IPZ needed to initiate ingestion-sampling activities, recreational surface waters, and recreational fishing, hunting, and wildlife areas.
4. At the request of the **SCDHEC**, activate fish, game, and water sampling personnel, and assist with sampling at specified locations within the IPZ.
5. Participate in the **IPZ** assessment process by providing information on the condition of fishing, hunting, and wildlife in the IPZ (e.g., condition of current status of hunting and fishing restriction, wildlife activity or migratory patterns, etc.), and the implications of short- and long-term protective actions on these. (This assessment process continues throughout the term of the **event**)
6. For those areas of agency responsibility, monitor the implementation of PADs by state and local government agencies, agricultural, business, industrial, and volunteer organizations, and the general public.
7. Assist with the development of ingestion related information for the JIC, the media, local officials, and the public. This information should focus on PADs relating to public water supply, fishing, hunting, and wildlife.
8. **Coordinate** with SCEMD to provide periodic information on the status of the incident and offsite response efforts to State and federal elected officials who represent the affected area.
9. **Coordinate** jointly with federal, state, and local agencies to identify the time for final relaxation of PADs and other restrictions on hunting, fishing, and recreational water use.

G. South Carolina Law Enforcement Division

1. Initiate actions to protect the public from IPZ related exposures
2. Participate in the PAD making process for IPZ related activities.