S.C. Department of Health and Environmental Control

South Carolina Department Of Health and Environmental Control

Frequently Asked Questions

Subject **Page**

This page intentionally left blank.

S.C. Radiation History/Overview

Background

South Carolina is a radiological state. From the development of the Savannah River Site near Aiken – in the early 1950s – to the opening of the state's first nuclear power generating facility in 1971 near Darlington, South Carolina has been a forerunner in the use of radiological technology.

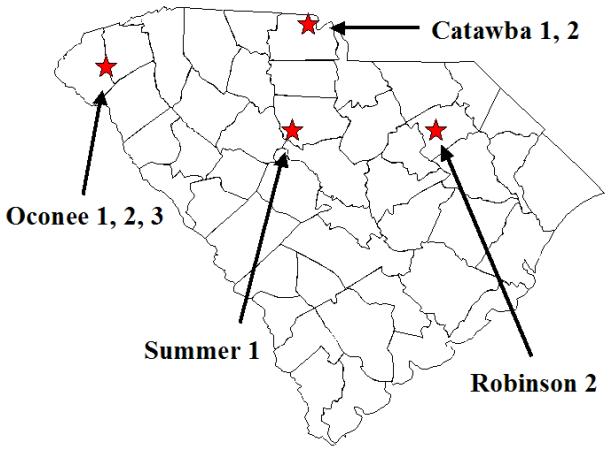
South Carolina's role in the history of radiation began in 1950 when the Atomic Energy Commission (predecessor of the U.S. Department of Energy – The USDOE or DOE and the U.S. Nuclear Regulatory Commission – the USNRC or NRC) authorized the design and construction of the Savannah River Site near Aiken, South Carolina. The facility's main role, in the 1950s, involved producing materials used in the fabrication of nuclear weapons.

With the end of the Cold War, the Savannah River Site's role changed significantly in its support of the National Nuclear Security Administration (NNSA) of the U.S. Department of Energy (USDOE). The NNSA's Savannah River Site Office (SRSO) is responsible for the Defense Program missions at this site. A new Tritium Extraction Facility has been operational since 2007 at the Savannah River. The NNSA also manages the project that, once construction is completed, will convert approximately 34 metric tons of surplus weapons-grade plutonium to mixed oxide fuel (MOX). The MOX fuel can be safely used in commercial nuclear power plants for the production of electricity.

Currently, four nuclear power generating facilities provide more than 50% of South Carolina's electricity. One additional nuclear power generating facility in the state of Georgia (Vogtle Electric Generating Plant), just beyond the Palmetto State's borders, must also be taken into emergency planning consideration. In total, the state of South Carolina is home to seven reactors; two are located at the Catawba Nuclear Station, one is located at the Robinson Nuclear Plant, three are located at the Oconee Nuclear Station and one is located at the V. C. Summer Nuclear Station. All seven reactors are Pressurized Water Reactors (PWRs). The Vogtle Electric Generating Plant is home to two additional pressurized water.

Sources of Electricity in South Carolina

Natural Gas – Fired	**18%**
Coal – Fired	**22%**
Nuclear	**55%**
Other (petroleum-fired, hydro, solar, etc.)	**5%**



***Source**: Energy Information Administration, S.C. Total Energy Production Ranking by State*
https://www.eia.gov/state/print.php?sid=SC

The Oconee plant has the most nuclear capacity of any of the State's plants, with three light water reactors rated at 846 Megawatts (electric) each. The largest reactors, however, are the pair of PWRs at the Catawba plant, rated at 1,129 MW (e) each. The other two nuclear plants are single-unit operations.

Power Generation capacity Per Reactor

Reactor	City	Capacity (MWe)	2016 Generation (Megawatt Hours)
Catawba 1	York	1,205	10,242,365
Catawba 2	York	1,205	9,315,899
Robinson 2	Hartsville	769	6,432,188
Oconee 1	Seneca	887	6,472,061
Oconee 2	Seneca	887	7,609,827
Oconee 3	Seneca	893	7,095,215
V. C. Summer 1	Jenkinsville	1,030	8,658,361
Total		**6,876**	**55,825,916**

Source: Energy Information Administration
https://www.eia.gov/nuclear/generation/index.html

Permanently Shutdown Commercial Reactors

According to the Nuclear Regulatory Commission, the Carolinas-Virginia Tube Reactor (CVTR) in Parr, South Carolina, was shut down on January 1, 1967.

South Carolina Nuclear Notes

In 2008, South Carolina ranked 3rd among the 31 States with nuclear capacity and 3rd in nuclear generation. It has the most nuclear capacity in the southeastern United States.

South Carolina's nuclear industry opened the new century with a new State record for nuclear output: more than 53 billion kilowatt hours. It is the current record.

Santee Cooper Corporation and South Carolina Electric and Gas have suspended construction on two (2) AP1000 reactors at the V. C. Summer plant. The targeted completion date for construction is now unknown.

Duke Energy has shelved a combined construction and operating license application for two AP1000 reactors that were to be built in Cherokee County.

Nuclear Power Plant Site-Specific Information

Catawba Nuclear Station

The Catawba Nuclear Station is located six miles north of Rock Hill, on the western shore of Lake Wylie. Unlike sister stations McGuire Nuclear Station in Mecklenburg County, N.C. and Oconee Nuclear Station in Oconee County, S.C., Catawba is jointly owned by North Carolina Municipal Power Agency Number One, North Carolina Electric Membership Corporation, Piedmont Municipal Power Agency and Duke Energy.

In operation since 1985, the site has two nuclear reactors with a power production capability of 2,258

megawatts. The license for Reactor #1 was issued Jan. 17, 1985 and expires Dec. 6, 2024. The license for Reactor #2 was issued May 15, 1986 and expires Feb. 24, 2026. Both reactors are pressurized water reactors.

For emergency planning and response purposes, the 10-mile Emergency Planning Zone is located within York County.

Robinson Nuclear Plant

The Robinson Nuclear Plant is located 26 miles east of Florence and west of the Lake Robinson Dam in western Darlington County. The facility is owned and operated by Duke Energy, whose corporate headquarters are located in Charlotte, N.C.

In operation since March 1971, the site has one nuclear reactor with an electric power generating capacity of 710 megawatts. The Robinson Plant is one of the country's few electrical generating stations with side-by-side coal and nuclear plants. Robinson coal-fired plant, also referred to as Reactor #1, began operation in May 1960. The coal-fired unit was retired on October 1, 2012. Robinson's nuclear reactor, also referred to as Reactor #2, generates 710 megawatts of electricity. The license for Reactor #2 was issued Sept. 23, 1970 and expires July 31, 2030. Reactor #2 is a pressurized water reactor.

Portions of Chesterfield, Darlington and Lee counties are located in the 10-mile Emergency Planning Zone of the facility. A small portion of the Lynches River Swamp in Kershaw County is within this 10-mile zone, therefore, Kershaw County has been included in the planning efforts since 2008. The area is sparsely populated and prevailing wind patterns in the area make it highly unlikely the area would be affected in the event of an incident.

Oconee Nuclear Station

The Oconee Nuclear Station is located 30 miles west of Greenville, near the eastern border of Oconee County and just north of Bridge 183 on the Keowee River. The station is owned and operated by Duke Energy Corporation, headquartered in Charlotte, N.C. Oconee earned the further distinction of being the second nuclear station in the country to have its licenses renewed by the Nuclear Regulatory Commission for an additional 20 years. All U.S. reactors are initially licensed by the NRC for 40 years.

In operation since 1973, the Oconee Nuclear Station has three nuclear reactors with a power production capability of 2,538 megawatts. It is a vital component of the Keowee-Toxaway Complex which includes two hydroelectric developments. The license for Reactor #1 was issued Feb. 6, 1973 and expires Feb. 6, 2033. The license for Reactor #2 was issued Oct. 6, 1973 and expires Oct. 6, 2033. The license for Reactor #3 was issued July 19, 1974 and expires July 19, 2034. All three reactors are pressurized water reactors.

For emergency planning and response purposes, parts of Oconee and Pickens counties are located within the 10-mile Emergency Planning Zone of the station. Prevailing winds in the area make it most likely that residents in the Pickens County portion of the EPZ would be affected by an accident with off-site considerations; however, shifting wind conditions could affect Oconee residents downwind of the site.

Savannah River Site

The Savannah River Site, which has historically played a role in the production of tritium and plutonium for national defense, continues to execute missions that involve the processing, disposition and storage of nuclear materials.

The Savannah River Site is located in parts of Aiken, Allendale and Barnwell counties. Historically, facilities at the 310 square mile site were used to produce materials, primarily plutonium and tritium, for national defense. The site continues to play a role in the processing of tritium for national defense; other missions focus on the disposition of plutonium and radioactive waste along with handling, processing and storage of a variety of nuclear materials. The site also hosts the Savannah River Nuclear Laboratory; whose mission includes research and development on nuclear materials.

The current mission also includes extracting, loading and recycling tritium reservoirs to support the U.S. nuclear stockpile; environmental cleanup including soil and groundwater; construction and operations of plutonium disposition facilities; and construction and operations of radioactive liquid waste facilities.

For emergency planning and response purposes the 10-mile Emergency Planning Zone includes Aiken, Allendale and Barnwell counties.

V. C. Summer Nuclear Station

The V. C. Summer Nuclear Station is located 26 miles north of Columbia, at the southern end of the Monticello Reservoir in western Fairfield County.

The station began operation in Jan. 1984 and has one nuclear power reactor with an electric power generation capability of 966 megawatts. The license for Reactor #1 was issued Nov. 12, 1982 and expires Aug. 6, 2042. The reactor is a pressurized water reactor.

For emergency planning and response purposes, portions of Fairfield, Lexington, Newberry and Richland counties are located within the 10-mile Emergency Planning Zone of the facility.

Vogtle Electric Generating Plant

The Vogtle Electric Generating Plant is located 34 miles southeast of Augusta, G.A., in the eastern portion of Burke County.

Vogtle has two nuclear reactors that become operational in 1987 with a combined power generating capability of 2,450 megawatts. The license for Reactor #1 was issued Mar. 16, 1987 and expires Jan. 16, 2027. The license for Reactor #2 was issued March 31, 1989 and expires Feb. 9, 2029. Both reactors are pressurized water reactors.

The State of South Carolina maintains emergency plans for this facility since a small, low population area located within its 10-mile Emergency Planning Zone. For emergency planning and response purposes, small portions of Aiken, Allendale and Barnwell counties are located in the 10-mile EPZ.

DHEC's Role in Response

The South Carolina Department of Health and Environmental Control (SCDHEC or DHEC) is tasked with providing radiological technical assistance, emergency planning and advice to the Governor's Office and the South Carolina Emergency Management Division (SCEMD). This important role in the state's ability to respond to radiological emergencies requires both technical responses, during an actual emergency and extensive day-to-day planning and liaison work.

DHEC created the Nuclear Response and Emergency Environmental Surveillance (NREES) section to provide the department's response to radiological emergencies.

The NREES responsibilities assigned to this section include:

- Maintaining a radiological hazard assessment capability and provide radiological technical support, coordination and guidance for the state.
- Preparing and updating supporting technical radiological emergency response plans.
- Provide for a 24-hour accident notification system.
- Provide protective actions guides as well as recovery and re-entry guidelines.
- Provide technical representative to industry and county and state government.
- Obtain and coordinate emergency radiological assistance from the federal government, other state and private industry.
- Direct monitoring efforts in the 10-mile emergency planning and the 50-mile ingestion pathway zones.
- Coordinate monitoring at shelters and reception centers and of emergency workers and vehicles.
- Provide technical advice on decontamination and disposal of contaminated materials.
- Provide water supply information required for sampling and monitoring and respond to radioactive waterborne releases that threaten public water supply.
- Provide radiological monitoring training to technical personnel and members of local and state government.
- Participate in annual training programs at nuclear facilities.
- Assist in the development and coordination of and participate in, nuclear facility emergency exercises.
- Coordination with Clemson Extension Service on crop and other agricultural information. Provide advice on protection recovery and re-entry.

This page intentionally left blank.

DHEC: Radiation Basics

Background

Radioactive materials are composed of atoms that are unstable. An unstable atom gives off its excess energy until it becomes stable. The energy emitted is radiation. Each of us is exposed to radiation daily from natural sources, including the Sun and the Earth. Small traces of radiation are present in food and water. Radiation also is released from man-made sources such as x-ray machines, television sets and microwave ovens. Radiation has a cumulative effect. The longer a person is exposed to radiation, the greater the effect. A high exposure to radiation can cause serious illness or death.

Radiation Basics

What is an atom?

Everything and everyone in the universe, is composed of different types of matter with different chemical elements. The smallest pieces of each of those elements are called "atoms". Atoms are so tiny that they can be seen only with very powerful microscopes. But the atoms make up the very core of every substance in the universe.

Are all atoms alike?

Atoms can be very different. They are unique for each element, such as gold, silver, lead, tin, radium, carbon and thorium. Our bodies are made mostly of hydrogen, carbon, oxygen and calcium atoms. Air is made of oxygen, hydrogen, nitrogen and other atoms. Water is hydrogen and oxygen. Even man-made things like cars, computers and cell phones are made of some type of metal and plastic atoms. Just like some atoms carry specific characteristics – that cause them to become chemicals like chlorine – others carry different characteristics making them Uranium or Potassium. Both Potassium and Uranium have naturally radioactive characteristics.

What is radiation?

Everything and anything…Radiation is a form of energy and it is present all around us all of the time. The term radiation is a broad term used to describe such things as heat, light, radiowaves, microwaves and other familiar forms of energy. Different types of radiation exist; some have more energy than others.

When radiation is given off from an atom, it is moving at very high speeds – faster than can be seen by the naked eye. So something that is radioactive means it is giving off a lot of "energy". Even something natural, like fruit, can be radioactive.

Radiation is colorless, odorless, tasteless and invisible. It is a type of energy in the form of particles or electromagnetic rays that are given off by atoms. The type of radiation we are concerned with, during radiation incidents, is “ionizing radiation”.

What is radioactivity?

Sometimes the center of an atom (its nucleus) has too much energy in it. An atom cannot hold this energy forever. Sooner or later, the atom must get rid of the excess energy and return to its normal (stable) state. Atoms with too much energy in their nuclei, the center of the atoms, are called "radioactive". They get rid of their excess energy by releasing radiation through energy. Some radioactive atoms exist naturally; others are

made artificially.

When fruits rot or vegetables ripen they are going through a very slow radioactive change – one that occurs naturally. Radioactive atoms give off tiny pieces of themselves in an attempt to get rid of excess energy. The radiation can be in the form of particles moving at high speeds, or pure energy. Anything that undergoes the process of changing is actually going through a radioactive change.

Thinking about the sun's effect is a good way to think about how radiation and radioactivity affect our bodies. When the rays from the sun reach our bodies they deposit their energy and the warmth we feel is the radiation and energy from the sun's rays. A suntan or sunburn is the effect of the sun's radiation being deposited onto our skin. When the radiation collides with something, they deposit some – or all – of that energy in the thing with which they have collided. When radiation from a radioactive atom penetrates an object, it deposits its energy in that object just like the sun's rays' deposit energy in our bodies. Over a lifetime, too much exposure to the sun can have negative health effects such as the development of skin cancer.

What is ionizing radiation?
It is a type of radiation that has enough energy to break chemical bonds (knocking out electrons). Materials that give off, or emit, ionizing radiation have enough strength to actually change cells and/or change the nature of objects on the atomic level.

What types of ionizing radiation are there?

Three different kinds of ionizing radiation are emitted from radioactive materials: alpha (helium nuclei); beta (usually electrons); x-rays and gamma (high energy, short wave length light).

- **Alpha particles** are dense and stop after traveling only a few inches in air. Alpha particles can be stopped by a thin sheet of cloth or a sheet of paper. However, alpha particles (also referred to as alpha emitting materials) pose serious health dangers primarily if they are inhaled or ingested (breathed in or eaten).

- **Beta particles** can travel farther in air, as they are less dense than alpha particles. Beta particles (or beta emitting material) can easily be stopped by aluminum foil or human skin. Unless Beta particles are ingested or inhaled they usually pose very little danger to people.

- **Gamma rays, photons rays and x-rays** are very penetrating. They pose a large danger to people because of they are able to penetrate, or even pass completely through, the human body. Gamma rays and x-rays can go through many feet of air or several inches of lead/concrete protection (shielding).

What is non-ionizing radiation?

Non-ionizing radiation is a type of radiation that has a long wavelength. Long wavelength radiations do not have enough energy to "ionize" materials (knock out electrons). Some types of non-ionizing radiation sources include radio waves, microwaves produced by cellular phones, microwaves from microwave ovens and radiation given off by television sets.

Can radioactivity be neutralized?

Currently there is no way in which we can neutralize radioactivity. The best we can do is transfer radioactive material to some place safe and then wait for it to decay. Decay is usually measured or discussed in reference to a material's "half-life."

What is radioactive decay?

It is the process where radioactive materials disintegrate as they release radiation.

What is half-life?

Half-life is the amount of time it takes for half of the atoms in a sample of radioactive material to decay. For example, a sample of 1,000 atoms of a radioactive material with a half-life of one year will have only 500 atoms of the material left after one year and by the end of the second year there will only be 250 atoms of the material left.

Radiation Measurements

What is a "unit"?

A “unit” is simply a way to express certain measurements. For example, an "inch" is a unit of length. A "second" is a unit of time. A "pound" is a unit of weight. It is the same with radiation.

What is a “dose”?

A “dose” is the amount of radiation, or energy, absorbed by a person during a given amount of time. Units of dose are used to describe the potential for radiation damage to body tissues.

What is a "rem" or “Rem”?

A "rem" is a unit of “radiation dose” or the way we describe how much radiation "energy" is deposited into someone or something. If our body absorbs radiation energy equivalent to about two-millionths (2/1,000,000) of a “calorie”, we say we have received a "rem" of radiation dose.

So then what is a “calorie”?

Calories are another measurement of energy. A calorie is defined as the amount of energy it takes to raise 1 gram of water (about 1 cubic centimeter or about a thimble full) one (1) degrees Celsius. One calorie is equal to 4.186 kilojoules.

How much energy is in a “joule” or a “kilojoule”?

A joule, kilojoules or megajoule are all measurements of energy. A joule, the smallest of the three, is not much energy at all. If you had a joule of energy in your battery, your typical flashlight would stay on for about 0.1 seconds. A kilojoules, which = 1,000 joules, would keep that light burning for 100 seconds and a megajoule would have it burning for 100,000 sec (about 28 hours).

So then is a “rem” a large radiation dose?

It can be when compared to the types of radiation doses people commonly receive every day. Every day people receive small amounts of natural background radiation – from the sun, the ground, the water, even the food we eat. Compared to those amounts a “rem” is a substantial dose... just like a "ton" is a substantial weight when we're talking about pieces of notebook paper and a "mile" is a substantial length when we're talking about inches on a ruler.

Are there smaller units than a Rem?

Yes, the "millirem" – abbreviated mRem. A millirem is one-thousandth (1/1,000) of a Rem. An even smaller, but frequently more practical unit is the "microrem" – abbreviated μRem – which is one-millionth (1/1,000,000) of a Rem. Beginning on page **14** of this document you can find a list of common radiation exposures, annual average radiation exposures and how much radiation is generated by each activity.

What does the term "rate" mean?

A "rate" is the amount of any unit of measurement that occurs over some specific time period. For example, "miles per hour" is a rate of speed, or the distance traveled in one hour. Likewise, "millirems per hour" is a dose rate, or the amount of radiation energy deposited in a one-hour period of time.

What is a "curie"?

A "curie" is a unit of radioactivity. It tells us how many radioactive atoms - within any group of atoms – are giving off radiation. Just like a "ream" of paper in a drawer tells us that there are 500 sheets in the drawer, a curie of radium in a container tells us that there are 37,000,000,000 radium atoms giving off radiation.

Is a curie a lot of radioactivity?

Yes. Compared to the amount of naturally occurring radioactivity in our bodies, it is a very large amount -- about ten million times larger. Therefore, it is sometimes more convenient to use units like "picocuries". A picocurie is one trillionth of a curie.

Is there an easy way to distinguish "millirems" from "picocuries"?

Yes, there is. A fireplace with a nice fire burning in it is a good way to explain the difference between these two terms. In a fireplace, the burning wood or coals radiate heat. In this case, the amount of burning wood/coal (fuel) in the fireplace is similar to the number of picocuries of radioactivity. The amount of heat (energy) given off by the fireplace is similar to the number of millirems of radiation energy.

Is there another example that gives us an equivalent to the term "picocurie"?

Yes. This time, picture yourself sitting in a stadium watching a sporting event. When something exciting happens, you are likely to see a lot of flashes coming from the stands where people are taking pictures.

If you could somehow count the number of flashes over a particular time period – say 10 minutes – you would know the "flash rate" from all the cameras that are in the stadium. This measurement is similar to how the amount of radioactivity – in a collection of atoms – is determined. In this case we count the bursts of radiation (flashes) being given off by the atoms (cameras) per unit time (10 minutes). When we see 22 bursts in 10 minutes, we know we have measured a picocurie of radioactivity (22 flashes in 600 seconds or 11 flashes in 5 minutes).

How does the term "millirem" fit into this example?

Let's say that while you are in the stadium, you take out your light meter and measure how much light is coming from the flashes in the stand over a one-hour period. The amount of light measured by the meter is a measurement of the amount of "energy" coming from the cameras in the stadium. This measurement is similar to the radiation dose (energy) from a collection of atoms (cameras) per unit time (one hour). The units of this measurement would be "millirems per hour".

What does the term "picocurie per gram" mean?

This refers to the amount of radioactivity in a solid substance. Picture a one-ton batch of concrete that contains 1,000 pounds of gravel, 500 pounds of cement and 500 pounds of water. To describe this particular mix of concrete, one might say it contains "500 pounds per ton" of cement. This means that for every pound of concrete, there will also be a quarter of a pound of cement present. Similarly, if you wished to describe the amount of radioactivity that typically exists in soil throughout the United States, you would say that it contains about "one picocurie per gram" of radium, one picocurie per gram of thorium and a host of other radioactive elements. This means that for every gram (about 0.002 pounds) of soil, there will also be one picocurie of radium and one picocurie per gram of thorium present, along with the rest of the radioactive elements commonly found in soil.

What does the term "picocurie per liter" mean?

This refers to the amount of radioactivity in a liter (about a quart) of liquid substance, such as water. Water directly out of the tap contains about 0.01 "picocuries per liter" each of Uranium, Radium and radioactive Lead. It may also contain between 100 and 400 picocuries per liter of radioactive hydrogen, between 100 and 500 picocuries per liter of radioactive carbon, between 10 and 30 picocuries per liter of radioactive beryllium and a variety of other radioactive elements such as aluminum, chlorine, silicon, lead, bismuth, polonium and argon. It can contain several hundred to several thousand picocuries per liter of radon gas, particularly if you get your drinking water from a well.

Is there radioactivity in the world around us?

Absolutely. The earth has always been radioactive. Everyone and everything that has ever lived has been radioactive. In fact, the natural radioactivity in the environment is just about the same today as it was at the beginning of the Neolithic Age, more than 10,000 years ago.

Is there radioactivity in our bodies?

Yes. During our lifetime, our bodies harbor measurable amounts (billions) of radioactive atoms. About half of the radioactivity in our bodies comes from Potassium-40, a naturally radioactive form of Potassium. Potassium is a vital nutrient and is especially important for the brain and muscles. Most of the rest of our bodies' radioactivity is from radioactive carbon and hydrogen. We have about 120,000 picocuries of radioactivity in our bodies. These naturally occurring radioactive substances expose our bodies to about 25 "millirem" per year, abbreviated as "mrem/yr" or "mRem/yr".

Most radioactive substances enter our bodies as part of food, water or air. Our bodies use the radioactive as well as the non-radioactive forms of vital elements such as Iodine and sodium. Radioactivity can be found in all foods. As we said before, it is even in our drinking water. In a few areas of the United States, the naturally occurring radioactivity in the drinking water can result in a dose of more than 1,000 millirem in one year.

Sources of Radiation

Are there other sources of natural radiation?

Another type of natural radiation is cosmic radiation given off by the sun and stars in outer space. Because the earth's atmosphere absorbs some of this radiation, people living at higher altitudes receive a greater dose than those at lower altitudes.

In Ohio, for example, the average resident receives a dose of about 40 millirem in one year from cosmic

radiation. In Colorado, it is about 180 millirem in one year. Generally, for each 100-foot increase in altitude, there is an increased dose of one (1) millirem per year.

Flying in an airplane increases our exposure to cosmic radiation. A coast-to-coast round trip gives us a dose of about four millirem.

In Ohio, radiation in soil and rocks contributes about 60 millirem in one year to our exposure. In Colorado, it is about 105 millirem per year. In Kerala, India, this radioactivity from soil and rocks can be 3,000 millirem per year and at a beach in Guarapari, Brazil, it is over 5 millirem in a single hour or 43,800 millirem per year (5 millirem **x** 24 hours **x** 365 days = 43,800 millirem or 43.8 Rem).

If you live in a wood house, the natural radioactivity in the building materials gives you a dose of 30 to 50 millirem per year. In a brick house, the dose is 50 to 100 millirem per year. And, if your home is so tightly sealed that the leakage of outside air into the home is small, natural radioactive gases (radon) can be trapped for a longer period of time and thus increase your dose.

What are naturally occurring sources of ionizing radiation?

They include elements in the soil, naturally occurring radon, naturally occurring Potassium and naturally occurring Uranium mill tailings and cosmic rays from the sun.

Where do man-made sources of ionizing radiation come from?

The sources include medical sources (x-rays, medical treatments) and from nuclear weapons testing. Some consumer products that contain radioactive materials include: smoke detectors, some watches and clocks (especially older radium dial types), some ceramics (such as old orange-red glazed Fiesta ware), some glass (especially antique glassware with a yellow or greenish color), fertilizer, food and even gas lantern mantles.

What is the most commonly occurring radionuclide in the human body?

Potassium-40 is the most common. It is found in Potassium-rich foods such as bananas.

So, almost everything is radioactive, right?

Yes, radiation is everywhere. Our bodies and the world around us, are radioactive. But there is no cause for alarm. These very small but detectable levels of radioactivity are natural. We are exposed to a constant stream of radiation from the sun and outer space. Radiation is in the ground, the air, the buildings we live in, the food we eat, the water we drink and some of the products we use. The average U.S. resident receives about 620 millirem per year from these natural sources of radioactivity, as well as, from typical man-made medical radiation exposures such as x-rays.

Prior to 2009, the average annual exposure was 360 millirem but in 2009 the National Council on Radiation Protection (NCRP) increased their estimates based on studies and surveys that showed an increase in human exposure to radiation and radioactive material. The increase was found to be a result of the increased number of medical procedures and treatments involving radioactive medical products such as MRIs, CAT scans and nuclear stress tests.

Is any amount of radiation safe?

Some scientists believe that low levels of radiation are beneficial to health (known as hormesis). However, there do appear to be thresholds of exposures for various health effects, for example: at **50 Rem** nausea occurs, at **70 Rem** vomiting occurs, at **400-to-500 Rem** death occurs.

What are some of the most common exposures of/to radiation?

Gastrointestinal series (upper & lower)	**1,400 millirem per exam**
Cigarette Smoking (average – several packs/day)	**1,300 millirem per year**
CT Scan (head & body)	**1,100 millirem per exam**
Nuclear medicine examination of the brain	**650 millirem per exam**
Average annual background dose to humans	**620 millirem per year**
Nuclear medicine examination of the thyroid	**509 millirem per exam**
Barium Enema	**405 millirem per exam**
Upper gastrointestinal tract series	**245 millirem per exam**
Radon in average household	**200 millirem per year**
Dose to members of airline crews	**170 millirem per year**
Nuclear medicine examination of the lung	**150 millirem per exam**
Computerized tomography of the head	**110 millirem per exam**
Plutonium-powered pacemaker	**100 millirem per year**
Natural radioactivity in your body (120,000 pCi/L)	**40 millirem per year**
Cosmic radiation	**31 millirem per year**
Mammogram	**30 millirem per exam**
Smoking Cigarettes (1 cigarette/day)	**15 to 20 millirem per year**
Consumer products	**11 millirem per year**
Using natural gas in the home	**9 millirem per year**
To spouses of recipients of certain cardiac pacemakers	**7.5 millirem per year**
Chest X-ray	**6-8 millirem per exam**
Foods grown on lands (where phosphate fertilizers are used)	**5 millirem per year**
Road construction material	**4 millirem per year**
Dental X-ray	**3 millirem per exam**
The use of gas mantles	**2 millirem per year**
Domestic water supplies	**1 to 6 millirem per year**
Living near a nuclear power station	**1 millirem per year**
Air travel (every 2006 miles)	**1 millirem per trip**
(Cross-country flight)	**2 millirem per trip**
Television receivers	**1 millirem per year**
Eating one-half pound of Brazil nuts	**0.5 millirem per bag**
Combustible fuels (i.e.-coal, natural gas, liquefied petroleum)	**0 .3 millirem per year**
Drinking a quart of Gatorade each week	**0.2 millirem per year**
Sleeping with one's spouse (or "significant other")	**0.1 millirem per year**

Sources:
- U.S. DOE Oak Ridge
- 2004 DOE Annual Site Environmental Report Summary

Compact fluorescent light bulb (Krytpton-85)	**15,000 p/Ci per year**
Salt Substitute	**2,400 p/Ci per teaspoon**
Airborne radioactivity from nuclear power plants	**550 p/Ci per year**
Common lawn & garden fertilizer	**30 to 50 p/Ci per 50 lb. bag**
Loose leaf of spinach	**8 p/Ci per salad**
Bananas	**4 p/Ci per banana**
Waterborne radioactivity from nuclear power plants	**0.6 p/Ci per year**

Sources:
- KAPL Analysis, 2000
- NCRP Report # 95, Radiation Exposure from Consumer Products and Miscellaneous Sources, 1987
- U.S. NRC Report NUREG/CR-2907, Vol. 14, Annual Report 1993

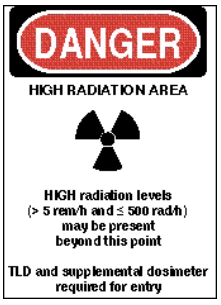
Is a radiation dose of 620 millirem (or 0.62 Rem) in a year harmful?

No. No effects have ever been observed at doses below 5,000 millirem (5 Rem) delivered over a one-year period. In fact, effects seen when humans are exposed to 100,000 millirem (100 rem) over a short time period are temporary and reversible. It takes a short-term dose of well over 500,000 millirem (500 rem) to cause a fatality.

Radiation Signs and Symbols

The symbol above is called a tri-foil and it is the international symbol for radiation. The symbol can be magenta or black, on a yellow background. This sign is posted where radioactive materials are handled, where radiation-producing equipment is used, or where a radiation exposure is possible. This sign is used as a warning to protect people from being exposed to radioactivity or contaminated by radioactive material.

Some examples of signs using this tri-foil symbol are shown below. You might see the radiation symbol in a hospital where radioactive medicine is used, or in a university, or research facility. In a radiation incident, the signs would be posted where radioactive materials have been found and a site clean-up is taking place.



How do I minimize my radiation exposure?

There are key three components to consider in minimizing your radiation exposure. They are time, distance and shielding.

Time: By limiting the amount of time you spend near the radiation source you can reduce the amount of

radiation exposure that you will receive.

Distance: The greater the distance between you and the radiation source, the less radiation exposure you will receive.

Shielding: The more heavy and denser the material between you and the source of the radiation the better. The shielding will block much of the radiation from reaching you.

This page intentionally left blank.

DHEC: Radiation and Health Issues

Contamination vs. Exposure

What is radioactive contamination?

Radioactive contamination is when a person or object has radioactive material either internally or externally. Radioactive materials released into the environment can cause air, water, surfaces, soil, plants, buildings, people or animals to become contaminated.

What is external contamination?

External contamination on humans occurs when radioactive material, in the form of dust, powder, or liquid, comes into contact with a person's skin, hair, or clothing (any contact outside of the body).

What is internal contamination?

Internal contamination occurs when people swallow or breathe in radioactive materials or when these materials enter the body through an open wound or are absorbed through the skin (anything introduced into the body). Some types of radioactive materials stay in the body and are deposited in different body organs. Other types are eliminated from the body in blood, sweat, urine and feces.

What is radiation exposure?

When a person is exposed to some types of ionizing radiation the energy can penetrate the body. For example, when a person has an x-ray, they are exposed to radiation.

How can an exposure occur?

People are exposed to small amounts of radiation every day. This radiation comes from both naturally occurring sources and man-made sources.

What types of exposure occur?

Exposures can be either internal or external. Internal exposures occur when radioactive material is taken into the body through breathing, eating, drinking, absorption through the skin, or through cuts in the skin. External exposure refers to radioactive material that is deposited anywhere 8(except internally) that it is not supposed to be, such as on an object or on a person's skin.

How does contamination differ from exposure?

A person can be exposed to radiation and not become contaminated. Take an x-ray for example. An x-ray exposes parts of the body to radiation so that an internal picture can be taken – so that we can know what is going on inside. While an x-ray exposes you to radiation, there is nothing "left over" on the surface of the skin or body after the x-ray is over.

Contamination means you've come in direct contact with something radioactive and part of that radiation is left on you or your skin or clothing. The contamination can be removed, through washing (also known as decontamination), but until it does anything you have touched – with that contaminated body part – will get some on that contamination on it. It is similar to touching wet paint and then touching another surface. You will carry some of that wet paint with you to the next surface. The paint will stay on you and those surfaces

until it is removed.

Radioactive contamination emits radiation. If a person is contaminated, they will continue to be exposed to radiation until the contamination is removed.

How is radioactive contamination spread?

People who are externally contaminated with radioactive material can contaminate other people or surfaces that they touch. People who are internally contaminated can expose people near them to radiation from the radioactive material inside their bodies. The body fluids (blood, sweat, urine) of an internally contaminated person can contain radioactive materials. Coming in contact with these body fluids can result in contamination and/or exposure (through contact with contaminated urine or feces).

How could your home become contaminated?

People who are externally contaminated can spread the contamination by touching other surfaces, sitting in a chair, or even walking through a house. Homes can also become contaminated with radioactive materials in body fluids from internally contaminated people.

How can exposure or contamination happen?

Man-made radioactive materials could be released into the environment in the following ways:

- An accidental release from a medical or industrial device.
- A nuclear power plant accident.
- An atomic bomb explosion.
- Nuclear weapons testing.
- An intentional release of radioactive material as an act or terrorism.

How is radioactive material contamination cleaned up?

Techniques include sandblasting buildings to remove the layers of contamination and removing the layers of contaminated soil and trucking it away to a radioactive waste disposal site. **We cannot completely eliminate radioactivity**. We can only transfer radioactivity from one place to another. Then we must wait until the radioactive materials decay.

How can I limit the chances of becoming contaminated?

When safe, or directed to do so, get out of the immediate area of the radiation incident. Go inside the nearest safe building or to the area to health officials or emergency management officials direct you.

Remove the outer layer of your clothing. If radioactive material is on your clothes, getting it away from you will reduce the external contamination and decrease the risk of internal contamination. It will also reduce the length of time that you are exposed to radiation.

Place the clothing in a plastic bag or leave it in an out-of-the-way area. Keep people away from it to reduce their exposure to radiation. Keep cuts and abrasions covered when handling contaminated items to avoid getting radioactive material in them.

Wash all of the exposed parts of your body using lots of soap and water to remove contamination.

If medical authorities determine that internal contamination may have occurred, you may be able to take medication to reduce the radioactive material in your body.

Be on the lookout for information. Once health officials assess the scene and the damage, they will be able to tell people whether or not radiation was involved in the incident.

Health Effects of Exposure

What happens when people are exposed to radiation?

Radiation can affect the body in many ways and the health effects may not be apparent for many years. These effects include mild symptoms, such as skin reddening, to serious effects such as cancer and death. These effects are dependent upon the amount of radiation absorbed by the body (the dose), the type of radiation, whether or not the exposure was internal or external and the length of time the person was exposed. Any living tissue in the human body can be damaged by ionizing radiation. The body attempts to repair the damage, but sometimes the damage is too severe or widespread. Mistakes can also be made in the body's natural repair process as it tries to repair the damage caused by the radiation. These mistakes are referred to as mutations.

What is prenatal radiation exposure?

It is the exposure of an unborn baby to radiation. This can occur when the mother's abdomen is exposed to radiation, either externally or internally. Also, radioactive materials may enter the mother's bloodstream if a pregnant woman accidentally swallows or breathes in radioactive materials. From the mother's blood, radioactive materials may pass through the umbilical cord to the baby.

Unborn babies are less sensitive during some stages of pregnancy than others. However, unborn babies are particularly sensitive to radiation during their early development, between the second and fifteenth weeks of pregnancy. The health consequences can be severe, even if radiation doses are too low to make the mother sick. Such consequences can include stunted growth, deformities, abnormal brain function, or cancer that may develop sometime later in life. The radiation dose to the unborn baby is usually lower than the dose to the mother for most radiation exposure events.

Pregnant women should consult with their doctors if they have any concern about radiation exposure to their unborn baby.

What are the risks of other long-term health effects?

There is the possibility of mutations in fetuses and genetic effects in children and adults.

What are the possible genetic effects due to radiation exposure?

Genetic effects are mutations that can be passed from parent to child or mutations that occur in the person exposed. They can include: stunted growth, small head/brain size, developmental concerns and childhood cancers.

How are radiation exposure victims medically treated?

Treatment of a victim, within the first six-weeks to two-months after exposure, is vital. Only once the type of radioactive material is determined, the material to which the victim was exposed, can the treatment take place. Treatment always depends on the type of material, on the way in which the victim was exposed or contaminated

and on the length of time the victim was exposed to the material.

There is no "one-size-fits-all" treatment for all exposures to radiation. Medical personnel will treat victims for physical injuries first (such as cuts, broken bones, trauma, hemorrhage and shock, etc.). Open wounds are usually cleaned to remove any bits of radioactive materials that may be in them. Amputation of limbs may occur if a wound is highly contaminated and recovery of its function is not likely.

If radioactive material is ingested, treatment is given to reduce absorption into the body and enhance body's natural elimination processes (excretion and elimination). It can include stomach pumping or giving the victim laxatives or aluminum antacids.

If radioactive material has gotten into internal organs and/or tissues, treatment includes giving the patient blocking and diluting agents, such as Potassium Iodide, to decrease absorption into the body. Other chemicals such as ammonium chloride, diuretics, expectorants and inhalants are given to a patient to force the body to release the harmful radioactive materials. Other treatments involve chelating agents, which, when ingested, bind with some radioactive metals to form a stable material that is more easily removed from the body through the kidneys.

In the event you suspect you have been exposed to radiation, **DO NOT ATTEMPT TO TREAT YOURSELF**. See a doctor immediately.

Is any amount of radiation safe?

Some scientists believe that low levels of radiation are beneficial to health (known as hormesis). However, there do appear to be thresholds of exposures for various health effects, for example:

- Up to **100 Rem**, there remains little to no lasting effect.
- At **50 Rem** nausea may occur, but there are no lasting effects.
- At **70 Rem** vomiting may occurs, but again there are few, if any, lasting effects.
- Between **300-to-500 Rem**, radiation sickness can occur.
- **Mild symptoms** include: fatigue, loss of appetite, severe nausea, vomiting and fever.
- **Severe symptoms** include: fatigue, loss of appetite, severe nausea, vomiting, fever, diarrhea, inflamed mouth and throat and hair loss.
- At **600 Rem, or higher,** death occurs.

* Examples are based on adult exposure. Children, the elderly and those with compromised immune systems, are more susceptible to excessive radiation exposure and may show more serious symptoms at lower levels of exposure.

What is radiation sickness?

Radiation sickness, known as acute radiation syndrome (ARS), is a serious illness that occurs when the entire body (or most of it) receives a high dose of radiation, usually over a short period of time.

People exposed to radiation will get ARS only if:

- The radiation dose was high.
- The radiation was able to reach internal organs.
- The person's entire body (or most of it) received the dose.
- The radiation was received in a short time, usually within minutes.

The first symptoms of ARS typically are nausea, vomiting and diarrhea. These symptoms will start within minutes to days after the exposure. The symptoms may come and go. The person usually looks and feels healthy for a short time, after which he or she will become sick again with loss of appetite, fatigue, fever, nausea, vomiting, diarrhea and possibly even seizures and coma. This stage may last from a few hours up to several months.

People with ARS usually have some skin damage that can start to show within a few hours after exposure. This damage can include swelling, itching and redness of the skin (like a bad sunburn). There can also be hair loss, nausea and diarrhea. As with the other symptoms, the skin may heal for a short time, followed by the return of swelling, itching and redness days or weeks later. Complete healing of the skin may take from several weeks to a few years depending on the radiation dose to the skin.

The chance of survival for people with ARS decreases with increasing radiation doses. Most people who do not recover from ARS will die within several months of exposure. The cause of death in most cases is the destruction of the person's bone marrow, which results in infections and internal bleeding. For the survivors of higher doses, the recovery process may last from several weeks to two years.

If a radiation emergency occurs that exposes people to high doses of radiation in a short period of time, they should immediately seek medical care from their doctor or local hospital.

How do we know radiation causes cancer?

We have learned through observation. Scientists didn't understand that there were any health effects associated with radioactive materials when people first began working with them. As the use of radioactive materials and reports of illnesses became more frequent, scientists noticed a pattern to the illnesses. People working with radioactive materials and x-rays developed particular types of uncommon medical conditions. Among the best-known long-term studies are those of Japanese atomic bomb blast survivors, other populations exposed to nuclear testing fallout (natives of the Marshall Islands for example) and Uranium miners.

Aren't children more sensitive to radiation than adults?

Yes, because children are growing more rapidly, there are more cells dividing and a greater opportunity for radiation to disrupt the process. Fetuses, depending on their stage of development, can also be highly sensitive to radiation.

What are the possible health effects that an unborn baby could experience when exposed to ionizing radiation?

During the first two weeks of pregnancy, the radiation-related health effect of greatest concern is the death of the baby. Of the babies that survive, some will have birth defects related to the exposure, regardless of how much radiation they were exposed to.

Large radiation doses to the unborn baby during the stages of development (between the second and 15^{th} weeks of pregnancy) can cause birth defects, especially to the brain. Babies exposed to the atomic bombs dropped on Hiroshima and Nagasaki during the 8^{th} to 15^{th} week stage of pregnancy were found to have a high rate of brain damage that resulted in lower IQ and even severe mental retardation. They also suffered stunted growth (up to 4% shorter than average people) and an increased risk of other birth defects.

Between the 16^{th} week of pregnancy and birth, health effects due to radiation exposure are unlikely unless the unborn baby receives an extremely large dose of radiation. In the 16^{th} to 25^{th} week of pregnancy, health consequences similar to those seen in the 8^{th} to 15^{th} week could occur, but only when the doses are extremely large (more than the equivalent of about 5,000 chest x-rays received at one time). At this dose level, the mother

could also be showing signs of acute radiation syndrome.

After the 26th week of pregnancy, the radiation sensitivity of the unborn baby is similar to that of a newborn. Unborn babies exposed to radiation during this stage of pregnancy are no more sensitive to the effects of radiation than are newborns. This means that birth defects are not likely to occur and only a slight increase in the risk of having cancer later in life is expected.

Do chemical properties of radioactive materials contribute to radiation health effects?

The chemical properties of a radionuclide can determine where health effects occur. To function properly many organs require certain elements. The organs cannot distinguish between radioactive and non-radioactive forms of the element and the body will try to absorb or accumulate one just as quickly as the other. For example:

- Radioactive Iodine concentrates in the thyroid. The thyroid needs Iodine to function normally. As a result, radioactive Iodine contributes to thyroid cancer more than any other types of cancer.

- Calcium, Strontium-90 and Radium-226 have similar chemical properties. The result is that Strontium and Radium tend to collect in Calcium rich areas of the body, such as the bones and teeth. Therefore, the Strontium-90 and Radium-226 can contribute to bone cancer.

What is the cancer risk from radiation? How does it compare to the risk from other sources?

Currently estimates are that overall, if each person in a group of 10,000 people exposed to one (1) Rem of ionizing radiation, in small doses over a life time, we would expect five or six more people to die of cancer than would otherwise. In this group of 10,000 people, we can expect about 2,000 to die of cancer from all non-radiation causes.

DHEC: How Nuclear Power Plants Work

Basic Information

Nuclear power plants use the heat generated from nuclear fission in a contained environment to convert water to steam. The steam powers generators to produce electricity. Nuclear power plants produce about 20% of the nation's power. Nearly three million Americans live within 10 miles of an operating nuclear power plant.

Nuclear power plants are similar in operation to fossil plants. The difference is the fuel. In a nuclear power plant, Uranium – a naturally occurring ore that is enriched through a man-made process – is used. Steam is generated through fission instead of burning oil, gas or coal. Nuclear power plants do not burn any fuel, so there are no pollutants released into the air. The process works like this:

Description

Stage 1: Tiny parts of the Uranium, known as atoms, are made to split, a process called "fission".

Stage 2: During fission, even smaller particles of the atom, called neutrons, are released at high rates of speed.

Stage 3: The neutrons strike more Uranium atoms, resulting in the release of heat needed to generate electricity.

The United States Nuclear Regulatory Commission (USNRC or NRC) regulates commercial nuclear power plants that generate electricity. There are several types of these power reactors. Only the Pressurized Water Reactors (PWRs) and Boiling Water Reactors (BWRs) are in commercial operation in the United States. Currently, nuclear power plants generate about 20% of the country's electric power use.

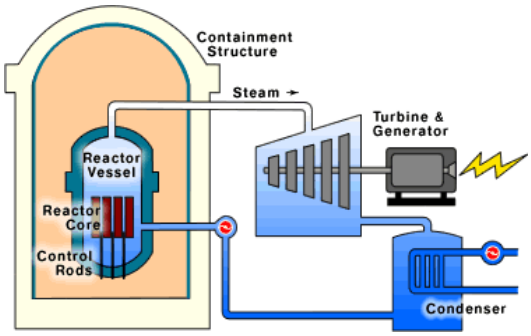
Although the construction and operation of these facilities are closely monitored and regulated by the USNRC, accidents are possible. An accident could result in high levels of radiation that could affect the health and safety of the public living near the nuclear power plant.

Types of Nuclear Power Plants

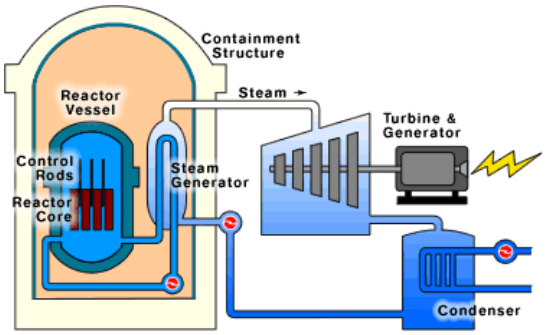
There are two types of nuclear power reactors: Boiling Water Reactors and Pressurized Water Reactors. In total, the state of South Carolina is home to seven reactors; two are located at the Catawba Nuclear Station, one is located at the Robinson Nuclear Plant, three are located at the Oconee Nuclear Station and one is located at the V. C. Summer Nuclear Station. All seven reactors are Pressurized Water Reactors (PWRs).

The Vogtle Electric Generating Plant is home to two additional pressurized water reactors.

Boiling Water Reactors (BWRs) boil water so that it is converted to steam. The steam drives a turbine connected to a generator before being recycled back into water by a condenser and used again in the heat process.



Pressurized Water Reactors (PWRs) keep water under pressure so that it heats up but does not boil. Water from the reactor and water in the steam generator never mix. All seven reactors in operation in South Carolina are Pressurized Water Reactors.



For more information:

USNRC Nuclear Power Reactors http://www.nrc.gov/reactors/power.html
USNRC Boiling Water Reactors http://www.nrc.gov/reactors/bwrs.html
USNRC Pressurized Water Reactors http://www.nrc.gov/reactors/pwrs.html

DHEC: Potassium Iodide (KI)

Basic Information

Potassium Iodide (KI) is a dry salt-like tablet. Its chemical symbol is KI, which represents a compound of Potassium (K) and Iodine (I). Iodine is used by the thyroid gland to produce hormones. Iodine normally enters the bloodstream from the food we eat. The thyroid is designed to absorb and store Iodine.

KI is also added to table salt ("iodized salt") to provide a source of dietary Iodine.

The U.S. Food and Drug Administration (FDA) classifies KI as a nonprescription drug, approved for over-the-counter sale, as a safe and effective method to protect the thyroid gland from radioactive Iodine (radioiodine).

In the event of a radiation emergency or accident that involves a release of radioactive Iodine, KI may be used to help prevent the risk of thyroid cancer. Local and state officials may ask citizens to evacuate or shelter-in-place as the primary public safety measure and use. Potassium Iodide (KI) tablets as a **supplemental** protective measure in addition to evacuation or shelter-in-place).

Frequently Asked Questions and Answers about KI

What is KI?

Potassium Iodide (KI) is available in tablet form for purchase over the counter, without a prescription. If taken when needed at the appropriate time and dosage, KI protects the thyroid gland from radioactive Iodine and can reduce the risk of thyroid cancer after a severe nuclear emergency event resulting in a release of radioactive Iodine.

KI IS NOT AN "ANTI-RADIATION" TABLET.

Taking KI is only an additional protective measure, secondary to evacuation or sheltering in place and it is only effective in protecting the thyroid gland. **Evacuation and sheltering-in- place remain the primary protective actions during a radiological emergency.**

What does KI do?

In the event of a threatened or actual nuclear power plant release, **evacuation remains the best course of action for protecting your health**. KI works as a "thyroid-blocking agent" by replacing radioactive Iodine with stable Iodine. The radioactive Iodine would pass through the body harmlessly rather than being absorbed. KI must be taken shortly before or shortly after exposure to radioactive Iodine, to protect the thyroid from being damaged by radioactive Iodine.

KI does not provide protection from full body exposure to radiation, nor does it protect the body from other radioactive elements that may result from a nuclear power plant release or other radiological emergencies. An actual nuclear release may contain other types of radiation.

What is the benefit of taking KI during a radiological emergency?

Radioiodines (or radioactive iodines) are one of the potential by-products of nuclear fission or nuclear power plant operations. An accident involving a nuclear reactor or nuclear weapon could result in a release of potentially harmful amounts of radioactive Iodine into the environment. Inhalation of (breathing in) radioiodine,

or ingestion through (eating or consuming) contaminated food or milk increases the radiation dose to the thyroid gland and to the rest of the body.

Taking KI is a method of blocking the thyroid's absorption of radioiodine. KI provides stable Iodine that saturates the bloodstream. If an appropriate dose of KI is taken before exposure, or shortly after exposure, to radioactive Iodine absorption of radioiodine from the bloodstream will be limited and the risk of thyroid effects will be reduced.

Who can take KI?

Most people can take Potassium Iodide (KI) safely. A small number of people could have an adverse reaction. **Anyone with an existing thyroid gland condition or anyone allergic to Iodine or shellfish should NOT take KI without consulting a physician.** Consult your physician if unsure whether you should take KI.

Recommended Doses of KI

Age Group	KI Dosage	Number of 130mg Tablets	Number of 65mg Tablets
Adults and Adolescents* (Over 150 lbs.)	**130**mg	**1 tablet** ●	**2 tablets** ●●
Children 3-18 yrs (Under 150 lbs.)**	**65**mg	**½ tablet** ◖	**1 tablet** ●
Infants (1 month – 3 yrs)**	**32**mg	**¼ tablet** ◢ **Liquid form preferred**	**½ tablet** ◖
Infants (Birth – 1 month)	**16**mg	**⅛ tablet** ◥ **Liquid form preferred**	**¼ tablet** ◢ **Liquid form preferred**

* Adolescents approaching adult size (150 pounds) should receive the adult dose (130mg).

** KI tablets may be crushed to form a powder. Powdered KI or liquid KI may be mixed in milk, water, formula, or soft foods.

What are the common side effects of taking KI?

Side effects usually happen when people take more doses than advised. Possible minor side effects are skin rashes, swelling of the salivary glands, metallic taste, burning mouth, sore teeth/gums, stomach upset, diarrhea, or headaches. Take only the amount indicated on the table (on page 2) for your weight and age group. Do not take KI for longer than is recommended by public health authorities. If you experience side effects or a severe allergic reaction, consult with a physician.

How should KI tablets be stored?

KI tablets come in a sealed foil packet. **DO NOT OPEN THEM UNTIL INSTRUCTED TO TAKE THEM BY A PUBLIC HEALTH OFFICIAL.** Keep the sealed tablets in a cool, dry, safe place that is a readily available location in your home. Keep the tablets at room temperature. Keep them out of the reach of children.

KI tablets can be stored in your home for up to approximately five-to-six years. As with any other medication, be sure to regularly check the expiration date and discard any expired tablets.

Do I need a prescription for KI?

KI tablets can be purchased over-the-counter at some local pharmacies without a doctor's prescription.

What are the limitations to taking KI during a radiological emergency?

KI is not a "magic bullet." KI will not provide protection from any type of radiation exposure other than radioactive Iodine.

KI should not be taken simply because there is a public notification of a radiation emergency. DHEC public health officials will advise the public when it is appropriate to consume the drug; based on whether radioactive Iodine is being released.

Taking KI is ***not*** a substitute for evacuation or sheltering in place when state and local authorities recommend those actions. The most effective means of preventing unnecessary exposure is to follow the emergency recommendations broadcast by local officials.

What is South Carolina's KI policy?

The State of South Carolina Department of Health and Environmental Control has taken advantage of an offer made by the U.S. Nuclear Regulatory Commission (USNRC or NRC) to receive a supply of Potassium Iodide (KI) tablets for free distribution to South Carolina residents living and or working within a 10-mile radius of the five (5) Nuclear Power Plant sites that affect areas near South Carolina residents.

Those counties include: Aiken, Allendale, Barnwell, Chesterfield, Darlington, Fairfield, Lee, Lexington, Newberry, Oconee, Pickens, Richland and York.

DHEC public health officials have stockpiled KI tablets in strategic locations for distribution to the general public. These locations are in close proximity to each of the state's nuclear power plants and would be used in the event of a radiological emergency where there is a risk of exposure to radioiodine. Individuals living or working within the 10-mile EPZ can receive a two-day supply of tablets to store in a convenient place. If a nuclear disaster occurs and a decision is made to distribute KI because of the event, distribution will occur at pre-designated shelters and reception centers that are located outside of the evacuated areas as part of local plans for nuclear power plant emergencies.

Residents and community members will be aided in evacuating contaminated areas through detailed emergency evacuation plans (such as lane reversals, etc.). Strategically stockpiling KI allows emergency officials the greatest flexibility in distributing it to the populations at greatest risk of exposure to radioiodine. In the case of a radiological emergency, the locations of the centers can be found in the annual emergency calendars distributed to residents living and working in the 10-mile EPZ.

In the event of such an emergency, the public should listen to and follow all emergency alert messages where all protective action recommendations will be communicated.

When should KI be taken?

IN THE EVENT OF A NUCLEAR EMERGENCY, POTASSIUM IODIDE (KI) SHOULD ONLY BE TAKEN AFTER SPECIFIC INSTRUCTIONS TO DO SO BY A STATE PUBLIC HEALTH OFFICIAL.

KI is most effective if taken within a few hours before, during, or immediately after inhalation or ingestion exposure to radioactive Iodine. If taken about four hours after exposure, its effectiveness is diminished to about 50%.

Is KI safe?

KI is considered safe for most people but can cause minor side effects such as gastrointestinal disturbances (nausea, diarrhea, etc.) and rashes. Those who are allergic to Iodine or shellfish should not take KI. Anyone who is not sure if they can take KI should talk to their doctor in advance of a nuclear emergency. **Do not take KI unless and until, public health officials tell you to do so.**

Will KI protect me? What should I do if there is a radiological incident?

In the event of a threatened or actual nuclear power plant release, evacuation remains the best course of action for protecting your health. **KI is not a replacement for evacuation or other protective action orders.**

When would I need to take KI?

If KI is recommended because of a possible radiation release from the power plant, county emergency alert systems will instruct people in the threatened areas to take KI. When the emergency sirens sound, you should turn to an emergency radio station. You and your family will be told how and when to take KI. Remember that when possible evacuation, before any release, is the best protective action in a radiation emergency. However, if evacuation is not feasible or proper, you and your family will be instructed how and where to shelter safely. Be sure to take only the amount indicated on the table below and do not take it for longer than you are told.

How soon after a nuclear emergency should KI be taken?

KI should be taken as soon as possible **after** public health officials tell you to do so. The effectiveness of KI as a thyroid-blocking agent depends on when it is consumed. Ideally, it should be taken no more than four hours *before* exposure occurs so there is time for the drug to be absorbed into the bloodstream. The drug's effectiveness is diminished once radioiodine has been ingested (eaten) or inhaled (breathed in), but significant benefits are obtained even if KI is taken several hours after radioiodine exposure occurs.

You should take one dose per day. Taking more will not help you because the thyroid can only "hold" or process small amounts of Iodine. When ordered to do so, make sure to take only the appropriate recommended dose. Taking more than the recommended doses will not increase the tablet's effectiveness and may increase the risk of side effects.

KI should ***not*** be taken simply because there is a public notification of a radiological emergency. State and local authorities will advise the public when it is appropriate to consume the drug based on whether a radioiodine hazard exists.

Do not substitute other sources of Iodine (such as Iodine tablets for water purification, etc.) for KI. These products contain a different form of Iodine that can be poisonous if misused.

Those who have a known allergy to Iodine, such as those who must avoid certain seafood and other foods with high natural Iodine content, should *not* consume KI. Severe allergic reactions could result. Those suffering certain thyroid disorders or taking thyroid medications, as well as pregnant women, nursing mothers and individuals taking certain heart medications or antipsychotic drugs should consult their doctors before deciding to use KI.

Those who consume KI, particularly for prolonged periods or in larger than recommended doses, may encounter side effects. Side effects may include: skin rashes, swollen neck glands, stomach upset, or diarrhea. More serious allergic reactions may produce fever, joint pain, facial swelling or shortness of breath. Should any adverse reaction occur, stop taking the drug and seek immediate medical attention.

As with any medication, you should consult your doctor to determine if KI is safe for you. Keep KI and all drugs out of the ready reach of children.

Do I have to take KI? Is it mandatory?

No. Anyone taking KI would do so on a volunteer basis. No one is required to accept it or use it.

How do I know how much to take and to give to my children?

Your family or your office will be provided a two-day supply of tablets for each person (family member or worker); living or working within the 10-mile Emergency Planning Zone. Use the table (on page 2) to determine the daily dose for each person in the family. Use a sharp knife, or a pill-cutter, to break the tablets for small children. Children might be more willing to take KI if it is crushed and put in some food or drink they like.

Can everyone take KI?

People who are allergic to Iodine should NOT take KI. If you are allergic to shellfish or have certain thyroid conditions then you should talk with your doctor first.

If you are taking medicine for thyroid problems and you have questions about using KI, talk with your doctor before obtaining the KI tablets. Do not take KI if you have the rare disorders of dermatitis herpetiformis or hypocomplementemic vasculitis.

Women who are pregnant or breast-feeding can take KI but should have their thyroid function monitored after the first dose is taken. KI can also be given safely in the doses recommended to babies and children.

Doesn't my doctor have to determine whether I take the KI tablet?

As with any medication, you should discuss this with your physician. KI is used in small amounts in iodized salt. The FDA has determined that most people can safely take KI at the doses listed in the table shown on the previous page.

What if I am allergic to Iodine?

If you are allergic to Iodine, or if you have either of two rare disorders associated with allergy to Iodine (dermatitis herpetiformis and hypocomplementemic vasculitis), you should not take KI.

What if I am pregnant?

Pregnant women and newborns should not receive more than one dose of KI before being checked by a doctor to make sure thyroid function remains normal. Monitoring should take place as soon as possible.

I have a chronic medical condition, cancer or am receiving chemotherapy, should I take KI?

Those persons with -any- chronic illnesses should check with their physician before deciding to take any medications other than what is ordered by their doctor.

I am on a low salt diet. Will it hurt me to take it?

Potassium Iodine does not contain sodium. A low salt diet is used to reduce the amount of sodium.

How will I know when to take KI?

In the event of a release of radioactive material from a nuclear power plant, you will be advised through the Emergency Alert System and the media (radio and TV) of the protective actions you should be taking. These instructions could include: evacuate the area, shelter-in-place (stay inside, turn off all machines and/or close all vents that pull air in from the outside), take KI and/or other possible protective actions. Any recommendation to take KI will be made by public health officials. ***Do not take KI before you are advised to do so by public health officials.***

Where do I go to get my supply of KI to keep on-hand for a radiological emergency?

In non-emergency (day-to-day) instances – people, who live or work within the designated 10- mile Emergency Planning Zones (EPZs) of each nuclear power plant, can visit their local DHEC Public Health Department. Those residents will receive a two-day supply for each member of their family to keep on-hand in the event of a nuclear incident.

Reminder: **DO NOT TAKE THE KI WHEN YOU RECEIVE IT**. The tablets should be stored in a cool, dry area and not consumed until, or unless, residents are advised to take them.

In emergency situations, the KI stored at each DHEC public health department will be taken from the DHEC Public Health Departments and moved to the shelters and relocation centers. **In an emergency, do not attempt to go to your DHEC county public health departments to obtain KI**. Those supplies of KI will be transferred to the pre-designated shelter and reception areas for distribution.

Why am I not getting KI? I live 12 miles from the site. Who determined only those living within 10-miles of the nuclear power plants get KI free?

The state has been supplied KI for those living and working within the 10-mile Emergency Planning Zones (EPZs) of the five (5) Nuclear Power Plant sites that affect South Carolina residents. This KI was provided through a grant from the United States Nuclear Regulatory Commission (USNRC or NRC) specifically for residents living within the 10-mile EPZs.

These tablets can be re-distributed throughout the state, as needed, in the event of a nuclear disaster involving the release of radioiodines (radioactive Iodine). If you live outside of the 10- mile EPZ and wish to obtain KI, you can purchase it without a prescription at most local pharmacies or local drugstores. If the tablets are not sold there you can request the store order some tablets for you to purchase. Most drugstores can accommodate this request.

If I can't find my KI when the event occurs, where should I go to get it?

If a nuclear incident occurs, your first concern should be to follow the additional emergency orders (such as shelter-in-place or evacuation). If you don't have your KI on-hand, you will be able to get it at shelters and relocation centers upon evacuation if it is being recommended.

How long is KI good? Where should I keep it so that it will still be safe to take?

KI has a shelf life of approximately five-to-seven years. It should not be kept in the car, the bathroom or kitchen due to the changing temperatures and humidity levels, since all drugs react to intense heat and cold. You do not

need to keep it refrigerated. It **is** important to keep it somewhere it will not get wet. Water, or liquid, can dilute the medication if it were to come in contact with the tablet itself.

Is there an alternative to taking KI tablets?

The absolute best protection is to not get exposed to unnecessary radiation. The primary and most effective protective actions are evacuation and sheltering. KI is a **supplemental** action that should only be taken when warranted. If advised by DHEC public health officials to evacuate or shelter, this should be done immediately.

Should my animals take KI?

KI will NOT be distributed to animals. The state KI stockpile is intended for humans only. KI is not considered harmful to pets if ingested but may not have the same protection for them that it has for humans. If you are concerned about what to do to protect your pets, check with your veterinarian.

What age group has the highest risk from exposure to radioactive Iodine?

Young children and infants have the highest risk.

Does KI work in all radiation emergencies?

KI will only protect you from radioactive Iodine. It does not protect you from other kinds of radioactive material.

If KI has been stored for a while, is it still OK to use?

If you keep it in a dry, dark and cool place, it should last for many years. Refer to the printed expiration date on the foil package or consult public health officials if you have any questions.

Can KI be purchased at local pharmacies?

Yes, though it may not widely available in drugstores near you. If you live within 10-miles of a nuclear power plant you can pick up a two-day supply of KI at the 13 DHEC Public Health Departments that provide it. DHEC Public Health Department offices are open between 8:30 a.m. and 5:00 p.m. – Monday through Friday.

Where can I get more information?

The following links provide additional information on KI:

Federal Emergency Management Agency (FEMA):
"Federal Policy on the Use of Potassium Iodide"
https://www.fda.gov/Drugs/EmergencyPreparedness/BioterrorismandDrugPreparedness/ucm072265.htm#What%20potassium

Health Physics Society: "HPS Fact Sheet – Potassium Iodide" http://hps.org/documents/kifactsheetdetail.pdf

Health Physics Society:
"Is Potassium Iodide a "Magic Bullet" for Radiation Exposure?"
https://hps.org/publicinformation/ate/faqs/ki.html

U.S. Food and Drug Administration:
Frequently Asked Questions on Potassium Iodide (KI)
https://www.fda.gov/Drugs/EmergencyPreparedness/BioterrorismandDrugPreparedness/ucm072265.htm#What%20potassium

U.S. Centers for Disease Control and Prevention: Emergency Preparedness and Response – Potassium Iodide
https://emergency.cdc.gov/radiation/ki.asp

U.S. Nuclear Regulatory Commission:
"Consideration of Potassium Iodide in Emergency Planning"
https://www.nrc.gov/about-nrc/emerg-preparedness/about-emerg-preparedness/potassium-iodide.html

U.S. Nuclear Regulatory Commission:
"Frequently Asked Questions About Potassium Iodide"
https://www.nrc.gov/about-nrc/emerg-preparedness/about-emerg-preparedness/potassium-iodide/ki-faq.html

DHEC: Nuclear Accidents and/or Emergencies

Background

Nuclear power plants use the heat generated from nuclear fission in a contained environment to convert water to steam, which powers generators to produce electricity. Nuclear power plants produce about 20 percent of the nation's power. Nearly three million Americans live within 10 miles of an operating nuclear power plant.

Although the construction and operation of these facilities are closely monitored and regulated by the U.S. Nuclear Regulatory Commission (USNRC or NRC), accidents are possible. An accident could result in dangerous levels of radiation that could affect the health and safety of the public living near the nuclear power plant.

Local and state governments, federal agencies and the electric utilities have emergency response plans in the event of a nuclear power plant incident. The plans define two "emergency planning zones." One zone covers an area within a 10-mile radius of the plant, where it is possible that people could be harmed by direct radiation exposure. The second zone covers a broader area, usually up to a 50-mile radius from the plant; where radioactive materials could contaminate water supplies, food crops and livestock.

The potential danger from an accident at a nuclear power plant is exposure to radiation. This exposure could come from the release of radioactive material from the plant into the environment; usually characterized by a plume (cloud-like formation) of radioactive gases and particles. The major hazards to people in the vicinity of the plume are radiation exposure to the body from the cloud and particles deposited on the ground, inhalation of radioactive materials and ingestion of radioactive materials. Although the risk of an accident is slight, knowing how to handle these products and how to react during an emergency can reduce the risk of injury.

If an accident at a nuclear power plant were to release radiation in your area, local authorities would activate warning sirens or another approved alert method. They also would instruct you through the Emergency Alert System (EAS) on local television and radio stations on how to protect yourself.

Know the Terms

First, familiarize yourself with these terms to help identify a nuclear power plant emergency:

Notification of Unusual Event
A small problem has occurred at the plant. No radiation leak is expected. No action on your part will be necessary.

Alert
A small problem has occurred and small amounts of radiation could leak inside the plant. This will not affect you and no action is required.

Site Area Emergency
Area sirens may be sounded. Listen to your radio or television for safety information.

General Emergency
Radiation could leak outside the plant and off the plant site. The sirens will sound. Tune to your local radio or television station for reports. Be prepared to follow instructions promptly.

What is radiation?

Radiation is a form of energy that is present all around us.

Different types of radiation exist; some of which have more energy than others.

How can exposure occur?

People are exposed to tiny amounts of radiation every day, both from naturally occurring sources (such as elements in the soil or cosmic rays from the sun) and man-made sources. Man-made sources include some electronic equipment (such as microwave ovens and television sets), medical sources (such as x-rays, certain diagnostic tests and treatments) and from nuclear weapons testing.

The amount of radiation from natural or man-made sources to which people are exposed is usually very small; different types of radiation emergencies (such as a nuclear power plant accident or a terrorist event) could expose people to different doses of radiation, depending on the situation.

Scientists estimate that the average person in the United States receives a dose of about one-third (2/3) of a rem, or about 620 millirem, per year. About 50% of human exposure comes from natural sources and the remaining 49% comes from man-made radiation sources mainly medical x-rays.

Internal exposure refers to radioactive material that is taken into the body through breathing, eating or drinking.

External exposure refers to an exposure to a radioactive source outside of our bodies.

Contamination refers to particles of radioactive material that are deposited anywhere that they are not supposed to be; such as on an object or on a person's skin.

What happens when people are exposed to radiation?

Radiation can affect the body in a number of ways and the adverse health effects of exposure may not be apparent for many years.

These adverse health effects can range from mild effects, such as skin reddening, to serious effects such as cancer and death; depending on the amount of radiation absorbed by the body (the dose), the type of radiation, the means of exposure and the length of time a person was exposed.

Exposure to very large doses of radiation may cause death within a few days or months.

Exposure to lower doses of radiation may lead to an increased risk of developing cancer or other adverse health effects **later in life**.

For more information about radiation, check the following websites:

https://www.epa.gov/radiation

https://orise.orau.gov/reacts/

https://orise.orau.gov/reacts/resources/

https://emergency.cdc.gov/radiation/index.asp

What preparations can I make for a radiation emergency?

You should know that planning for a radiation emergency is similar to planning for hurricanes, earthquakes and other emergencies. Local, State and Federal agencies plan and practice responses to worst-case nuclear incidents just like they plan for hurricanes, earthquakes, dam failures and much more.

Whether you live within the 10-mile EPZ or outside of it, your community should have a plan in place in case of a radiation emergency. Check with community leaders to learn more about the plan and possible evacuation routes.

Check with your child's school, the nursing home of a family member and your employer to see what their plans are for dealing with a radiation emergency.

Develop your own family emergency plan so that every family member knows what to do in the event of a nuclear emergency.

At home, put together an emergency kit that would be appropriate for any emergency. (see last page for possible emergency kit items to consider).

For more information about preparing for a radiation emergency event, check the following websites:

https://www.ready.gov/nuclear-power-plants

https://www.fema.gov/

https://www.fema.gov/media-library/assets/documents/7877

http://www.redcross.org/get-help/how-to-prepare-for-emergencies

How can I protect myself during a radiation emergency?

After a release of radioactive materials, DHEC public health officials will test and monitor the levels of radiation and determine what protective actions to take.

The most appropriate action will depend on the situation. When emergency sirens sound around the plant and Emergency Alert System (EAS) messages go out to the public, you will be directed to tune to local news stations for information and instructions during any emergency.

If a radiation emergency involves the release of large amounts of radioactive materials, you may be advised to "Shelter-In-Place", which means to stay in place at your home or office.

If you are advised to “Shelter-In-Place”; you should do the following:

- Close and lock all doors and windows.
- Turn off fans, air conditioners and forced-air heating units that bring in fresh air from the outside. Only use units to re-circulate air that is already in the building; such as indoor fans.
- Close fireplace dampers.
- If possible, bring pets and animals inside. For more information what to do to protect pets and farm animals and livestock, click here: https://www.clemson.edu/research/safety/radsafety/
- Move everyone to an inner room or basement.
- Keep your radio and/or television tuned to emergency channels or local news to find out what additional actions you will have to take. Information will be sent out via the Emergency Alert System messages as well.

If you are advised to evacuate, follow the directions that your local officials provide and proceed to the nearest available shelter or relocation center. **Even if you plan to stay at a hotel or with friends/family, rather than a shelter, GO TO THE SHELTER OR RELOCATION CENTER FIRST so you can be accounted for and checked and/or monitored for radiation exposure.**

If advised to evacuate, leave the area quickly but in an orderly manner. Do not panic. In addition:

- Take a flashlight, portable radio, batteries, first-aid kit, supply of sealed food and water, hand-operated can opener, essential medicines and cash and credit cards.
- Take pets only if you are using your own vehicle and going to a place you know will accept animals. Emergency vehicles and shelters **may not** accept animals. If evacuating with a pet, take the pet with you to the shelter or relocation center to be checked and monitored for radiation exposure. Then, once cleared, proceed to the place you want to stay (hotel, motel, shelter, with family, with friends, etc.).
- Click here for a list of pet-friendly hotels and motels:
  Official Pet Hotels.com –
  http://www.officialpethotels.com/?source=google#axzz4vbuuq0EZ

For more information about preparing for a radiation emergency event, check the following websites:

https://www.ready.gov/nuclear-power-plants

https://www.fema.gov/

https://www.fema.gov/media-library/assets/documents/7877

http://www.redcross.org/get-help/how-to-prepare-for-emergencies

Should I take Potassium Iodide (KI) during a radiation emergency?

Potassium iodide (KI) should only be taken in a radiation emergency that involves the release of radioactive iodine; such as an accident at a nuclear power plant or the explosion of a nuclear bomb containing radioactive iodine. A "dirty bomb" most likely will not contain radioactive iodine. Public health officials will tell you when to take KI. Do not take it until or unless ordered.

A person who is internally exposed to radioactive iodine may experience thyroid disease or thyroid cancer later in life. Without KI, the thyroid gland could absorb enough radioactive iodine to cause an exposed person to develop cancer or abnormal growths later in life. KI will fill the thyroid gland with a non-radioactive form of iodine, decreasing the amount of harmful radioactive iodine that can be absorbed.

KI only protects the thyroid gland and does not provide protection from any other radiation exposure.

Some people are allergic to iodine and should not take KI. Check with your doctor about any concerns you have about potassium iodide.

For more information about KI, check the following websites:
http://www.scdhec.gov/ki

https://emergency.cdc.gov/radiation/ki.asp

https://www.fda.gov/Drugs/EmergencyPreparedness/BioterrorismandDrugPreparedness/ucm072265.htm

How to Prepare for a Radiation Emergency

What preparations can I make for a radiation emergency?

Check with your community leaders to learn more about your community's plans and evacuation routes for a radiation emergency (they should have one). Check with your child's school, the nursing home of a family member and/or your employer to see what their plans are for dealing with a radiation emergency. Also, you can develop your own family emergency plan so that every family member knows what to do in case of a radiation emergency. At home, put together an emergency kit that would be appropriate for any emergency.

Are local and state agencies in South Carolina prepared for radiation emergencies?

Local and state agencies as well as emergency response personnel (emergency medical technicians, police, firefighters and hospital staff) are constantly being trained and re-trained for radiological responses. South Carolina is considered one of the states leading the nation when it comes to training local and state agencies and it is one of the most prepared states for dealing with radiation emergencies.

Emergency plans are in place. Practice drills are required biennially, every other year, at each Nuclear Power Plant and involve planning for exposure within the 10-mile Emergency Planning Zone. Ingestion pathway exercises, that involve planning for 50-mile Ingestion Planning Zone, are required every eight years.

How do I minimize my radiation exposure?

There are key three components to consider in minimizing your radiation exposure. They are time, distance and shielding.

Time: By limiting the amount of time you spend near the radiation source you can reduce the amount of radiation exposure that you will receive.

Distance: The greater the distance between you and the radiation source; the less radiation exposure you will receive.

Shielding: The more heavy and denser the material between you and the source of the radiation the better. The shielding will block much of the radiation from reaching you. Concrete and lead are examples of shielding.

What are some of the things to consider in developing a family emergency plan?

First, create a family emergency disaster kit and store it somewhere that you will be able to get to it quickly. You may want to consider a smaller individual emergency disaster kit to keep in your car as well.

Then, create a notification plan. List all telephone numbers, as well as e-mail addresses for everyone that you will need to notify in an emergency. Ask an out-of-state friend or relative to serve as the family contact. Make sure everyone in your family knows the name, address and telephone number of the contact person.

Finally, practice and quiz your family about the emergency plan at least once every six months. Also, work together with neighbors and know what specialized equipment they might have, like power generators or expertise such as medical knowledge that might help in a crisis.

How can I get information during a radiation emergency?

Tune to the local news stations, radio stations and listen to the instructions given through the Emergency Alert System; for information and instructions during any emergency. It is very important to visit and monitor – ***only trusted*** – news sources as misinformation from less trustworthy sources could cause your family harm.

The **Emergency Alert System (EAS)** is a national warning system in the United States put into place in 1994, which replaced the Emergency Broadcasting System (EBS). At the state level it is coordinated by the S.C. Emergency Management Division (SCEMD) and the 46 counties in South Carolina. The EAS is designed to allow emergency officials to relay emergency directions to the public.

You may be advised to "Shelter-In-Place" (stay inside your home or office) or you may be advised to evacuate.

Sheltering-In-Place

How do I "Shelter-In-Place" at home?

You should:

- Close and lock all doors and windows.
- Turn off fans, air conditioners and forced-air heating units that bring in fresh air from the outside. Re-circulating air within a home is appropriate but it is key to ensure all intakes of fresh air are closed off.
- If you are told there is a chance an explosion may occur, close the window shades, blinds or curtains.
- Close fireplace dampers.
- If possible, bring pets and other animals inside.
- Move to an inner room or basement.
- Keep your TV or radio tuned to the local news to find out what else you need to do.

How do I "Shelter-In-Place" at work?

You should:

Close the business. If there are customers, clients or visitors in the building; ask them to stay, not leave. When authorities provide directions to shelter-in-place, they want everyone to take those steps immediately, where they are and not drive or walk back outdoors – unless there is a more life-threatening situation occurring (such as a fire inside). Ask employees, customers, clients and visitors to call their emergency contact to let them know where they are and that they are safe.

Turn on call-forwarding or alternative telephone answering systems or services. If the business has voice mail, or an automated attendant, change the recording to say that the business is closed and that staff and visitors are remaining in the building until authorities advise you that it is safe to leave. Close and lock all windows, exterior doors and any other openings to the outside. If you are told there is a danger of an explosion, close the window shades, blinds or curtains. Have employees familiar with your building's mechanical systems turn off all fans, heating and air conditioning systems that draw air in from the outside. Re-circulating air within a home or office is ok but it is key to make sure all intakes of fresh air are closed off.

Gather essential disaster supplies, such as nonperishable food, bottled water, battery-powered radios, first aid supplies, flashlights, batteries, duct tape, plastic sheeting and plastic garbage bags. Pick the interior room(s), with the fewest windows or vents. The room(s) should have adequate space for everyone to be able to sit. Avoid

overcrowding by selecting several rooms if necessary. Large storage closets, utility rooms, pantries, copy and conference rooms without exterior windows will work well. Avoid selecting a room with mechanical equipment like ventilation blowers or pipes, because this equipment may not be able to be sealed from the outdoors. It is ideal to have a hard-wired telephone in the room(s) you select.

Call emergency contacts and have the phone available if you need to report a life-threatening condition. Cellular telephone equipment may be overwhelmed or damaged during an emergency, so have a landline available if possible. Use duct tape and plastic sheeting to seal all cracks around the door(s) and any vents into the room. Bring everyone into the room(s). Shut and lock the door(s). Write down the names of everyone in the room and call your business' designated emergency contact to report who is in the room with you and their relationship to your business (employee, visitor, client, customer, etc.).

Keep listening to the radio or television until you are told all is safe or you are told to evacuate. Local officials may call for evacuation in specific areas at greatest risk in your community.

How will schools and daycares "Shelter-In-Place"?

Contact the local school district or your child's daycare center and ask them for a copy of their emergency plan. Ask how they will communicate with families during a crisis. You can ask if they store adequate food, water and other basic supplies. Find out where they plan to go if they must evacuate. You should also ask about the locations of any pre-designated reunification points (pick-up points where parents can meet back up with children after the children have been evacuated).

> **Note**: Parents should **never** go to the school in the event of an emergency. This could further complicate efforts to safely remove, relocate and care for children at the school. It could also hamper the process of evacuation. Public health and school officials will care for school children until such time as they can be reunited with parents.

An example emergency plan is below:

Close the school. Activate the school's emergency plan. Follow reverse evacuation procedures to bring students, faculty and staff indoors. If there are visitors in the building, provide for their safety. Ask visitors to stay and not leave.

Provide for answering telephone inquiries from concerned parents by having at least one telephone with the school's listed telephone number available in the room selected to provide shelter for the school secretary or person designated to answer these calls; designate several people if needed. This room should also be sealed. There should be a way to communicate among all rooms where people are sheltering-in-place in the school. Ideally, provide for a way to make announcements over the school-wide public address system from the room where the top school official takes shelter.

If children have cell phones, allow them to use them to call a parent or guardian to let them know that they have been asked to remain in school until further notice and that they are safe. If the school has voice mail or an automated attendant, change the recording to indicate that the school is closed, students and staff are remaining in the building until authorities advise that it is safe to leave.

Provide directions to close and lock all windows, exterior doors and any other openings to the outside. If you are told there is danger of explosion, direct that window shades, blinds or curtains be closed. Have employees familiar with your building's mechanical systems turn off all fans, heating and air conditioning systems. Some systems automatically provide for exchange of inside air with outside air; these systems, in particular, need to be turned off, sealed or disabled.

Gather essential disaster supplies, such as nonperishable food, bottled water, battery-powered radios, first aid supplies, flashlights, batteries, duct tape, plastic sheeting and plastic garbage bags. Select interior room(s) above the ground floor, with the fewest windows or vents. The room(s) should have adequate space for everyone to be able to sit in. Avoid overcrowding by selecting several rooms if necessary. Classrooms may be used if there are no windows or the windows are sealed and cannot be opened. Large storage closets, utility rooms, meeting rooms and even a gymnasium or secure hallways without exterior windows will also work.

It is ideal to have a hard-wired telephone in the room(s) you select. Call emergency contacts and have the phone available if you need to report a life-threatening condition. Cellular telephone equipment may be overwhelmed or damaged during an emergency. Bring everyone into the room. Shut and lock the door. Use duct tape and plastic sheeting to seal all cracks around the door(s) and any vents into the room. Write down the names of everyone in the room and call your schools' designated emergency contact to report whomever is in the room with you.

Listen for an official announcement from school officials via the public address system and stay where you are until you are told all is safe or you are told to evacuate. Local officials may call for evacuation in specific areas at greatest risk in your community.

How do I "Shelter-In-Place" in my vehicle?

If you are driving a vehicle and hear advice to "shelter-in-place" on the radio, go immediately to the nearest home, office, or public building and go inside. Try not to travel more than five to ten minutes to find shelter. Do not head in the direction of the affected area. Follow the shelter-in-place recommendations for the place you pick (as described above).

If you are unable to get to a home or building quickly and safely; then pull over to the side of the road. Stop your vehicle in a safe, shaded place. Turn off the engine. Close windows and vents. Listen to the radio regularly for updated advice and instructions. Stay where you are until you are told it is safe to get back on the road. Be aware that some roads may be closed or traffic detoured. Follow the directions of law enforcement and emergency officials.

How do I prepare a shelter in my home?

As in the case of a tornado, the safest place in your home – during an emergency involving the release of radioactive materials – is a centrally located room or basement. This area should have as few windows as possible. The further your shelter is from windows, the safer you will be. Sheltering is up to 80% effective in reducing exposure to radiation (depending upon the building design). The thicker the walls and more airtight the design, the safe the structure will be.

Store emergency supplies in this area. Every six months check the supplies in your shelter. Replace any expired medication, food or batteries. Also replace the water in your shelter every six months to keep it fresh. Make sure that all family members know where the shelter is and what it is to be used for. Caution them not to take any items from that area.

If you have pets, prepare a place for them to relieve themselves in the shelter. Pets should not go outside during a radiation emergency because they may track radioactive materials into your shelter when they come back inside.

What emergency supplies should I store in my shelter's supply kit?

The following is a list of things that you should consider storing in your emergency supplies kit. Most of these items should be stored in waterproof containers. You should also have small emergency disaster supply kits in

each vehicle; as well as supplies at your workplace (water, first aid kit, flares, jumper cables, flashlight and extra batteries, etc.). You should have a portable supply kit (one per family member) as well located near an exit of your house or sheltered somewhere in your backyard to take with you if you are told to evacuate.

Food with a long shelf life, preferably, store foods that do not need cooking. Store enough food for each member of the household for at least three days. Make sure you also have a hand-operated can opener on hand. Include any special dietary foods that may be necessary. See last page for an example of items to include in your emergency kit.

Can you give me an example of a portable emergency supply kit?

See **page 53** for an example of items to include in your emergency kit.

What else do I need to know before entering a shelter?

If you are outside when the alert is given, try to remove clothing and shoes and place them in a plastic bag before entering the house. During severe weather, remove at least the outer layer of clothes before entering the home to avoid bringing radioactive material into your shelter. Leave clothing and shoes outside. Shower and wash your body with mild soap and warm (but not hot) water. Scrub gently, being careful not to scrape or tear the skin. Radioactive materials can enter the body through open wounds. Removing clothing will eliminate up to 80-90% of radioactive contamination.

Before entering the shelter, turn off fans, air conditioners and forced-air heating units that bring air in from the outside. Close and lock all window and doors and close fireplace dampers.

Use duct tape and plastic sheeting to seal any doors, windows or vents for a short period of time in case a radiation plume is passing over (listen to your radio and television for instructions). Within a few hours, you should remove the plastic and duct tape and allow fresh air into the room but wait until being told that it is safe to do this.

Keep your radios and televisions tuned to a local news stations at all times and listen for EAS message updates on the situation.

How long can a family stay in a sealed room?

The Federal Emergency Management Agency recommends that individuals allow ten square feet of floor space per person in order to provide sufficient air to prevent carbon dioxide build up. This will allow for up to five hours of air for each person.

Why does the government recommend duct tape and plastic sheeting?

Duct tape and plastic sheeting or even heavy-duty trash bags can be used to create an airlock in a room to reduce the amount of radioactive materials that might get into an area. These materials provide temporary shelter for you and your family for about five hours. Once the danger or plume has passed, it is easy to remove these materials and exit.

Is there a particular type (brand) of duct tape that I should buy?

The Federal Emergency Management Agency recommends using duct tape with a minimum thickness of 10 millimeters (0.01 in).

What is the most effective type of plastic sheeting?

The Federal Emergency Management Agency recommends using plastic sheeting with a thickness of 0.01 inch (10 millimeters). Commercially available sheeting is typically sold at 0.7, 1, 1.2, 1.5, 2, 2.5, 3, 4, 6 and 10 millimeters thickness. But, keep in mind that any type of plastic sheeting, even heavy trash bags, is better than nothing.

Will shrink wrap plastic used for weatherproofing work?

The Federal Emergency Management Agency ***does not*** recommend using shrink-wrap plastic. Installing shrink-wrap plastic would take more time than using plastic sheeting and duct tape due to the two steps required (adhesion to the frame using double sided tape and use of hair dryer to achieve a tight fit).

Evacuation

What do I need to do if told to evacuate?

Before an emergency, learn how to turn off utilities (locate the electric, gas and water shut-off valves). Keep the necessary tools near gas and water shut off valves. Teach family members how to turn off utilities. If you turn off the gas, a professional must turn it back on. Do not attempt to turn the gas back on yourself.

Follow the directions that your local officials provide. Leave the area as quickly and orderly as possible. Listen to the radio or television for information about evacuation routes, temporary shelters and procedures to follow.

Before you leave, close and lock windows and doors and turn off air conditioning vents, fans and furnace. Close fireplace dampers.

Use your own transportation; if possible. If traveling by car, keep all windows closed and turn off the heater and ventilators. If you do not have your own transportation, the police should have you go to a designated assembly point from where a bus should pick you up and evacuate you.

Do not attempt to pick up children from school. School and emergency officials will ensure that they are looked after. You will be informed of where to rejoin you children once they have been evacuated/relocated.

Take a flashlight, portable radio, batteries, first-aid kit, supply of sealed food and water, hand-operated can-opener, essential medicines and cash and credit cards.

Take pets only if you are using your own vehicle and going to a place you know will accept animals. Emergency vehicles and shelters usually will only allow service animals inside of them. Take extra food, water and supplies for your pet.

> **Click here for information on pet-friendly hotels:**
> Official Pet Hotels.com – **http://www.officialpethotels.com/?source=google#axzz4vbuuq0EZ**

Remember your neighbors and certain family members may require special assistance, especially infants, elderly people and people with special needs. Find out what their special needs are and plan ahead.

If you have a car, keep a half tank of gas in it at all times.

If time allows:

- Call or email the "out-of-state" contact in your family communications plan.
- Tell them where you are going.
- If there is damage to your home and you are instructed to do so, shut off water, gas and electricity before leaving.
- Leave a note telling others when you left and where you are going.
- When you leave, report to a shelter or relocation center **first** so that you can be checked out/monitored for exposure to radiation.
  - This also allows emergency officials to account for you during the emergency.

Preparations for people with special needs

How do people with special needs prepare for radiation incidents?

Maintain a list of the following important items and store it with the emergency supplies. Give a copy to another family member and a friend or neighbor.

- Special equipment and supplies, like hearing aid batteries.
- Current prescriptions names and dosages.
- Names, addresses and telephone numbers of doctors and pharmacist.
- Detailed information about your medication regime.

Create a self-help network of relatives, friends or co-workers to assist in an emergency.

Tell these people where you keep your emergency supplies. Give one member of your support network a key to your house or apartment. If you think you may need assistance in a disaster, discuss your disability with relatives, friends and co-workers and ask for their help. For example, if you need help moving or require special arrangements to receive emergency messages, make a plan with friends/family.

Contact your local emergency management office now – before an emergency. Advise them of your special needs status/concerns. (You do not need to share specific medical conditions but be sure to advise them of the type of assistance you will need in an emergency.) Many local emergency management offices maintain registers of people with special needs so they can be located and assisted quickly in a disaster.

Wearing medical alert tags or bracelets to identify your special needs may help in case of an emergency.

Know the location and availability of at least two medical facilities offering the care you need. For example: if you are dependent on a dialysis machine or other life-sustaining equipment or treatment.

If you have a severe speech, language, or hearing disability: You can dial 9-1-1, tap space bar to indicate TTY/TDD call. Store writing pads and pencils to communicate with others. Keep a flashlight handy to signal whereabouts to other people and for illumination to aid in communication. Remind friends that you may not receive some or any warnings or emergency instructions due to the nature of your condition. Ask them to be your source of emergency information as it comes over their radio or television. If you have a hearing-ear dog or seeing-eye dog, be aware that the dog may become confused or disoriented in an emergency. Store extra food, water and supplies for your dog.

Planning for Evacuation:

People with special needs have the same choices as other community residents about whether to evacuate their homes and where to go when an emergency threatens. Listen to the advice of local officials.

If you need a wheelchair:

Show friends how to operate your wheelchair so they can move you if necessary. Know the size and weight of your wheelchair as well as whether or not it is collapsible in case it needs to be transported.

Caring for Pets

How should I prepare to care for my pets before a disaster?

Contact your local animal shelter, humane society, veterinarian and/or emergency management office for information on caring for pets in an emergency. Find out if there will be any shelters set-up to take pets in an emergency. Also, see if your veterinarian will accept your pet in an emergency.

Do not leave pets behind. You may be away for a short time or you may be away for several weeks. Pets left behind will not be able to survive. The decision of how long

You will need a pet carrier that allows your pet to stand up and turn around inside. Put familiar items such as the pet's normal bedding and favorite toys inside. Train your pet to become comfortable with the carrier. Use a variety of training methods such as feeding it in the carrier or placing a favorite toy or blanket inside.

If your pet is on medication or a special diet, try and get an extra supply of medications.

Make sure your pet has a properly fitted collar that includes current license and rabies tags. Include an identification tag that has your name, address and phone number. If your pet normally wears a chain link "choker" collar, have a leather or nylon collar available.

Keep your pet's shots current and know where the records are. If possible, store copies in the same place you store all your important personal document copies (in your family disaster kit).

Most kennels require proof of current rabies and distemper vaccinations before accepting a pet.

Keep an up-to-date list of motels and hotels in communities outside of your area and find out if they will accept pets in an emergency.

When assembling emergency supplies for the household, include items for pets.

- Extra food/water stored in watertight, sturdy containers.
- Kitty litter if you have a cat.
- Large capacity self-feeder and water dispenser.
- Extra medications if they require them.

Trained Guide Dogs:

In most states, trained guide dogs for the blind, hearing impaired or those with special needs will be allowed to stay in emergency shelters with their owners. Check with local emergency management officials for more specific information.

What should I do with my pets during an emergency involving radiation?

Bring your pets inside immediately.

Animals have instincts about severe weather changes and will often isolate themselves if they are afraid. Bringing them inside early can stop them from running away. **Never** leave a pet outside!!

Even if your dogs and cats normally get along, the anxiety of an emergency situation can cause pets to act irrationally. Separate dogs and cats. Keep small pets (such as rabbits, gerbils, hamsters, birds, etc.) away from cats and dogs as well.

If you evacuate your home, **DO NOT LEAVE YOUR PETS BEHIND!** Pets most likely will not be able to survive on their own.

Make sure identification tags are up to date and securely fastened to your pet's collar. If possible, attach the address and/or phone number of your evacuation site. If your pet gets lost, his tag is his ticket home. Make sure you have a current photo of your pet for identification purposes.

Put your pet in a secure pet carrier (or on a leash or harness) so that if it panics it cannot escape.

Consider making and taking a pet survival kit with you containing: pet food, bottled water, medications, veterinary records, cat litter/pan, can opener, food dishes, first aid kit and other supplies with you in case they're not available later.

If it is impossible to take your pet with you to temporary shelter, contact friends, family, veterinarians or boarding kennels to arrange for care. Make sure medical and feeding information, food, medicine, medical records and other supplies accompany your pet to his foster home. **NOTE:** Some animal shelters will provide temporary foster care for owned pets in times of disaster but this should be considered only as a last resort.

Birds must eat daily to survive. In an emergency, you may have to take your birds with you. Talk with your veterinarian or local pet store about special food dispensers that regulate the amount of food a bird is given. Make sure that the bird is caged and the cage is covered by a thin cloth or sheet to provide security and filtered light.

If you have no alternative but to leave your pet at home, there are some precautions you must take, but remember that leaving your pet at home alone can place your animal in danger!

Confine your pet to a safe area inside – NEVER leave your pet chained outside!

Place notices outside in a visible area, advising what pets are in the house and where they are located. Provide a phone number where you or a contact can be reached as well as the name and number of your vet.

Should I do anything special with my pets after the emergency?

If after a radiation incident you have to evacuate, take your pets with you. Pets are not likely to survive on their own.

In the first few days after the radiation incident, leash your pets when they go outside. Always maintain close contact. Familiar scents and landmarks may be altered and your pet may become confused and/or lost.

The behavior of your pets may change after an emergency. Normally quiet and friendly pets may become aggressive or defensive. Watch animals closely. Leash dogs and place them in a fenced yard with access to shelter and water.

Precautions farmers should take in a radiation incident

What disaster planning tips do you have for dealing with livestock?

Evacuate livestock whenever possible. Arrangements for evacuation, including routes and shelter sites, should be made in advance. Alternate routes should be mapped out in case the planned route is inaccessible.

The evacuation sites/shelters should have or be able to readily obtain safe food, protected water, veterinary care, handling equipment and facilities.

Trucks, trailers and other vehicles suitable for transporting livestock (appropriate for transporting each specific type of animal) should be available along with experienced handlers and drivers to transport them. Whenever possible, the animals should be accustomed to these vehicles in advance so they're less frightened and easier to move.

If evacuation is not possible, a decision must be made whether to move large animals to available shelter or turn them outside. This decision should be determined based on the type of radiation incident and the soundness and location of the shelter's structure.

All animals should have some form of identification that will help to make their return easier.

Your disaster plan should include a list of emergency phone numbers for local agencies that can assist you if disaster strikes – including your veterinarian, state veterinarian, local animal shelter, animal care and control, county extension service, local agricultural schools and the American Red Cross. These numbers should be kept with your disaster kit in a secure, but easily accessible place.

For more information and guidance on emergency livestock sheltering contact Clemson Extension at (803) 788-2260.

What other precautions should farmers take?

The following are suggested actions to protect dairy animals and livestock from radiological contamination follow.

It is unlikely that animals will suffer from contamination that will cause death or permanent injury, but radioactivity ingested by dairy animals can contaminate milk and milk products. Therefore, dairy animals should be provided with shelter, stored feed and protected water supplies before precautions are taken for other farm animals. If there is sufficient shelter, feed and water available, move other livestock indoors and place them on stored feed and protected water supply. The major concern for protecting dairy animals from contamination is to protect the milk and other dairy products produced for human consumption.

Water from a covered well, tank, cistern or from a freely running spring is best. To prevent contamination from radioactive particles, do not add water to covered tanks unless the water is from a protected well or spring. Use all the water originally present in the tanks first.

Water in an exposed pond would be contaminated but, usually, the level of contamination would decrease rapidly. Such water could be used for surface irrigation. It could also be used to wash off farm buildings and unsheltered livestock. Surface water should be safe within a few days after the incident. The surface waters in ponds and rivers would tend to be safer sooner if there is no rain. Otherwise, if possible, obtain drinking water for livestock from another source.

Covered feeds are the safest feeds. Radioactive particles are like dust or dirt; a cover will prevent contamination from coming in contact or mixing with the feed.

Grain stored in a permanent bin, hay in a barn or in a covered silo can be considered safe. They can be used as feed for your dairy animals and livestock. A haystack in an open field can be protected with a tarp or similar covering.

Pay attention to emergency alert messages and other communications that will notify you of radiation levels and if animal feed growing in your area is considered harmful. As a precautionary measure, house the dairy animals and livestock and do not let them graze. In the event you have no stored feed during an emergency, you should know that animals could survive for a period of time on water alone.

DHEC emergency response personnel, along with members of other state agencies, will be monitoring milk and milk stations and sampling will also be done on the farms. You will be informed whether or not your milk contains radioactive materials.

Poultry is somewhat more resistant to radiation than other farm animals. Also, most poultry is raised under shelter and given feed that has been protected or stored, so they are of less concern following a radiological emergency. However, the same protective measures recommended for other livestock should be used for poultry as well.

Do not destroy any animal food products unless spoilage has made them inedible. Milk should be safe to use if it is from dairy animals that have been adequately sheltered and protected. However, do not attempt to make you own determination about whether food is safe to consume. Only state officials can make this determination for you. Livestock exposed to external contamination can be used for food if the radiation level is not excessive, if they are adequately washed and if monitored by state authorities prior to slaughtering. Meat animals that have internal contamination cannot be slaughtered until the appropriate state authorities advise the owner that it is safe to do so. You will receive specific instructions from public health officials and other state authorities.

**** Do not take any action until health officials tell you to do so. ****

If milk pickups and deliveries are interrupted because of an emergency, officials will be in touch with milk transport companies and will provide instructions. There may be delays in pickups, which will necessitate holding milk for longer than normal periods. It is possible that some milk may have to be discarded. Do not discard these products until you are advised to do so, by public health officials. Follow all guidance given.

It is unlikely that the type and level of radioactive release would cause any animal illness. Animal skins containing radioactive materials can be washed off with soap and water. When washing animals, protective clothing should be worn similar to what is worn when applying pesticides.

It is anticipated that most affected land could be returned to normal use in several weeks after having been contaminated. The exact length of time that the land would remain unusable would depend on the amount and

type of radioactive materials deposited in a given area. Do not return to these areas until advised to do so by public health and emergency management officials.

Extension agents and state agricultural officials will guide farmers in determining how to use their land following a radiological emergency.

Growing fruit and vegetables can become externally contaminated. Leaves, pods and fruits that are contaminated with radioactive particles can be cleaned before being eaten. Green vegetables that are contaminated should have outer layers removed. Vigorous washing is the most effective measure.

Roots (such as carrots) and tubers (such as potatoes) absorb small amounts of contamination. The normal cleaning or peeling of underground vegetables such as potatoes and carrots would be adequate for removing contamination.

Fruits that are ripe at the time of a radiological accident may be lost due to a possible personal hazard to the worker. Fruits that do not have to be picked immediately can be saved and picked after the contamination has decayed. Be sure to wash them thoroughly before eating them.

Protective Equipment

Should I buy a radiation detector?

You do not need one, but if you would like to buy a radiation detector, try to find a dose rate meter that has a scale from 1 millirem/hour up to 1 Roentgen/hr. You can use this to determine if there is radiation in an area (air, a room, a field, etc.). You might also buy a contamination meter that measures dose. You can use this to see if the surface of something is contaminated (clothing, your skin, etc.). Make sure you take the time to learn how much background radiation normally exists in your area. Also know how and when to get the instrument calibrated. If you do not understand what these terms mean, how to take a measure of radiation dose or dose rate, or what the differences between the two types of meters are; then it might not be beneficial to you to purchase them. Improper use may cause you to panic when there is no real danger.

Should I buy some sort of protective/gas mask?

An ordinary surgical facemask provides some protection against inhaling radioactive particles. It is not recommended that you use any other type of mask. Other types of masks need to be fitted carefully for each face and there are different kinds of masks for different types of agents. Having or using a protective mask may offer a false sense of security. They can also be unsafe for children or people with asthma. Over-the-counter "N95" masks are designed to be 95% effective at blocking many particles including biological agents. The "N95" masks might be able to provide some protection against inhalation. But, better advice would be to stay away from the immediate area of a radiological incident, minimize the time near the area, maximize the distance between you and the source of the radiation and place as much protective shielding as possible (like a building) between yourself and the contaminated area.

Nuclear Power Plants and County Emergency Management Planning

Can a Nuclear Power Plant blow up?

Not U.S. plants. On April 26, 1986, a Soviet Union power plant named Chernobyl caught fire and blew up but Chernobyl was a very different design. It was an open, graphite-moderated reactor. There was no containment

around the core and the graphite that was used to slow the reactor was susceptible to burning at high temperatures and that caused the fire and subsequent release at Chernobyl.

On March 11, 2011, the Fukushima Daiichi plant suffered a catastrophic low of power when an earthquake caused a Tsunami, more than 30-feet high, to slam into the plant and flood its mechanical controls and control room. Operators were unable to take action to release the buildup of steam and hydrogen within the reaction; an action known as "venting" the reactor. The inability to vent the reactor caused a buildup of pressure and massive buildup of hydrogen. Hydrogen built up outside of the reactor's containment but inside the concrete shell. If that hydrogen comes in contact with a spark, as it did in Fukushima, a hydrogen blast can occur. During Fukushima, that blast ripped the roof and wall of the outer shell from the building and exposed the reactor.

All U.S. power plants are required to have several levels of containment to prevent this kind of emergency. This prevention design is referred to as "defense-in-depth" and involves several layers to protection.

How many and what kind of, reactors are in operation in the State of South Carolina?

In total, the state of South Carolina is home to seven reactors; two are located at the Catawba Nuclear Station, one is located at the Robinson Nuclear Plant, three are located at the Oconee Nuclear Station and one is located at the V. C. Summer Nuclear Station. All seven reactors are pressurized water reactors. The Vogtle Electric Generating Plant (VEGP) is home to two additional pressurized water reactors that have the potential to South Carolina residents. VEGP has two more commercial reactors under construction.

There are two types of nuclear power reactors: Boiling Water Reactors and Pressurized Water Reactors. A **Boiling Water Reactor (BWRs)** boils water so that it is converted to steam. The steam drives a turbine connected to a generator before being recycled back into water by a condenser and used again in the heat process. In a **Pressurized Water Reactors (PWRs), the reactor** keeps water under pressure so that it heats up but does not boil. Water from the reactor and water in the steam generator never mix.

Where can I learn more about the plans for my county?

To learn more about the plans for your county please contact your city or county Emergency Management Director. The EMD for each county can be reached by contacting your county office or by clicking on the following link:

http://scemd.org/who-we-are/county-agencies

How can I help my county in an emergency?

Please contact your county Emergency Management Director in advance of a disaster. There are many positions that can be filled during trainings, drills and real emergencies. Your EMD may have certain functions that they need performed.

What can I do about wildlife in the area?

Most wildlife will evacuate an area when a loud sound – like a bomb detonation – or when there are significant changes in weather. They may panic, however, if you see an injured or stranded wild animal in need of assistance, or you need help with removing a wild animal from your home, please contact your local animal control office or animal shelter. **Do not attempt to approach them on your own.**

I live in a high-rise, do I respond the same way as if I lived in a house?

Know and practice your building's evacuation route and plan. Listen to the advice of local government officials. If advised to "Shelter-In-Place", select an interior room on the floor that you are on (such as an interior stairwell) and take refuge. If advised to evacuate, follow the advice of local government officials and/or building management.

What radio or television stations should I listen to for information?

All stations are required to carry "Emergency Alert System Messages" when government officials issue them.

The **Emergency Alert System (EAS)** is a national warning system in the United States put into place in 1994, which replaced the Emergency Broadcasting System (EBS). At the state level it is coordinated by the S.C. Emergency Management Division (SCEMD) and the 46 counties in South Carolina. The EAS is designed to allow emergency officials to relay emergency directions to the public.

How do I stay calm?

Know how to be prepared for emergencies. Develop a plan on how to respond with your family, including loved ones who will be concerned about you but who do not live with you. Include an emergency communications plan. If a disaster happens, follow your plan. Knowing that you know what to do and doing it is the best way to remain calm.

How can I handle the fears and concerns of my children?

First it is important that parents stay calm, since children will look to your reaction for comfort. Having a family communications plan in place and talking about disasters before they occur, will give your child confidence in knowing what to do and how to contact you. Agencies like The American Red Cross have resources available that can help children deal with terrorism and tragic events. See the lessons and activities titled Facing Fear: Helping Children Deal With Terrorism and Tragic Events. These materials are available to be downloaded from:

http://www.redcross.org/get-help/how-to-prepare-for-emergencies/resources-for-schools.

Will whole house air filtration systems protect me?

These systems are designed to reduce, but not completely remove, particulate matter in the air inside a home. A house or apartment is not completely air tight or sealed, even when doors and windows are closed. This is why using plastic sheeting and duct tape to seal windows and doors is recommended when and where possible.

Other than Potassium Iodide (KI), are there any other supplements or over-the-counter products which might be helpful in a radiation incident?

The simple answer is no. Some people have asked in the past if they should take something like large doses of calcium to protect against Strontium-90 (which can accumulate in bone). Since Strontium-90 is not a gas, but a particle, it would enter the body through contaminated food and drink. It is therefore easy to prevent exposure to Strontium-90 by not eating or drinking anything that might be contaminated.

There are additional medications, such as Prussian Blue and DTPA, that can be used to treat internal exposure to radiation but they are not readily available to the public and they **must** be administered by a doctor or other medical official.

How can I protect my family and myself from a terrorist nuclear attack?

You should take the same actions you would to protect against a hazardous chemical spill or release. Cover your nose and mouth and immediately seek shelter in a stable undamaged building. Once inside close windows and doors, turn off air conditioners, heaters or other ventilation systems if possible. Listen to local radio or television stations for national emergency-alert information. As a general rule, you can reduce the potential exposure and subsequent health consequences by limiting your time near the radiation source, increasing your distance from the source or keeping a physical barrier (such as the wall of a building) between you and the source.

What should I do if there is a terrorist attack on a nuclear power plant near my home?

A terrorist attack on a nuclear power plant will initiate a national emergency response that has been carefully planned and rehearsed by local, state and federal agencies for more than 20 years. Concerned residents should contact the DHEC Nuclear Response and Emergency Environmental Surveillance section for more information.

You can also contact the plant and ask for a copy of their emergency plan. Study these plans and be prepared to follow the instruction that local and state public health officials provide in the event of a terrorist incident involving the nuclear power plant near your home.

What do I do if there is a dirty bomb explosion in or very close to the building that I am in and there is a danger the building might collapse?

Exit the building as soon as possible. If that is not possible, take shelter against your desk or a sturdy table.

- Do not use elevators.
- Check for fire and other hazards.
- Take your emergency supply kit if time allows.
- Find a safe place to take shelter until local authorities tell you to do otherwise.

What do I do if I am in the area where a dirty bomb has exploded and there is a fire?

- Exit the building as soon as possible.
- Crawl low if there is smoke.
- Use a wet cloth to cover your nose and mouth.
- Use your hand to feel a door top to bottom.
- If the door is hot do not open it, look for another way out.
- If the door is not hot, brace yourself against it and open it slowly.
- Do not use elevators.
- If you catch fire, do not run. Stop-drop-and-roll to put out the fire.
- Go to a previously designated meeting place.
- Account for your family members or coworkers. Carefully supervise small children.
- Never go back into a burning building.
- Find a safe place to take shelter until local authorities tell you to do otherwise.

What do I do if I am trapped in debris?

- If possible, use a flashlight, whistle or air horn to signal your location to rescuers.
- Avoid unnecessary movement so that you do not kick up dust.
- Cover your mouth and nose with anything you have on hand (dense-weave cotton material can act as a good filter). Try to breathe through the material.

- Tap on a pipe or piece of metal or wall so that rescuers can hear where you are.
- Shout only as a last resort. Shouting can cause a person to inhale dust and possibly radioactive materials.

Radiation Incidents Abroad

What should I do if I am traveling abroad and a radiation incident occurs near me?

In general, you should do the same things to prepare and to help yourself, as you would do at home. You probably will not have a disaster supply kit with you, however, you can still try to find shelter. Stay as far away from the site of the incident as possible and minimize your time near any areas that might be radioactive.

In addition you should contact the U.S. Embassy or Consulate if you need help. Be sure to register with the U.S. Embassy or Consulate by phone, fax or in person; if possible, when planning to travel. Monitor the U.S. Embassy and State Department's home pages. Monitor Voice of America and BBC broadcasts announcements.

When a crisis occurs abroad the State Department sets up a task force to bring together all of the people necessary to work on the event. Usually this task force will be in touch by telephone 24-hours-a-day with our Ambassador and Foreign Service Officers at the embassy in the country affected.

What happens if a family member is involved in a radiation incident abroad?

Relatives will want information on the welfare of their family members and on the disaster. Despite the possibility of lack of electricity, phone lines, gasoline, etc. that could occur in a disaster, foreign service officers work hard to get information back to the State Department as quickly as possible.

As concerned relatives call in, officers of the Bureau of Consular Affairs collect the names of the Americans possibly involved in the disaster and pass them to the embassy and consulates. Officers at these posts attempt to locate these Americans in order to report on their welfare. The officers work with local authorities and may personally search hotels, airports, hospitals, or even prisons.

When an American dies abroad, the Bureau of Consular Affairs must locate and inform the next-of-kin. Sometimes discovering the next-of-kin is difficult. If the American's name is known, the Bureau's Office of Passport Services will search for his or her passport application. However, at times, the information there may not be current.

The Bureau of Consular Affairs provides guidance to grieving family members on how to make arrangements for local burial or return of the remains to the U.S. The disposition of remains is affected by local laws, customs and facilities, which are often vastly different from those in the U.S. The Bureau of Consular Affairs relays the family's instructions and necessary private funds to cover the costs involved to the embassy or consulate. The Department of State has no funds to assist in the return of remains or ashes of American citizens who die abroad. Upon completion of all formalities, the consular officer abroad prepares an official Foreign Service Report of Death, based upon the local death certificate and sends it to the next-of-kin or legal representative for use in U.S. courts to settle estate matters.

Emergency Kit Items to Consider

Having a well-stocked, organized and easily accessible emergency kit is ***critical*** in any disaster. In most cases, emergency kit items can be used for multiple hazards; one created for a hurricane or earthquake can be used for a nuclear or radiation incident with just a few modifications.

Items to consider for an Emergency Kit

- A flashlight,
  - Electrical power may be spotty, temporarily out or completely unavailable. A flashlight will help you see.
- Toiletries:
  - Keep a supply of soap, shampoo, toothpaste, toothbrushes, washcloths, towels, feminine sanitary products, hand sanitizer, toilet paper, deodorant, disinfectants, etc.
- A telephone or cell phone:
  - Although cell phone or ground phone service may be interrupted, there is still a chance that you will be able to use a phone to call outside for information and advice from emergency services.
  - Make sure you have chargers/extra batteries for the cell phone.
- Extra eyeglasses or contact lenses and their cleaning supplies as well as hearing aids, dentures or canes.
  - If you have elderly family members store extra medical equipment that they might need.
- A portable radio with extra batteries,
- A first-aid kit with the following supplies:
  - A first aid reference book.
  - Sterile adhesive bandages.
  - Sterile gauze pads in 2 inch and 4 inch sizes.
  - Adhesive tape.
  - Soap or hand sanitizer.
  - Latex or vinyl gloves.
  - Safety pins.
  - Aspirin or aspirin free pain reliever.
  - Anti-diarrhea medication.
  - Sterile rolled bandages.
  - Scissors.
  - Tweezers.
  - Needle.
  - Thermometer.
  - Moistened towelettes.
  - Eye wash solution.
  - Antiseptic and antibiotic ointment.
  - Tube of petroleum jelly or other lubricant.
  - Laxative.
  - Antacids.
  - Syrup of ipecac to cause vomiting if advised by the Poison Control Center.
  - Activated charcoal to stop vomiting if advised by the Poison Control Center.
- Essential prescription medications and vitamins,
  - Have two-to-three day dose of current prescription medications in a childproof bottle for your shelter medical kit; label it with the name and expiration date of the medicine. Be sure to check medicines in your kit every six months to make sure they are not past the expiration date. Also keep prescribed medical supplies (such as a thermometer, a glucose (blood-sugar monitoring) device and blood pressure monitoring equipment and supplies.
  - Bottle of potassium iodide (KI) tablets.
- A battery-operated radio will allow you to listen to emergency messages. Try to store a radio that can receive the National Oceanic and Atmospheric Administration (a weather-alert radio).
- A supply of canned, sealed or packaged food, such as:
  - Ready-to-eat canned meats, fruits and vegetables,
  - Protein or fruit bars,
  - Dry cereal or granola,
  - Peanut butter,

  - Dried fruit,
  - Nuts,
  - Crackers,
  - Canned or bottled juices,
  - Non-perishable pasteurized milk or dry milk, etc.
  - Pet food, baby formula, diapers, items needed for the elderly, etc.
    - If you have and infant, store extra formula and diapers.
    - If you have pets keep a three-day supply of pet food.
- A hand-operated can opener,
- Personal items such as paper towels, garbage bags and toilet paper,
- A change of clothes and shoes. Check clothing every six months and remove clothes that no longer fit or are unsuitable for seasonal weather.
  - Remember to include underwear, socks, sturdy shoes or work boots and winter or summer clothes as needed.
  - Keep rainwear items in your supply kit as well.
- A tool kit.
- Scissors.
- Sewing kit.
- Paper plates, paper towels and plastic utensils. Store disposable dishware and utensils because you will not have enough stored water to wash dishes.
- Plastic bags. Because you may not be able to leave your shelter for several days, you will need to collect your waste in plastic bags until it can be removed.
- Bedding. Store sheets, blankets, towels and cots and/or sleeping,
- Games, books, magazines, toys and other entertainment. You may be in your shelter for several days, keep items on hand to occupy your family during that time.
- Matches and a second method to light a fire (like a lighter).
- Candles and light sticks.
- A whistle with neck cord, flares, or an air horn (for signaling rescuers if you are trapped).
- Cash, credit cards and important papers:
  - Copies of identification, valuable papers, insurance policies, medical insurance cards, Medicare/Medicaid cards and sentimental photographs should be put into a waterproof container.
- Water – Store bottled water or water from the tap in non-breakable containers (soft drink bottles work well).
  - Each person in the household will need about one gallon per day.
  - Plan on storing enough water for at least three days.
  - Children, nursing mothers and sick people may need more than one gallon of water per day.

If possible, consider the following as well:

- A portable generator.
- A portable air purifier with a HEPA filter.
- An extra set of car keys.
- Duct tape and heavy plastic sheeting. You can use these items to seal the door to your shelter and to seal any vents that open into your shelter for a short period of time.
- Portable outdoor camping stove or grill with fuel supply.
- Some form of alternative heating (kerosene heat, wood heat, heating pouches).

Where can I find more information on these topics?

American Nuclear Society
http://www.ans.org

Centers for Disease Control (CDC) Public Response Source at 1-888-246-2675
http://www.cdc.gov/

Clemson University – Clemson Extension Services at 803-788-2260
https://www.clemson.edu/research/safety/radsafety/

Conference of Radiation Control Program Directors (CRCPD) at 502-227-4543.
http://www.crcpd.org/

Federal Emergency Management Agency (FEMA) at 202-646-4600
https://www.fema.gov/
https://www.ready.gov/nuclear-power-plants

Health Physics Society
http://www.hps.org/

Humane Society of the United States, Disaster Services Program at (202) 452-1100
http://www.humanesociety.org/about/departments/disaster_preparedness.html

International Atomic Energy Agency (IAEA)
www.iaea.org

Radiation Emergency Assistance Center/Training Site (REAC/TS) at 865-576-3131
http://orise.orau.gov/reacts/

U.S. Department of Energy (USDOE or DOE) at 1-800-DIAL-DOE
http://www.energy.gov/

U.S. Department of Homeland Security – Ready.gov
http://www.ready.gov/

U.S. Department of State, The Bureau of Consular Affairs
http://travel.state.gov

U.S. Environmental Protection Agency
http://www.epa.gov

U.S. Food and Drug Administration (FDA) at 1-888-INFO-FDA
http://www.fda.gov

U.S. Nuclear Regulatory Commission (USNRC or NRC) at 301-415-8200
http://www.nrc.gov/

This page intentionally left blank.

DHEC: Radiation and Terrorism

What types of terrorist events might involve radiation?

Possible terrorist events could involve introducing radioactive material into the food or water supply, using explosives (like dynamite) to scatter radioactive materials (also referred to as a "dirty bomb"), bombing or sabotage a nuclear facility or exploding a small nuclear device/weapon.

Although introducing radioactive material into the food or water supply most likely would cause great concern or fear, it probably would not cause much contamination or increase the danger of adverse health effects.

Although a dirty bomb could cause serious injuries from the explosion, it most likely would not have enough radioactive material left after the explosion that would cause serious radiation sickness among large numbers of people. However, people who were exposed to radiation scattered by the bomb could have a greater risk of developing cancer later in life, depending on their dose.

A meltdown or explosion at a nuclear facility could cause a large amount of radioactive material to be released. People at the facility would probably be contaminated with radioactive material and possibly be injured if there was an attack that resulted in an explosion. Those people who received a large dose might develop acute radiation syndrome. People in the surrounding area could be exposed or contaminated.

Clearly, an exploded nuclear device/weapon could result in a lot of property damage. People could be killed or injured from the blast and might be contaminated by radioactive material. Many people could have symptoms of acute radiation syndrome. After a nuclear explosion, radioactive fallout would extend over a large region far from the point of impact; potentially increasing someone's risk of developing cancer over time.

For more information about radiation terrorist events, check the following Web sites:

www.bt.cdc.gov/radiation/terrorismqa.asp

www.orau.gov/reacts

www.nrt.org

www.energy.gov

www.nrc.gov

www.epa.gov

What can I do in advance to prepare for the possibility of a terrorist attack involving radioactive materials?

Take the same precautions you would take for an accident at a nuclear power plant.

Terrorist Events

What types of terrorist events might involve radiation?

The events could include the introduction of radioactive material into the food or water supply, using explosives to scatter radioactive materials (dirty bombs), bombing or destroying a nuclear facility (low probability), or

exploding a small nuclear device (also low probability). Some radioactive materials can be vaporized and sprayed widely; still others can be burned and vaporized.

Dirty Bombs

What is a dirty bomb (RDD)?

A dirty bomb, or radiological dispersion device (RDD), is a bomb that combines conventional explosives, such as dynamite or TNT, with radioactive materials. Such bombs can be as small as a firecracker or as big as a truck. The idea behind a dirty bomb is to blast radioactive material into the area around the explosion. This could possibly cause buildings and people to be exposed to and contaminated by, radioactive material. The main purpose of a dirty bomb is to frighten people and make buildings or land unusable for a long period of time as actual damages would be relatively minor.

How do dirty bombs compare to the atomic bombs in Hiroshima and Nagasaki?

The atomic explosions that occurred in Hiroshima and Nagasaki were conventional nuclear weapons involving a fission reaction. A dirty bomb is designed to spread radioactive material and contaminate a small area. Dirty bombs do not include the radioactive fission material products necessary to create a large blast like those seen in Hiroshima and Nagasaki.

Is a dirty bomb attack more or less likely than a nuclear bomb attack?

A dirty bomb attack is much more likely to occur, mainly because of the prevalence of commercial radioactive materials and the relative ease it would take to construct a dirty bomb.

What are the terrorist's sources of radioactive material?

The most harmful radioactive materials are found in nuclear power plants and nuclear weapons sites. However, increased security at these facilities makes obtaining materials from them more difficult.

The radioactive materials that are easiest to obtain and most likely to cause harm are also ones that have significant commercial applications and are widely available. They are used in medical, academic, agricultural and industrial settings around the world. This makes it extremely difficult to secure and to regulate these sources as well.

The U.S. Nuclear Regulatory Commission has estimated that approximately one licensed source is lost every day of the year in the U.S. alone. There have been more than 700 incidents of illegal trafficking of radioactive materials worldwide including 440 incidents in the United States according to the International Atomic Energy Agency (IAEA). By far the most likely method terrorists can use to acquire radioactive material is open and legal purchase from a legitimate supplier.

There are no requirements that foreign suppliers selling radioactive material verify the validity of any license submitted by a U.S. purchaser. Most reputable foreign suppliers try to be scrupulous about checking for valid licenses but there are limitations to the process. In addition, U.S. exporters of radioactive material are not required to notify the authorities in the destination country that radioactive material has been shipped to their country or to verify that a foreign purchaser is authorized to receive the material. The only exceptions to these loopholes are for special nuclear material (Plutonium or Uranium that is usable in nuclear weapons – also referred to as "weapons-grade"), which is already safeguarded.

What would happen if a dirty bomb were detonated?

The explosion itself could cause serious injuries. The bomb would probably not have enough radioactive material to cause serious radiation sickness among large numbers of people. However, people exposed to the radiation could have a slightly greater risk of developing cancer later in life; depending upon their dose.

What would happen if a nuclear facility were bombed or destroyed?

Where an attack to result in a complete meltdown – due to attack or explosion from the outside – at a nuclear facility could cause radioactive material to be released into the environment. People at the nuclear facility would probably be contaminated and possibly injured. People in the surrounding areas could potentially be exposed or contaminated.

The likelihood of that occurring is very small as facilities are tested for their structural integrity and can withstand significant attacks from the outside.

What would happen if a nuclear device were detonated?

It could result in a lot of property damage, a lot of injuries and deaths. People close to the detonated device could suffer from symptoms of acute radiation syndrome. Radioactive fallout could extend over a large region far from the point of impact, potentially increasing people's risk of developing cancer later in life. This is a low probability event.

Is anything being done to find lost radioactive materials?

American and Russian officials have stepped up efforts to track down these materials and secure them. In the United States, the U.S. Department of Energy is the lead agency in these efforts.

What are the dangers of a dirty bomb?

The primary danger from a dirty bomb would be the blast itself. The levels of radiation created by the most probable sources are not high enough to cause severe illness from exposure.

What effect would a dirty bomb have on a large body of water, a pond or a stream?

Contaminating large bodies of water would require much more radioactive material than would be contained in a dirty bomb. Some radioactive materials would sink to the bottom and stay there posing little threat to human health. It could, however, highly contaminate a small pond depending on the amount of radioactive material released and the type of radioactive material.

What types of psychological damage can a dirty bomb do?

The fear of ionizing radiation is deep-seated and frequently irrational. An RDD attack is unlikely to cause mass deaths, due to a lack of radiation strong enough to mutate or kill cells, but it is almost certain to cause great panic and fear.

Some initial reactions could be shock, disbelief and reluctance to abandon property, anxiety and fear. Long-term psychological effects could be anxiety disorders, Post Traumatic Stress Disorder (PTSD), depression, anger and suspicion, feelings of powerlessness, feelings of being overwhelmed and acute stress disorder.

Are there any incidents in the past in which a dirty bomb was used?

Iraq tested a dirty bomb device in 1987 but found that the radiation levels were too low to cause significant damage. Iraq abandoned any further use of the device.

In 2002, Jose Padilla and American citizen with known ties to Al Qaeda, was arrested on suspicion of planning to build and detonate a dirty bomb in an American city.

How much expertise does it take to make a dirty bomb?

Dirty bombs are relatively easy to construct. It does not take much more expertise to construct a dirty bomb than it does to construct a conventional bomb or improvised explosive device.

Is a dirty bomb a Weapon of Mass Destruction?

No, they are better described as weapons of "mass disruption" that could spread fear and disrupt daily life. The health consequences from the use of a dirty bomb would be relatively minimal. Widespread destruction would be unlikely. The greater concern is the long-term psychological, social and political impacts.

Do Post Offices, Airports and border-entry points scan for radioactive materials?

Currently 0.5% of all shipments contain radioactive substances. It is not practical to inspect every truck and package to verify which ones contain radioactive substances and which ones do not. Efforts are currently underway, by federal authorities, to establish inspection points at all major airports, border-entry points and along major routes of transportation

Do terrorists have the types of radioactive substances that can be used in a dirty bomb?

International authorities have recorded hundreds of cases of trafficking in nuclear or radiological materials since the end of the Cold War. Many such supplies are subject to few controls or are poorly guarded; particularly in the former Soviet countries.

How do we know that a dirty bomb hasn't already been used in the U.S.?

There could have already been a terrorist release of radioactivity that went unnoticed because a RDD would not even require a bomb blast (a firecracker would work). A "silent" attack – using what is known as a Radiological Exposure Device (RED) – is possible, but not very probable. Terrorists usually want a lot of people to know about an attack immediately in order to cause terror among the surrounding population. Terrorists cannot cause or inflict terror if no one knows about the attack.

Suitcase Bombs

What are suitcase bombs?

In 1997, the public became aware of a Russian nuclear device called a suitcase bomb. A "suitcase" bomb is a compact and portable nuclear weapon and would have the approximate dimensions of 24 x 16 x 8 inches. The smallest possible bomb-like object would be a single critical mass (unit needed to create a self-sustaining chain reaction) of Plutonium (Pu-239) or Uranium (U-233). It doesn't take much more than a single critical mass to cause a significant explosion.

As an example, if a device like this were used in Washington, D.C. it could destroy all objects within a half-mile radius. Within hours, prevailing winds could carry the nuclear fallout through the rest of Washington, D.C. Radioactive iodine could be carried downwind for miles. While this is a possibility; it is a remote possibility. These types of materials are highly regulated and closely tracked.

What is a backpack bomb?

Another portable weapon is a "backpack" bomb. The Soviet nuclear backpack system was made in the 1960s for use against NATO (North Atlantic Treaty Organization) targets in time of war. It consisted of three "coffee can-sized" aluminum canisters in a bag.

Who has suitcase bombs?

Some nuclear suitcase bombs may have been developed by the Soviet Union during the Cold War. There is a fear that some of the devices may be sold to terrorists. Russian scientists have testified they are certain that suitcase bombs were created, though the Russian government denies their existence.

Nuclear Blasts/Bombs

What is a nuclear blast?

A nuclear blast, produced by explosion of a nuclear bomb (sometimes called a nuclear detonation), involves the joining or splitting of atoms (called fusion and fission respectively) to produce an intense pulse or wave of heat, light, air pressure and ionizing radiation. The bombs dropped on Hiroshima and Nagasaki at the end of World War II produced nuclear blasts.

What happens when a nuclear device is exploded?

A large fireball is created. Everything inside of this fireball vaporizes, including soil, water and the majority of the radioactive materials. What is left would be carried upwards. This creates the mushroom cloud that we associate with a nuclear blast.

The remaining radioactive material, from the nuclear device, would mix with the vaporized material in the mushroom cloud. As this vaporized radioactive material cools, it becomes condensed and forms particles (such as dust). The condensed radioactive dust then falls back to the earth; this is what is known as fallout. Because fallout is in the form of particles, it can be carried by the wind and could potentially end up some distance from the site of the explosion. Fallout is radioactive and could cause contamination of anything on which it lands; including food and water supplies.

What sorts of effects are there from a nuclear blast?

The effects on a person from a nuclear blast will depend on the size of the bomb, the type of nuclear fuel used, the design of the device, whether it is exploded in the air or on the earth's surface, the geography of the surrounding area, the weather and the distance the person is from the explosion. Nuclear blasts would likely cause great destruction, death and injury and have a wide area of impact.

In a nuclear blast, injury or death may occur as a result of the blast itself or as a result of debris thrown from the blast. People may experience moderate to severe skin burns, depending on their distance from the blast site. Those in very close proximity to the blast and who look directly at it, could experience eye damage ranging

from temporary blindness to severe burns on the retina. Individuals near the blast site would be exposed to radiation and could develop symptoms of radiation sickness (called Acute Radiation Syndrome).

People may experience two types of exposure from radioactive materials from a nuclear blast: external exposure and internal exposure.

How can I protect my family and myself during a nuclear blast?

If you are near the blast when it occurs:

- Turn away and close and cover your eyes to prevent damage to your eyesight.
- Drop to the ground face down and place your hands under your body.
- Remain flat until the heat and two of the shock waves have passed.

If you are outside, but not near the blast site, when the blast occurs you should:

- Find something to cover your mouth and nose, such as a scarf, handkerchief, facemask or other cloth. Keep your mouth and nose covered until the fallout cloud has passed.
- Remove any dust from your clothes by brushing, shaking and wiping in a ventilated area — also, cover your mouth and nose while you do this, to reduce internal contamination.
- Move to a shelter, basement or other underground area; preferably located away from the direction that the wind is blowing.
- Remove clothing since it may be contaminated. If possible, take a shower, wash your hair and change clothes before you enter the shelter. Make sure to gently scrub hair and skin to remove any contaminated materials. Do not scratch, scrape or tear the skin as radioactive materials can enter the body through open cuts and wounds.

If you are already in a shelter or basement:

- Shut off ventilation systems that draw in fresh air. Close fireplace dampers. Seal doors and windows until the fallout cloud has passed. After the fallout cloud has passed, unseal the doors and windows to allow some air circulation.
- Stay inside until authorities say it is safe to come out.
- Listen to the local radio or television for information and advice. Authorities may direct you to stay in your shelter or evacuate to a safer place away from the area.
- If you leave your shelter cover your mouth and nose with a damp towel or cloth until you return to the shelter. When returning to the shelter, remove the clothing and shower – making sure to gently scrub hair and skin to remove any contaminated materials. Do not scratch, scrape or tear the skin as radioactive materials can enter the body through open cuts and wounds.
- Use stored food and drinking water. Do not eat local fresh food or drink water from an open water supply.
- Clean and cover any open wounds on your body.
- If you are advised to evacuate:
    - Listen to the radio or television for information about evacuation routes, temporary shelters and relocation centers and procedures to follow.
    - Before you leave, close and lock windows and doors and turn off air conditioning vents, fans and furnace. Keep fireplace dampers closed.
    - Take disaster supplies with you (such as a flashlight and extra batteries, battery-operated radio, first aid kit and manual, emergency food and water, non-electric can opener, essential medicines, cash and credit cards and sturdy shoes).
    - Remember your neighbors and some family members may require special assistance, especially infants, elderly people and people with special needs.
    - If you have a car, keep a half tank of gas in it at all times.

- Take your pets with you! (Have a plan on how you will care for pets in an emergency, as most public shelters do not allow pets.)
- If time allows:
  - Call or email the "out-of-state" contact in your family communications plan.
  - Tell them where you are going.
  - If there is damage to your home **and** you are instructed to do so, shut off water, gas and electricity before leaving.
  - Leave a note telling others when you left and where you are going.

What do I do if someone near me is injured in the nuclear blast?

Radioactive contamination of injured persons, or of emergency workers, is a hazard that can be dealt with after the life-threatening injuries of the person have been treated. Do not flood emergency rooms or doctor's offices with non-emergency patients. The first priority for medical attention should be to physical injuries. Contamination with radioactive materials should not be a barrier to adequate and timely medical treatment of life threatening injuries.

Is a nuclear bomb the same as a suitcase bomb?

The "suitcase" bombs that have been described in news stories in recent years are small nuclear bombs. A suitcase bomb would produce a nuclear blast that is very destructive, but not as great as a nuclear weapon developed for strategic military purposes.

Would an airplane crashing into a nuclear power plant have the same effect as a nuclear blast?

While a serious event such as a plane crash into a nuclear power plant could result in a release of radioactive material into the air, a nuclear power plant would not explode like a nuclear weapon. Post 9-11, the NRC has required evaluations of nuclear power plants to ensure these building can withstand a direct strike from an aircraft.

Additional Concerns About Attacks Involving Radiation

What would happen if radiation were introduced into the food or water supply?

It would cause a great deal of concern and fear; however, it probably would not cause much radioactive contamination or increase the danger of adverse health effects.

What are the potential adverse health consequences from radiation exposure from a terrorist nuclear attack?

People may become externally exposed and/or internally exposed. If there is a nuclear detonation, bodily injury or death may occur as a result of the blast itself or as a result of debris thrown from the blast. People may experience moderate to severe skin burns, depending on their distance from the blast site.

How to Prepare for a Radiation Emergency

How can I protect my family and myself from a terrorist nuclear attack?

You should cover your nose and mouth and immediately seek shelter in a stable undamaged building. Once inside close windows and doors, turn off air conditioners, heaters or other ventilation systems if possible. Listen to local radio or television stations for national emergency-alert information. As a general rule, you can reduce the potential exposure and subsequent health consequences by limiting your time near the radiation source, increasing your distance from the source or keeping a physical barrier (such as the wall of a building) between you and the source.

What should I do if there is a terrorist attack on a nuclear power plant near my home?

A terrorist attack on a nuclear power plant will initiate a national emergency response that has been carefully planned and rehearsed by Local, State and Federal agencies for more than 20 years. Contact the plant and as for a copy of their emergency plan. Study these plans and be prepared to follow the instruction that local and state public health officials provide in the event of a terrorist incident involving the nuclear power plant near your home.

What do I do if there is a dirty bomb explosion in or very close to the building that I am in and there is a danger the building might collapse?

Exit the building as soon as possible. If it is not possible, take shelter against your desk or a sturdy table.

- Do not use elevators.
- Check for fire and other hazards.
- Take your emergency supply kit if time allows.
- Find a safe place to take shelter until local authorities tell you to do otherwise.

What do I do if I am in the area where a dirty bomb is exploded and there is a fire?

- Exit the building as soon as possible.
- Crawl low if there is smoke.
- Use a wet cloth to cover your nose and mouth.
- Use your hand to feel a door top to bottom.
  - If the door is hot do not open it, look for another way out.
  - If the door is not hot, brace yourself against it and open it slowly.
- Do not use elevators.
- If you catch fire, do not run. Stop-drop-and-roll to put out the fire.
- Go to a previously designated meeting place.
- Account for your family members or coworkers. Carefully supervise small children.
- Never go back into a burning building.
- Find a safe place to take shelter until local authorities tell you to do otherwise.

What do I do if I am trapped in debris?

- If possible, use a flashlight, whistle or air horn to signal your location to rescuers.
- Avoid unnecessary movement so that you do not kick up dust.
- Cover your mouth and nose with anything you have on hand (dense-weave cotton material can act as a good filter). Try to breathe through the material.
- Tap on a pipe or wall so that rescuers can hear where you are.

- Shout only as a last resort. Shouting can cause a person to inhale dangerous amounts of dust and possibly radioactive materials.

Prussian Blue

What is Prussian Blue?

Prussian Blue is a medication named for a blue dye formerly used by artists and manufacturers. It is also called Radiogardase. It got its name from its use as a dye for Prussian military uniforms. Prussian Blue dye and paint are still available today from art supply stores.

How is Prussian Blue used to treat radioactive contamination?

Prussian Blue is used to treat people who have been internally contaminated with radioactive cesium or thallium. Prussian Blue can be given at any point after doctors have determined that a person is internally contaminated. Prussian Blue will help speed up the removal of cesium and thallium from the body. Prussian Blue can only be administered by a medical official when deemed necessary.

How does Prussian Blue work?

Radioactive cesium and thallium, whether ingested or inhaled, will end up in the intestines. Prussian Blue traps these materials in the intestines and keeps them from being absorbed by the body. The radioactive materials then move through the intestines and are excreted in bowel movements. Prussian Blue reduces the time that radioactive cesium and thallium stay in the body, it helps limit the amount of time the body is exposed to radiation.

Who can take Prussian Blue?

The drug is safe most all adults, children and infants, including pregnant women and women who are breast-feeding their babies. Prussian Blue may not be recommended for people who have had constipation or blockages in the intestines.

What are the side effects of taking Prussian Blue?

The most common side effects of Prussian Blue are upset stomach and constipation. These side effects can easily be treated with other medications. People will likely have blue feces during the time that they are taking Prussian Blue.

How soon after exposure to radioactive cesium or to thallium does somebody have to receive Prussian Blue to avoid illness and death?

Prussian Blue should be taken as soon as possible after exposure. However, even when treatment cannot be started right away, patients should be given Prussian Blue as soon as it becomes available because it is still effective even after time has elapsed since exposure.

Where can I get Prussian Blue?

Prussian Blue is not routinely available. It is supplied in 500-milligram capsules that can be swallowed whole or mixed in liquid for children to drink. The amount to be taken depends on how badly a person is contaminated.

Prussian Blue must be taken 3-4 times a day for up to 150 days, depending on the extent of the contamination, under the supervision of a doctor.

People ***SHOULD NOT*** take Prussian Blue artist's dye in an attempt to treat themselves. This type of Prussian Blue is not designed to treat radioactive contamination and is not manufactured in a germ-free area. People who are concerned about the possibility of being contaminated with radioactive cesium or thallium should go to their doctors for advice and treatment.

Can my doctor write a prescription for Prussian Blue for me to keep on hand?

No. Prussian Blue should be given only under the supervision of a physician after assessing your medical condition. It is only effective in treating contamination with radioactive cesium or thallium. The dose and duration of treatment depends on the amount of contamination a person is exposed to. Therefore, this drug should be given only when the physician has determined your need for it.

How do I know that Prussian Blue will be available in case of an emergency?

The U.S. government makes sure that needed medications, especially medicines that may be needed to treat a terrorist threat, are stored in sufficient quantity to provide treatment if there is an emergency.

Will Prussian Blue be added to the Strategic National Stockpile?

It is already part of the National Stockpile of drugs that can be used in an emergency situation.

Where can I find more information on these topics?

American Nuclear Society
http://www.ans.org/

Centers for Disease Control (CDC) Public Response Source at 1-888-246-2675
https://emergency.cdc.gov/radiation/

Clemson University – Clemson Extension Services at 803-788-2260
https://www.clemson.edu/research/safety/radsafety/

Conference of Radiation Control Program Directors (CRCPD) at 502-227-4543.
http://www.crcpd.org/

Federal Emergency Management Agency (FEMA) at 202-646-4600
https://www.fema.gov/
https://www.ready.gov/nuclear-power-plants

Health Physics Society
http://hps.org/

Humane Society of the United States, Disaster Services Program at (202) 452-1100
http://www.humanesociety.org/ace/352

International Atomic Energy Agency (IAEA)
https://www.iaea.org/

National Terror Alert Resource Center

http://www.nationalterroralert.com/

Radiation Emergency Assistance Center/Training Site (REAC/TS) at 865-576-3131
https://orise.orau.gov/reacts/

U.S. Department of Energy (USDOE or DOE) at 1-800-DIAL-DOE
https://www.energy.gov/

U.S. Department of Homeland Security – Ready.gov
https://www.ready.gov/

U.S. Department of State, The Bureau of Consular Affairs
https://travel.state.gov/content/travel/en.html

U.S. Environmental Protection Agency
https://www.epa.gov/

U.S. Food and Drug Administration (FDA) at 1-888-INFO-FDA
https://www.fda.gov/

U.S. Nuclear Regulatory Commission (USNRC or NRC) at 301-415-8200
https://www.nrc.gov/

World Health Organization, Radiation and Environmental Health Unit
http://www.who.int/ionizing_radiation/en/

For more information on DHEC's response to radiological and nuclear emergencies, contact:

Mary Nguyen Bright
Public Information Officer
S.C. Department of Health and Environmental Control
Nuclear Response and Emergency Environmental Surveillance
301 Gervais Street
Columbia, South Carolina 29201
brightmn@dhec.sc.gov
(803) 896-4099 or 1-844-723-7377

This page intentionally left blank.