Emergency Workers and Personnel & Equipment Monitors

State of Alabama
Office of Radiation Control
Alabama Department of Public Health

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Basic Radiation Training

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ADPH-Office of Radiation Control
FEMA/DHS is required to interview a certain number of emergency workers, personnel and equipment monitors to insure that they are aware of their radiation dose limits, equipment, and the basics of radiation. The training manual has a table of contents for looking up the answers for evaluated exercises.

This manual has a glossary in the back with radiation terms not routinely used. The glossary serves as a quick reference.

There is also text at the bottom of each page to assist you with any explanation that might occur at the time of a radiological incident.
Everything you need to know about radiation will be in this manual. In other words, this manual is not intended for a one time use. Place this manual in a location where you know you can get your hands on it when it is needed. An ideal place for law enforcement would be in their patrol car, for firemen would be on each fire truck, etc.
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In Alabama, there are two nuclear power plants. Plant Farley is in Houston County near Dothan, Alabama and Plant Browns Ferry is in Limestone County near Athens, Alabama.

Browns Ferry has four risk counties (counties within the 10-mile radius) and one host county for the overflow of the evacuees. The risk counties are: Limestone, Morgan, Lawrence, and Lauderdale. The host county is Madison.

Farley has only two risk counties (Houston & Henry) because of geographic ownership of the Chattahoochee River. We share responsibility with Georgia.

We train all emergency workers and personnel & equipment monitors in the 10-mile Emergency Planning Zone (EPZ). The EPZ is the 10-mile radius around the plant. We also have a different training program for the ingestion pathway counties (50-mile radius).

Training and equipment are the same across the entire State of Alabama. We keep a training database to keep track of trained personnel. We appreciate assistance from trained personnel in the event of a radiological incident at one of the nuclear power plants.
The Radiological Emergency Response Plan is the policy of the State of Alabama. The plan details the concept of radiological emergency planning and operation for off-site emergency response and recovery in the event of a radiological accident at a nuclear power plant. The plan is reviewed and updated annually.

During an evaluated exercise, FEMA/DHS evaluates us according to our plan. As long as we follow our plan and procedures, we can’t go wrong! The county EMAs take what is needed from the state plan and put it in their county plan. The county plan is tailored to a county’s needs. If you are a county emergency responder then follow your county plan.

No one agency can handle a radiological emergency alone. We must build and rely on partnerships from the States, Counties, Utilities and Federal agencies.
There are four Emergency Classification Levels (ECL) at all U.S. nuclear power plants. Nuclear power facilities use the ECLs as the method of communicating different types of incidents. Each ECL describes the specific actions that must be completed by both the licensee and the offsite emergency responders. Emergency classifications are declared for events that are occurring or have occurred affecting plant radiation safety or plant security. Each time an ECL is declared or changed, the State EOC Communications Center and/or the Utility (owner of plant) is required to make notifications to the responsible state agency, the Office of Radiation Control.

**Notification of an Unusual Event** - The least serious of the four classifications. Events in this class indicate:
- Potential degradation of plant safety
- Security threat to facility protection is initiated
- No release of radioactive material unless plant conditions degrade

**Alert** - An Alert is declared when events:
- Potential or actual degradation in plant safety
- Lives of onsite personnel may be threatened or site equipment may be damaged due to a hostile action

**Site Area Emergency** - A Site Area Emergency is declared when events:
- Actual or likely plant functions failure. Plant functions would be needed to protect the public’s health and safety
- Hostile actions that result in an intentional damage to plant personnel or equipment used to protect the public
- Malicious acts that could lead to failure of equipment used to protect the public or could prevent effective access to said equipment used to protect the public

*If not already accomplished, Radiation Control will issue two health orders, Public Warning and Restricted Access (of the 2-mile radius of the plant) and will send out radiological field monitoring teams to survey the area. We have state-trained and county-trained radiological field monitoring teams.*

**General Emergency** - A General Emergency is declared when events:
- Involve actual or imminent significant core degradation or melting.
- There is a potential for loss of containment integrity which may result in radioactive material to the atmosphere.
- Hostile action that results in an actual loss of physical control of the facility

*Based on the field measurements, wind speed, wind direction and status of the plant, Radiation Control could issue evacuation health orders or other health orders that are applicable.*
Radiation is a process where energy travels from one point to another by waves or particles, like the waves on the surface of the ocean. Radiation comes in various forms. A good example is the sun. Radiation is used everyday to improve our quality of life, from medical treatments to warming leftovers.

Atoms are the basis for all matter, consisting of a nucleus made up of neutrons, protons, and electrons. Naturally, only certain combinations of protons and neutrons occur. Some are stable and some unstable. Stable nuclei have no excess energy, but unstable nuclei become stable by releasing energy. This releasing energy is commonly called radioactivity. Radiation takes the form of either non-ionizing radiation or ionizing radiation.
The REM is the unit of dose equivalence and is the measure which accounts for the varying effects of different types of radiation on the human body. Two other units that are important in the scientific study of radiation are the ROENTGEN and RAD (radiation absorbed dose). But for our purposes, one roentgen equals one rad equals one rem.

**Roentgen (R)** is a unit of measurement for radiation exposure in air from x-rays or gamma rays.

**REM** is an acronym for Roentgen Equivalent in Man. It is measurement of the effect of all types of radiation on the human body.

**RAD** is an acronym for Radiation Absorbed Dose. It is a dose unit which is used to describe the amount of radiation absorbed by an object or person.
An average American’s annual effective dose is about 620 millirem per year. A millirem is 1/1000\textsuperscript{th} of a rem. Roughly 310 millirem come from natural sources; 310 millirem comes from man-made sources, primarily medical applications such as x-rays. Less than 1 millirem comes from nuclear power generation.

Virtually everything emits radiation. Radiation is a natural part of our environment. Radiation is in the air we breathe, the food we eat, the soil, our homes, sunshine, and even our bodies. Radiation is also present in consumer products such as tobacco products, smoke detectors, lantern mantels and building supplies. The radiation naturally occurring or existing in our environment is called background radiation. The amount of background radiation varies from one location to another. People may also be exposed to radiation through medical procedures (diagnostic & therapy) and dental x-rays.

The health effects of radiation exposure to people are measured in units called millirem. On average, Americans receive a radiation dose of about 620 millirem each year. Half of this dose comes from natural background radiation. Most of this background exposure comes from radon in the air, with smaller amounts from cosmic rays and the Earth itself. The other half (310 millirem) comes from man-made sources of radiation which includes medical, commercial and industrial sources. In general, a yearly dose of 620 millirem from all radiation sources has not been shown to cause humans any harm.

- Protective Action Guide for Nuclear Power Plants Evacuations 1,000 millirem
- Chest X-ray (posterior/anterior) 2 millirem
- Panoramix Dental X-ray 1 millirem
- Abdominal X-ray 7 millirem
- CT of Abdomen 800 millirem
- PET Scan for Cancer Staging 1,410 millirem
- Cardiac Stress Test with Thallium 201 4,070 millirem
- PET CT 4,500 millirem
In Alabama, we have two nuclear power plants and approximately 400 licensees that are authorized to use radioactive material. The types of licensed uses include medical, industrial and research. We also have naturally occurring radioactive material or (NORM) in the state. In addition, the Department of Energy (DOE) has shipments of low level waste as part of the Waste Isolation Pilot Plant (WIPP) that come down I-59 and I-20.

**Nuclear Power Plants**: Browns Ferry and Joseph M. Farley  
**Medical Uses**: Medical uses include hospitals, cancer centers, cardiology clinics and nuclear pharmacies.  
**Industrial Uses**: Industrial radiography companies in Alabama use radioactive material to x-ray welds at temporary job sites including paper mills, chemical plants, shipyards, oil and gas pipelines, etc. Well Logging Companies use radioactive material to help study geological formations. Moisture density gauges are commonly used by highway construction crews at job sites to help determine moisture content and compaction of the soil.  
**Research**: Most of the universities in Alabama have radioactive material licenses for research purposes.  
**NORM**: Naturally Occurring Radioactive Material. In South Alabama around Citronelle or Gilbertown, you will find elevated levels of NORM due to the scale that has accumulated on the gas wells’ piping and in the tanks. If it is greater than 50 microR/hr at the surface we require them to dispose of it through a radioactive waste broker. We have also seen piping from paper mills that had elevated radiation levels caused by kaolin clay used in the process. Kaolin is a white clay found primarily in Alabama and Georgia containing elevated levels of uranium and thorium decay series. In the paper process, it is used to produce high gloss for magazines and beer packaging. Up in Muscle Shoals, there is a giant slag pile with elevated radiation levels that exceed 100 microR/hr due to the byproducts created as part of the National Fertilizer Company in the 1970’s. This is under exclusive federal jurisdiction as part of TVA.  
**WIPP**: The WIPP program started in 1999 and its purpose is to secure national defense related transuranic waste below ground in the remote desert of New Mexico. Shipments come through Alabama from Oak Ridge National Lab and Savannah River National Lab. We are notified of these shipments and have computer access to track these shipments via GPS while they travel through Alabama. Transuranic waste is man-made isotopes that are heavier than uranium.
There are two types of radiation: non-ionizing and ionizing

One type of radiation, non-ionizing radiation, has enough energy to cause electrons within atoms to move and vibrate, but not enough to remove them from the atom itself. For example, microwave ovens use microwaves to force the electrons in food to move around, thus producing heat and heating the food. However, these electrons do not break away from the atoms of the food. We also come in contact with many types of non-ionizing radiation daily, such as, the sun that delivers light and heat. Other examples of non-ionizing radiation include visible light and radar waves.

Ionizing radiation comes in two forms: particulate and waves or rays. Ionizing radiation is more energetic than non-ionizing radiation. Ionizing radiation has enough energy to remove electrons from atoms, thus forming ions. When ionizing radiation passes through material, it deposits enough energy to break molecular bonds and displace (or remove) electrons from atoms thus creating ions. Ions are two electrically charged particles which may cause changes in living cells of plants, animals, and people. These types of radiation are associated with nuclear power plant generation. In nuclear power generation, fission (splitting an atom’s nucleus) takes place which results in radiation being produced by splitting an atom’s nucleus and may be emitted in three forms: alpha particles, beta particles, and gamma rays.
Alpha particle- A positively charged particle emitted from the nucleus of an atom. Alpha particles are charged particles, which are emitted from naturally occurring materials (such as uranium, thorium, and radium) and man-made elements (such as plutonium and americium). Alpha emitters are primarily used (in very small amounts) in items such as smoke detectors.

In general, alpha particles have a very limited ability to penetrate other materials. In other words, these particles of ionizing radiation can be blocked by a sheet of paper, skin, or even a few inches of air. As a result, alpha particles do not usually make anything radioactive. Nonetheless, materials that emit alpha particles are potentially dangerous if they are inhaled or ingested, but external exposure generally does not pose a danger.

Beta particle- A negatively charged particle emitted from the nucleus of an atom.

In general, beta particles are lighter than alpha particles, and they generally have a greater ability to penetrate other materials. As a result, these particles can travel a few feet in the air, and can penetrate skin. Nonetheless, they can be stopped by several sheets of paper, i.e. a thick book, a sheet of aluminum or plastic. Beta particles are both an internal and external hazard which can damage the skin and cause second-degree burns and eye damage. Elements with beta emitters can be used for medical purposes, such as treating eye disease.

Gamma ray- A photon originating from the nucleus of an atom. Gamma rays and x-rays consist of high-energy waves that can travel great distances at the speed of light and generally have a great ability to penetrate other materials. For that reason, gamma rays (such as cobalt-60) are often used in medical applications to treat cancer and sterilize medical instruments. Similarly, x-rays are typically used to provide static images of body parts (such as teeth and bones), and are also used in industry to find defects in welds. X-rays and gamma rays have great penetrating power and can easily pass through the human body.

Thick, dense shielding, such as lead, is necessary to protect against gamma rays. The higher the energy of the gamma ray, the thicker the lead must be. X-rays pose a similar challenge, so x-ray technicians often give patients receiving medical or dental X-rays a lead apron to cover other parts of their body. Gamma rays are external and internal hazards.
Video of the 4 types of ionizing radiation: Alpha, Beta, Gamma & Neutron
The ALARA philosophy is the foundation for all exposure (dose) limits. ALARA is based on the assumption that radiation exposure of any amount is a potential hazard. ALARA means making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical, thus As Low As Reasonably Achievable.

Do not spend more time than necessary near a radiation source. Stay as far away from a radiation source as you can. Place material between you and the source of radiation.

Use a common sense approach when dealing with radiation!
We cannot eliminate radiation from our environment. But we can, however, reduce our risk by controlling our exposure to it. Radiation is very easily detected. There are several simple, sensitive instruments capable of detecting minute amounts of radiation from natural and man-made sources. There are three ways in which people can protect themselves from ionizing radiation:

1. Time
2. Distance
3. Shielding
For people who are exposed to radiation, in addition to natural background radiation through their work, the dose is reduced and the risk of illness essentially eliminated by limiting exposure time.

If you decrease the amount of time you spend near the source of radiation, you will decrease the amount of radiation exposure you receive. To imagine this, think of a trip to the beach as a comparison. For instance, if you spend a lot of time on the beach, you will be exposed to the sun, and, ultimately, get a sunburn. If you spend less time in the sun and more time in the shade, your sunburn will be much less severe. This is a comparison of how radiation exposure works.

The less time you spend in a radiation area, the less dose you will receive. Emergency workers will be assigned to work in a radiation area only for the amount of time required to accomplish their particular task.

For example, if you were working in an area where the exposure rate was 50mR/hr and you stayed there for one (1) hour, you would receive a dose of 50 millirem. But if you remained there for only a half an hour (30minutes), you would receive half the dose or 25 millirem.
The farther away you are from a source of ionizing radiation, the less dose you will receive. In the same way that heat from a fire is less the farther away you are, the intensity of radiation decreases farther from its source.

Because of the inverse square law ($1/d^2$), each time you double your distance from a point source of radiation, you will receive one-fourth (1/4) of the dose. If you triple the distance from a point source of radiation, you will only receive one-ninth (1/9) of the dose.

Example: If your exposure rate at a distance of one (1) foot from a point source of radiation is 100 mR/hr, then if the distance is doubled to two (2) feet away, then the exposure rate will now only be 25 mR/hr.

Example: The farther away you are from a radiation source, the less dose you will receive. Compare this to an outdoor concert. You can sit directly in front of a speaker, 50 yards from the stage, or on the grass in the park across the street. If you sit in front of the speaker, you will probably suffer some damage to your hearing. If you sit 50 yards from the stage, you will be exposed to an average amount of music. If you sit in the park across the street, the noise is even further reduced and you might not even hear the concert, or even know what song they are playing.
The use of shielding, such as lead, steel, concrete, or earth, between you and a source of radiation will also reduce your exposure. The amount of reduction depends on the type and thickness of the shielding material. Barriers of lead, concrete, or water give good protection from penetrating radiation such as gamma rays. Radioactive materials are therefore often stored or handled under water, or by remote control in rooms constructed of thick concrete or lined with lead.

If you increase the shielding around a radiation source, it will decrease your exposure. For example, if you stand out in the rain without an umbrella, you will get wet. But, if you use an umbrella to shield you from the rain, you will remain dry and protected. This is similar to the idea of shielding in radiation protection.

So when possible, emergency workers in radiation areas should take advantage of shielding (standing behind buildings, cars or some other means of shelter) to reduce their exposure. Keep something substantial between you and a point source of radiation. In the event of a radioactive plume, sheltering while the plume passes may be helpful.
Video of the 3 protection principals: Time, Distance & Shielding
Radiation exposure is energy that passes through and may do damage but does not contaminate. So when a person is exposed to radiation it does not necessarily mean that the person is contaminated. In order to become contaminated a person has to be physically in contact with the radioactive material. When radioactive material is where it is not wanted (e.g., on the ground, in water, or on you), we refer to it as “contamination”. Contamination is measured in counts per minute (cpm) and disintegrations per minute (dpm).

If someone is contaminated (externally), most of the material could be easily removed from the body by removing the clothing and washing with a mild soap and shampoo.

Example: We all go to the dentist and periodically receive an x-ray of our dental work. The energy of the x-ray travels through our tissue and teeth which develops the film to be read by the dentist. The x-ray passed through our teeth but did not physically touch our body in any way. Note: X-rays, CT scans, fluoroscopy, any machine producing radiation does not contaminate the patient.

If a radiological incident or accident occurs at a nuclear power plant in Alabama, the risk counties have procedures in place to open reception centers in order to monitor evacuees and emergency workers for radiation contamination and if needed, decontaminate. At reception centers, the evacuees and/or emergency workers can be decontaminated by gender which typically takes place at school gymnasiums, recreation centers, or decontamination tents.
External hazards of radiation dose are beta particles and gamma rays. Beta particles can cause burns to the skin. Gamma rays are very energetic and can penetrate through internal organs.

Internal hazards of radiation dose are alpha particles, beta particles, gamma rays and neutron particles. Once inside the body, they all become very harmful internal hazards. Radiological materials may enter the body by ingestion, by inhalation, or by absorption through a cut or break in the skin such as a wound.
Contamination occurs when an individual comes in contact with radioactive material. This may be external, internal, or a combination of the two. When people walk through, touch, or have radioactive material spill or fall upon them, they are externally contaminated. The contamination causes exposure.
A contaminated individual may have also sustained a physical injury. In all cases, the treatment of an injury takes priority over decontamination.

Contamination is nothing more than a nuisance. Injuries come first and decontamination comes second.
Video of Radiological basics
Acute dose- A one time, limited, or short term dose. The greater the radiation dose and the shorter the period of time during it is received, the greater the risk to the individual. Note: Radiation Therapy is not the same as Chemotherapy.

Large doses of radiation directed specifically at a tumor are used in radiation therapy to kill cancerous cells, and thereby often save lives. Much larger doses are used to kill harmful bacteria in food, and to sterilize bandages and other medical equipment. Radiation has become a valuable tool in our modern world.

Chronic dose- Continuous or long term dose. With a chronic dose, the effects are the results of radiation dose over a long period of time, due to background or occupational radiation exposure.
Video of the Biological effects of radiation
Ionizing radiation cannot be detected by our five (5) senses. We **cannot** feel, taste, smell, see, or hear radiation. The safety of emergency responders is the most important consideration when responding to a radiological incident. Safety is accomplished by the use of radiological instruments which help the first responder detect, measure, and document the amount of radiation in a radiological response. Therefore, we must use radiation detection instruments such as pocket dosimeters and other equipment to know if, when, and how much radiation is present.

You must learn to read the instruments properly because the instruments will let you know if radiation is present. You have to rely on them.
In a radiation emergency at a nuclear power plant, radioactive iodine in the form of I-131 may be released into the air. Potassium Iodide can help prevent radioactive iodine from being absorbed into your thyroid.

All radioactive material targets different parts of our bodies. Some are organ seekers, bone seekers, blood seekers, etc. Radioactive iodine is a thyroid seeker. Our thyroid gland works like a sponge. We’re going to fill the thyroid gland up with nonradioactive iodine in the form of KI (Potassium Iodide). So if radioactive iodine happens to be breathed in, the thyroid gland is already full and would not accept much more, if any. So the radioactive iodine would be excreted from your body with minimal damage.

When there is a need for Potassium Iodide, KI will be made available to you. Potassium Iodide is stockpiled at the county health departments (Houston, Morgan, Lawrence, Lauderdale, and Limestone) in the possession of the county health nurse. If you are told to take KI, take 1 dose for every 24 hours (Daily dose = (1) 130 mg tablet or (2) 65 mg tablets) you are exposed to radioactive iodine. Do not take more often and do not take this drug if you know you are allergic to iodine.
Pocket Dosimeters

- Look through the dosimeter toward a light source

The pocket dosimeter is read by pointing it toward a good source of light and viewing the scale and hairline through the lens at the clip end of the dosimeter. When reading pocket dosimeters, always keep the scale in the horizontal position to ensure an accurate reading.

If the dosimeter is exposed to radiation, the hairline will move along the scale to indicate the amount of exposure.

While performing the tasks of an emergency worker, **read your dosimeter every 15 to 30 minutes.** Record the beginning and ending dosimeter readings on the Radiation Exposure Record. The difference between the beginning and the ending is your exposure.
Emergency workers measure their radiation exposure with a pocket dosimeter. Pocket dosimeters are a piece of equipment which can be read immediately by the wearer. Radiation exposure is measured in Roentgen (R) and Milliroentgen (mR). The pocket dosimeter will let you read how much dose you have received.

Pocket dosimeters are similar to odometers. The accumulated exposure recorded on a dosimeter can be compared to the accumulated distance on an odometer.

All emergency workers working in a radiation field will be issued two (2) pocket dosimeters. One (1) low-range dosimeter reading in 0-200 mR and one (1) high-range dosimeter reading in either 0-20 R or 0-5 R.
Video on dosimetry
The dosimeter charger is used to charge or zero the pocket dosimeters with different lengths and ranges. The charger provides 200 volts to the direct-read dosimeter that moves the hairline down to zero.

Instructions on using the CDV 750 dosimeter charger:
1. Adjust the clamp to fit the length of the dosimeter.
2. Pull the clamp trigger back and insert the dosimeter with the clip toward the back. The dosimeter must have a snug fit. Make sure the scale of the dosimeter is horizontal.
3. Look to see if there is a hairline. If there is a hairline, pump the black generator lever to “charge” or zero the dosimeter. If you don’t have a hairline, then give the generator lever a few quick pumps and the hairline will appear on the right hand side. Continue pumping the generator lever until the hairline is on zero.
4. If the hairline falls below zero, press the black discharge button to bring the hairline back to zero.
5. Dosimeter removal: to remove from the charger, squeeze the clamp trigger and lift the dosimeter above the end of the clamp, pulling it straight back to disengage it from the chargingcontact.
6. Once removed from the charger, read the dosimeter to ensure that the hairline has remained on the zero reading. It may be necessary to re-zero the dosimeter.
The thermoluminescent dosimeter, sometimes called a TLD card, is a laminated wallet-sized card which provides a permanent record of the wearer’s dose. TLDs are extremely accurate and will give the exact amount of exposure. The TLD card serves as your legal/permanent record to radiation.

TLD cards are so precise, they will give the exact amount of dose from radiation. TLDs contain two (2) lithium fluoride chips which absorb and store the energy received from exposure to radiation. Unlike the pocket dosimeters, TLD cards cannot be read directly by the user. When you complete your emergency worker duties, you will turn the TLD card in, your TLD will be sent off to be read and you will be notified of your dose.

Remember the thermoluminescent dosimeter serves as your legal/permanent record.
TLDs and pocket dosimeters should be placed between the shoulder and the waist (preferably on the chest area).

Since TLDs cannot be read by the wearer, TLDs should be placed on street clothes or under protective clothing.

Pocket dosimeters need to be placed on the outside of the clothing whether it’s street clothing or protective clothing so they can easily be accessible when reading and reporting at predetermined time (15-30 minute) intervals.
In Alabama, the administrative limit is stated in terms of the external dose which is measured by a pocket dosimeter. To account for the internal dose, which cannot be measured prior to or during a mission, the internal dose is assumed to be equal to the external dose. The two doses (internal & external) added together is the Total Dose or TEDE. In Alabama, twice (2x) the pocket dosimeter reading is recorded as a person’s TEDE.
Although emergency workers are not expected to be exposed to significant levels of radiation, the dosimeter reading values are shown in the right hand column. The administrative limit for emergency workers in Alabama is set at one-half of the EPA-recommended limits. This table shows the dosimeter readings that will most likely keep the TEDE (Total Dose) from exceeding the EPA limit. Do not exceed the limits in the right hand column and you will not exceed your TEDE (Total Dose).

The green wallet size card is for Emergency Workers. The 3 radiation dose limits apply to all emergency workers.

Emergency workers are instructed to seek relief at 100 mR on their dosimeter. Do not wait until the dosimeter is on 100 mR before you request relief. Remember you are recording your dosimeters every 15-30 minutes. Call to request relief when your dosimeter approaches 100 mR; this gives your replacement ample time to travel to your destination to relieve you.

- Remember 100 mR on dosimeter (external) + 100 millirem (internal) = 200 mrem TEDE.
- Which dosimeter would you be reading? Answer: Low range (black or silver)

Emergency workers are allowed to receive 1 rem per day TEDE; your dosimeter would be reading 500 mR.

- 500 mR on dosimeter (external) + 500 millirem (internal) = 1000 mrem = 1 rem TEDE.
- Which dosimeter would you be reading? High Range (yellow)

Emergency workers are allowed to receive 5 rem maximum per accident TEDE; your dosimeter would be reading 2.5 R.

- 2.5 R on dosimeter (external) + 2.5 rem (internal) = 5 rem TEDE.
- Which dosimeter would you be reading? High Range (yellow)

The Annual Occupational Limit (AOL) for individuals who work in the radiation area are allowed to receive 5 rem per/year TEDE.
The back of the green wallet size card shows additional radiation dosage limits for emergency workers. An emergency worker could receive up to 25 rem TEDE for life saving situations. At that point your dosimeter should be reading 12.5 R. 12.5 R on dosimeter (external) + 12.5 rem (internal) = 25 rem TEDE.

Key reminders for emergency workers are listed at the bottom.

Remember – You can carry/have the green wallet-sized card at all times. This green card lists all your limits and keynotes since you may not have access to the manual.
1. KI tablet
   - When do you take the KI? (when your county EMA has instructed you to)
   - How often and how many should you take? (one (1) 130 mg tablet or two (2) 65 mg tablets every 24 hours as needed)
   - Who should not take KI? (a person who has a known medical history to iodine)

2. Thermoluminescent Dosimeter (TLD Card)
   - Can you read a TLD card? (No)
   - What does the TLD card serve as? (Your legal permanent record)

3. Two Pocket Dosimeters. One low range and one high range.
   - By color, which is the high range? (Yellow)
   - What units are used by the high range dosimeter? (0-20 Roentgen) or (0-5 Roentgen)
   - How often would you check and record your dosimeters? (Every 15-30 minutes; Read 15 minutes in > 1 mR/hr field or every 30 minutes < 1 mR/hr field)
   - What is your seek relief limit? (100 milliroentgen)
   - Which dosimeter would you be reading? (Black or Silver- Low range, 0-200 milliroentgen)

4. Record your pocket dosimeter readings on the Radiation Exposure Record.
Emergency Worker Training
The Ludlum 14C survey meters are highly sensitive broad range radiation detectors. The Ludlum 14Cs may have two probes. The pancake probe is used to survey for radiation contamination. The HP probe (hotdog) is used to measure radiation exposure rate. The broad range of the Ludlum 14C is $0 - 6,600,000$ cpm or $0 - 2000$ mR/hr. The Ludlum 14C can detect radiation contamination and discriminate between beta and gamma radiation. When using the pancake probe, face the window toward the equipment/personnel being surveyed. The Ludlum 14C will detect beta and gamma radiation. By flipping the probe over and facing the window away from the equipment/personnel being surveyed, the Ludlum 14C will detect gamma radiation only. When using the HP probe (hotdog probe) with the shield open, the Ludlum 14C will detect beta and gamma radiation. By closing the shield, the Ludlum 14C will detect gamma radiation only.
Parts of the Ludlum 14C
1. Response Switch – Turn to the “F” position for a fast response.
2. Audio Switch – Turn to the “ON” position to hear the clicks.
3. Reset Button – Press this button when you change the dial for the meter to read a different scale.
4. Battery Check Button – Press this button to insure batteries are good. The hairline will peg to the “BAT Test” or “BAT OK” area on the scale.
5. Scale – Use the top scale when monitoring for contamination (CPM). Use the middle scale when measuring dose rate when the meter is set on the X0.1, X1, and X10. And use the bottom scale when measuring dose rate when the meter is set on the X100.
6. Probe connector – Connect cable to probe connector and the probe.
7. Multiplier Switch – A 6-position switch marked OFF, x1000, x100, x10, x1, x0.1. Always set switch at X0.1 to check background and to monitor for contamination.
8. Battery compartment – Two “D” size batteries.
A contamination reading from a survey meter can be compared to the rate of speed registered on an automobile speedometer. A speedometer tells us our rate of speed in miles per hour.

We can use a survey meter to determine if radioactive contamination is present. Radioactive contamination is measured in COUNTS PER MINUTE (CPM or C/M) and can be measured with a survey meter such as a Ludlum 14C (top scale).
The face plate of the Ludlum 14C has three (3) scales and a hairline. The top scale is used when monitoring for contamination. The middle scale is used for measuring exposure rate. The bottom scale is also used for measuring exposure rate but only when the multiplier switch is in the X100 position.

Contamination is always measured in CPM (Counts Per Minute). Use the pancake probe (44-9) for contamination survey. Always start on the lowest scale of x0.1.

**NOTE:** With the dial set on the X.1 (lowest), the CPM scale is reading 0-600 CPM.  
Dial set on X1, the CPM scale reads 0-6,000 CPM.  
Dial set on X10, the CPM scale reads 0-60,000 CPM.  
Dial set on X100, the CPM scale reads 0-600,000 CPM.  
Dial set on X1000, the CPM scale reads 0-6,000,000 CPM.
Before any possibly contaminated individuals arrive at the reception center, check the operation of
the survey meter and record background radiation at that location. Follow the steps below:

1. Verify annual calibration due date has not expired.
2. Conduct a physical inspection of meter.
3. Turn the selector switch to the Off position.
4. Turn toggle switch(s) to AUD “on” and to “fast” response.
5. Open battery compartment beneath handle and install 2 D-cell batteries.
6. Connect cable to unit and a pancake (44-9) probe.
7. Turn selector Switch to lowest scale (x0.1) and press BAT button. Needle should deflect to “BAT OK”
8. Open the source window and place open probe against source for visual needle deflection and listen for an audible sound then scale up with selector switch until a reading is obtained.
9. Each probe shall read within +/- 20% of the reference reading found on the calibration sticker.
Place open probe (like photo above) against the open source window and compare with calibration label found on meter.
10. Cover probe with plastic (Cling or Saran) Wrap, Zip lock (Non-freezer) bag or Latex glove. This prevents the probe from being contaminated. If using glove, fold back fingers and tape down toward handle.
11. Take a background radiation reading with probe open window (X0.1 position) using the pancake probe (44-9). Take the highest average needle deflection and divide by 2. Average background using a Ludlum is typically 50 counts per minute (cpm).
12. For problems contact the local EMA.

*Follow instructions attached to Ludlum for reference*
Ludlum 14C
What is the Meter Reading?

360 CPM
Ludlum 14C
What is the Meter Reading?

80 CPM
Ludlum 14C
What is the Meter Reading?

54,000 CPM
Ludlum 14C
What is the Meter Reading?

6,200 CPM
Ludlum 14C
What is the Meter Reading?

OFF-SCALE: Need to change “Multiplier Switch” to x1. Check cable and batteries “RESET” button.
Ludlum 14C
What is the Meter Reading?

180,000 CPM
Ludlum 14C
What is the Meter Reading?

42,000 CPM
Ludlum 14C
What is the Meter Reading?

2,400 CPM
Ludlum 14C
What is the Meter Reading?

400,000 CPM
Ludlum 14C
What is the Meter Reading?

540 CPM
Monitoring for contamination using a Ludlum 14C

1. Using the pancake probe, face the window toward the equipment/personnel.
2. Start at the top of the head.
3. Hold pancake probe 1” inch away.
4. Move at a rate of 1” inch per second.
5. Pay close attention to the hair and soles of the shoes.
6. When contamination is detected, record on a personnel/monitoring record where the contamination was found.
7. Survey thyroid gland with the probe closed window.

NOTE: If the hairline reaches the max amount, step away from the victim, switch the dial to the next position, push the reset button then continue monitoring. Repeat steps if needed. Once contamination is no longer present in that area and has been recorded on the personnel/monitoring record, remember to turn the scale back to the lowest scale and continue the survey.

Typical background radiation using a Ludlum 14C is 50 cpm. Twice background radiation warrants decontamination.
Monitoring the thyroid
1. Place the back of the pancake probe (window face away from the personnel or metal side facing the personnel) 1 inch away from the Adam’s apple.
2. Multiply the meter reading by .04 to determine the thyroid uptake in rem.
3. Thyroid uptake limit is 5 rem.

If the thyroid uptake is ≥5 rem, then additional internal monitoring should be conducted by the appropriate medical department.
Although personnel & equipment monitors are not expected to be exposed to significant levels of radiation, dosimeter reading values are shown in the right hand column.

These are the same limits as the emergency workers (Green Card).
The back side of the Personnel & Equipment Monitors “yellow card” is different.

Listed at the top are key reminders that a personnel & equipment monitor needs to remember when dealing with radiation.

Listed at the bottom are instructions on determining the uptake of radioactive iodine in rem. A check of the thyroid gland can be made by holding the probe (shield closed) in a horizontal position just below the Adam’s apple. And using the Ludlum 14C, the count rate in excess of background and surface contamination multiplied by .04 is assumed to be due to thyroid uptake. The thyroid uptake limit is 5 rem.
Portal monitors (look similar to metal detectors in court houses) are used in Radiological Emergency Preparedness (REP) program counties to quickly screen large populations for contamination. Portal monitors can be used to screen personnel and vehicles for radiation contamination.

- Unpack and assemble portal monitor per instructions. Power for portal is 110v AC, 3 “D” cell batteries or generator.
- Set the base on the ground and insert corresponding labeled sections to base. Detector screens must be facing in and latched.
- Connect horizontal crossover piece to the vertical legs.
- Connect the power cord to the bottom of the Controller Module; then align Controller Module to bottom left section with black connectors. Ensure the pin on back of the bottom left section goes into hole of Controller Module.
- Check for the annual accuracy label which should be affixed to the monitor.
- Connect power cord to 110v AC outlet and turn on the Controller Module using the rocker switch.
- Background count (YELLOW light) will be initialized by portal followed by a GREEN light. The Controller Module has a digital display which is illuminated in RED or GREEN when the beam is broken by a person or vehicle.
- Verify all detectors are operating by taking a 1 µCi beta/gamma-emitting check source and pass through portal at five points as a minimum check. Each location is operationally checked when the RED light and digital display correspond to the location of the check source.
- Hold check source at waist level (center line) then step into the portal; an audible alarm with a flashing RED light should be heard when detection occurs. Conduct a separate check for all four quadrants which include both upper (right and left) and lower (right and left) panels.
- Wrap entire portal monitor with plastic wrap for contamination control and place appropriate step-off pad(s) for monitoring.
- A RED light and a digital display showing location will trigger the need for a hand-held instrument.
- Establish a boundary line at least ten (10) feet for people and vehicles. Verify contamination does not exist on shoes; if contamination is found then bag and label.
- Document survey for people on appropriate form. Note: a chair may be necessary to assist with the individual’s balance when requested to pick up feet in order to monitor the soles of a shoes.
Screening Personnel

- Establish a boundary line at least ten (10) feet for people and vehicles. Verify contamination does not exist on shoes; if contamination is found then bag and label.

- Document survey for people on appropriate form. **Note:** a chair may be necessary to assist with the individual’s balance when requested to pick up feet in order to monitor the soles of a shoes.

- If the person is contaminated, the individual will be surveyed using a Ludlum 14C handheld survey meter (1 inch away and 1 inch per/second) and then directed to the showers.

- If the person is not contaminated, the individual will be directed to go to registration.

Vehicle Use

- Assemble portal monitor per instructions; except base and top plate will not be needed for surveillance of vehicles.

- Base plate will be replaced by two (2) stands connected by cables.

- Protect cables by using a vehicle ramp or available material.

- Instruct drivers to drive slowly through the portal.

- Portals are to be used in tandem with a hand-held instrument. Refer to Vehicle/Monitoring Record for areas to be scanned.

- Document survey for vehicles on appropriate vehicle form.

- Refer to survey form and those in charge for decontamination methods.

- For problems or questions, contact local EMA official.

Contamination level is twice the background (2 X BKG).
1. If survey readings are greater than (> background radiation but less than (<) twice background radiation, a shower and change of clothes is recommended.

2. If survey readings are greater than twice background radiation (2x), a shower and change of clothes is required. Contamination can be localized therefore required actions maybe limited to washing hands, removal of shoes, etc for decontamination.

3. After a shower and change of clothes, a survey reading of twice (2x) background will require a detailed decontamination.

4. Conduct another survey of individual and if greater than (> background radiation then contact the Radiation Control Agency (RCA).
1. KI tablet
   - When do you take the KI? (when your county EMA has instructed you to)
   - How often and how many should you take? (one (1) 130 mg tablet or two (2) 65 mg tablets every 24 hours as needed)
   - Who should not take KI? (a person who has a known medical history to iodine)

2. Thermoluminescent Dosimeter (TLD Card)
   - Can you read a TLD card? (No)
   - What does the TLD card serve as? (Your legal permanent record)

3. Two Pocket Dosimeters. One low range and one high range.
   - By color, which is the high range? (Yellow)
   - What units are used by the high range dosimeter? (0-20 Roentgen) or (0-5 Roentgen)
   - How often would you check and record your dosimeters? (Every 15-30 minutes; Read 15 minutes in > 1 mR/hr field or every 30 minutes < 1 mR/hr field)
   - What is your seek relief limit? (100 milliroentgen)
   - Which dosimeter would you be reading? (Black or Silver- Low range, 0-200 milliroentgen)

4. Record your pocket dosimeter readings on the Radiation Exposure Record.

5. Ludlum 14C.
   - How fast and how far should you monitor for contamination? 1 inch away and 1 inch per/second.
   - What is the contamination level in Alabama? 2 x background.
   - Is the probe open or closed to monitor for contamination? Open.
   - When is the only time the probe is closed? Checking the thyroid for the uptake of radioactive iodines.

6. Record survey readings on the “Personnel Monitoring/Decontamination Record” and “Vehicle Monitoring/Decontamination Record”.
Personnel & Equipment Training
Glossary

• **ALPHA RADIATION** – A positively charged particle emitted from the nucleus of a radioactive element. It has a low penetrating power and has a short range - a few inches. Alpha particles are not an external hazard but are extremely hazardous when introduced into the body.

• **ALARA** – An acronym for As Low As Reasonably Achievable. An approach to radiation protection to control or manage exposures as low as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit but a process to keep dose levels as far below applicable limits as reasonably achievable.

• **BACKGROUND RADIATION** – The radiation in the natural environment, including cosmic rays and radiation from the naturally radioactive elements, both outside and inside the bodies of humans and animals. It is also called natural radiation. The average individual exposure from background radiation is 620 millirem per year.

• **BETA RADIATION** – A negatively charged particle emitted from the nucleus during radioactive decay. It has a medium penetrating power and a range of up to a few feet. Large amounts of beta radiation may cause skin reddening, and are harmful if they enter the body. Beta radiation is an external and internal hazard.

• **CONTAMINATION** – The deposition of unwanted radioactive material on the surface of structures, areas, objects, or personnel. Radioactive material in a location where it is unwanted.

• **CPM** – An acronym for counts per minute and is associated with contamination surveys. The pancake probe (44-9) with the Ludlum 14, is used when detecting for contamination.

• **DECONTAMINATION** – The reduction or removal of radioactive material from a location where it is unwanted.

• **DOSIMETER** – A portable instrument or device used for measuring and registering the total accumulated exposure to ionizing radiation. Examples are pocket dosimeter, TLD or film badge.

Glossary

- **EMERGENCY WORKER** – An individual performing duties to protect the health and safety of the public during a radiological emergency (e.g., firemen, school bus driver, police, highway personnel, medical personnel, etc.)

- **EXPOSURE** – The absorption of radiation or ingestion of a radionuclide.

- **EXPOSURE RATE** – The measure of radiation by a device (survey meter) over some time period, usually an hour.

- **GAMMA RADIATION** – A high energy photon emitted from the nucleus of an atom. It has the most penetrating power and a range of up to hundreds of feet. Gamma rays will penetrate the internal organs, therefore, they are an internal and external hazard.

- **GEIGER-MUELLER COUNTER** – A radiation detection and measuring instrument. It consists of a gas-filled tube containing electrodes, between which there is an electrical voltage but no current flowing. When ionizing radiation passes through a tube, a short intense pulse of current passes from the negative electrode to the positive electrode and is measured or counted. The number of pulses per second measures the intensity of radiation.

- **ION** – An atom that has too many or too few electrons, causing it to be chemically active; an electron that is not associated (in orbit) with a nucleus.

- **IONIZING RADIATION** – Any radiation capable of displacing electrons from atoms, thereby producing ions. Examples: alpha, beta, gamma, x-rays, neutrons and ultraviolet light. High doses of ionizing radiation may produce severe skin or tissue damage.

- **INVERSE SQUARE LAW** – The law states the gamma rays intensity is inversely proportional to the square of the distance from a point source. Therefore, doubling the distance from a point source of gamma radiation decreases the exposure rate to one-fourth (1/4) the original exposure rate.
Glossary

- IONIZATION – The process of adding one or more electrons to, or removing one or more electrons from, atoms or molecules, thereby creating ions. High temperatures, electrical discharges, or nuclear radiation can cause ionization.

- LITHIUM FLUORIDE – A chemical compound used in thermoluminescent dosimeters.

- KCPM – An acronym for kilo counts per minute (thousands of counts per minute).

- MILLI – A prefix meaning one-thousandth (1/1000) or divides a basic unit by 1000. For example, millirad is one-thousandth part of a rad.

- PERSONNEL MONITORING EQUIPMENT – Devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), and pocket dosimeters.

- POTASSIUM IODIDE (KI) – A chemical form of stable iodine that can be used by the body to block absorption of radioactive by the thyroid gland.

- RAD – An acronym for Radiation Absorbed Dose. The special unit of absorbed dose. One (1) rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).

- RADIATION – Excess energy in the form of rays or high-speed particles. Radiation occurs naturally as in sunlight. Radiation is also produced by the form of x-rays, medical treatments, nuclear weapons, and commercial nuclear power facilities. All forms of electromagnetic radiation make up the electromagnetic spectrum.

- RADIOACTIVE MATERIAL – Any material which spontaneously emits particle or photon radiation in an effort to expend excess energy.

- RADIOACTIVITY – The spontaneous emission of radiation, generally alpha or beta particle often accompanied by gamma rays from the nucleus of an unstable isotope.
Glossary

- **RCA** — An acronym for Radiation Control Agency.

- **REM** — Roentgen Equivalent in Man. The special unit of dose equivalent in man. It is measurement of the effect of all types of radiation on the human body.

- **ROENTGEN (R)** — A unit of exposure to ionizing radiation in air. It is radiation effect in air from x-rays or gamma rays.

- **SHIELDING** — Any material or obstruction that absorbs radiation and thus tends to protect personnel or material from the effects of ionizing radiation.

- **SURVEY METER** — Any portable radiation detection instrument adapted for inspecting an area to establish the existence and amount of radioactive material present.

- **TEDE** — An acronym for Total Effective Dose Equivalent. Total Dose = External Dose + Internal Dose.

- **THERMOLUMINESCENT DOSIMETER (TLD)** — An extremely accurate device used to measure and provide a permanent record of exposure to radiation.

- **X-RAY** — A photon originating from the electron cloud rather than from the nucleus of an atom. One form of electromagnetic radiation. It has penetrating power like gamma radiation. X-rays will penetrate the internal organs, therefore, they are an internal and external hazard.
## Radiation Exposure Record

<table>
<thead>
<tr>
<th>#</th>
<th>Time (24 hr)</th>
<th>Reading</th>
<th>Status (✓)</th>
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<tbody>
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<td>Low Range</td>
<td>High Range</td>
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<tr>
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<td>Initial Reading</td>
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Note! Read dosimeter every 30 minutes

7/2016

Name: ________________________ Date: ___/___/___
<table>
<thead>
<tr>
<th>#</th>
<th>Date (M/D/Y):</th>
<th>Name:</th>
<th>Dosimeter(s)</th>
<th>TLD Card</th>
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</table>
# Personnel Monitoring/Decontamination Record

## PERSONNEL MONITORING/DECONTAMINATION RECORD

### PERSONAL INFORMATION

<table>
<thead>
<tr>
<th>Name:</th>
<th>SSN:</th>
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<tbody>
<tr>
<td>Address:</td>
<td>Sex: M/F</td>
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<tr>
<td>City:</td>
<td>State:</td>
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<tr>
<td></td>
<td>Zip Code:</td>
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<tr>
<td></td>
<td>Phone#:</td>
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<tr>
<td>Reception Center:</td>
<td>Date:</td>
</tr>
</tbody>
</table>

## THYROID DOSE

<table>
<thead>
<tr>
<th>Ludlum 14C (multiply CPM x .04)</th>
<th>Adult Thyroid Uptake Limit - 5,000 mRem (5 Rem)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Reading: _______ mRem</td>
<td>Following 1st Decon: _______ mRem</td>
</tr>
<tr>
<td></td>
<td>Following 2nd Decon: _______ mRem</td>
</tr>
</tbody>
</table>

**NOTE:** If reading ≥ 5 rem, escort individual to hospital for internal decontamination.

## EXTERNAL CONTAMINATION

<table>
<thead>
<tr>
<th>Area of Contamination (Indicate Location on Diagram Below)</th>
<th>Initial Reading (Hairline x Dial)</th>
<th>Background Reading: _______ CPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tbody>
</table>

Initial Reading  
1st Decon  
2nd Decon

- □ Not Contaminated  
- □ Sent to 1st Decon  
- □ Decontaminated  
- □ Sent to 2nd Decon  
- □ Decontaminated  
- □ Contact Radiation Control

Monitor’s Signature:  
Decon Monitor’s Signature:  
JUL16  
73
Vehicle Monitoring/Decontamination Record

<table>
<thead>
<tr>
<th>VEHICLE MONITORING/DECONTAMINATION RECORD</th>
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<td>Model:</td>
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<tr>
<td>Color:</td>
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<td>Tag:</td>
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</table>

NOTE: Contamination Limit in Alabama is 2 X Background

Initial survey of vehicle:

(Indicate the Location)

<table>
<thead>
<tr>
<th>Front Bumper</th>
<th>Rear Bumper</th>
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</thead>
<tbody>
<tr>
<td>_____ CPM</td>
<td>_____ CPM</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Driver’s Side Tire/Wheel Well</th>
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</thead>
<tbody>
<tr>
<td>(Front) _____ CPM</td>
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<tr>
<td>(Rear) _____ CPM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Driver’s Side Door Handles</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Front) _____ CPM</td>
</tr>
<tr>
<td>(Rear) _____ CPM</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Passenger’s Side Tire/Wheel Well</th>
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<tbody>
<tr>
<td>(Front) _____ CPM</td>
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<tr>
<td>(Rear) _____ CPM</td>
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<table>
<thead>
<tr>
<th>Passenger’s Side Door Handles</th>
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<td>(Front) _____ CPM</td>
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<tr>
<td>(Rear) _____ CPM</td>
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<table>
<thead>
<tr>
<th>Roof</th>
<th>Interior Area(s)</th>
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</thead>
<tbody>
<tr>
<td>_____ CPM</td>
<td>Steering Wheel _____ CPM</td>
</tr>
<tr>
<td></td>
<td>Seat(s) _____ CPM</td>
</tr>
<tr>
<td></td>
<td>Floorboard _____ CPM</td>
</tr>
</tbody>
</table>

Remarks


Monitor’s Signature

Decon Monitor’s Signature

JUL16
Vehicle Monitoring/Decontamination Record

Decontamination of vehicle:

Front Bumper
1st Decon ______ CPM
2nd Decon ______ CPM

Rear Bumper
1st Decon ______ CPM
2nd Decon ______ CPM

Driver’s Side -Tire/Wheel Well (Front)
1st Decon ______ CPM
2nd Decon ______ CPM
(Rear)
1st Decon ______ CPM
2nd Decon ______ CPM

Driver’s Side-Door Handles (Front)
1st Decon ______ CPM
2nd Decon ______ CPM
(Rear)
1st Decon ______ CPM
2nd Decon ______ CPM

Passenger’s Side-Tire/Wheel Well (Front)
1st Decon ______ CPM
2nd Decon ______ CPM
(Rear)
1st Decon ______ CPM
2nd Decon ______ CPM

Passenger’s Side-Door Handles (Front)
1st Decon ______ CPM
2nd Decon ______ CPM
(Rear)
1st Decon ______ CPM
2nd Decon ______ CPM

Roof
1st Decon ______ CPM
2nd Decon ______ CPM

Interior Area(s)
1st Decon:
Steering Wheel ______ CPM
Seat(s) ______ CPM
Floorboard ______ CPM
2nd Decon:
Steering Wheel ______ CPM
Seat(s) ______ CPM
Floorboard ______ CPM

NOTE: In event that after the 2nd attempt to decon still remains above the established contamination limit, isolate vehicle and contact Radiation Control.

METHOD OF DECONTAMINATION.
☐ Wipe inside with damp cloth
☐ Vacuum floor boards
☐ Wash outside with soap and water

FURTHER ACTION REQUIRED.
☐ Decon complete. Refer to Clean Parking Area
☐ Further Decon required. Refer to Secured Parking Area

Remarks

_________________________  ________________________
Monitor’s Signature        Decon Monitor’s Signature

JUL16

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**LUDLUM 14C SURVEY METER**

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**Pancake Probe (44-9)**

**Response Check**

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**LUDLUM 14C PRE-OPERATIONAL CHECK**

- Verify annual calibration due date has not expired.
- Conduct a physical inspection of unit.
- Turn selector switch to off position.
- Turn toggle switch(s) to AUD “on” and to “fast” response.
- Open battery compartment beneath handle and install 2 D-cell batteries.
- Connect cable to unit and a pancake probe (44-9).
- Turn selector switch to X0.1 and press and hold BAT button. Needle should deflect to “BAT OK”.
- Open the check source window and place open probe against source for visual needle deflection and listen for audible sound.
- Conduct an operational check with pancake probe by placing probe (open window) against the open source window and scale up with selector switch until a reading is obtained.
- Each probe shall read 20% of reference reading found on the calibration label. Label is affixed to side of instrument.
- Cover probe with plastic (Cling or Saran) wrap. Zip lock (non-freezer) bag or latex glove to prevent the probe from being contaminated. If using a glove, fold back the fingers and tape down.
- Take a background radiation reading in counts per minute (cpm) and record. For background radiation using the pancake probe (44-9) take the highest average needle deflection in cpm and divide by 2. Record background radiation on appropriate form.
- Contamination levels are set in Alabama at twice (2x) background radiation.
- For problems contact local EMA.

---

**Ludlum Model 14C**

<table>
<thead>
<tr>
<th>Probe</th>
<th>Setting</th>
<th>Upper Scale - Reads CPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pancake 44-9</td>
<td>X 0.1</td>
<td>100, 200, 300, 400, 500, 600</td>
</tr>
<tr>
<td>Contamination</td>
<td>X 1</td>
<td>1000, 2000, 3000, 4000, 5000, 6000</td>
</tr>
<tr>
<td></td>
<td>X 10</td>
<td>10000, 20000, 30000, 40000, 50000, 60000</td>
</tr>
<tr>
<td>Internal Probe</td>
<td>X 1000</td>
<td>1000000, 2000000, 3000000, 4000000, 5000000, 6000000</td>
</tr>
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- Verify calibration due date has not expired.
- Conduct a physical inspection of unit.
- Turn selector switch to off position.
- Turn toggle switch(s) to AUD “on” and to “fast” response.
- Open battery compartment beneath handle and install 2 D-cell batteries.
- Connect cable to unit and a pancake probe (44-9).
- Turn selector switch to X0.1 and press BAT button. Needle should deflect to “BAT OK”.
- Open the check source window and place open probe against source for visual needle deflection and listen for audible sound then scale up with selector switch until a reading is obtained.
- Each probe shall read within 20% of the reference reading found on the calibration label.
- Cover probe and take a background radiation reading and record. For background radiation using the pancake probe (44-9) take the highest average deflection and divide by 2.
- For problems contact local EMA.

---

**Card to be attached to Ludlum 14C**

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**Calibration Label**

**Survey Meter Calibration**

Cal Date _____ Due Date _____
Model ______ Serial # ______

* Range within 10% unless noted
  X
  X
  X
  X
  X

Ded. Ck. Source S/N
Act. Range +/- 20%
READS: (44-9)

Calibrated By: __________________________

AEMA RAD FACILITY
Montgomery, AL • 205-280-2225

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**CALIBRATION LABEL**

**GUIDE**

**+/− 20% PANCAKE PROBE (44-9)**

- Complete the Pre-Operational Check.
- Verify the probe reads 20% of reference reading by:
  1. Turn selector switch to the first scale listed (See Above “A”).
  2. Open the check source window and place open probe against source. The reading should be +/− 20% of the reading that is noted on the calibration label (See Above “B”).
  3. Follow same steps for each scale.
- For problems contact local EMA.

---

**Ludlam Model 14C**

<table>
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<td></td>
<td>X 10</td>
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</tr>
<tr>
<td></td>
<td>X 100</td>
<td>100000, 200000, 300000, 400000, 500000, 600000</td>
</tr>
<tr>
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<td>1000000, 2000000, 3000000, 4000000, 5000000, 6000000</td>
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- Verify calibration due date has not expired
- Conduct a physical inspection of unit
- Turn selector switch to off position
- Turn toggle switch(es) to AUD “on” and to “fast” response
- Open battery compartment beneath handle and install 2 D-cell batteries
- Connect cable to unit and a probe (44-9)
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- Open the check source window and place open probe against source for visual needle deflection and listen for audible sound then scale up with selector switch until a reading is obtained
- Each probe shall read within 20% of the reference reading found on the calibration label
- Cover probe and take a background radiation reading and record
- For background using the pancake probe (44-9) take the highest average deflection and divide by 2
- For problems contact local EMA
Joseph M. Farley Nuclear Plant
Ingestion Planning Zone
50 Mile Radius
RADIOLOGICAL EMERGENCY ASSISTANCE

CONTACTS

USE FOR INCIDENTS INVOLVING RADIOACTIVE MATERIAL

24-hour
State EOC Communication Center
(205) 280-2310
(800) 843-0699

If contact is not established, please call:
Alabama Radiation Control Duty Officer
(334) 324-0076

For additional contacts, please call the following:
Radiation Control Office (334) 206-5391

<table>
<thead>
<tr>
<th>Cell Primary</th>
<th>Linc</th>
</tr>
</thead>
<tbody>
<tr>
<td>David Walter</td>
<td>77*1106</td>
</tr>
<tr>
<td>David Turberville</td>
<td>77*1109</td>
</tr>
<tr>
<td>Brad Grinstead</td>
<td>77*1107</td>
</tr>
<tr>
<td>Tonya Appleyard</td>
<td>77*1105</td>
</tr>
<tr>
<td>Myron Riley</td>
<td>77*1110</td>
</tr>
<tr>
<td>Neil Maryland</td>
<td>77*1123</td>
</tr>
<tr>
<td>Nick Swindall</td>
<td>77*1119</td>
</tr>
</tbody>
</table>

*Current as of January 1, 2017
*Destroy all Earlier Editions

Alabama Department of Public Health
Office of Radiation Control
Montgomery, AL

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ADPH-RAD-1/REV.1-17