Radiological Emergency Preparedness

Emergency Worker Handbook
for
State of California Employees
Responding to a Nuclear Power Plant Incident

Cal EMA
CALIFORNIA EMERGENCY MANAGEMENT AGENCY

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California Nuclear Generating Stations

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Purpose

This State Emergency Worker Handbook is to familiarize responders with actions and terms specific to response to radiological incidents at nuclear power plants in California. Most State Emergency Workers will be deployed to locations free of any radiological contamination. Specific Workers are trained for assignments in areas where they must be monitored for radiation contamination. Emergency Worker Exposure Control information is included for those employees. Please read through this handbook before deployment. If you have any questions or concerns, discuss them with your supervisor or state radiological program staff.

San Onofre Nuclear Generating Station (SONGS)
Southern California Edison (SCE)

Diablo Canyon Power Plant (DCPP)
Pacific Gas and Electric Company (PG&E)

Radiological Emergency Preparedness

Federal regulations require nuclear power plants, states and surrounding counties have a federally tested and approved emergency response plan. The Federal Emergency Management Agency (FEMA) is responsible for ensuring adherence to emergency planning and exercising requirements by emergency response organizations outside of the power plant boundaries ("offsite.") The Nuclear Regulatory Commission (NRC) is responsible for the regulatory application of these guidelines at the nuclear power plants. Radiation releases are monitored and controlled by strict Environmental Protection Agency (EPA) guidelines to keep the public and emergency responders safe.

Emergency Notification

In the event of a nuclear power plant (NPP) incident, the power plant (utility company) gives immediate notification to the California State Warning Center (CSWC) and counties in the Emergency Planning Zone. The CSWC continues the notification process to other agencies according to procedures for NPP incidents. The power plant provides the emergency classification level and plant information to the CSWC for updates along the notification chain. In addition, the power plant recommends protective actions to the state and affected counties. These recommendations may include sheltering-in-place or evacuations and/or ingesting potassium iodide (KI).

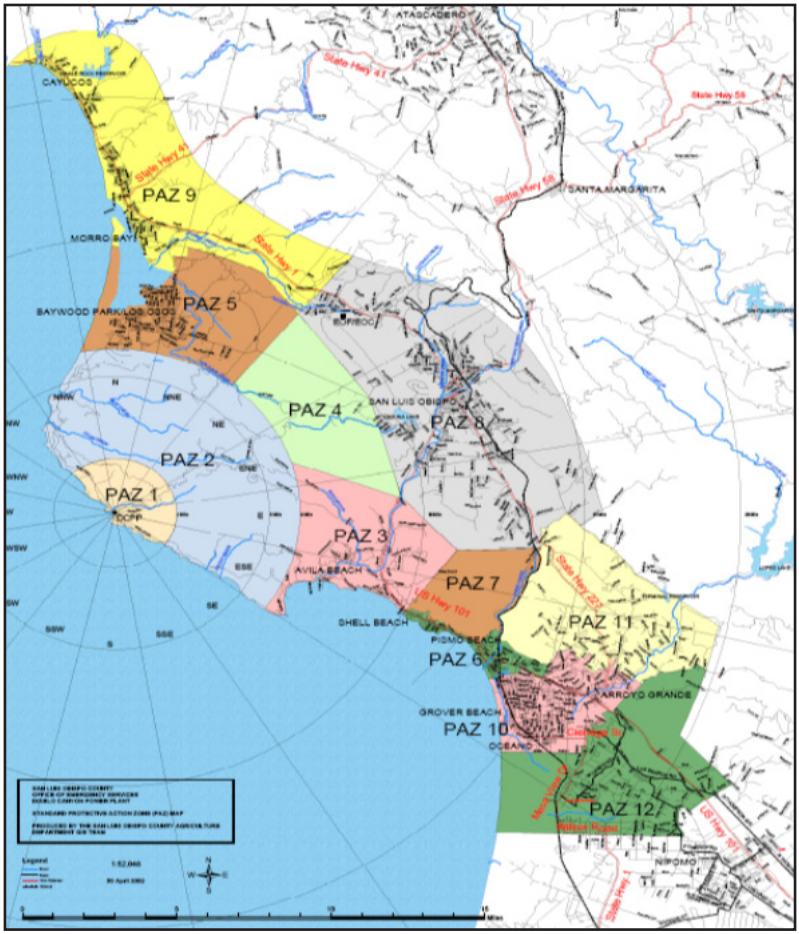
Emergency Planning Zones

Emergency Planning Zone

The Emergency Planning Zone (EPZ) is a defined area where it is possible people downwind from a nuclear power plant could be exposed to radiation from a radioactive plume if released from the plant during an incident. This EPZ is divided into numbered protective action zones (PAZ). Not all residents in the EPZ may be affected during an incident so residents may be advised to take certain actions depending on their PAZ.

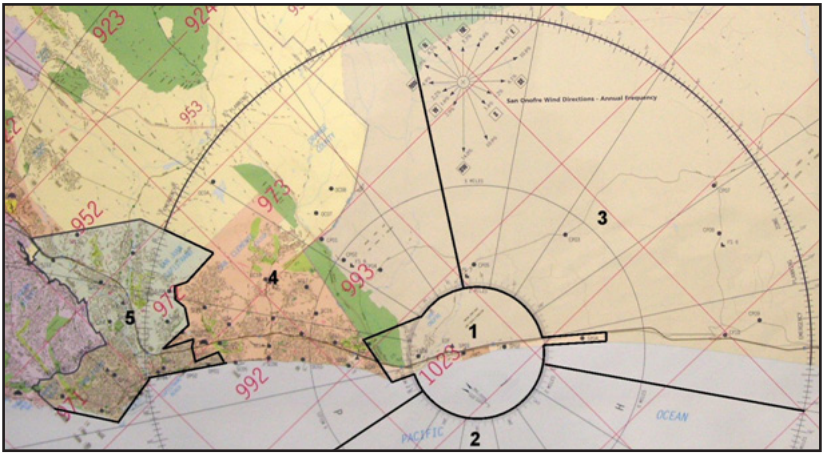
EPZ Map - Diablo Canyon Power Plant (DCPP)

(Approximately 18 to 22 miles from the power plant)



EPZ Map – San Onofre Nuclear Generating Station (SONGS)

(Approximately 10-14 miles from the plant)



Ingestion Pathway Zone

The Ingestion Pathway Zone (IPZ) is an area of up to 50 miles around the plant in which a radioactive release could have the potential to contaminate food and/or liquid produced or collected from the area. This area is designed to protect consumers from the ingestion of contaminated crops, agricultural products, water and livestock.

Emergency Classification Levels (ECL)

When an incident occurs, the utilities (SCE and PG&E) classify events based on potential impacts to safety processes or equipment, or to plant security. There are four emergency classification levels:

1. Notification of Unusual Event (NOUE)

An Unusual Event is the least serious of four emergency classification levels. An Unusual Event is declared when there is a potential degradation of the level of safety or security at the plant. An Unusual Event is one that is declared for "other-than-normal" plant conditions and does not require any emergency action by the general public or government authorities. No releases of radioactive material requiring off-site response or monitoring are expected unless further degradation of safety systems occurs. State and local authorities are informed, but action to protect the public is unnecessary at this level.

Examples:

- Loss of off-site power for more than 15 minutes On-site power still available.
- Onsite or offsite communications equipment lost.

2. Alert

There is an actual, or potentially substantial, impact on the level of safety or security at the plant. Any release of radioactive material is expected to be limited to amounts well below federal guidelines for exposure levels. Designated Emergency Operations Centers (EOCs) and facilities may be activated. Public action is not needed.

Examples:

- Fire potentially affecting safety systems.
- A natural or man-made event threatens vital equipment (Earthquake).

3. Site Area Emergency (SAE)

There is an actual or likely major failure of plant systems needed for protection of the public, or security events result in the intentional damage of, or malicious acts toward, site personnel or equipment. Limited actions to protect the public may be needed.

Examples:

- Large amount of cooling water lost.
- Loss or potential loss of 2 of 3 barriers.

4. General Emergency (GE)

There is actual or imminent substantial core damage or melting with the potential for a loss of containment integrity. A general emergency is also declared if there is a security event resulting in the loss of physical control of the facility. Releases, if any, can be expected to exceed federal guidelines for more than the immediate site area. Warning sirens will be sounded. Instructions for public action will be announced on Emergency Alert System (EAS) stations.

Examples:

- Operators have lost control of the facility.
- Loss of 2 of 3 fission product barriers with a potential loss of the third barrier (e.g., loss of primary coolant boundary, clad failure, and high potential for loss of containment.).

Protective Actions

State and local authorities will make protective action decisions from recommendations by the utility and field monitoring data from the Dose Assessment Centers.

EPA PAG = Protective Action Guides – Developed by the EPA to provide suggested actions to protect the public from projected dose. The EPA PAGs are used to develop the PAR.

PAR = Protective Action Recommendation – a licensee is required to provide protective action recommendations to authorities responsible for implementing offsite emergency measures within 15 minutes of ECL declaration.

PAD = Protective Action Decision – the decision made by appropriate authority to implement emergency actions based on the PAR, PAGs and in some instances laws.

Possible Protective Actions are:

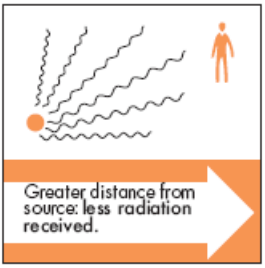
- Evacuate beaches, schools and people in the path of the plume.
- Shelter in homes, schools, hospitals or office buildings.
- Take potassium iodide (KI).

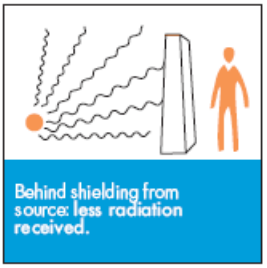
ALARA = "As Low As (is) Reasonably Achievable"

ALARA is an acronym for "as low as (is) reasonably achievable," which means making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical.

Practice ALARA to reduce exposure as much as possible by reducing exposure time, increasing distance from contamination, and using shielding when possible.

Minimize **Time**	Dose= dose rate X time. Minimizing the time of exposure directly reduces radiation dose.
Maximum **Distance**	Exposure rate is 4 times less at double the distance from the source.
Incorporate **Shielding**	Place a lead or concrete shield between you and the gamma radiation source to reduce radiation exposure.





Radiation Protection

Deployed State workers that may possibly be exposed to radiation, such as field samplers from Public Health or road/safety workers from Caltrans and California Highway Patrol, will receive training and an Emergency Worker Exposure Control Personal Dosimetry Kit. Each kit contains an Emergency Radiation Worker Exposure Form (Form-1) and Pregnancy Declaration Memorandum (Form-2), a direct-reading dosimeter, a Thermoluminescent dosimeter, potassium iodide (KI) tablets, AA batteries, important instructions, and a checklist.

Emergency Worker Exposure Control (EWEC) Kit Contents

1. Emergency Radiation Worker Exposure Form, Form - 1

Form-1 has specific instructions for the emergency worker on the front of the form and an important dosimetry checklist on the back of the form. Form -1 is used to document your dosimeter readings and potassium iodide ingestion.

2. Pregnancy Declaration Memorandum, Form - 2
– A Word of Caution

Federal radiation exposure guidelines stress caution about exposing a fetus to any amount of radiation. The guidelines suggest no matter how small, exposure may have a harmful effect. A pregnant female emergency worker is asked to consider the risks to her fetus and make a decision about limiting her radiation exposure. The "Pregnancy Declaration Form" (Form 2) will be used by the responder to document the decision and any associated limitations. The form should be reviewed, acknowledged and signed by your radiological emergency response supervisor and filed for future reference. The emergency worker is responsible for communicating any change in status to their radiological emergency response supervisor.

3. Thermoluminescent Dosimeter (TLD)

A TLD records the amount of radiation from an individual exposure. The TLD badge is worn throughout the incident on the front of the body between the waist and shoulders with the small circular window facing outward. The TLD badge provides a permanent record of exposure after processing in a laboratory.

4. Direct Reading Dosimeter (DRD)

While a TLD provides an accurate record of exposure, it cannot be read in the field by the responder. In order to allow workers to monitor their radiation exposure while working, a second type of dosimeter, a Direct Reading Dosimeter (DRD), is issued in the EWEC Kit. A DRD is designed to work together with the TLD badge. The DRD gauges any exposure an emergency worker receives. Individuals can take the appropriate action based on the reading shown. This personal dosimeter is a pager-sized device. It sounds an alarm when limits are exceeded.

5. Potassium Iodide (KI) for Emergency Workers

One of the radioactive materials that may be released during a radiological incident is radioactive iodine. Iodine is used in the human body by the thyroid gland.

Potassium iodide (KI) is a thyroid-blocking agent in tablet form and is used to "fill up" the thyroid with nonradioactive iodine. This reduces the chance that radioactive iodine will build up in the thyroid. It is important to read and understand the warnings and instructions for taking KI. DO NOT take KI unless directed by the State Health Officer or designated County Health Official.

Emergency Worker Exposure Limits

If you are issued an EWEC Kit:

There are THREE exposure limits that apply to radiation emergency workers. Using the direct reading personal electronic dosimeter, for the SONGS counties and cities, these limits are:

1. Notification Level 500 millirem - If your dosimeter reading reaches 500 millirem you should **notify your radiological emergency response supervisor immediately.** You will be given further instructions, assigned a different Turn Back Limit or told to report back to have your TLD sent for reading.

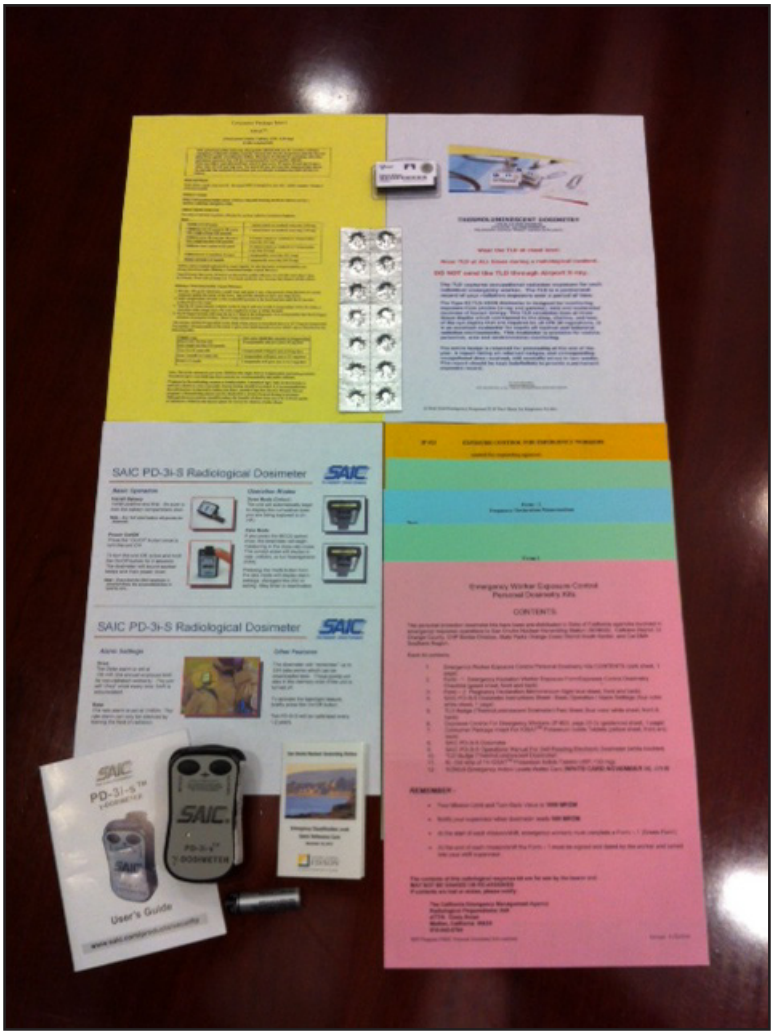
2. Turn Back Value – Mission Limit 1000 millirem - If your dosimeter reading reaches 1,000 millirem you have reached the limit for responding to the incident, **notify your radiological emergency response supervisor immediately.** In some cases, an extension above this limit can be approved (see below). You will receive specific instructions in either case.

3. Maximum Limit 5000 millirem - The emergency worker maximum limit may be extended to save exposure to large populations, save lives or save property. You cannot exceed the above limits **unless you have permission from your emergency response supervisor.** No emergency worker is allowed to reach an exposure level above 25 rem for lifesaving activities unless they volunteered to exceed that level and received approval.

If You Are Issued an EWEC Kit …….Remember!

At the start of each shift, turn on your dosimeter, review and complete Form-1. Log your dosimeter readings every 30 minutes. At the end of each shift, sign and date your Form-1 and give it to your shift supervisor or coordinator.

- Notify your supervisor when dosimeter reads 500 millirem.
- Your Mission Limit and Turn-Back Value is 1000 millirem.



Radioactive Contamination

Radioactive contamination is radioactive material in an unwanted place. External radioactive contaminates can be particles or liquids that adhere to hair, skin, clothing, etc. Contaminated individuals will continue to receive exposures until these materials are removed.

Contamination Prevention

There are a few simple steps you can take to prevent yourself from becoming contaminated:

- Do not eat, chew, or drink while responding when radioactive material may be present unless instructed to do so - to avoid internal contamination.
- Do not apply lotions, sunscreen or lip balm when radioactive material may be present - contaminates may "stick" and are more difficult to wash off.
- Use protective equipment when provided. Follow instructions for monitoring yourself and logging equipment readings.
- Follow procedures from your safety officer for your specific task.

Contamination Monitoring

Radioactive contamination may be detected with hand held instruments or larger portal monitors. Monitoring for emergency workers is done at a reception/care center or an emergency worker decontamination center. Locations may be obtained from your radiological emergency response supervisor.

Decontamination Methods

(Exposure to radiation without contamination does not require decontamination.)

Follow directions and procedures from your safety officer or radiological emergency response supervisor; use these self-decontamination actions unless other specific protocols apply. These actions can be performed at any location of opportunity or at the reception/care locations set up by the emergency response organization to facilitate washing.

1. If you are outdoors and fallout is still accumulating, do not remove your clothing. Close your eyes and gently dust off any visible fallout dust while being careful not to breathe or swallow the dust.

2. Once you have some overhead cover or no visible fallout is accumulating, remove outer clothing, dusting it off until you have access to clean clothing.

3. When you arrive home or another destination, act as if you are covered with mud and try to minimize tracking the material inside. You may want to partially disrobe before entering. Remove shoes and the rest of your clothing and place them in a bag. Place the bag as far away from people and animals until you receive further instructions from officials.

4. Take a shower, washing well from the top down, with warm water and soap. Use shampoo, but do not use conditioner. Bend forward to direct washwater away from the body. Use a cloth, sponge, or soft brush on your skin, but do not use a scrub brush. Keep material out of eyes, nose, mouth and wounds.

5. If a shower is not available, use a sink paying particular attention to your hair and areas around your mouth, nostrils and eyes. If no water is available, use moist wipes to clean the hands and face.

Decontamination Locations – Reception/Care Centers

The goal of reception/care centers is to monitor, and if necessary decontaminate emergency workers, vehicles and the general public. Reception/Care Centers have been pre-identified in the planning and training process and have equipment and staff ready to assist. Radiological emergency response supervisors and safety officers may direct responders to a specific center as listed:

SONGS Reception / Care Centers

Orange County Fairgrounds
88 Fair Drive
Costa Mesa, CA 92626

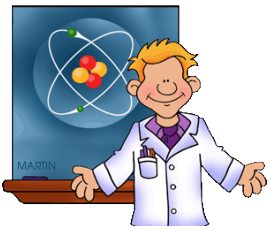
Carlsbad High School
3557 Lancer Way
Carlsbad, CA 92008

DCPP Reception / Care Centers

Camp Roberts
Highway 101 - Nine miles north of Paso Robles
Camp Roberts, CA 93451

Santa Maria Fairpark
937 South Thornburg Street
Santa Maria, CA 93458

How Nuclear Power Plants Work

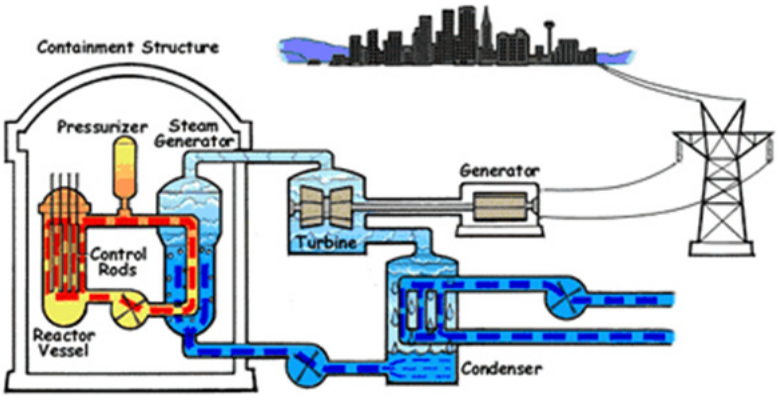


In a nuclear-fueled power plant – much like a fossil-fueled power plant – water is turned into steam, which in turn drives turbine generators to produce electricity. The difference is the source of heat. At nuclear power plants, the heat to make the steam is created when uranium atoms split – called fission. There is no combustion in a nuclear reactor. Here's how the process works.

There are two types of nuclear reactors in the United States:

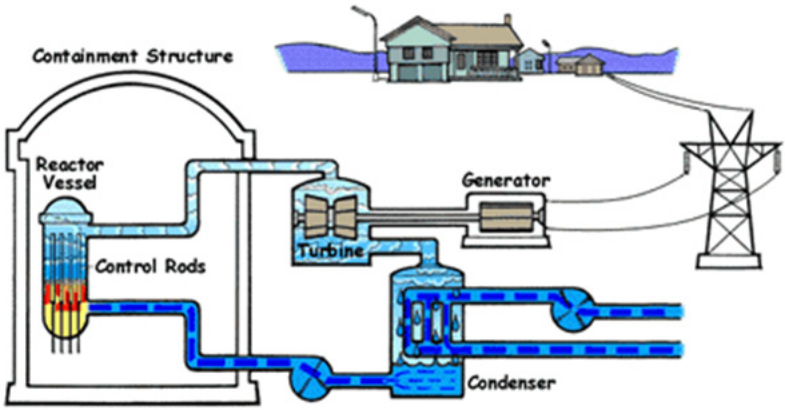
Pressurized Water Reactor

Pressurized water reactors (also known as PWRs) keep water under pressure so that it heats, but does not boil. This heated water is circulated through tubes in steam generators, allowing the water in the steam generators to turn to steam, which then turns the turbine generator. Water from the reactor and the water that is turned into steam are in separate systems and do not mix. In California, SONGS and DCPP are both pressurized water reactors.



Boiling Water Reactor

In boiling water reactors (also known as BWRs), the water heated by fission actually boils and turns into steam to turn the turbine generator. In both PWRs and BWRs, the steam is turned back into water and can be used again in the process.



Nuclear Power Plant Safety

Commercial nuclear power plants operate safely around the world every day despite the potential for the release of radiation. Enriched uranium fuel is used to create a radioactive fission process that heats water to turn steam turbines for the purpose of generating electricity cleanly and efficiently. Nuclear power plants are built to safely contain any radioactive material. No deaths or serious injuries have been recorded during 50 years of nuclear power plant production in the United States due to exposure to radiation.

Fission Product Barriers

The primary focus for safe operation of these plants is prevention of both the release of airborne radioactive fission products and the contamination of articles with radioactive particles. Several steps are taken to prevent radiation from leaving nuclear power plants.

1st Barrier – Fuel Assembly (Cladding)

The simple arrangement of the fuel rods in the fuel assembly prevents the material from detonating. Nuclear fuel rods consist of the uranium (fuel) pellets and a zirconium alloy container, or cladding. The radioactive fission process occurs only inside the fuel cladding. It will remain contained and not leak as long as the cladding is intact and free of cracks or holes.

2nd Barrier – Reactor Coolant System (RCS)

This barrier consists of the reactor coolant system, which is a self-contained loop of cooling water that supplies water to cool the reactor core. The coolant water covers the core to prevent excessive heat from melting the material. The coolant water is contained within the loop and not exposed elsewhere in the plant. However, if the fuel cladding has even a small leak, radioactive fission products will leak into the reactor coolant system. The RCL system must remain intact to prevent the release of radiation.

3rd Barrier – Reactor Containment Building

This thick concrete structure houses the radioactive core as well as the reactor coolant system and other components vital to the nuclear steam supply systems. Even if leaks occur in the first two barriers, the containment structure will prevent release of radiation to the atmosphere. The containment structure can also withstand the high pressures and temperatures that would occur in a devastating accident within the fuel or reactor coolant system.

Radiation Basics

People have been exposed to radiation since the beginning of time — from the air, our food and water, and from the earth itself. Radiation is energy from unstable atoms. Atoms are the building blocks of all matter. Unstable atoms try to become stable by giving off energy. This energy is radiation.

In a nuclear power plant, atoms in the uranium fuel split into fragments. These fragments are not stable. Unstable atoms lose their excess energy by emitting four types of radiation: alpha, beta and neutron particles, and gamma rays.

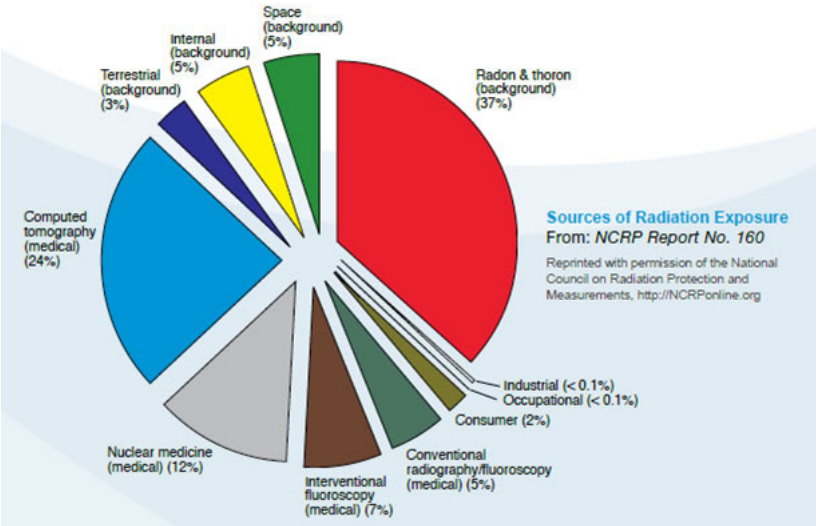
- Alpha particles are the least penetrating and can be stopped by sheets of paper.
- Beta particles are more penetrating and can be stopped with a few layers of plastic or by the outside layers of skin.
- Gamma rays have a high penetrating power but can be slowed by dense shielding material such as lead or concrete.
- Neutron particles have the ability to "activate" another material. Neutrons are very powerful and may travel hundreds of yards. Neutrons may be stopped by thick concrete or lead-lined concrete.

Radiation and Us

Exposure to radiation can damage cells in the human body. It is possible for cells to repair themselves depending on the amount of radiation exposure and the physical condition of the person exposed. We measure the biological effects of radiation on the body using the measurements of "rem" or "millirem" (a millirem or mrem equals one-thousandth of a rem).

Average U.S. Radiation Doses and Sources

All of us are exposed to radiation every day, both from natural sources such minerals in the ground and from man-made sources such as medical x-rays. According to this chart published by the National Council on Radiation Protection and Measurement, the average annual radiation dose per person in the U.S. is 620 millirem (6.2 milliSieverts). The pie chart shows the sources of this average dose.



Half of our average dose comes from natural background sources: cosmic radiation from space, naturally occurring radioactive minerals in the ground and in your body, and from the radioactive gasses radon and thoron, which are created when other naturally occurring elements undergo radioactive decay. Another 48 percent of our dose comes from medical diagnostics and treatments.

Here are some examples of ways people can be exposed to radiation:

Radiation Exposures From Various Sources	
NRC Occupational Limit for Adults Working with Radioactive Material	5000 millirem/year
Nuclear Power Plant Worker Average Dose	170 millirem/year
Ion Smoke Detector	0.008 millirem/year
One Banana	0.01 millirem
Air Travel (one hour)	1 millirem
Granite Countertops	175 millirem/year
Cigarettes (1 pack/day)	7,000 millirem/year (lung)
Chest X-Ray (two views)	10 millirem
Chest CAT Scan	700 millirem
Cardiac Stress Test (Thallium)	4070 millirem
Living next to Nuclear Power Plant	1 millirem/year
Reference: ICRP Report 60, Xrayrisk.com NUREG-0713	

The effects of large amounts of radiation are well understood; however, effects of small amounts of radiation are not clear. Federal guidelines suggest that there is risk with any exposure to radiation. The main concern is the cumulative risk of radiation exposure over a period of several years. Therefore, exposures to small amounts of radiation are considered less risky than large amounts of radiation. The limits used in the Radiological Emergency Preparedness (REP) program are designed to limit your exposure.

Acronyms and Abbreviations

ALARA –	As low as reasonably achievable
BWR –	Boiling Water Reactor
CSWC –	California State Warning Center
DCPP –	Diablo Canyon Power Plant
DRD –	Direct Reading Dosimeter
EAS –	Emergency Alert System
ECL –	Emergency Classification Level
EOC -	Emergency Operations Center
EPA –	Environmental Protection Agency
EPZ –	Emergency Planning Zone
EWEC –	Emergency Worker Exposure Control
FEMA –	Federal Emergency Management Agency
FRMAC-	Federal Radiological Monitoring and Assessment Center
GE –	General Emergency
IPZ –	Ingestion Pathway Zone
KI –	Potassium Iodide
mR –	milliRoentgen
NOUE –	Notification of Unusual Event
NPP –	Nuclear Power Plant
NPP –	Nuclear Power Preparedness
NRC –	Nuclear Regulatory Commission
PAD –	Protective Action Decision
PAG –	Protective Action Guidance
PAR –	Protective Action Recommendation
PAZ –	Protective Action Zone
PG&E –	Pacific Gas and Electric Company
PWR –	Pressurized Water Reactor
R-	Roentgen
RCS –	Reactor Coolant System
REP-	Radiological Emergency Preparedness
SAE –	Site Area Emergency
SCE –	Southern California Edison
SDAC-	State Dose Assessment Center
SONGS –	San Onofre Nuclear Generating Station
TLD –	Thermoluminescent Dosimeter

Common Terms for an NPP Incident

ALARA-As Low As is Reasonably Achievable. As defined in Title 10, Section 20.1003, of the Code of Federal Regulations (10 CFR 20.1003), ALARA means making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical, consistent with the purpose for which the licensed activity is undertaken. Use the principles of time, distance and shielding.

Alpha Particle- A positively charged particle ejected spontaneously from the nuclei of some radioactive elemetns. It has a low penetrating power and a short range.

Background Radiation- Radiation that is emitted from the naturally occurring radioactive materials in the earth and from cosmic rays that bombard the earth from outer space.

Beta Particle- A charged particle emitted from a nucleus during radioactive decay. Large amounts of beta radiation can cause skin burns and beta emitters are harmful if they enter the body. Most beta particles can be stopped by aluminum foil.

Boiling Water Reactor (BWR)- A common nuclear power reactor design in which water flows upward through the core, where it is heated by fission and allowed to boil in the reactor vessel. The resulting steam then drives turbines, which activate generators to produce electrical power. BWRs operate similarly to electrical plants using fossil fuel, except that the BWRs are powered by 370–800 nuclear fuel assemblies in the reactor core.

Containment structure- A gas-tight shell or other enclosure around a nuclear reactor to confine radioactive gasses and particles that otherwise might be released into the atmosphere in the unlikely event of an accident. Such enclosures are usually dome-shaped and made of steel-reinforced concrete.

Contamination (Radioactive)- The deposition of radioactive material on surfaces of structures, areas, objects, or personnel where is not desired or supposed to be.

Control rods- Moveable rods made of neutron-absorbing material used to regulate the nuclear fission process inside a reactor.

Controlled Area- Any area controlled for purposes of radiation safety. Airborne radioactivity areas, high radiation areas, and radiation areas are considered controlled areas.

Core- The central part of a nuclear reactor containing the fuel and control rods. This is where nuclear fission takes place producing the heat that nuclear power plants use to create steam and generate electricity.

Decay- The decrease in the amount of any radioactive material with the passage of time, due to the spontaneous emission from the atomic nuclei or either alpha or beta particles, often accompanied by gamma radiation. The decay rate is the decrease in activity of a radioactive material within a given time.

Decontamination- The operation of removal or reduction of contaminating radioactive material from a structure, area, object or person.

Dose- The amount of radiation absorbed by an object. Dose can be expressed in units of Roentgens, rems, or rads.

Dose Rate- Dose delivered or absorbed per unit of time, such as rads per second or rem per hour.

Dosimeter- A device that measures radiation dose, such as a thermoluminescent dosimeter (TLD).

Emergency Exposure/Dose Limit- The maximum dose allowed following a nuclear incident above which the total risk to health of an individual is considered excessive. Also known as Mission Limit or Turnback Limit.

Emergency Phase- The Emergency Phase begins upon the declaration by the nuclear plant operators of any one of the four emergency classifications/action levels which are Notification of an Unusual Event, Alert, Site Area Emergency and General Emergency. The purpose of the Emergency Phase is to respond to protect the health and safety of the public and to protect property and the environment during any event which involves the actual or potential uncontrolled offsite release of radioactive material from a nuclear power plant. When an actual uncontrolled offsite release of radioactive material from a nuclear power plant is in progress, the Emergency Phase is referred to as the Plume Phase.

Emergency Planning Zone (EPZ)- The area around a nuclear plant that could be adversely affected if a serious nuclear accident occurred. This area is defined for the plume and ingestion exposure pathways to facilitate offsite emergency planning to protect public health and safety.

Exclusion Area- The area surrounding a nuclear reactor in which the facility operator has the authority to determine al activities, including exclusion or removal of personnel and property from the area. A specific area off-limits (expressed in miles) from a nuclear power plant.

Exposure- A measure of the ionization produced in air by gamma radiation. The Roentgen (R) is the unit of exposure. The term "dose," sometimes used interchangeably with exposure, refers to absorbed ionization or energy.

Federal Radiological Monitoring and Assessment Center (FRMAC)- The Department of Energy FRMAC teams bring extensive resources to conduct the federal radiological monitoring and assessment of the release. In California, the FRMAC will be colocated with at the State Dose Assessment Center; see State Dose Assessment Center (SDAC).

Fuel Rods- Metal rods holding uranium in the form of ceramic pellets.

Gamma Ray- High-energy, short wavelength electromagnetic radiation emitted form the nucleus. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded against by dense materials, such as lead or concrete.

Half-Life- The time in which half the atoms or a particular radioactive substance disintegrates to another nuclear form. Measured half lives vary from milliseconds to billions of years.

Hostile Action- An act toward a Nuclear Power Plant (NPP) or its personnel that includes the use of violent force to destroy equipment, takes hostages, and/or intimidates the licensee to achieve an end. This includes attack by air, land, or water using guns, explosives, projectiles, vehicles, or other devices used to deliver destructive force. Other acts that satisfy the overall intent may be included. Hostile action should not be construed to include acts of civil disobedience or felonious acts that are not part of a concerted attack on the NPP. Security based Emergency Action Levels should be used to address such activities, (e.g., violent acts between individuals in the owner controlled area.)

Hostile Force- One or more individuals who are engaged in a determined assault, overtly or by stealth and deception, equipped with suitable weapons capable of killing, maiming, or causing destruction.

Ingestion Pathway Zone (IPZ)- The area around a nuclear power plant, defined by county, where exposure to radiation by ingestion of contaminated water or foods such as milk or fresh produce might be possible. The federally recommended size of the ingestion pathway zone is a fifty miles radius surrounding the nuclear plant.

Interdiction- A protective action taken to prevent use of contaminated areas or ingestion of contaminated foodstuff.

Interjurisdictional Planning Committee (IPC)- The IPC was formed in 1982 to address the emergency planning requirements within the Emergency Planning Zone for the San Onofre Nuclear Generating Station (SONGS). The IPC is composed of representatives from the cities of San Clemente, Dana Point and San Juan Capistrano; the counties of Orange and San Diego; Marine Corps Base Camp Pendleton; California State Parks; and, Southern California Edison. The mission of this group is to integrate emergency plans, coordinate decision-making for SONGS-related activities and educate the public. The IPC is a strong partnership that is recognized at the local, state and federal levels.

Internal Radiation- Radiation (including alpha, beta and neutron particles and gamma radiation) resulting from radioactive substances within the body.

License (Licensee)- The holder of a license issued under Nuclear Regulatory Commission licensing requirements to operate a nuclear power plant facility.

Milli-Roentgen (mR)- One thousandth (1/1,000) of a Roentgen.

Mission Limit- See Emergency Exposure/Dose Limit.

Monitoring, Radiological- The operation of locating and measuring radiation and radioactive contamination by means of survey instruments that can detect and measure ionizing radiation.

Neutron- An uncharged particle found in the nucleus of every atom heavier than hydrogen. Neutrons sustain the fission chain reaction in a reactor.

Off-site- The area beyond the boundaries of the nuclear power plant site.

On-site- The area within the boundaries of the nuclear power plant site.

Plume- The volume of air containing the radioactive release from an accident.

Plume Exposure Pathway- The area surrounding a nuclear facility site (usually a radius of approximately 10 miles) where the principal exposure would be from: (a) whole body exposure to gamma radiation from the plume and from deposited material, and (b) inhalation exposure from the passing plume. The duration of principal potential exposures could range in length from hours to days.

Plume Phase- (see Emergency Phase)

Potassium Iodide (KI) or KI pills- Following a radiological or nuclear event, radioactive iodine could be released into the air and breathed into the lungs. Radioactive iodine could also contaminate the local food supply and get into the body through food or beverages. The thyroid quickly absorbs this chemical causing contamination. KI acts to block radioactive iodine from being taken into the thyroid gland. KI pills are available without prescription. KI is a prophylactic drug used to minimize the uptake of radioactive iodine and reduce the radiation dose to the thyroid.

Pressurized Water Reactor (PWR)- A power reactor in which heat is transferred from the core to a heat exchanger by water kept under high pressure to achieve high temperature without boiling in the primary system. Steam is generated in a secondary coolant system.

Projected Dose- An estimate of the radiation dose which individuals could potentially receive if protective actions are not taken.

Protective Action- Physical measures such as evacuation or sheltering are taken to prevent potential health hazards resulting from a release of radiation to the environment from adversely affecting employees or the off-site population.

Protective Action Guide (PAG)- The projected dose to the public from an accidental release of radioactive material at which a specific protective action to reduce or avoid that dose is warranted.

Public Education Zone (PEZ)- An area 10 to 35 miles from the plant, outside the Emergency Planning Zone, in which information regarding nuclear emergency planning and safety is provided.

Rad- The unit of absorbed dose in body tissue or other material.

Radiation- As used in nuclear terminology refers to energy propagated in the form of high frequency electromagnetic waves such as x-rays, or in the form of nuclear particles such as alpha and beta radiation.

Recovery Phase- The Recovery Phase of an emergency begins when, following the classification of an emergency at a nuclear power plant, the nuclear power plant operators concur with the Nuclear Regulatory Commission that the plant is in a stable condition, and that there is no further potential for an uncontrolled release of radioactive material offsite. If an actual uncontrolled release of radioactive material had occurred, but the plant is now stable and no further releases are anticipated, this phase will be referred to as the Post-Plume Phase.

Rem- The unit of dose equivalent in body tissue. It is equal to the absorbed dose (measured in rads) multiplied by the quality factor, which takes into account the effectiveness of different types of radiation, and by other multiplying factors. For beta and gamma radiation, the quality factor is 1.

Roentgen (R)- The unit of radiation exposure in air. Roentgens are the units for quantities of x- or gamma radiation measured by detection and survey meters.

Sheltering (also Sheltering-in-Place)- An in-place, immediate protective action which calls for people to go indoors, close all doors and windows, turn off all sources of outside air, listen to radio or television for emergency information, and remain indoors until official notification that it is safe to go out.

Shielding- Any material or barrier that reduces or prevents penetration of radiation.

Source Term- The quantity of radionuclides being released to the environment from a facility using radioactive material. In its broadest sense, the source term also describes the conditions and mode of emission.

State Dose Assessment Center (SDAC)- A state facility established near a radiological emergency where local, state and federal authorities can monitor, assess and analyze the extent and intensity of the radiological release, in order to determine the health and safety potential, and coordinate protective actions. The federal radiological teams from, the FRMAC will collocate at the SDAC.

Steam Generators- Large devices much like car radiators where heat from the primary reactor coolant system heats a secondary steam loop used to generate electricity without mixing the two water systems.

Survey Meter- A portable instrument used in radiological monitoring to detect and measure ionizing radiation.

Thyroid Exposure- Exposure of the thyroid gland to radiation from radioactive isotopes of iodine that have been either inhaled or ingested.

Turbine- A large piece of equipment in which pressurized steam is driven against blades much like wind blowing very large fan blades. The turbine shafts turn generator shafts, producing electricity.

Turnback Limit- See Emergency Exposure/Dose Limit.

Whole-body Exposure- An exposure of the body to radiation, in which the entire body rather than an isolated part is irradiated. Where a radioisopope is uniformly distributed throughout the body tissues, rather than being concentrated in certain parts, the irradiation can be considered as a whole-body exposure.

X-Ray- A penetrating form of electromagnetic radiation that is used in medical and industrial applications.

Notes

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Cal E·M·A

CALIFORNIA EMERGENCY MANAGEMENT AGENCY

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For more information on the State of California Nuclear Power Preparedness Program, Please contact the Radiological Preparedness Unit Phone (916) 845-8731 or (916) 845-8755

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