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NAVIGATING RADIATION RISKS:

KEY CONCEPTS FOR PROTECTING WORKERS AND RESPONDERS

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NAVIGATING RADIATION RISKS: KEY CONCEPTS FOR PROTECTING WORKERS AND RESPONDERS

Radiation is most simply described as energy that moves from one location to another in a wave or particle form. Occupational radiation exposure for healthcare workers, airline personnel, and others is well understood and for most people, exposure to common radiation sources comes with little to no increased risk to their long-term health. However, for those on the front line, such as first responders, Hazmat teams, and workers in industrial fields such as mining and oil and gas, there is an increased risk of accidental exposure to dangerous levels of radiation, meaning that utmost care and planning must be taken to ensure worker and community safety.

In this whitepaper, we will provide a high-level description of the different types of radiation, with a special focus on gamma radiation and its dangers, common radiation sources, impact to the human body, and radiation detectors and sensors. We will cover what comprises a robust emergency safety protocol for industries most actively at risk for unsafe exposure to radiation and how the concept of time, distance, and shielding can and should be incorporated into that plan.

Finally, we will discuss how the use of technology plays a role in worker and community protection and how area monitoring can be used as one of the first lines of defence.

Executive Summary

- Radiation Overview: This section provides a high-level description of non-ionizing versus ionizing radiation (alpha, beta, and neutron particles, and gamma rays), with a focus on describing gamma radiation.
- Sources of Radiation: This section outlines where we expect to find radiation and the impact of the varying exposure limits on the human body.
- How Radiation is Measured: This section covers the U.S. versus international units of measure for the three ways radiation is typically measured: radioactivity, absorbed dose, and effective dose of radiation.
- Gamma Radiation Detectors: This section explores the different types of gamma radiation technology currently available and the common uses, advantages, and disadvantages of each.
- Basics of Radiation Safety: This section details radiation safety plans and how they ensure the three pillars of radiation safety (time, distance, and shielding). We discuss examples of industries and professions that would benefit from a radiation safety plan, and how area monitoring through Blackline Safety's EXO 8 Gamma plays a critical role.

Radiation Overview

There are number of ways to categorize the four main types of radiation: alpha, beta, neutrons, and electromagnetic waves, including whether the radiation is non-ionizing or ionizing (also referred to as nuclear radiation) and whether it is particle or waveform.

NON-IONIZING VERSUS IONIZING RADIATION

Non-ionizing radiation is radiation that does not have enough energy to add or remove electrons from an atom. Exposure to some forms of non-ionizing radiation, like UV light from the sun, can cause health effects such as burns or skin cancer. Other than sunlight, the general public is typically not at a huge risk of health effects from non-ionizing radiation. This is also called background radiation. Worldwide, the total average effective dose from background radiation is approximately 2.4 millisieverts (mSv) annually, where effective dose implies a known relationship between the measured physical quantity of the radiation exposure and the biological effect.

The other category of radiation is ionizing (also called nuclear radiation). With ionizing radiation, enough energy is present for subatomic particles or electromagnetic waves to ionize atoms or molecules by altering their electron structure. Ionizing radiation, including X-ray machines, cosmic particles from outer space, and radioactive elements,

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release ionizing radiation as their atoms undergo radioactive decay. During this decay process, depending on the type of particles or waves that the nucleus releases in its effort to become stable, ionizing radiation is produced in the form of alpha, beta, or neutron particles, or gamma rays.

PARTICLE VERSUS WAVEFORM RADIATION

In particle radiation, tiny, fast-moving particles have both energy and mass. Alpha and beta radiation are examples of radiation that is in particle form. Electromagnetic radiation includes different kinds of light waves, such as radio waves, microwaves, gamma rays, and X-rays. Some electromagnetic radiation is non-ionizing (such as radio waves and microwaves) and some is ionizing (such as X-rays and gamma rays). Each type of light wave has different energies.

Electromagnetic Spectrum

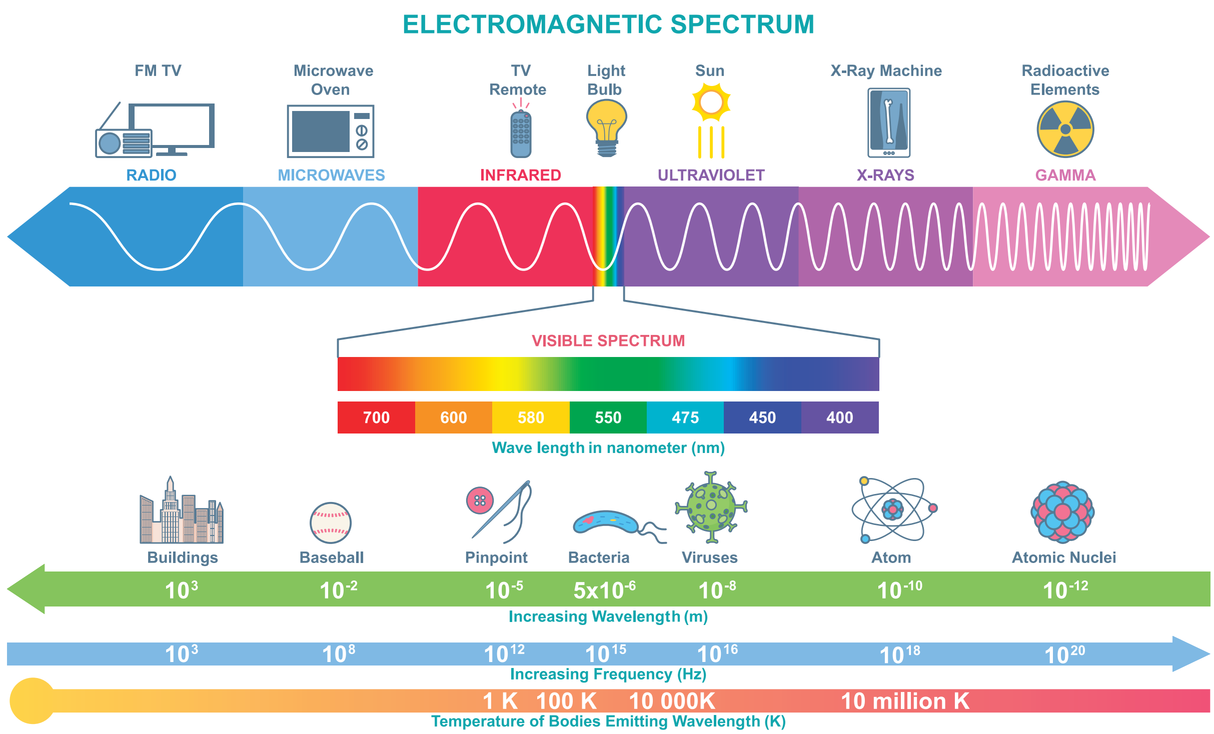

IMAGE SOURCE: www.space.com/what-is-the-electromagnetic-spectrum

WHAT IS GAMMA RADIATION?

Gamma radiation (or gamma rays) is a form of electromagnetic radiation that occurs when the nucleus inside an unstable atom loses energy as it tries to stabilize. Gamma radiation is one type of ionizing radiation.

Gamma rays have the highest energy (greater than 100 kiloelectronvolts (keV)) and shortest wavelengths (10^{-17} to10^{-20} meters) on the electromagnetic spectrum and are undetectable with the naked eye.

Unlike other forms of ionizing radiation, gamma rays penetrate deep into our cells and can only be stopped by very thick layers of concrete, lead and tungsten, and water. The higher the energy of the gamma radiation, the thicker the shield requirement. According to the American Nuclear Society, shield thickness must be about 13.8 feet of water, 6.6 feet of concrete, and about 1.3 feet of lead. The inherent density of lead makes it the best shielding material and the one most commonly used to shield from exposure to gamma radiation in facilities.

SOURCES OF NUCLEAR RADIATION

There are two general categories where nuclear radiation can be found: naturally occurring radioactive material and artificial sources.

NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM)

While most of the radiation we are exposed to occurs by simply breathing the air around us, we can also be exposed when we ingest food and drink water that contains radiation. The good news is that our bodies are designed to handle these small exposures with little to no ill effect.

While exact naming may vary by location, natural sources of radiation are often referred to as background radiation or NORM (naturally occurring radioactive materials). TENORM refers to NORM that have been disturbed or technologically altered due to human activities and practices such as when radioactive material is released from soils and rock formations during the extraction process for oil and gas. NORM sources can include:

- Cosmic events such as solar flares and black holes that stream radioactive particles to earth. The level of exposure to cosmic radiation increases with altitude as there is less atmospheric air to act as a shield. This increased exposure impacts people living and working in higher elevation areas, such as Denver, Colorado with an elevation of 5280' above sea level, and workers such as flight attendants and pilots who spend time at altitudes of 30,000' – 40,000' above sea level. Where the average human is exposed to approximately 6.2 mSv of annual radiation, flight personnel add an additional average of 3 mSv of annual exposure.
- Terrestrial radiation originates mostly from natural deposits of uranium, potassium, and thorium that can decay and release small amounts of radiation. This material can end up in consumer products like building materials, tobacco, and drinking water. A good example of a commonly found source of terrestrial radiation is radon. Radon is a naturally occurring radioactive gas that is odorless, tasteless, and colorless and is the second leading cause of lung cancer in the US (as of 2024). Because it is contained in the soil, it can be found within homes and buildings (usually at the lower levels or those closest in contact with the soil). The US Environmental Protection Agency (EPA) reports that one in three homes checked in seven states had radon levels that surpassed the recommended safe exposure levels.
- Technologically altered NORM (TENORM): TENORM occurs when naturally occurring radiation materials are exposed to the environment as a result of human activities. Industries commonly responsible for TENORM include mining and oil and gas production. During oil and gas extraction, contaminated waste (found in the rocks, soil, and water during excavation process) can be accidentally released into the environment through incidents such as spillage or leakage of the waste during transit or from the pits, tanks, or landfills where it is stored. Another issue is when radioactive material becomes stored in the equipment used in oil and gas extraction activities, such as compressors, pumps, and pipes. The radioactive material can build to dangerous concentration levels. When the contaminated equipment or pipe is tampered with, radiation can be released into the surrounding environment. If not properly managed, this can create a potential threat to human safety, most often in the case of exposure to Radium-226 and Radium-228, leading to an increased risk of developing cancers such as lung cancer.

ARTIFICIAL RADIATION SOURCES

Medical Radiation

Radiation has been harnessed for various medical applications, including diagnosing, monitoring and treating many conditions. Specific applications include:

- Medical imaging, with X-rays, CT scans, and PET scans.
- Radiation therapy treatments to destroy mutated cells, either through beamed, targeted destruction or the ingestion of radiopharmaceuticals.

Non-medical Radiation

- Nuclear weapons:
  - Atomic bombs use nuclear fission of uranium or plutonium, which releases enormous amounts of heat and gamma rays, causing environmental destruction, death, and health effects like cancer.
  - Radiological Dispersal Devices (RDD – also called "dirty bombs") are explosives that contain radioactive material. This weapon is typically associated with terrorism, because the threat of detonation can cause mass panic in a population. To date, RDDs have never been detonated outside of testing environments.
- Nuclear power plants, which generate electricity. Nuclear energy is considered a clean energy source due to the lack of emissions (unlike the burning of coal or fossil fuels).

- Some household items, such as smoke detectors, which may use a small amount of a low-level radioactive material sealed inside the detector to help detect smoke, or old watches with radium luminescent paint on the hands and dials.

Workplaces

Exposure to radiation may be higher for some occupations due to the location or nature of the work being performed, such as:

- Emergency and Hazmat responders and environmental clean-up workers after the release of radioactive material.
- Miners, especially those who are mining for radioactive material such as uranium.
- Healthcare workers treating radiation injuries or administering imaging tests and radiation therapies.
- Nuclear power plant employees.

These workers are closely monitored to ensure their exposure does not exceed acceptable levels. Workplaces can also implement a number of engineering and administrative controls, including a radiation safety plan to protect workers, in addition to providing Personal Protective Equipment (PPE).

Relative Doses from Radiation Sources

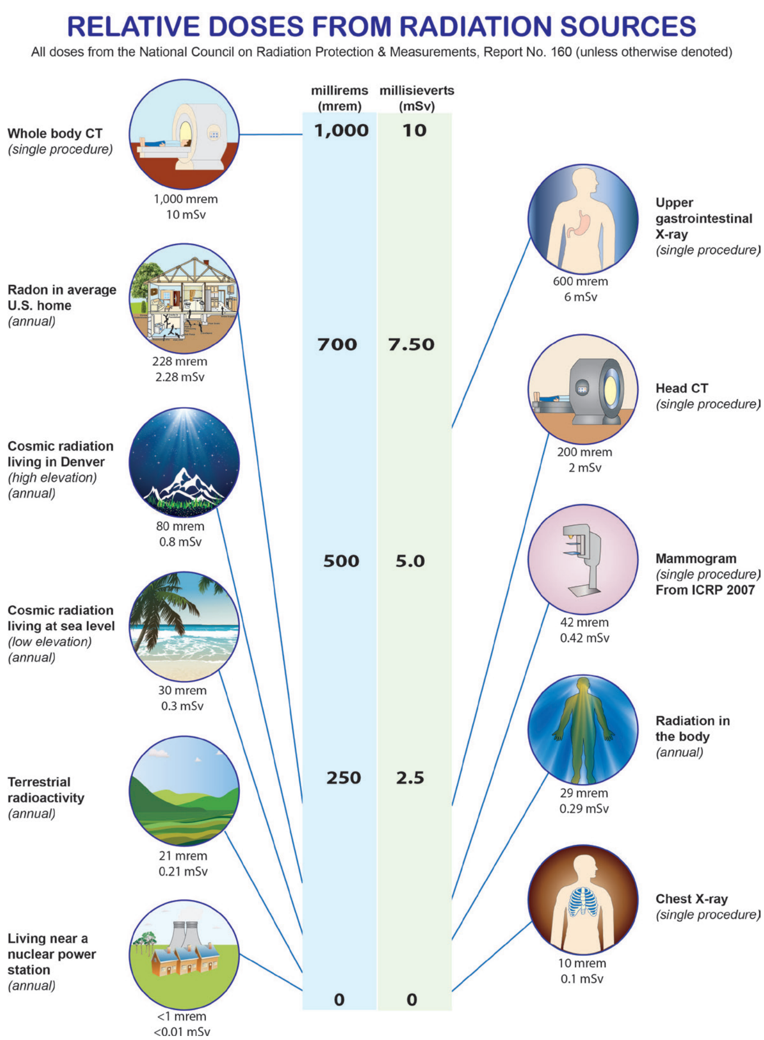

IMAGE SOURCE: Radiation Sources and Doses | US EPA

How Radiation is Measured

The US measures radiation in millirems (mrem) per year, while most other countries measure radiation in millisieverts (mSv) per year. Measuring ionizing radiation and estimating the overall health effects of that radiation is typically done in three ways:

- **Radioactivity:** Indicates the amount of radiation that has been released by a material in a given time period. Used when measuring soil, water or air samples. Radioactivity is measured in becquerels (international unit) or curies (US unit).
- **Absorbed dose:** Indicates the amount of radioactive energy that has been absorbed into a given mass. Used when measuring exposure from medical imaging tests, like CT scans. Absorbed dose is measured in grays (international unit) or rads (US unit).
- **Effective dose:** Indicates the potential for long-term health effects from exposure to radiation in a population over a given time and is measured for radiological protection purposes to set regulatory exposure limits and guidelines. Effective dose is calculated for the whole body, where body tissues (such as eyes versus hands) react differently to radiation and cancer inductions occur at different dose rates. The Effective dose is measured in sieverts (Sv) or rem. Though calculation methods vary slightly between different regulatory agencies (such as the EPA and the Canadian Nuclear Safety Commission), the standard purpose of the calculation is to estimate the amount of the dose from most sources of ionizing radiation a person is exposed to for a given year.

Note:

- Sieverts: 1 Sv = 100 rem. International unit.
- Rem: 1 rem = 0.01 Sv. US unit. Stands for Roentgen equivalent man. Based on the legacy unit of roentgens.

EXPOSURE TO GAMMA RADIATION

Exposure to gamma radiation can cause nausea, skin burns, and other radiation poisoning symptoms such as fatigue, fever, hair loss, and dehydration. Gamma rays can alter our DNA and increase our risk of cancer.

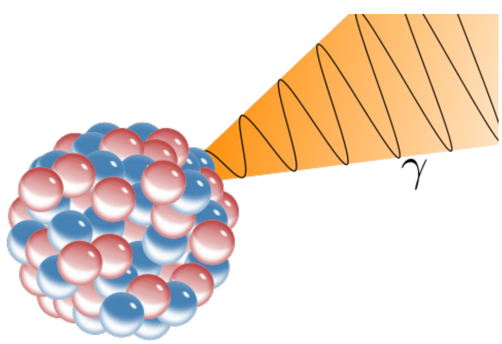

IMAGE SOURCE: www.wikipedia.org/wiki/Gamma_ray

Exposure limits are regulated in many countries for occupational workers—people who work with and around radioactive materials, including exposure to artificial radiation (nuclear reactors, healthcare, manufacturing, Hazmat response) and elevated exposure to natural radiation (flight crews, mining, construction).

The table on the following page provides measurements for some common radiation exposures. To help understand how the increasing exposure levels risk impacting human health and safety, the rows are color-coded going from tolerable to high risk.

Table: Exposure Comparisons

Chest X-ray	0.1 mSv
Average background exposure in one year	3 mSv
Abdominal X-ray	4 mSv
Average yearly does for a uranium miner	5-10 mSv
Yearly dose for airline crews	9 mSv
Full-body CT scan	10 mSv
Yearly limit for nuclear workers	20 mSv
Mild radiation sickness (headache, risk of infection)	0.5-1 Sv
Light radiation poisoning (mild to moderate nausea, fatigue, 10% risk of death after 30 days)	1-2 Sv
Severe radiation poisoning (vomiting, hair loss, permanent sterility, 35% risk of death after 30 days)	2-3 Sv
Severe radiation poisoning (bleeding in mouth and under skin, 50% risk of death after 30 days)	3-4 Sv
Acute radiation poisoning (60% fatality risk after 30 days)	4-6 Sv
Acute radiation poisoning (bone marrow destroyed, nearly 100% fatality after 14 days)	6-10 Sv
Acute radiation poisoning (symptoms appear within 30 minutes, massive diarrhea, internal bleeding, delirium, coma)	10-50 Sv
Coma in seconds or minutes, death within hours	50-80 Sv
Instant death	>80 Sv

TABLE LEGEND: Tolerable levels Moderate risk High risk

As mentioned previously, gamma radiation cannot be detected through sight or taste. We rely on technology to assist us in determining its presence and the development of policies and procedures for helping to deal with how gamma radiation levels are both monitored and what steps need to be taken in the case of a radiation emergency.

Gamma Radiation Sensors

There are three main types of gamma radiation sensors (often referred to as detectors) currently on the market: gas-filled, scintillators, and solid-state sensors. The effectiveness of a radiation sensor is described using the following considerations:

- Energy resolution: How accurate is the sensor at determining the energy of incoming radiation?
- Counting efficiency: What is the ratio between the number of particles or photons counted and the number of particles or photons of the same type and energy emitted by the radiation source?
- Inherent dead time: What is the minimum amount of time required between two events?

GAS-FILLED DETECTORS

Gas-filled detectors were the first radiation detector invented and still the most commonly used today. There are several types of gas-filled detectors including Geiger-Müller (G-M) tubes, gas ionization chambers, and proportional counters. Each type uses similar principles: when the gas in the detector makes contact with radiation, it reacts by ionizing the gas to create a measurable electronic charge.

Geiger-Müller Sensor

These sensors exploit the ionization process to detect radiation. The chamber (or tube) houses a stable gas which ionizes when exposed to radioactive particles, and results in a generated electrical current. The current provides a reading (often in mSv).

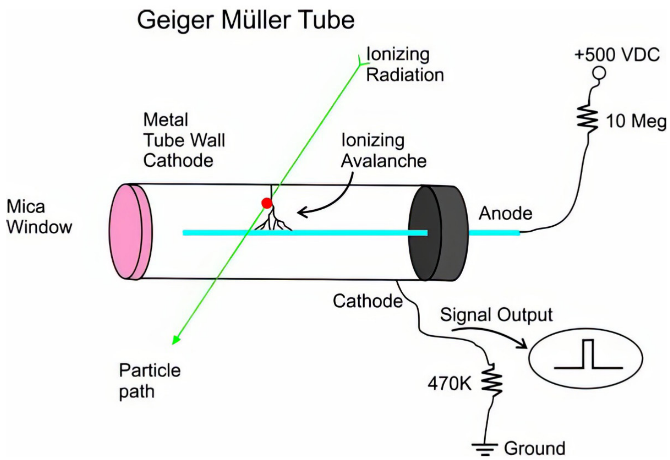

IMAGE SOURCE: www.imagesco.com/geiger/geiger-counter-tube.html

Common Uses

- Mineral prospecting: Detects radiation levels found in rocks and minerals.
- First responders and Hazmat personnel: Allows emergency personnel to safely determine the radiation risk.
- Radiation detection near high-risk radiation sources such as nuclear power facilities, scrap metal processing, oil field drill pipes, X-ray labs, and many more places where radiation exposure might be a possibility.

Advantages

- High amplification allows the counter to produce more reliable results.
- Simple design allows for use in portable instruments and requires less complex electronics packages.
- Sensitivity to low-energy and low-intensity radiations over that of the ionization chamber detectors.

Disadvantages

- Can only function as simple counting devices, used to measure count rates.
- The technology cannot distinguish between particles of the different radiation types.
- After each pulse, has to be "reset" to its original state.
- Slow recovery time between successive pulses (dead time) means that high radiation rates may not be measured accurately.

Ionization Chambers

The ion-chamber is the simplest of the available gas-filled detectors. During the detection process, the detector adjusts the voltage used to correspond with the ionization region. The voltage level is not sufficient to produce gas amplification (secondary ionization). The detector collects the charges created by direct ionization within the gas in the chamber to produce a small direct current, which is then measured.

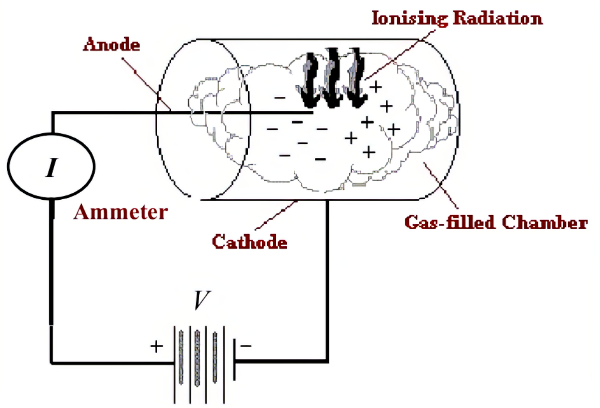

IMAGE SOURCE: www.researchgate.net/figure/9-The-basic-components-of-ionization-chamber_fig8_27336309

Common Uses

- Detection and measurement of ionizing radiation types such as X-rays, gamma rays, alpha particles, and beta particles.

Advantages

- Useful in measuring the overall ionising effect and high-energy gamma rays. Unlike Geiger-Müller tubes, they do not have a dead time which affects accuracy at high-dose rates.

Disadvantages

- More expensive than other detector types.
- Unable to discern between the different types of radiation (limiting where they can be used).

Proportional Counters

These sensors (commonly called counters) use gas amplification by using a higher gas pressure and voltage compared with that of other ionization chambers. When radiation enters the chamber, a pulse is produced that corresponds with the number of ion pairs generated resulting in a measurable signal.

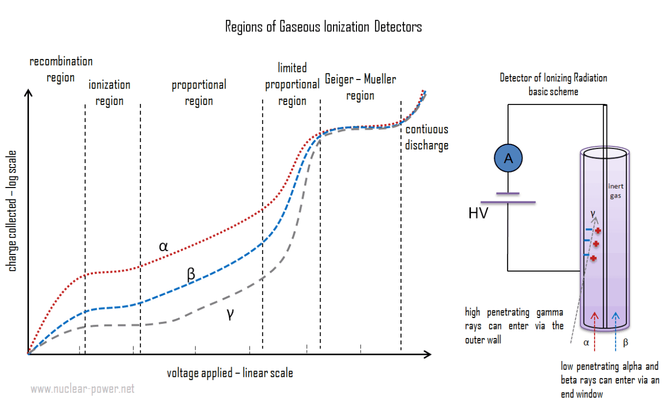

IMAGE SOURCE: https://nuclear-power.com/wp-content/uploads/2019/01/Gaseous-Ionization-Detectors-Regions-min.png

Common Uses

- Radioactive contamination detection on personnel, flat surfaces, tools, and clothing items.

Advantages

- High energy resolution: Can distinguish between the different radiation types.
- High sensitivity: Can detect low radiation levels making them ideal for environmental monitoring and trace-element analysis.
- Fast response time: Can detect radiation in a short-lived event or when there is a rapid change in radiation levels.

Disadvantages

- Gas leakage and aging: These counters require regular maintenance and gas replacement to ensure optimal ongoing radiation detection.
- Size and power supply: The counter can be bulky and cumbersome and requires a stable power supply with an amplifier which limits their use in field applications and portable devices.
- Sensitivity to environmental factors: Additional maintenance and calibration may be required to counter the effects of things like temperature, pressure, and humidity on the accuracy of the counter.

SCINTILLATION DETECTORS

A scintillation sensor (also referred to as a scintillation counter) consists of a transparent crystal, usually a phosphor, plastic, or organic liquid that fluoresces (emits light) when exposed to ionizing radiation. The scintillator must be transparent to light emissions and have a short decay time. It uses a thin opaque foil (such as aluminized mylar) with a low mass to shield it from ambient light to ensure that external photons do not swamp the ionization events caused by incident radiation. The signal (or pulse) holds data about the energy of the initial incident energy on the scintillator. This data can then be read to measure the energy and intensity of the radiation.

There are two main types of scintillators available today: organic or plastic, and inorganic or crystalline.

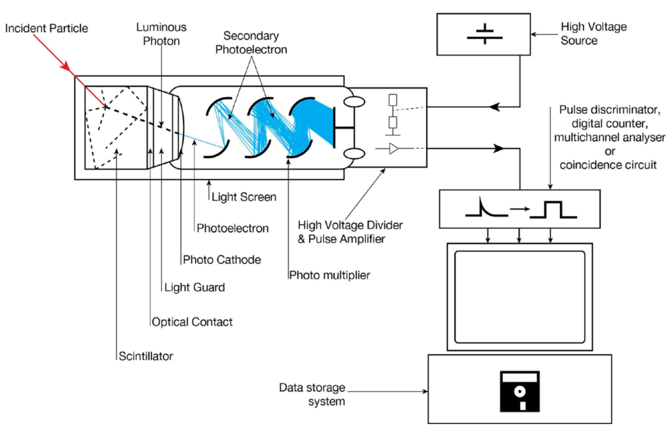

IMAGE SOURCE: https://nuclear-power.com/wp-content/uploads/2019/02/Scintillation_Counter-Photomultiplier-Tube.jpg

Common Uses

- Pharmaceutical, academic research.
- Nuclear power and environmental applications.
- Radioactive contamination.
- Cellular research, epigenetics and cancer research.

Advantages

- High sensitivity.
- High precision.
- Able to differentiate between natural or medical sources of radiation and sources of more immediate concern.
- Excellent quantum efficiency: Can determine the energy and intensity of incident radiation.
- Versatility: Can be used for several different radioactive conditions and radiation types.
- Fast response times.

Disadvantages

- Fluctuations in count rate.
- Variations between individual detectors.
- Changes in count rate with detector orientation.

Solid-State Sensors

These sensors, also called semiconductor radiation detectors, use a semiconductor material such as silicon or germanium crystal along with an electrical current to generate a pulse when an ionizing radiation particle passes through the device particles.

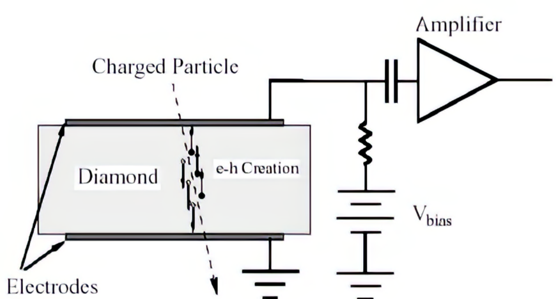

IMAGE SOURCE: https://riegler.web.cern.ch/lectures/lecture5.pdf

Common uses

- Medical field for internal and external scans.

Advantages

- Small in size and light in weight.
- Low-power consumption.
- No warmup time.
- Can measure specific ionization to identify radiation types.

Disadvantages

- Susceptible to leakage and degradation.
- Must be cooled to cryogenic temperatures for optimal operation.
- More expensive than other detector technologies.

Best Practices for Radiation Safety

Now that we know more about what radiation is, and its potential impacts to human health and safety, we need to look at the best ways to mitigate radiation exposure to workers and communities.

PROTECTION FROM RADIATION: TIME, DISTANCE, AND SHIELDING

There are three key principles associated with protection from radiation exposure: time (keeping the time of exposure to a minimum), distance (maintaining a safe distance from the source), and shielding (placing a shield between yourself and the source), such as in the use of proper protective clothing and equipment (PPE).

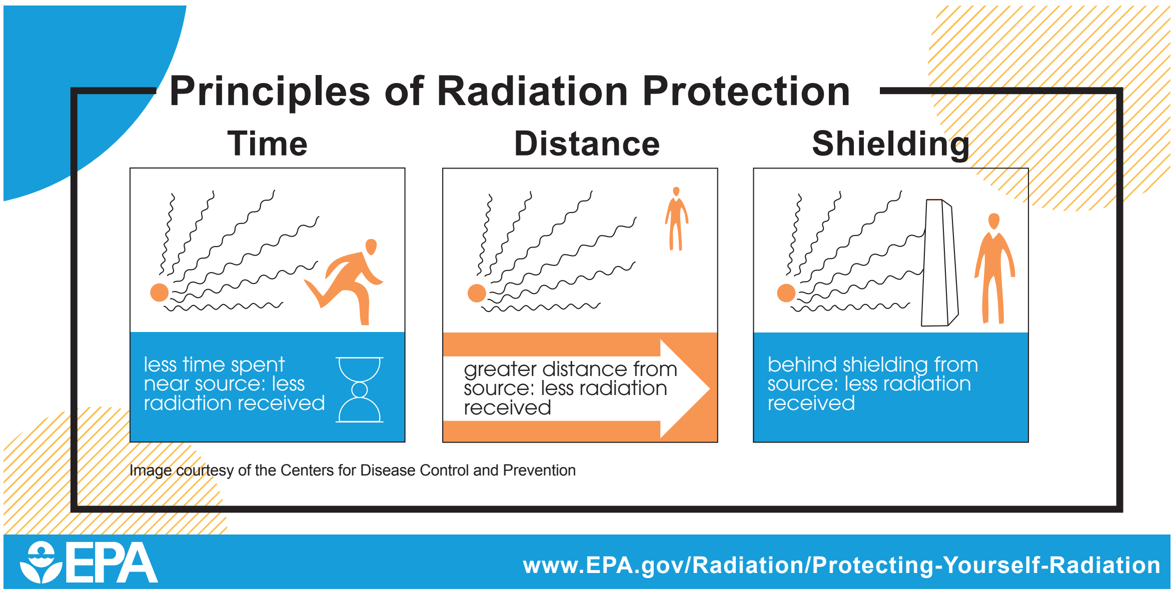

IMAGE SOURCE: https://x.com/EPAair/status/1009536617298657282

RADIATION REGULATORY AGENCIES

There are a number of different standards that govern the use of radiation throughout the world. Some of these agencies include:

- International Atomic Energy Agency (IAEA)
- European Commission
- United States Environmental Protection Agency (EPA)
- The Radiation Protection Bureau (Canada); Canadian Nuclear Safety Commission (CNSC)

RADIATION SAFETY PROGRAMS

Ensuring that your operation has a radiation protection program is vital to the safeguarding of your workers and surrounding community against the threat of exposure to dangerous radiation. This program is usually managed by a qualified expert such as a radiation safety officer (RSO) who may have medical training. In addition to the RSO, the program should have a radiation safety committee made up of the RSO, a management representative, and front-line workers who risk exposure on the job.

The radiation safety program should include the following:

- ALARA procedures: As a central concept for the protection program, procedures should be established that ensure that each worker's radiation exposure is As Low As Reasonably Achievable (ALARA) below the regulatory limits.
- Personal exposure monitoring (dosimetry): Employees who enter a restricted area, should wear dosimeters to measure, calculate, and assess the dose of ionizing radiation absorbed by a human body (or object).
- Surveys and area monitoring.
- Radiological controls.
- Worker training.
- Emergency procedures.
- Recordkeeping and reporting.
- Internal audit procedures.

Advanced Area Monitoring

Advanced monitoring should be a key component of every radiation safety program. Area monitors, such as Blackline Safety's EXO 8 Gamma, offer wide area gamma detection. Whether set up to continuously monitor for gamma at a concert or other public event, or set up on the fly when responding to an emergency, EXO 8 Gamma provides all the protection Hazmat teams need in a portable, drop-and-go device with up to 100 days of battery life.

EXO 8 Gamma uses a scintillator crystal sensor. Unlike other gamma radiation area monitors, EXO 8 Gamma has no warm-up time, and its sensor starts working as soon as the device is turned on. EXO 8 Gamma can also detect gamma radiation at up to three times the distance of any other area monitoring device available on the market today, keeping Hazmat personnel and the public safer than ever before.

In places where portability is required, such as event venues, portable area monitoring is instrumental in addressing the radiation safety pillars (distance, time, and shielding).

- **Distance:** EXO 8 Gamma can detect gamma radiation from up to three times the distance of other area monitors. This means that workers and responders can detect radiation from further away, letting them know about issues sooner and putting more distance between them and the source when radiation is detected.
- **Time:** Gamma radiation exposure can be devastating and life-altering. High doses of radiation, even for short durations, can cause short- and long-term health impacts. EXO 8 Gamma detects radiation levels immediately when the device is turned on, giving people the earliest warnings of radiation exposure so they can evacuate to a safe location.
- **Shielding:** Gamma rays have so much penetrating power that several inches of a dense material like lead, or even a few feet of concrete may be required to stop them. EXO 8 Gamma ensures that areas at risk of radiation exposure are constantly monitored and sounds an alarm at the first possible sign of exposure to notify responders so they can properly shield themselves before addressing the issue.

Radiation Safety Program Applications

EMERGENCY RESPONSE

The exact nature of some emergency situations might be unknown to responders when they arrive at the scene and responders face a critical challenge: knowing where their teams are and the hazards they may encounter before they enter a scene.

Additionally, radiation emergencies pose hazards for all workers. Occupational cancer is now the leading cause of death among firefighters. According to data from the International Association of Fire Fighters (IAFF), cancer caused 66 percent of the career firefighter line-of-duty deaths (LODD) from 2002 to 2019. By comparison, heart disease, the leading cause of death for men, women, and people of most racial and ethnic groups in the U.S., caused 18 percent of career LODDs for the same period.

EXO 8 Gamma gives Hazmat response teams peace of mind, as they will know if any radioactive material has been released as soon as they turn on the device, and can incorporate protective measures to guard against unsafe exposure.

EXO 8 Gamma also collects data, which responding teams can use to track potential exposure amount and duration that may have occurred while responding to an emergency.

PUBLIC SAFETY: RADIOACTIVE DISPERSAL DEVICES (RDD)

Event protection is crucial to public safety, as mass gatherings—including concerts and music festivals, sporting events, conventions, political events and public celebrations—are vulnerable to attacks and are considered soft targets for terrorism because they can inflict high numbers of casualties. Terrorism, built on the premise of fear, not only inflicts physical harm on a society or group but also seeks to interfere with the public's psychological wellbeing. In 2002, U.S. officials stated they detained an American citizen who intended to detonate an RDD (more dramatically known as a "dirty bomb") in the United States. Since then, several governments in Europe have stopped similar plots by terrorist groups. According to the Global Terrorism Database, 68% of attacks on concerts and festivals involve explosives, including the Bataclan bombing in 2015 in France, the Manchester Arena bombing in 2017 in the UK, and the threats of mass casualties that canceled Taylor Swift's Eras tour shows in 2024 in Vienna.

In response to this threat, portable devices such as EXO 8 Gamma can be placed in facilities that have a higher likelihood of being targeted, and at locations such as venue entrances and perimeters. The area monitors can detect the presence of gamma radiation and also help give peace of mind, guarding against the psychological impact of a radiation threat.

BORDER SECURITY

Border patrols on land and at sea are responsible for keeping our countries safe from the illegal movement of radioactive materials across our borders.

The International Atomic Energy Agency's (IAEA) Incident and Trafficking database has recorded more than 4,200 reported thefts or other incidents involving missing nuclear or radioactive material over the past 30 years, 350 of which are classified as connected or likely to be connected to trafficking or malicious use. The IAEA warns that dangerous materials remain vulnerable, especially during transport, and stresses the importance of strengthening transport security measures.

Using EXO 8 Gamma devices as part of border-crossing procedures can help personnel detect the unlawful movement of nuclear and radioactive materials in and out of countries. Such monitoring not only protects the agents themselves from unknowingly coming into contact with radiation, it also protects the public from accidents that may happen during transport, and from the risks posed by those in possession of the materials.

Conclusion

While our bodies are able to take in nominal levels of naturally occurring gamma radiation from the surrounding environment, they are not equipped to handle increased exposure levels without incurring severe, life-long damage to our health. Gamma radiation has many positive uses across multiple industries and occupations where radiation is a part of routine activities such as medical imaging, mining, or oil and gas extraction processes. Because of gamma radiation's tremendous penetrating power and ability to alter our DNA, the benefits of its use come with a heightened risk of its exposure at unsafe levels. For those areas where gamma radiation presents risks, radiation safety plans must be developed to ensure that the pillars of safety (time, distance, and shielding) are used to reduce or eliminate the possibility of unsafe exposure.

The EXO 8 Gamma area monitor plays a critical role in this radiation safety plan as it allows for the earliest detection of the radiation from the furthest distance possible. EXO 8 Gamma eliminates the most dangerous aspect of gamma radiation—that it is undetectable to human senses. With EXO 8 Gamma, you can safely monitor for gamma radiation 24/7, effectively mitigating the risk of unprotected human interactions with a gamma radiation source.

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About Blackline Safety: Blackline Safety is a proven leader for gas detection and lone worker protection. With over 165,000 workers protected in more than 70 countries around the world, our trusted cloud-connected safety solutions are used by some of the world's leading global brands to protect their most at-risk workers as well as the environment.

About EXO: EXO portable area monitors have unmatched connectivity—including an optional satellite module for remote locations—and precise location technology to deliver ultimate visibility across your worksites. When paired with 24/7 live monitoring and live alerts, they power high performance emergency response and evacuation management to ensure no worker is left behind.

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