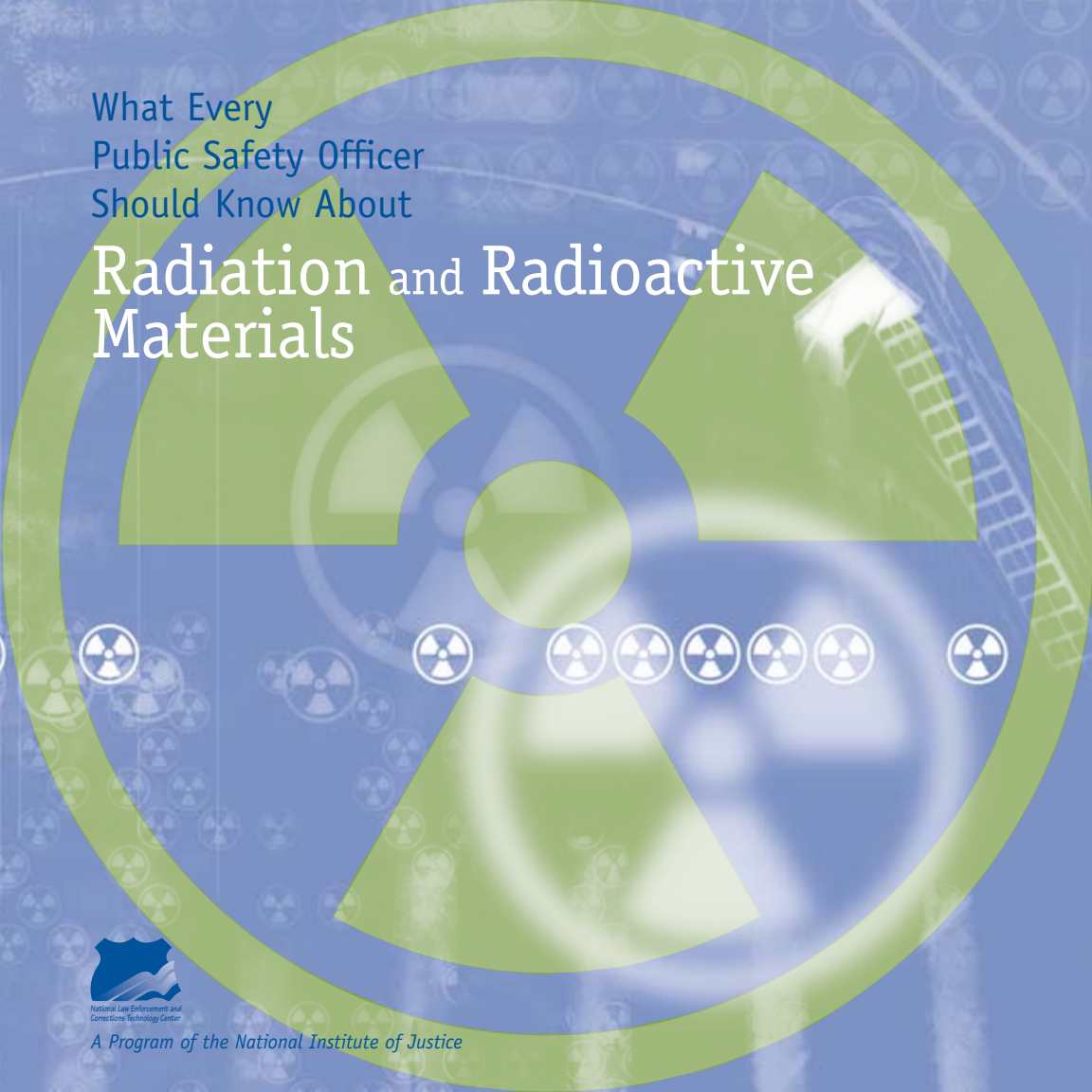
What Every
Public Safety Officer
Should Know About

Radiation and Radioactive Materials



National Law Enforcement and Corrections Technology Center

A Program of the National Institute of Justice

This quick-reference guide for public safety personnel provides basic information about and an understanding of radiation, radiation hazards, and initial response. It is not intended to replace an agency's existing policies, procedures, or training. Agency response protocols should be developed and followed for response to suspect weapons of mass destruction incidents. This aid is not intended to serve as a response guide.

Introduction

Radiation is part of our environment. It comes from both natural and manmade sources. Natural sources include cosmic radiation from space, radioactive rocks and soils, and other radioactive materials found in food and water. Humans have been exposed to these natural radiation sources since the dawn of humanity. Manmade sources of radiation include medical diagnosis and treatment, nuclear power industry, scientific research, consumer products, and nuclear weapons testing.

What Is Radiation and What Is Contamination?

Radiation is a form of energy. The atoms of some elements are radioactive and spontaneously release energy (radiation) as they transform from unstable to stable forms. Most elements are stable and do not emit radiation and therefore are not considered radioactive.

Radioactive material located in a place where it is not wanted is known as contamination. For example, radioactive fuel contained in a nuclear reactor is not considered contamination. However, if that same fuel is released from the reactor into the environment during an accident, it is considered contamination.

Different Kinds of Radiation

Remember that radiation is a form of energy released from a radioactive atom. That energy can be released in four different forms: **alpha particles, beta particles, gamma rays,** and **neutrons.** Awareness of the different forms of

radiation will better prepare you to protect yourself and the public.

- **Alpha particles** can travel short distances (inches). A sheet of paper or the outer layer of a person's skin easily stops them. **Radioactive materials that emit alpha particles are hazardous only when inhaled, ingested, absorbed, or injected.**
- **Beta particles** can travel farther and can pass through a sheet of paper and some clothing, but are stopped by thin metal or glass. **Beta particles can damage skin, but like alpha particles the greatest hazard comes when a person inhales, ingests, absorbs, or is injected with materials that emit beta particles.**
- **Gamma rays** are similar to x rays. They travel at the speed of light through air. Concrete, lead, steel, and other dense materials can be used to block (shield) gamma rays. **Gamma rays can be an extreme external body hazard.**
- **Neutrons** are extremely small atomic particles. They can travel long distances in air and are released when an atom breaks apart, a process known as fission. Water and concrete can be used to shield neutrons. **Neutrons, like gamma rays, can be an extreme external body hazard.**

Special instrumentation and trained personnel are needed to accurately identify the form(s) of radiation. Reliable packaging information (if available) may also help to determine the radiation form.

Natural Sources of Radiation

Radiation emitted by radioactive elements is naturally present in soil, water, and air. Radioactive materials are found all the way up the food chain, including in humans. The human body naturally contains many radioactive elements. Building materials, such as granite, contain radioactive materials. Even the air we breathe contains small concentrations of the radioactive gas radon, which seeps from the Earth's crust.

Cosmic radiation from outer space also is a source of natural radiation. The atmosphere screens out most cosmic radiation, but some still penetrates to the ground. The dose from cosmic radiation increases with altitude. As a result, people living at higher elevations receive a higher cosmic radiation dose than those living at sea level. People whose occupations require airline travel will experience a higher level of radiation exposure for the same reason.

Manmade Sources of Radiation

Radioactive materials can be produced in nuclear reactors. X-ray machines and nuclear reactors are examples of manmade radiation sources. Manmade radioactive materials are used in medicine, industry, research, and nuclear weapons.

Medical uses of radiation can be roughly broken into diagnostic and therapeutic. Diagnostic uses include routine x rays and injection or ingestion of radioactive materials for imaging internal organs. Therapeutic applications include cancer treatments. Industrial uses include well logging, physical property measurements, smoke detectors, and weapon night sights (tritium). Special nuclear materials, such as plutonium and uranium, are used in nuclear weapons.

What Is a Dirty Bomb?

According to the Environmental Protection Agency (EPA), the term “dirty bomb” commonly

refers to a device that spreads radioactive material by exploding a conventional (non-nuclear) explosive, such as dynamite. Dirty bombs are sometimes called radiological dispersal devices. Typically, the threat of a dirty bomb is from the explosion, not from radioactive materials or radiation. However, the spread of radioactive contamination is likely to create hysteria and terror among the public and contaminate the exposed area. Dirty bombs are not traditional nuclear weapons and cannot cause mass devastation like a nuclear weapon or an improvised nuclear device. They are difficult to accurately describe or characterize because they may be constructed using different types of containers and virtually any industrial or medical radiation source.

Detection of Radioactivity

The most obvious means of determining the presence of radioactive material is by locating a radiation warning symbol on a vehicle, container, or object, or at the entrances and exits of a room or facility. Nuclear radiation cannot be seen, heard, smelled, or tasted. It can be detected, however, using proper instrumentation. Various types of detectors are required to detect specific types of radiation. Some simple radiation detection instruments are available commercially. These types of detectors include personal devices used to detect radiation exposure and are similar to those worn by x-ray or medical personnel; duty-belt-worn detectors, commonly referred to as radiation pagers, which can be used for searching for sources; handheld monitors for determining radiation exposure data; and larger, more sophisticated instrumentation, which can be used to determine the type of radioactive atoms present. The cost of these types of detectors ranges from several hundred to several thousand dollars.

What Actions Do I Take If I Suspect a Radioactive Source or Contamination?

Follow the protocols established by your agency. Remember: Detection and identification of a radioactive source and contamination require special training and instrumentation. The extent of contamination can depend on many factors, including the size of the explosive, if any; the amount and type of radioactive material used; the weather; and the terrain.

Department policies and procedures may differ regarding whom to contact if a

radiological event is suspected. Make sure you have ready access to telephone numbers to contact the appropriate resources.

Supervisor: _____

Fire/HazMat: _____

FBI: _____

FEMA: _____

EPA: _____

NRC: _____

Other: _____

What Are the Risks and How Do I Protect the Public and Myself?

The fundamental principle in radiation protection is that all exposures should be kept to a minimum.

Typically, exposure to radioactivity has no immediate symptoms (asymptomatic). We are all continually exposed to natural radiation. However, heavy exposure to intense sources, although rare, can cause radiation sickness, which can include nausea, vomiting, and diarrhea. Eye damage, increased cancer risk, genetic defects, and even death can also result from higher exposure levels.

Three key factors influence an individual's radiation dose from exposure to a given source: **time, distance,** and **shielding.**

- **Time.** The most direct way to reduce a radiation dose is to reduce the time spent working with or in the vicinity of radiation sources. If the exposure time is cut in half, the dose will be cut in half.
- **Distance.** When the working distance from a point radiation source is increased by a factor of two, the dose received from that source will be reduced by a factor of four. Moving from 20 feet to 40 feet from the source will decrease your exposure to 1/4 of the original exposure.
- **Shielding.** Shielding is the use of any material to reduce the intensity of the radiation by absorbing or reflecting the radiation.

Again, first and foremost, follow your agency's response protocol. If one is not available, remember: In the case of an explosion, the blast may cause injury and death to those in its immediate proximity. Also, entry without proper equipment, training, and procedures into an area with

dispersed radioactive materials may put you at risk.

Individuals or items suspected of being radiologically contaminated should be isolated and secured until they can be surveyed with proper radiation detection instrumentation. Only trained personnel should perform the survey and decontamination of individuals or property. The area also should be secured so that unauthorized personnel are not exposed to radiation and do not disturb the scene.

Remember that dust and other airborne particles and fragments from an exploded dirty bomb may contain radioactive materials. Appropriate respiratory equipment and clothing should be worn and proper procedures followed.

For more information about other resources addressing this topic, contact the National Law Enforcement and Corrections Technology Center system at 800–248–2742, or e-mail asknlectc@nlectc.org. The web address is www.justnet.org.

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