TIP:18 - Environmental Monitoring

Background

The discharge of radioactive effluents from routine plant operations can have environmental impacts--on man, animals, plants, and sea life. During the licensing of a plant, NRC issues a Final Environmental Statement (FES) which identifies these potential impacts. As part of NRC's requirements for a license, licensees must:

(1) keep releases of radioactive material to unrestricted areas during normal operation as low as reasonably achievable (as described in the Commission's regulations in 10 CFR Part 50.36a), and
(2) comply with radiation dose limits for the public (10 CFR Part 20).

In addition, NRC regulations require licensees to have various effluent and environmental monitoring programs to ensure that the impacts from plant operations are minimized. The permitted effluent releases result in very small doses to members of the public living around the plants.

Monitoring Environmental Impacts

The NRC requires licensees to report plant discharges and results of environmental monitoring around their plants to ensure that potential impacts are detected and reviewed. Licensees must also participate in an interlaboratory comparison program which provides an independent check of the accuracy and precision of environmental measurements.

In annual reports, licensees identify the amount of liquid and airborne radioactive effluents discharged from plants and the associated doses. Licensees also must report environmental radioactivity levels around their plants annually. These reports, available to the public, cover sampling from TLDs (thermoluminescent dosimeters); airborne radioiodine and particulate samplers; samples of surface, groundwater, and drinking water and downstream shoreline sediment from existing or potential recreational facilities; and samples of ingestion sources such as milk, fish, invertebrates, and broad leaf vegetation.

Over the past 25 years, radioactive effluents released from nuclear power plants have decreased significantly. During the early part of that period, a significant contributor to the reduction was the addition of special systems (augmented offgas systems) to boiling water reactors, which process some of the noncondensible gases formed in the reactor process to limit the radioactive gases released to the environment. Later during the 25-year period, other contributors to the reduction were associated with improved fuel performance and licensees' improved effluent control programs.

Regulations

Current regulations to limit offsite releases and their associated radiation doses are much more restrictive than those required for nuclear power plants licensed in the 1960s. In 1975, the NRC amended its regulations (in 10 CFR Parts 50.34 and 50.36 and a new Appendix I) to provide numerical guides for design objectives and limiting conditions for operation to meet the radiation dose criterion "as low as is reasonably achievable." Adoption of these regulations requires that plant releases be kept to doses well below the radiation exposure limits for the public in 10 CFR Part 20.

In late 1979, the Environmental Protection Agency (EPA) placed an additional radiation dose requirement on reactor licensees. This requirement established total body, thyroid, and other organ dose limits for radioactive effluents and direct radiation. The NRC incorporated EPA's regulation into 10 CFR Part 20 in 1981, and all plants must now meet these requirements.

Current Status

The NRC conducts periodic inspections of each licensee's effluent and environmental monitoring programs to ensure compliance with NRC requirements. The NRC documents the status of licensee programs in inspection reports that are available to the public.

Monitoring Environmental Impacts of Nuclear Power Plants

Final Environmental Statements identify potential environmental impacts of radioactive materials discharged from each nuclear power plant during routine operations.

Permitted effluent releases result in very small doses to members of the public living around nuclear power plants.

Licensees report releases of radioactive liquid and airborne effluents and their associated doses in annual radioactive effluent release reports.

Licensees report radioactivity levels from the environmental sampling or air, ground, water, and ingestion pathways in annual radiological environmental operating reports.

NRC regulations (10 CFR Parts 50.34 and 50.36) require that each licensee keep releases of radioactive material to unrestricted areas as low as reasonably achievable, which is much less than the radiation dose limits for the public in 10 CFR Part 20.

The NRC verifies that licensees properly evaluate potential radiological impacts through NRC onsite inspections and interlaboratory comparisons.

NRC documents licensee effluent releases and the results of NRC's independent monitoring and assessment effort in plant-specific inspection reports available to the public.

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TIP:36 - Biological Effect of Radiation

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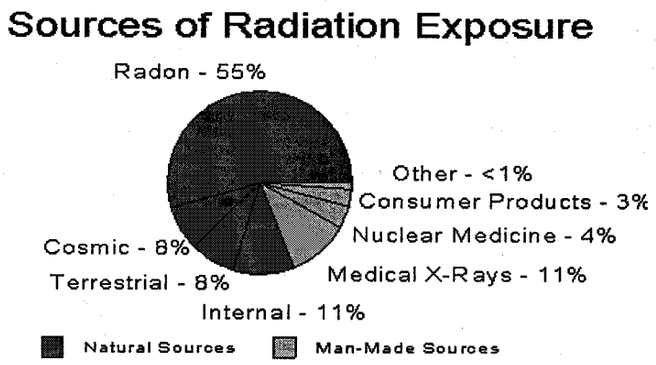
Background

Radiation is all around us, occurring naturally in the environment. We are exposed all the time to radiation from radon in the air; uranium, radium and thorium in the earth; cosmic rays from outer space and the sun; radioactive potassium in our food and water; and radioactive material within our own bodies. This is commonly called naturally-occurring background radiation.

The average radiation exposure to an individual in the United States is about 360 millirem (mrem) or 3.6 millisievert (mSv) per year. About 300mrem (3 mSv) of this is from natural sources, including radon [200 mrem(2mSv)] that emanates from the ground, as well as cosmic, terrestrial and internal radiation [100 mrem (1mSv)]. The largest man-made source is medical diagnosis, accounting for about 50 mrem (0.5 mSv) per year. Consumer products such as smoke detectors, exit signs and luminous watch dials contribute about 10 mrem (0.1 mSv) per year.



Background radiation varies depending on the area where you live, the type of housing construction you live in, and what you eat. For instance, Colorado has higher radiation levels because, at its high altitude, there is more exposure to cosmic rays and with its naturally-occurring uranium enriched soil, there is more terrestrial radiation. Brick homes have higher natural radiation levels than homes made of other materials such as wood; domestic water supplies naturally contain radon; and certain foods such as bananas and Brazil nuts naturally contain higher levels of radiation than other foods.

In addition, consumer products such as tobacco, fertilizer product and coal have noticeable concentrations of naturally-occurring radionuclides including potassium-40. Above this background level, the NRC limits maximum radiation dose to the public to 100 mrem per year (1 mSv/yr), and limits dose to adults working in nuclear operations to 5,000 mrem per year (50 mSv/yr).

Discussion

Biological effects of radiation on living cells may result in three outcomes: (1) cells repair themselves, resulting in no damage; (2) cells die, much like millions of body cells do every day, being replaced through normal biological processes; or (3) cells change their reproductive structure. The effects of radiation, like those of most chemical substances, can be seen clearly only at doses much higher than are allowed by Federal regulations.

Biological effects of radiation may be classified as prompt or delayed. Prompt effects can appear in a matter of minutes to as long as a few weeks after exposure to very high doses of radiation. The higher the dose, the sooner the effects will appear, and the higher the probability of death. For example, in 1986, firefighters battling the fire at the Chernobyl nuclear power plant in the Ukraine died from very large doses [approximately 1,100,000 millirad (11,000 milligray)] of radiation.

Because radiation affects different people in different ways, it is not possible to indicate what dose is needed to be fatal. However, it is believed that 50% of a population would die within thirty days after receiving a dose over a period of a few minutes to hours of between 250,000 to 450,000 mrem (2500 to 4500 mSv). This would vary depending on the health of the individuals before the exposure and the medical care received after the exposure.

It should be noted that the doses referred to above are acute whole body doses, meaning that the whole body is exposed to the radiation in a very short period of time (minutes to hours). Exposure of only parts of the body will likely lead to more localized effects, such as skin burns or tissue damage in the exposed area.

Delayed effects of radiation are effects that appear many years (usually between 5-20 years) after exposure. The period before cancer appears is known as the latent period. Genetic effects and the development of cancer are the primary health concerns. The cancers that may develop as a result of radiation exposure are indistinguishable from those that develop spontaneously or as a result of exposure to other carcinogens. Radiation exposure may be only the initiating step that may or may not eventually lead to cancer. Genetic effects may appear in the exposed person's direct offspring, or may appear several generations later, depending on whether the altered genes are dominant or recessive.

Although radiation is known to cause cancers at high doses and high dose rates, currently there are no data to unequivocally establish the occurrence of cancer following exposure to low doses and dose rates -- below about 20,000 mrem (200 mSv). Studies of a population exposed to chronic low-levels of radiation above normal background have shown no biological effects. This population includes occupationally exposed radiation workers and people living in areas having high levels of background radiation [above 1,000 mrem (10 mSv) per year].

In the absence of sufficient data to the contrary, the radiation protection community conservatively assumes that any amount of radiation may pose some risk for causing cancer and hereditary effects, and that the risk is higher for higher level doses. The NRC's dose limits for both radiation workers and members of the public were developed on that basis. (NRC regulations and radiation exposure limits are contained in Title 10 of the Code of Federal Regulations under Part 20.)

September 1999