Industrial Particle Accelerators

Particle accelerators are devices used to accelerate charged particles, usually electrons or protons, to increase their energy. The radiation produced by these high-energy particles is used for many kinds of research, medical applications, and by industry.

In 1928, Robert Van de Graaff demonstrated how a high-voltage device can accelerate charged particles, protons and electrons. That was the start of the development of a series of particle accelerators.

Accelerators use a combination of electric and magnetic fields to move atomic particles at higher and higher speeds before crashing them into pre-selected targets of high Z material to produce x-rays that then hit the target. The electric fields provide the particles with a series of jolts of energy to accelerate them. The magnetic fields steer the particles to the target.

This accelerator process was originally developed for use in "atom-smashing" experiments. A particle accelerator, or "atom-smasher," can speed up a particle to or near the speed of light before it collides with a target. The atomic particles created by the collision as well as the radiation emitted are detected and analyzed. This information tells us about the particles that make up the atom and the forces that hold it together.

Researchers later found a number of practical applications using the same high energy particle beams.

More than 15,000 accelerators are in use around the world. More than 97% of accelerators are used in commercial applications, such as the creation of ceramics, insulators, and plastics. Accelerators of many different designs have been developed. Some common accelerator applications include:

- Diagnosing and treating cancer
- Locating oil and minerals in the earth
- Processing semiconductor chips for computers
- Sterilizing medical equipment and food products
- Determining the age of materials through radiocarbon dating

Both the radiation produced during operation and the radioactive waste created from operation pose worker safety issues. During operations, accelerators produce x-rays. X-rays can be an external radiation hazard to those who work in close proximity to an accelerator.

One of the benefits of accelerators is that, unlike radioactive sources, they only produce radiation when they are operated. However, radioactive waste is produced during their operation. This waste is generally short-lived; decaying in less than one year and may be stored at laboratories or production facilities until it is no longer radioactive. An extremely small fraction of the waste can remain radioactive for more than one year.

Who is protecting you

The States
States regulate radiation-producing equipment, such as particle accelerators and X-ray machines for both medical and industrial use.

U.S. Food and Drug Administration (FDA)
FDA regulates the manufacturers and installers of radiation-emitting electronic products, including accelerators, to prevent unnecessary exposure to radiation from the use of these products. Specific requirements apply to all radiation-emitting electronic products in order to comply with the Food, Drug, and Cosmetic Act. Accelerators used as medical devices must also comply with any additional medical device regulations.

National Institute of Standards and Technology (NIST)
The Commerce Department's National Institute of Standards and Technology provides primary national standards, dosimetry methods, and measurement services. NIST also provides basic data for creating worker and public safety standards applying to the use of ionizing radiation in radiation therapy and diagnosis, nuclear medicine, radiography, industrial radiation processing, nuclear electric power, national defense, space science and environmental protection.

What you can do to protect yourself

State requirements may vary in the area of particle or linear accelerator so check with your state Radiation Protection Program. To avoid unnecessary exposure from accelerators and other radiation-emitting devices, follow all safety precautions and obey any posted instructions.

If you are undergoing nuclear medical treatment using particle accelerators, check to ensure that the medical facility and medical technologist have current licenses and training certifications.

Resources

You can explore this radiation source further through the resources at the following URL:
http://www.epa.gov/radtown/accelerators.htm#resources

We provide these resources on-line rather than here so we can keep the links up-to-date.