BACKGROUNDER
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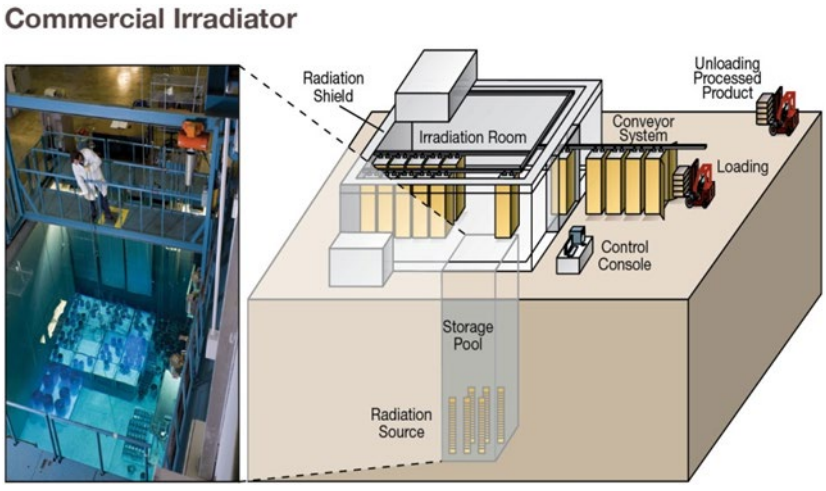
Commercial Irradiators

Irradiators are machines that expose products to gamma radiation to kill germs and insects or for other purposes. Food, food containers, spices, fruits, plants and medical supplies are the products most commonly irradiated. The process does not leave radioactive residue or cause the products to become radioactive. The radiation can come from radioactive sealed sources, an x-ray tube or an electron beam.

The NRC and its Agreement States regulate the use of irradiators that use sealed sources. These states have agreements with the NRC permitting them to regulate most of the radioactive materials used within their borders. The states regulate x-ray generators and electron beam irradiators.

Irradiators have been used in this country for more than 50 years. The NRC does not specify what products may be irradiated, nor does it have a position on food irradiation. The U.S. Food and Drug Administration and other agencies have approved the irradiation of meat, poultry, and fresh fruits and vegetables.

Sealed sources must be carefully controlled and handled at all times to avoid worker overexposure to radiation. All commercial irradiators regulated by the NRC use cobalt-60 as their source. There are two types of U.S. commercial irradiators using radioactive sealed sources: underwater and wet-source-storage panoramic models.



Commercial Wet-Source-Storage Irradiator

The sealed source is stored in water and raised into the air to irradiate a product moved into the room on a conveyor.

Photo courtesy of Nordion

Wet-source-storage panoramic irradiators store their sources in water. When products move into the room on a conveyor, the sources are raised into the air. Once the product has been irradiated, the source is lowered back into the pool. Thick concrete or steel walls and roofs protect workers and the public when the sources are lifted from the pool.

Underwater irradiators use sources that remain in the water at all times, providing shielding for workers and the public. The product to be irradiated is placed in a water-tight container, lowered into the pool, irradiated and then removed.

Properly designed and operated commercial irradiators operate safely and securely and pose no significant risk to workers or the public. In most cases, exposure to workers is so low it cannot be detected or distinguished from natural background radiation. (Each year, Americans receive about 300 millirems due to background radiation from natural sources.) The significant shielding required for these facilities means the public receives little, if any, exposure from the sources. NRC regulations limit the exposure to the public from a licensed facility to 100 millirems per year.

There are about 50 commercial irradiators in the United States. State and local governments can use zoning and planning laws to determine where an irradiation facility may be built.

Licensing and Inspection

Irradiators that use radioactive material must meet all safety and security requirements. These include:

- A company must have a license from the NRC or an Agreement State before obtaining a radioactive sealed source.
- Irradiator facilities and sealed sources must meet design and performance criteria.
- Irradiator facilities must undergo construction monitoring and acceptance testing.
- Operators must meet regulations for operating and emergency procedures, inspection and maintenance, and worker training.
- Operators must be able to detect, assess and respond to any actual or attempted unauthorized access, and must also report any unauthorized access or other suspicious activities to the NRC.

NRC and Agreement State license reviewers focus on radiation safety, facility security, the source's integrity, safety system design, and personnel training and experience. The NRC periodically inspects irradiators to ensure compliance with the regulations. If a facility fails to comply, NRC enforcement actions can range from ordering changes to assessing fines or even revoking a license.

Accidents and Contamination Events

The only serious radiation exposure events at U.S. irradiators involved two radiation-related injuries decades ago. In June 1974, an operator in Parsippany, N.J., walked into a room with an exposed source, saw it and quickly left. He developed observable symptoms of radiation sickness. In September 1977, an operator in Rockaway, N.J., entered a room while a source was unshielded. This worker also received a dose large enough to cause radiation sickness symptoms. Both overexposures occurred because of bypassed safety systems or failure to follow procedures. Two other workers died, unrelated to radiation exposure, in an accident moving materials to be processed at a U.S. irradiator.

Two cases of contaminated soil at U.S. irradiators required extensive cleanup. In 1988 in Decatur, Ga., an irradiator source leaked. The source dissolved easily in water, similar to table salt. The leak contaminated the facility and some surrounding soil. The cleanup work was costly to the facility's operator and the U.S. Department of Energy, which had supplied the source. No members of the public were exposed. In Dover, N.J., in 1982, a damaged cobalt-60 source contaminated water that was

released to the facility floor and surrounding soil. Extensive cleanup was required, but again there was no exposure to the public. Neither event affected groundwater sources.

The NRC reviewed the causes of various incidents, developing strict requirements designed to reduce the risk of future incidents. They ensure the facilities have safety features and redundancies to minimize the possibility of radiation exposure to workers and the public, and security measures to prevent unauthorized access to the sources. These regulations, implemented in 1993, are known as 10 CFR (Code of Federal Regulations) Part 36 and 10 CFR Part 37, respectively.

The 2011 earthquake and tsunami that struck the Fukushima Daiichi nuclear power plants in Japan prompted the NRC to review the generic facility design of commercial irradiators to determine if engineering controls and barriers are sufficient to protect the health and safety of the public and workers in the event of similar natural disasters. The NRC concluded that natural phenomena such as tsunamis, earthquakes, hurricanes, or fire are unlikely to cause a loss of control of radioactive material that might harm the public or the environment.

Shipment and Disposal of Radioactive Sources

Suppliers of radioactive sources must ensure their shipping packages are sufficiently robust and meet NRC standards. They must also follow U.S. Department of Transportation regulations when they transport radioactive materials. The sources are usually returned to the supplier once their radioactivity levels have dropped and they can no longer efficiently irradiate material. Again, NRC and Department of Transportation requirements must be met when sources are returned.

Security of Radioactive Sources

The NRC's security requirements for irradiators account for possible hostile actions. While no specific credible threats have developed against U.S. irradiators, the NRC required enhanced security at irradiation facilities after the events of September 2001.

Before receiving a license, the facility owner must take very specific actions to secure the irradiator and its sources. Those measures must be in place before radioactive sources are loaded into the irradiator. The NRC has considered a number of scenarios involving a terrorist obtaining a radioactive source and using it to build a so-called "dirty bomb." That review found it would be extremely difficult to use a cobalt-60 source to contaminate a wide area.

Emergency Procedures

The NRC requires irradiator operators to coordinate with local and state emergency response agencies in case of an emergency. Operators must have procedures for handling a variety of emergencies, including fires, earthquakes, tornadoes, loss of power, leaking sources and water leaks from the storage pool. Those procedures must be in place before the NRC will issue a license.

Decommissioning

As with all licensed nuclear facilities, irradiation facility sites must be decommissioned once they permanently close. This work includes safely disposing of radioactive sources and removing any contamination above acceptable levels. Before this work can be considered complete, the facility operator must do surveys to ensure the site meets applicable safety and health standards. The operator must also provide the NRC with assurance that it will have sufficient money to decommission the facility in a timely way.

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