

## Commercial Irradiators

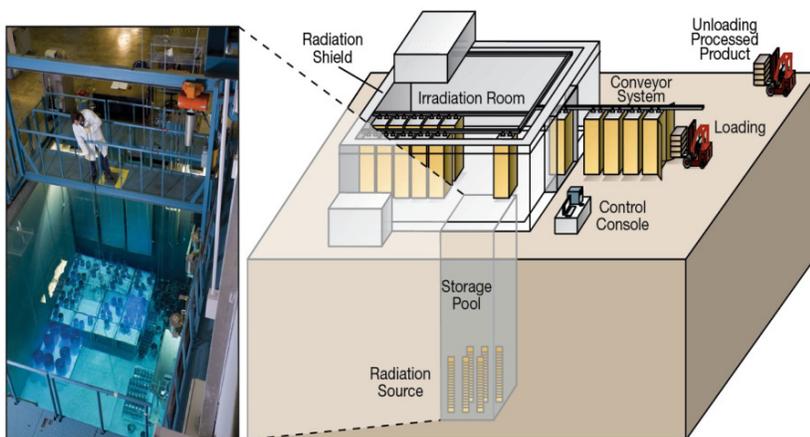
Irradiators are machines that expose products to gamma radiation to kill germs and insects or for other purposes. Food, food containers, spices, fruits, plants and medical supplies are the products most commonly irradiated. The process does not leave radioactive residue or cause the products to become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

The NRC and 37 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 40 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. In the United States, there are two types of commercial irradiators using radioactive sealed sources: underwater and wet-source-storage panoramic models.

### Commercial Irradiator



### 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 also 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 walls or steel 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.

With proper design and procedures, commercial irradiators can operate safely 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 the 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. States 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 requirements. These include:

- Operators must have a license from the NRC or an Agreement State before they obtain 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.

The NRC's license reviewers focus on radiation safety, the source's integrity, safety system design, and personnel training and experience. The NRC conducts periodic inspections to ensure compliance with the regulations. If a facility is not in compliance, the NRC can take enforcement action. Such action can range from ordering changes to assessing fines or even revoking a license.

## **Accidents and Contamination Events**

There have been no deaths from radiation exposure at irradiators in the United States. Two serious radiation-related injuries occurred 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. In both cases, the overexposures occurred because safety systems were intentionally bypassed or procedures were not followed. Two deaths unrelated to radiation exposure occurred at U.S. irradiators. These workers were crushed while moving materials to be irradiated on a conveyor.

No irradiators in the United States have contaminated groundwater. There were two cases of contaminated soil that 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.

The NRC reviewed the causes of various incidents over the years at irradiator facilities. From these reviews it developed strict requirements designed to reduce the risk of incidents going forward. They ensure the facilities have safety features and redundancies to minimize the possibility of radiation exposure to workers and the public. These regulations, implemented in 1993, are known as 10 CFR (Code of Federal Regulations) [Part 36](#).

## **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 knows the public is concerned about a possible terrorist attack on an irradiator. There have been no specific credible threats against any U.S. irradiators. Still, the NRC required increased security measures at irradiation facilities in response to the 9/11 attacks.

Before licensing an irradiator, the NRC issues an order to the facility owner requiring 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, leaking sources and alarms indicating low water in or water leakage 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 cleaned up 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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