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Preservation by Irradiation



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Irradiation

- **Physical process of exposing foods to short wave radiation energy to preserve them by sterilization, and disinfestation**
- **Food is exposed to controlled levels of ionizing radiation to kill harmful bacteria, pests, parasites and preserve its freshness and quality**
- **Food preservation by irradiation (cold pasteurization) is a process where food is exposed to ionizing energy – cobalt-60 and cesium-137**
- **High energy electrons and X-rays generated by machines are used for radiation**



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Radiation

- **Ionizing radiation is energy level not sufficient to remove electron/s from atoms, hence cannot form electrically charged particles**
- **Approved dose levels for irradiation cannot penetrate nuclei and thus food can never become radioactive**
- **Infrared and microwave radiations have low energy levels and are non-ionizing with longer wavelengths but generate heat through friction**



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Types of Ionizing Radiations

- **Electron beam generated at 10 million eV (MeV) are streams of very fast moving electrons produced in electron accelerators that require shielding**
 - **Penetrate only 1-1/2 inches deep hence cannot be used for bulk food commodities**
- **X-rays generated at 5 MeV are photons with greater penetration and are produced by bombarding heavy metal with cathode rays, require shielding**
- **Gamma rays emitted from Co-60 or Ce-137 with energy levels of 1.33 and 0.67 MeV energy levels respectively with deep penetration ability**



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Irradiation Concepts

- **Radiation dose is the quantity of radiation energy absorbed by the food as it passes through the radiation field during processing**
- **Gray (Gy) is the unit to measure absorbed dose of radiation and is equal to one joule of energy absorbed per kg of matter irradiated**
- **1 Gy = 100 rad, 1 kGy = 1000 Gy**
- **Radappertization – referred to as “radiation sterilization” involving high dose treatments**
- **Radurization- “radiation pasteurization” with low dose treatments to extend product’s shelf life**
- **Radicidation is also low dose radiation pasteurization for elimination of specific pathogen**



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Pros and Cons of Irradiation

- **Pros – does not change texture, appearance, flavour, nutritional value, colour, and freshness of food**
 - Does not induce radioactivity in food and does not leave toxic residues on foods
 - Highly penetrating and hence can be used on pre-packed food commodities thus sterilizing and improving shelf-life
 - Processing facilities are environment friendly
- **Cons – cannot be applied to all kinds of foods**
 - Cannot destroy pesticides and toxins in foods
 - Only specific foods that are duly permitted under PFA rules (1955) and FSSA regulations (2011) can be irradiated
 - Cannot make spoiled food look good



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Benefits of Irradiation

- **Can avoid use of harmful chemical compounds like methyl bromide and ethylene oxide for insect disinfestation in stored products and microbial decontamination of spices**
- **Dose of 3Kg – 10 kG of gamma irradiation will reduce microbial load and retains flavour quality**
- **Extende shelf life of meat, poultry, and sea foods**
- **Replaces chemicals for inhibiting sprouting in tubes and bulbs and delay ripening of fruits**
- **Radaiation sterilized food using doses upto 45 kGy are routinely consumed by NASA's astronauts**

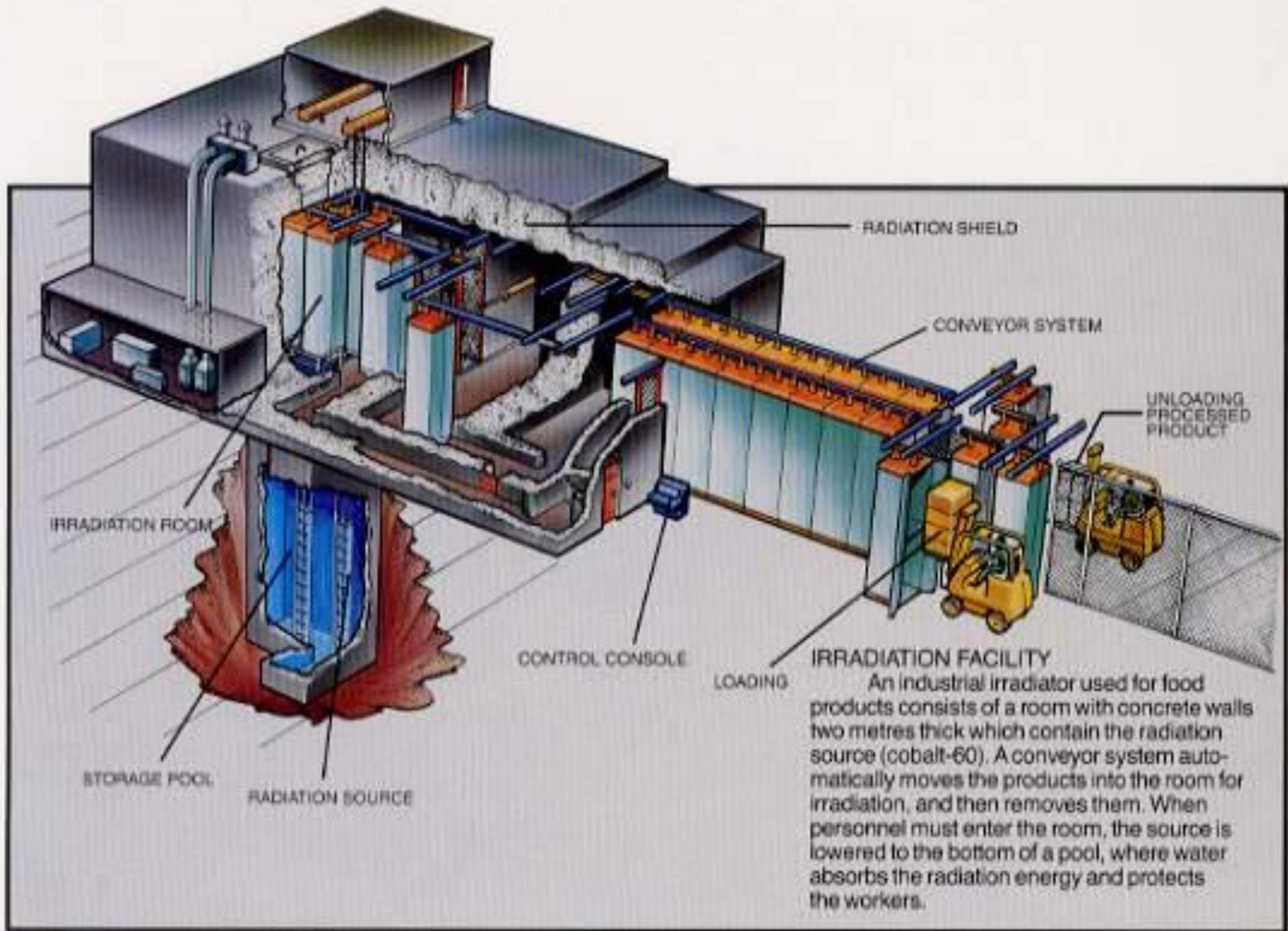


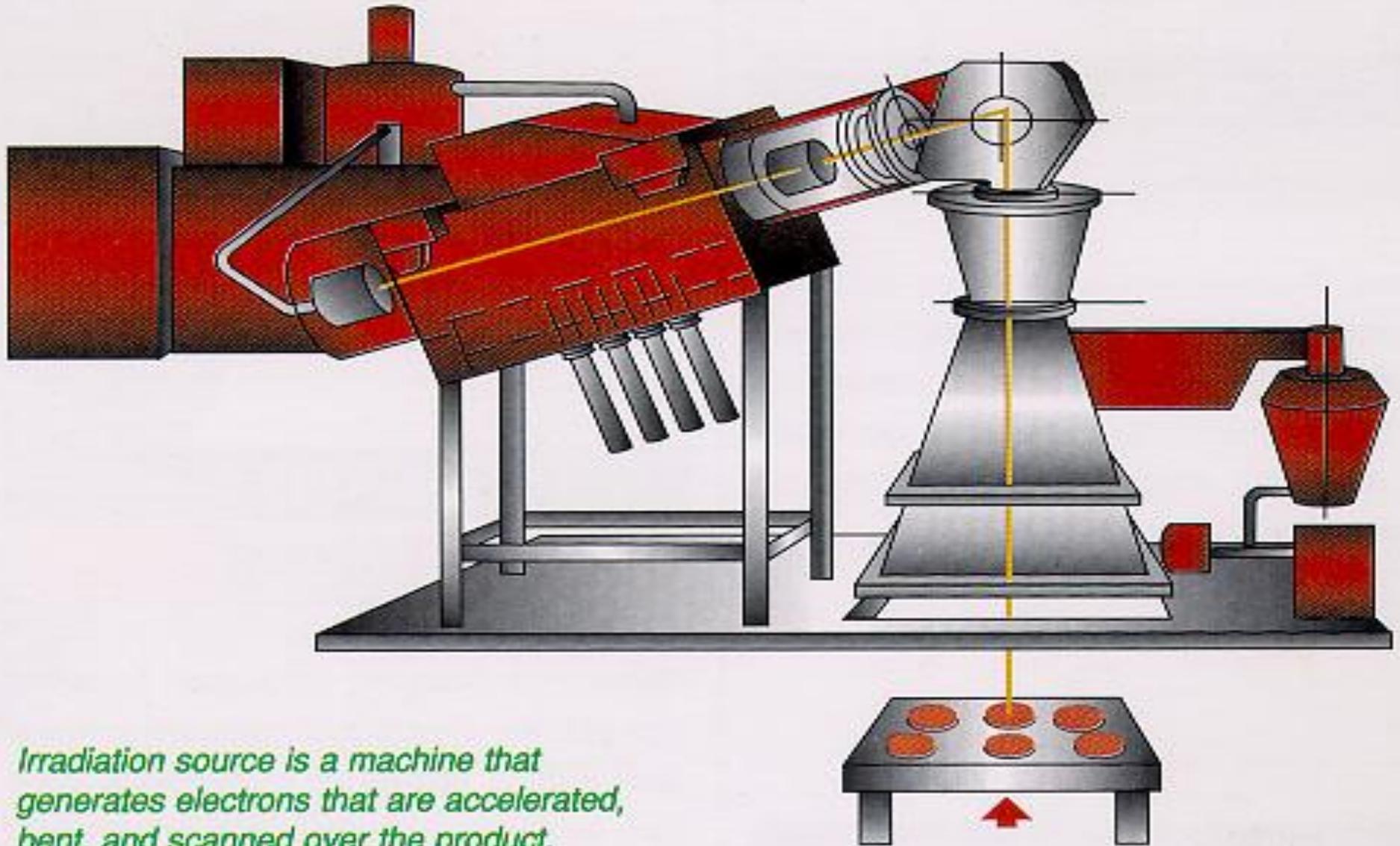
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Benefits of Irradiation

- Carbohydrates, lipids, proteins undergo minimal changes, thiamin, pyridoxine, and vitamin C are most susceptible with losses between 10-15%
- *Clostridium botulinum* is most resistant organism
- Irradiated foods are safe and wholesome for consumption
- Reduces post harvest losses, delays ripening, inhibits sprouting in onions, potatoes



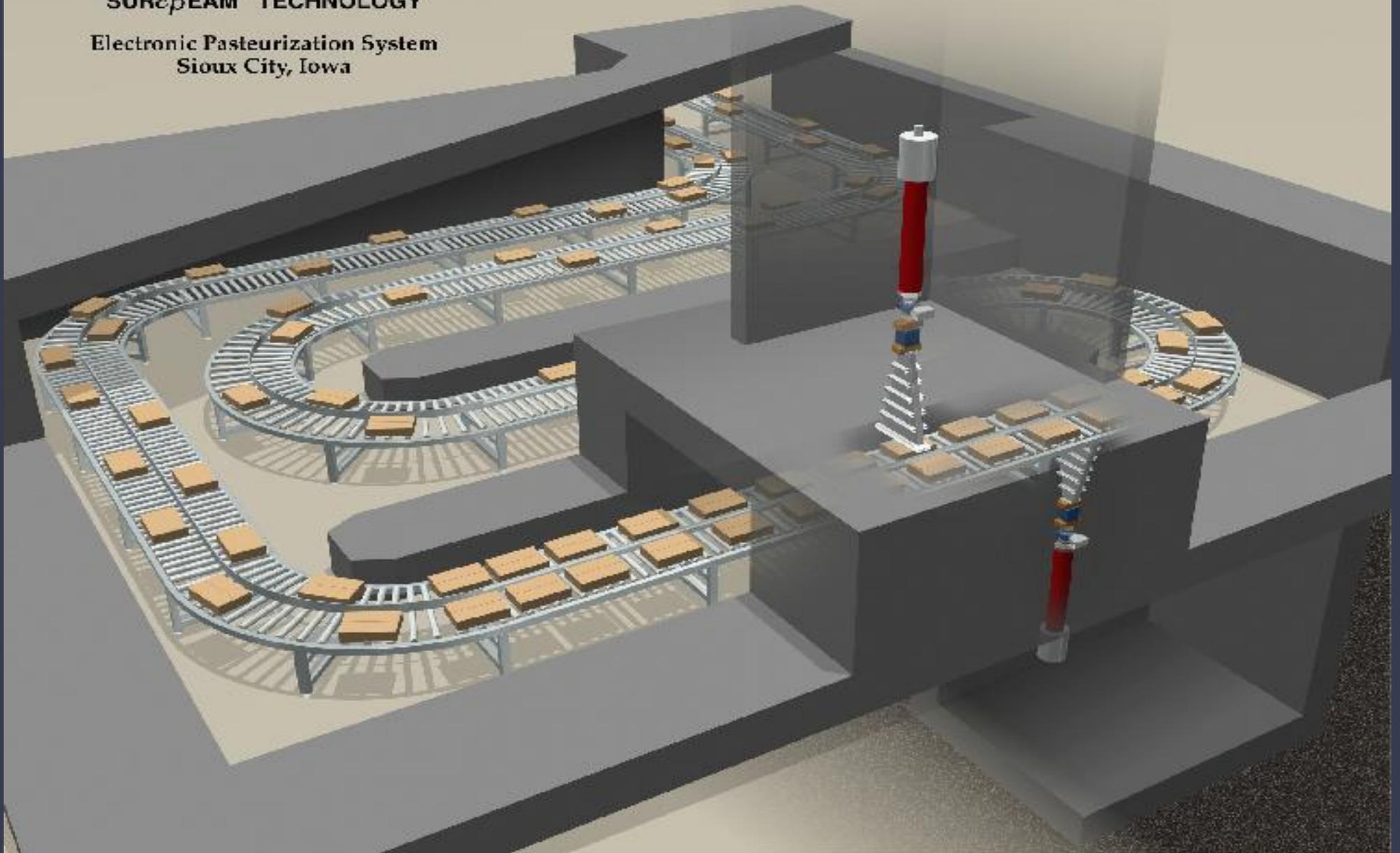


Irradiation source is a machine that generates electrons that are accelerated, bent, and scanned over the product.

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