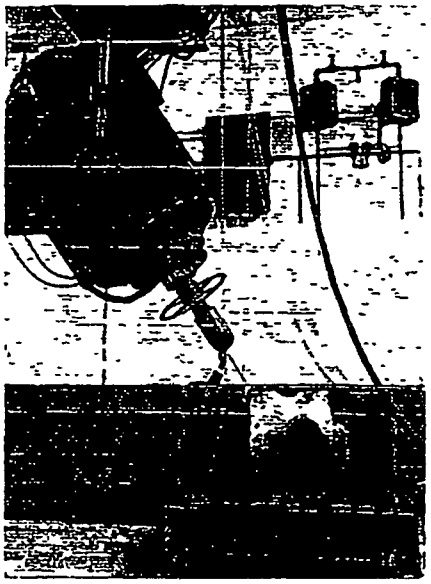


Fig. 42-5. A 2,000,000 volt industrial X-ray unit which is permanently installed in a laboratory room equipped with sufficient shielding to confine the radiation.

Courtesy General Electric X-Ray Corp

● Certain kinds of work involve applications using radiation from radium, thorium, and other naturally occurring materials which are not controlled exclusively by the AEC Some of these materials are used, for example, in luminous instrument dials, in gas mantles, in certain ceramic colors, and as radiation sources

● Radiation fields occur in the operation of such devices as industrial, medical, and dental X-ray machines and X-ray diffraction machines, and cyclotrons and other particle accelerators (see Fig 42-5) Relatively small amounts of radiation are emitted in electronic tubes, television receivers, and electron microscopes. See NBS Handbooks 50, 76, 55 *X-Ray Protection Design* (1952), *Medical X-Ray Protection up to Three Million Volts* (1961), and *Protection Against Betatron-Synchrotron Radiations up to* 100 MEV.

● Industrial operations in which radioactive materials are of prime importance include fuel fabrication, shipment and transportation of radioactive materials, construction or operation of reactors, and chemical processing to recover or separate radioisotopes from spent fuel elements See Safety Series No 6 *Regulations for the Safe Transport of Radioactive Materials*, published by the International Atomic Energy Agency, Vienna, 1961, and also *Nuclear Energy Materials Handling Manual*, Helm's Express, Inc, PO Box 268, Pittsburgh 30

● Radiation is also used in applications incidental to the main work in various industrial operations, such as radiography in which an X-ray machine or a radioisotope is used to detect and measure differences in density, discontinuities, and defects in manufactured products (Fig 42-6) Thickness gauges may use beta or gamma emitters as a source

● Some static eliminators contain alpha emitters and are used in high-speed rolling of sheet material or in operations such as calendering that involve the evaporation of flammable solvents

● Radioactive tracers are used in analytical chemistry and to trace the flow of fluids in process Parts of equipment may be irradiated to facilitate wear studies Other material may be irradiated for purposes of sterilization or for use in chemical reactions

Consider the sources of radiation

So that suitable radiation safety operating standards can be set up, consideration must be given to the kind of radiation sources and the magnitude of the exposures —actual and potential Compare contemplated operation with the operations described here, whose examples are given more or less in order of increasing radiation safety requirements. This ranking of risks, however, is absolute because the special circumstances of an operation may greatly affect the safety experience and, hence, the safety requirements

It should be noted that measurement of radiation and radioactivity is not always done for safety reasons Often, such measurements are made to provide background information against which future measurements can be compared. Frequently, radionuclides are employed so that measurements of their radiation will disclose useful infor-