There are currently about 10 accelerators in Canada that are attached to hospitals and cancer clinics and used routinely for radiation therapy.

The positive ion generator was designed and built by the High Voltage Engineering Corporation of Burlington, Massachusetts. An electrostatic high voltage generator which exceeds a direct current potential of four million volts, it is being used to accelerate ions. The energy reached by such ions is sufficient to produce nuclear reactions in nearly all elements.

Essentially, high voltage production is achieved in the accelerator by spraying an electric charge onto a moving belt and transporting it into a high voltage terminal. Inside the terminal the charge is removed and therefore brings the terminal to a high potential. Since electrical discharge into the air is a serious voltage limitation, the generator is enclosed in a pressure vessel filled with sulfur hexafluoride, an insulating gas. This increases voltage and charge density on the belt to about four times that possible in the open atmosphere.

The ions are produced in the inside of this high voltage terminal within a small glass vessel where an electrical gas discharge takes place, much as in a fluorescent tube. The ions pass through a small hole into the evacuated accelerator tube where they attain an energy corresponding to the D.C. voltage applied. An electromagnet deflects the accelerated ions into the desired experimental area and also separates out unwanted ions. Atomic hydrogen ions (H^+, also called protons) and helium ions are presently used as projectiles. Since singly charged helium ions, He^+, can be stripped of their second electron, a "stripper" has been incorporated into the machine to produce He^{++} (or alpha particles). Such doubly-charged ions will then reach twice the energy: a He^{++} ion will reach an energy corresponding to eight million volts in a four-million-volt D.C. machine.

Because of this unique feature available on the NRC machine, most of the work centres around irradiations with He^{++}. Two major experiments are in progress. The first experiment is concerned with neutrons – neutral nuclear particles which play an important role in the production of nuclear energy.

Password: safety

Elaborate safeguards against hazards from radiation have been established in the laboratories housing NRC's two new accelerators. It is virtually impossible for appreciable radiation to escape from the accelerator areas, or for anyone inside to be exposed to an overdose of radiation. More shielding is required in the linac laboratory because of the higher radiation energies and powers involved.

The foundation of the linac laboratory is set 20 feet into rock. The experimental area has a four-foot thick concrete slab on its roof and this in turn is topped by 10 feet of sand. The control room is separated from the experimental area by high-density concrete walls that are seven feet thick and give the protection of 11 feet of ordinary concrete.

Access to the linac area is strictly controlled because the electron beam generated by the accelerator can deliver a fatal radiation dose in a fraction of a second of direct exposure. All persons entering the laboratory must communicate by two-way radio with control room operators. The entrance to the laboratory then is unlocked and entry can be gained to the control room, where visitors are briefed on safety procedures. No one may enter the experimental area from the control room without removing and carrying one of 13 safety interlock keys located on the machine's control panel. All of these keys must be in the panel before the experimental area's 32-ton steel-sheathed concrete entrance doors can be closed. The accelerator will not operate unless the doors are closed.

Safety precautions also have been taken in the extremely unlikely event that someone should accidentally find himself in the experimental area during start-up procedures. During the 90 seconds it takes to close the concrete doors a siren is sounded. An interloper, on hearing the siren, can prevent the accelerator from going into operation by pressing any one of 15 "panic" buttons on the walls of the experimental area.

An air sampler sets off an alarm in the event of an excess buildup of radioactivity in the experimental area. All air in the air-conditioned experimental area goes through an elaborate filtering system to remove any radioactivity before it is exhausted through an outside stack.

Workers in the linac laboratory and in the one housing the positive ion accelerator wear film badges provided by the Department of National Health and Welfare to verify that they do not absorb radiation above internationally established tolerance levels. These badges are checked every fortnight. Each worker also carries a pocket ionization chamber that immediately informs him whether he is in an area where radiation is excessive.

The wisdom of all these precautions is best illustrated by the accident-free record of the X-Ray and Nuclear Radiations Laboratory.