about revisions in the basic theory of chemical reactions induced by radiation. This basic research may find a useful early application in the technology of using an organic liquid as coolant in nuclear-power reactors.

Since extracted plutonium is no longer required, the fuel in the NRX reactor has been changed from natural uranium metal to a combination of natural uranium oxide and a uranium-235 aluminum alloy. The available neutron flux has been increased thereby, while keeping the power at 42 megawatts. It is planned to revise the fuelling of NRU similarly at the end of 1963.

The research facilities of the NRX and NRU reactors have continued to attract individual scientists as well as teams from other countries. A team of Brookhaven (U.S.A.) and AECL scientists is using a neutron beam with a high-speed chopper and long flight-path for nuclear interaction studies. Another team, with scientists from Harwell (Britain) and other countries, is using another system of choppers for studying details of the slowing-down of neutrons by moderators. Both in NRX and NRU, the exceptional facilities for irradiations in high-temperature water, steam and organic liquids have brought teams from Britain and the United States and individuals from West Germany and Sweden to conduct tests important for the design of future power reactors.

<u>Nuclear Power Prospect</u>

The generation of electricity by nuclear power on a competitive economic basis is expected to be established by the type of reactor now under construction by the Nuclear Power Plant Division of AECL. This promise rests on the attainment of very-low-cost fuelling by an extremely simple system that has proved satisfactory in the Nuclear Power Demonstration Station reactor, where there has been no fuel failure in the first year of operation. The fuel is uranium dioxide specially prepared entirely in Canada from natural uranium. A wide range of tests in hot channels in the NRX and NRU reactors at heat ratings and energy yields in excess of those required has established that this oxide fuel is incomparably more dependable than the uranium metal fuel for which the NRX and NRU reactors were designed. No provision for reprocessing the irradiated fuel is involved, for, by careful attention in the reactor design to minimizing any waste of neutrons, an energy yield of over 9,000 thermal megawatt-days is expected from a ton of uranium before it is discarded. This results in a prospective fuelling cost of about 1 mill (0.1 cent) an electric kilowatt-hour, to be compared with about 3 mills from coal at $8 a short tone.

Canada has access to such an abundance of coal, oil and natural gas that the competitive cost level for electric power is lower than in many other countries. Nuclear-power plants of the types now under construction in Britain and the United States have been assessed as unable to reach a low enough cost level, at least until several successive plants have been built and operated to discover where economies are possible. Plants of the CANDU type do not promise to be significantly cheaper in total initial outlay, but the fuelling cost can be so much less that meeting the competitive target is a very real prospect.

The low fuelling cost derives as much from the details of the design proposed as from the general type of reactor chosen. Some of the important features seem worthy of mention. The full-scale plant will generate 220 megawatts with a steam-cycle efficiency of 33.3 per cent, so the reactor has to supply 660 thermal megawatts to the steam-raising plant. The reactor is essentially a tank of heavy water, 20 feet in diameter and 16.5 feet long, lying horizontally. It is penetrated by 306 fuel channels parallel to the axis on a 9-inch-square lattice. Each channel is a zirconium-alloy pressure tube of 3.25 inches inside diameter and about 0.16 inches thick. The fuel consists of bundles of 19 rods, 0.6 inches in diameter and 19.5 inches long, made of dense uranium dioxide in thin zirconium-alloy tubes. Heat is taken from the fuel directly by heavy water that passes at 560°F. to the steam boiler, where normal water is raised to saturated steam at 483°F. and 38 atomospheres. The heat developed in the heavy-water moderator that is in the tank outside the fuel channels is not directly used and amounts to about 35 thermal megawatts. The overall net plant