Nuclear Power Prospect.—The generation of electricity by nuclear power on a competitive economic basis is expected to be established by the type of reactor now being designed by the Nuclear Power Plant Division of AECL at Toronto.

This promise rests on the attainment of very-low-cost fuelling by an extremely simple system tested over many years by experiments in the NRX reactor. The fuel will be uranium dioxide specially prepared from natural uranium entirely in Canada. A wide range of tests in hot channels in the NRX reactor 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) per electric kilowatt-hour, to be compared with about 3 mills from coal at $8 per short ton.

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 the United Kingdom 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 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 32.8 p.c., so the reactor has to supply 670 thermal megawatts to the steam-raising plant. The reactor is essentially a tank of heavy water, 20 ft. in diameter and 16.5 ft. long, lying horizontally. It is penetrated by 316 fuel channels parallel to the axis on a 9-inch-square lattice. Each channel is a zirconium-alloy pressure tube of 3.25 in. inside diameter and about 0.17 in. thick. The fuel consists of bundles of 19 rods, 0.6 in. diameter, 19.5 in. 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 560 psi. 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 40 thermal megawatts. The over-all net plant efficiency is then 28.2 p.c. These details show that the design represents a very considerable advance over that originally conceived in 1956, and the improvement bears promise that continued progress will lead to costs well below the economic target. As examples of the advance, it may be noted that for the same electric power output, the reactor power has been brought down from 790 to 710 megawatts and the length of fuel rod from 86 to 30 kilometres. The prospective fuelling cost has dropped from 1.85 mill/kwh. to 1.0 mill/kwh. On the other hand, no over-all reduction has been achieved in the capital cost estimates which remain in the range $300 to $400 per electrical kilowatt for the whole plant. No reduction is expected until manufacturing experience has been gained that can be used in future construction.

These figures will serve to explain why the first plants seem to find economic application in Canada only in the Ontario system, where annual charges on capital are low and coal has to be imported and costs about $8 per short ton. Moreover the demand for electricity in Ontario is growing at more than 200 megawatts capacity per year. To build reactors for lower powers saves little in the cost, so the cost per kilowatt rises and becomes uneconomic. When confidence has been gained from the early plants, higher powers seem likely to be attempted and 400 electrical megawatts from one reactor may be attained.

Operating experience with the NRX and NRU reactors at Chalk River and with the many other types throughout the world has served to emphasize the extreme difficulty and costliness of making even minor operating repairs in the presence of the extremely