POWER COST ESTIMATES FOR CANDU
(mills/kwh.)

Item	First Unit 200 MW(e)	Twin Unit 400 MW(e)	2nd Unit Increment 200 MW(e)
Fixed charges	3.9 to 4.9	3.3 to 4.4	2.7 to 3.8
Fuelling	1.1 " 1.1	1.1 " 1.1	1.1 " 1.1
Operating	1.0 " 1.0	0.7 " 0.7	0.4 " 0.4
TOTALS	6.0 to 7.0	5.1 to 6.2	4.2 to 5.3

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 a 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 uneconomical. Now that confidence has been gained from the early plants, higher powers seem possible and designs up to 750 electrical megawatts from one reactor are being studied.

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 great difficulty and costliness of making even minor operating repairs in the presence of the extremely high levels of radiation that are encountered around reactors. Directly and indirectly, this is responsible for the current hesitation to construct a number of large plants that for economic power cost no less than $40,000,000 or $50,000,000 each. With every new design it is necessary to acquire operating experience before the reliability and availability can be effectively estimated. Experience with defective fuel has been deliberately sought at Chalk River, because this is one of the difficulties most likely to be encountered. Appropriate techniques of locating the defective element, removing it and cleaning up the released radioactive fission products have been established and practised; at the same time fuel designs and ratings which lead to least difficulty in these operations have been studied. Experience of mechanical failures of control rods has lent weight to reactor designs such as NPD where control rods are not needed. Temperature changes are likely to provoke mechanical failures, so design is aimed at keeping the reactor at power for all essential operations including refuelling and complete maintenance testing and readjustment of instruments and working parts of the control system.

A study is in progress of the relative merits of four types of large power reactor for which development work is active. All are heavy-water-moderated and would not require any reprocessing of spent fuel. The fuel could be natural uranium or slightly enriched in the form of uranium dioxide or uranium carbide. The differences lie in the coolant and steam cycle. The four coolants are pressurized (perhaps partly boiling) heavy water (as in CANDU), fog or wet steam, ordinary boiling water, and an organic liquid. The fog and boiling water reactors would pass steam directly to the turbine; the heavy water and organic liquid would raise steam via a heat exchanger. It is apparent that in large sizes construction costs would be comparable but the small differences may be significant. A larger difference is in prospect from fuel fabrication costs. The cost of development of each type although high may be justifiable economically by the cost savings in appropriate circumstances. All appear competitive with conventional plants except locally where fuel is abundant at low cost.

Section 3.—Space Research in Canada*

The most important event in Canadian space research during 1962 was the launching of the satellite 1962 Beta Alpha (*Alouette*). This satellite was designed and built in Canada and launched into orbit by the United States National Aeronautics and Space Administration on Sept. 29. The satellite carried a number of scientific experiments, but its main objective was the sounding of the ionosphere from above. The ionosphere is a diffuse layer of highly conducting gas lying between heights of about 60 to 300 miles.

* Prepared (March 1963) by Dr. D. C. Rose of the National Research Council, Ottawa.