automatic recorders, analogue and digital electronic computers. Many of these scientists and engineers are engaged, part- or full-time, on the development of nuclear fuel, on preliminary design and optimization calculations for nuclear power reactors, on solving technical problems encountered in the operation of the reactors, on studies of potential accident conditions in and around reactors such as a burst in a pressurized water-cooling system, on studying disposals of radioactive wastes, on design of instruments for reactor operation such as monitors for traces of normal water in heavy water, for radioactivity in flowing water, and on fail-safe and dependable control systems.

Other groups of engineers, scientists, technicians and tradesmen are engaged in operating and maintaining the reactors, accelerators, chemical plants, heavy-water upgrading plants, workshops, and nitrogen and helium liquefiers. Including the supporting services of finance, catering, library, plant hospital, fire protection, transportation, building maintenance, printing and reproduction and others, the total payroll numbers 2,300. Contractor's men and attached staff add more than 100. Compared with atomic energy establishments elsewhere, the Chalk River plant is of medium size but, for its size, it covers a very broad range of activities.

Heavy-water-moderated research reactors are now becoming numerous and widespread throughout the world, but most of those operating at a high flux of neutrons use enriched uranium fuel (e.g., CP-5 near Chicago in the United States, DIDO and PLUTO at Harwell and DMTR at Dounreay in the United Kingdom, and EL-3 at Saclay in France); however, these enriched uranium reactors do not have as much space available for experiments as do those fuelled with natural uranium and, with the exception of the new Canada-India reactor, NRX and NRU are the only heavy-water-moderated high-flux reactors using this fuel.

The intense beams of neutrons provided by NRX and the still more intense beams from NRU have made possible studies that have attracted scientists from other centres. At the present time (January 1961) a team of Brookhaven (U.S.) and AECL scientists is using an NRU beam with a high-speed chopper and long flight path for neutron nuclear interaction studies; also a team with scientists from Harwell (U.K.) is using another system of choppers on another beam for studying details of the slowing-down action of moderators on neutrons.

In recent years a great technological advance has been based on the properties of nearly perfect crystals with controlled impurities, of which the transistor is the best known example. Studies of the energy changes of very-low-energy neutrons have greatly extended the knowledge of other such processes in solids and liquids where a number of atoms co-operate and an interpretation is possible in terms of quantized elastic waves or phonons. Pioneer work has been done in neutron-phonon interactions using neutron beams from NRX and NRU. Scientists from other countries are also working in this field at Chalk River.

NRX and NRU share with other high-flux reactors, such as the MTR at Arco, Idaho, the ability to produce certain isotopes whose formation requires that two or more neutrons react with the original atom in rapid succession to forestall radioactive decay. In this use they may in a few years be supplanted by still-higher-flux reactors planned in the United States and the U.S.S.R. For chopped neutron beams they may be supplanted by pulsed neutron sources driven by high-current accelerators, but for engineering testing of materials and especially of new types of fuel assemblies, NRX and NRU seem likely to remain unsurpassed. Consideration is being given to raising the flux in NRU. Since 1950, NRX has been used for fuel test irradiations in high-temperature water, and has contributed to the design and operating conditions for fuel in U.S. Naval reactors and the pressurized water reactor at Shippingport. Similar irradiations have recently provided the basis for the design of fuel for the NPD and CANDU reactors.

NRU is the first high-power reactor in which the fuel is regularly changed at full power, a process that confers important advantages in power reactors. NRX is the first high-power solid-fuel reactor to operate without control rods, a feature that promises economies and safety in power reactors. Control is achieved by the level of heavy water maintained against a permanent drain by the speed of return by pumps.