❑ to provide an essential testing facility to advance the CANDU® power reactor design, to ensure the future competitiveness of the Canadian nuclear industry, and to have CANDU available to Canada now and in the future to provide environmentally-sound electricity.

A CNF project, beginning in 1999/2000, would have a projected reactor start-up in 2005/06. The total estimated cost for the reactor and program facilities at the Chalk River site is $388 million (1998$): $208 million for the CNF reactor and $90 million each for the CANDU development facilities and the neutron beam facilities.

Figure 4: Facilities for CANDU Development

Horizontal Fuel-Test Facilities	**3 test sections, each with up to 3 CANDU bundles, connected to 2 loops** **Bottom test section can be replaced with a high-integrity test section for future severe fuel damage Blowdown Test Facility (BTF) tests** **CANTHERM advanced fuel channel capability**
Vertical Fuel-Test Facilities	**1 test loop with 2 test sections for multi-element partial fuel bundles** **Space to connect one test section to a second loop** **Space for a BTF loop system**
Materials Irradiation Facilities	**4 split-core sites** **4 fast neutron sites**
Hot Cells	**1 general purpose cell**
Service Irradiation Facilities	**6 vertical tubes including:** **1 hydraulic rabbit system** **Provision for a pneumatic rabbit system**

The CNF Reactor

The CNF reactor (Figure 1) is based on AECL's well-established MAPLE technology. An artist's impression of the CNF Building, including the neutron beam guide hall, is shown in Figure 2. The reactor assembly is located at the bottom of a 15.6-metre-deep light-water-filled pool. The core is separated into two halves, with the space between containing three horizontal test sections, each capable of being fitted with a full-diameter CANDU fuel channel, holding three CANDU fuel bundles per channel. Cooling systems can simulate current and advanced CANDU conditions. Key systems include the fuel, the process and service systems, the control system, and two independent shutdown systems. The reactor uses low-enriched uranium fuel (U_3Si_2-Al, 19.7 wt% U-235), satisfying international nuclear non-proliferation guidelines. The fuel generates a flux of fast neutrons in the core and a high thermal flux in the surrounding heavy water reflector tank; a maximum unperturbed thermal neutron flux of 4×10^{18} neutrons.$m^{-2}.s^{-1}$ is achieved.

Figure 5. Facilities for advanced materials research using neutron beams

6 thermal beam tubes in the reactor hall
- **1 cold source feeding seven neutron guides**
- **1 thermal source feeding two neutron guides**
- **1 new spectrometer directly viewing the cold source**
- **5 instruments relocated from NRU**
- **5 new instruments in the Guide Hall**
- **Provision for 23 instrument stations**

Experimental Facilities

Experimental facilities are shown for CANDU development (Figure 4) and advanced materials research (Figure 5). The neutrons in the reactor core are used to irradiate advanced fuels, materials and components in test sections that reproduce a nuclear power reactor's operating environment. Additionally, the effects of different cooling conditions and chemistry can be simulated. After irradiation, these materials are examined and tested in shielded "hot cells" to obtain information on their performance under power reactor conditions. Irradiation research and proof-testing has, and continues to be, an essential element in ensuring a successful CANDU nuclear industry.

For advanced materials research, beams of neutrons are guided to experimental stations outside the reactor core, where they are used as powerful probes of materials. This technique, pioneered at Chalk River by Canadian Nobel Laureate Bertram Brockhouse in the 1950s and now used world-wide, is called neutron scattering. The neutron-beam instruments in the CNF will provide Canada with state-of-the-art capabilities in wide-ranging fields of science and engineering. Most importantly, the cold neutron source, a new capability for Canada, will open new research opportunities for Canadian scientists, particularly in the emerging fields of bio-materials and polymers.

Status

Pre-project technical activities specific to the CNF have been underway for four years supporting MAPLE technology, including a cost- and schedule-reduction program with the principle of maintaining CNF performance with the highest-priority facilities, "up-front" licensing with the Atomic Energy Control Board (AECB), and preliminary discussions on environmental assessment. The CNF will meet the regulatory requirements of the AECB; the AECB will issue a site approval. and construction and operating licenses, when