



# **NPD Start-up, Reactivity Balance and Fuel Management**

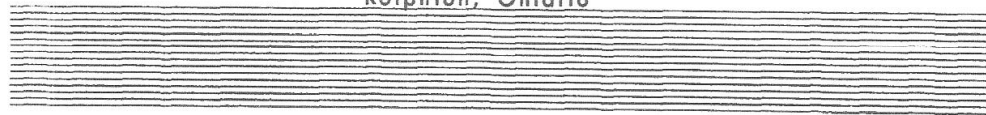
by

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# **NPD: The First CANDU**

(Canada Deuterium Uranium)

**Natural Uranium – Heavy Water**

**VS**

**Enriched Uranium – Tap Water**

**Thin-walled Pressure Tubes**

**VS**

**Thick-walled Pressure Vessel**

# **Historical Context**

**Discovery of fission – 1939**

**Canada, U.K., France; Montreal – 1944**

**CP-1; Chicago – 1942**

**Haigerloch; Germany – 1945 (February)**

**ZEEP; Chalk River – 1945 (September)**

**NRX; Chalk River – 1947**

**NRU; Chalk River – 1957**

**NPD; Rolphton – 1962 (June 28, 20 MWe)**

**Douglas Point – 1968 (200 MWe)**

# **NPD Commissioning – 1962**

**First critical**

**Neutron flux scan**

**Fuel management**

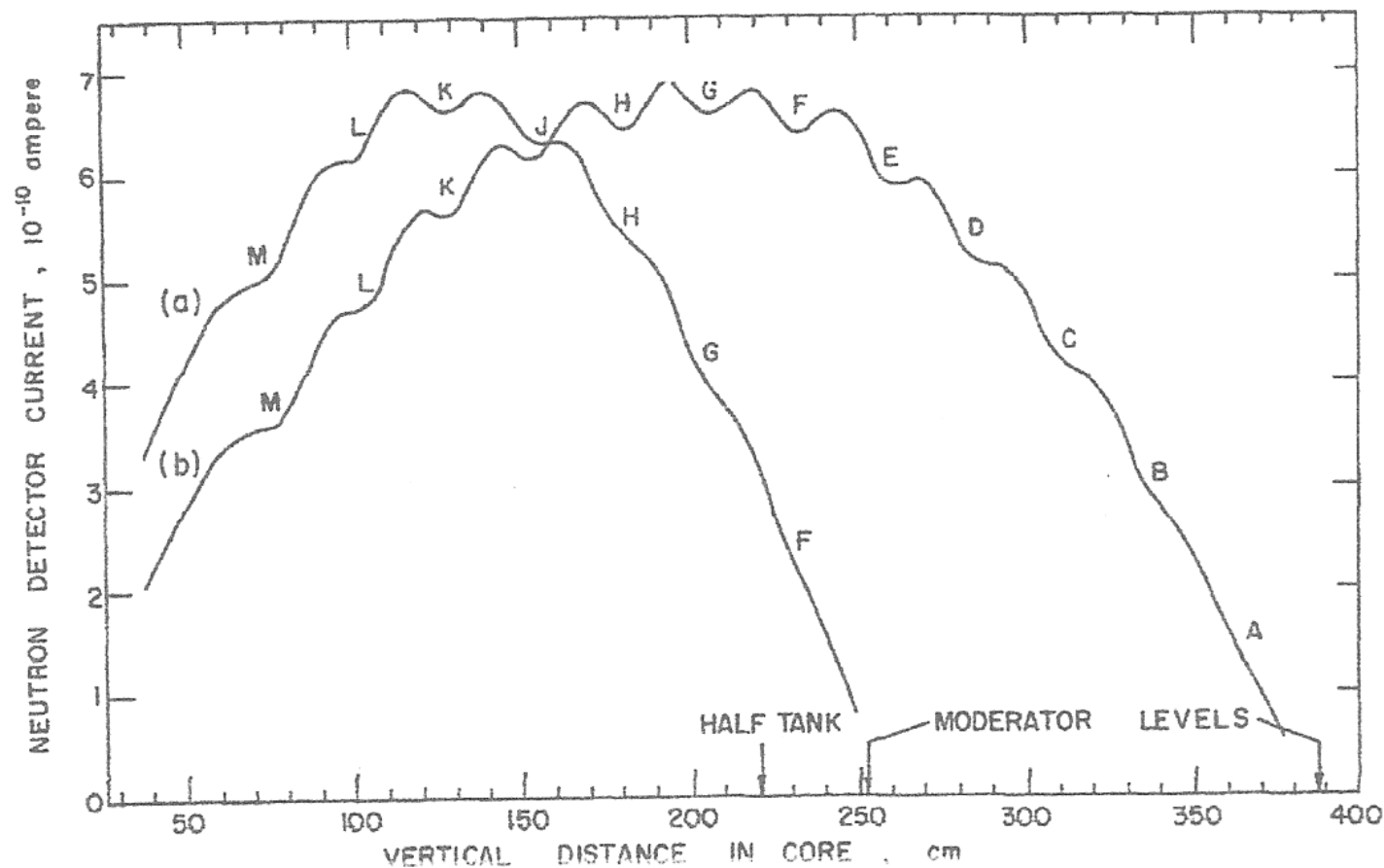
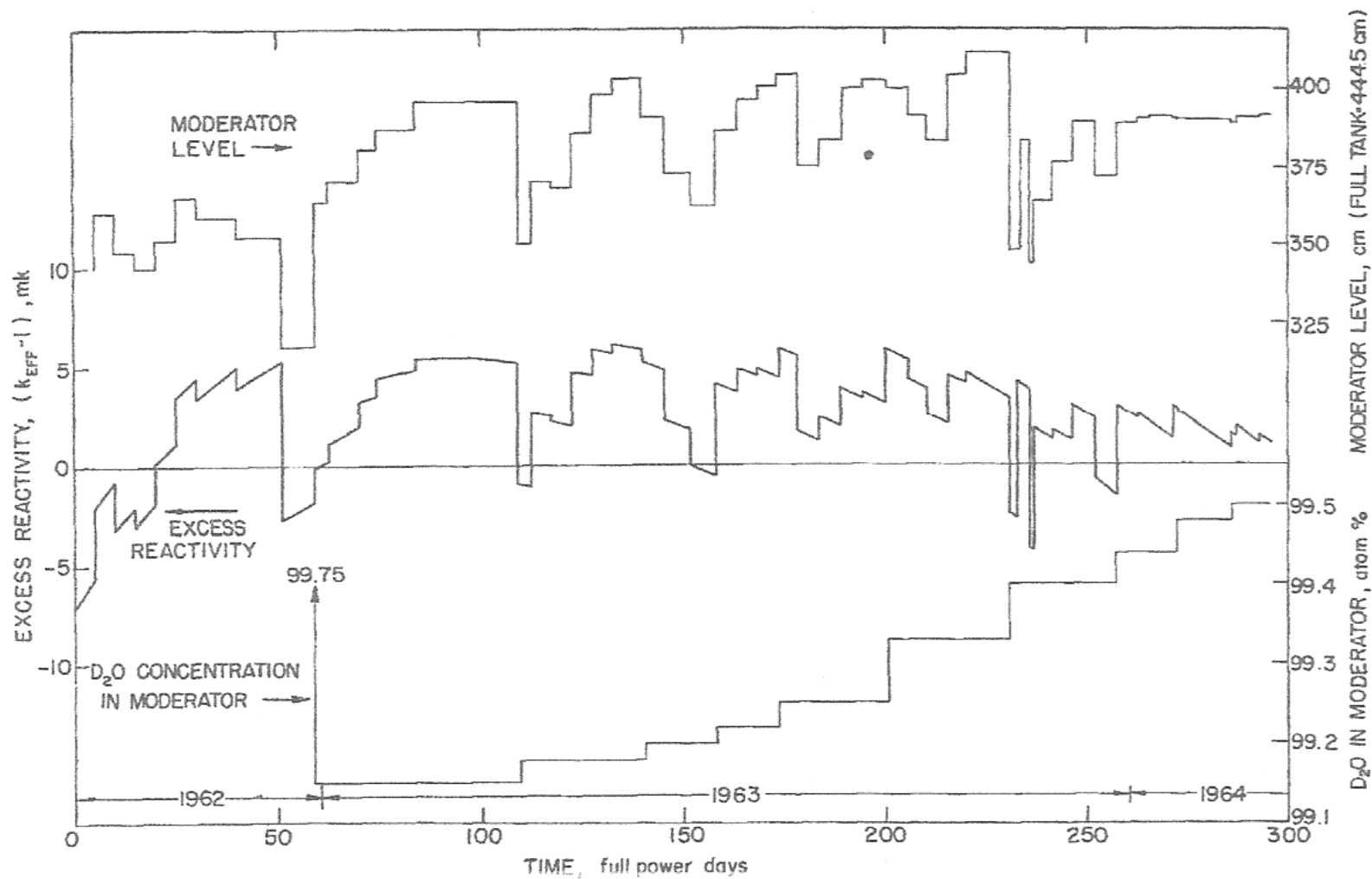


Fig. 5. Observed vertical flux distributions during low-power commissioning experiments:  
 (a) Coolant unpoisoned, H<sub>2</sub>O reflector full.  
 (b) Coolant poisoned (363 ppm cadmium), H<sub>2</sub>O reflector empty.



**Fig. 4 - PERIGEE simulation of NPD operation.**  
 Top, approximated moderator level;  
 Bottom, approximated D<sub>2</sub>O concentration;  
 Middle, excess of calculated over measured reactivity.

# **Technical & Economic Feasibility**

**Bidirectional on-power fuelling**

**Fuel integrity and lifetime**

**Heavy water leakage**

**Reactor safety and control**

**Operator Training**

# What Next?

**W.B.Lewis: *“How Much of the Rocks  
and Oceans for Power?”*  
1964 report.**

**Plutonium fast breeder – reprocessing**

**Super Phoenix, France; 1200 MW, 1986-97**

**Gentilly-1, boiling water, enriched uranium,  
thick-walled beryllium calandria tubes and  
graphite reflector, but no heavy water**



# Proxima – Closest Star

