SASKATCHEWAN RESEARCH COUNCIL

Using a Nuclear Reactor as a Remediation Tool

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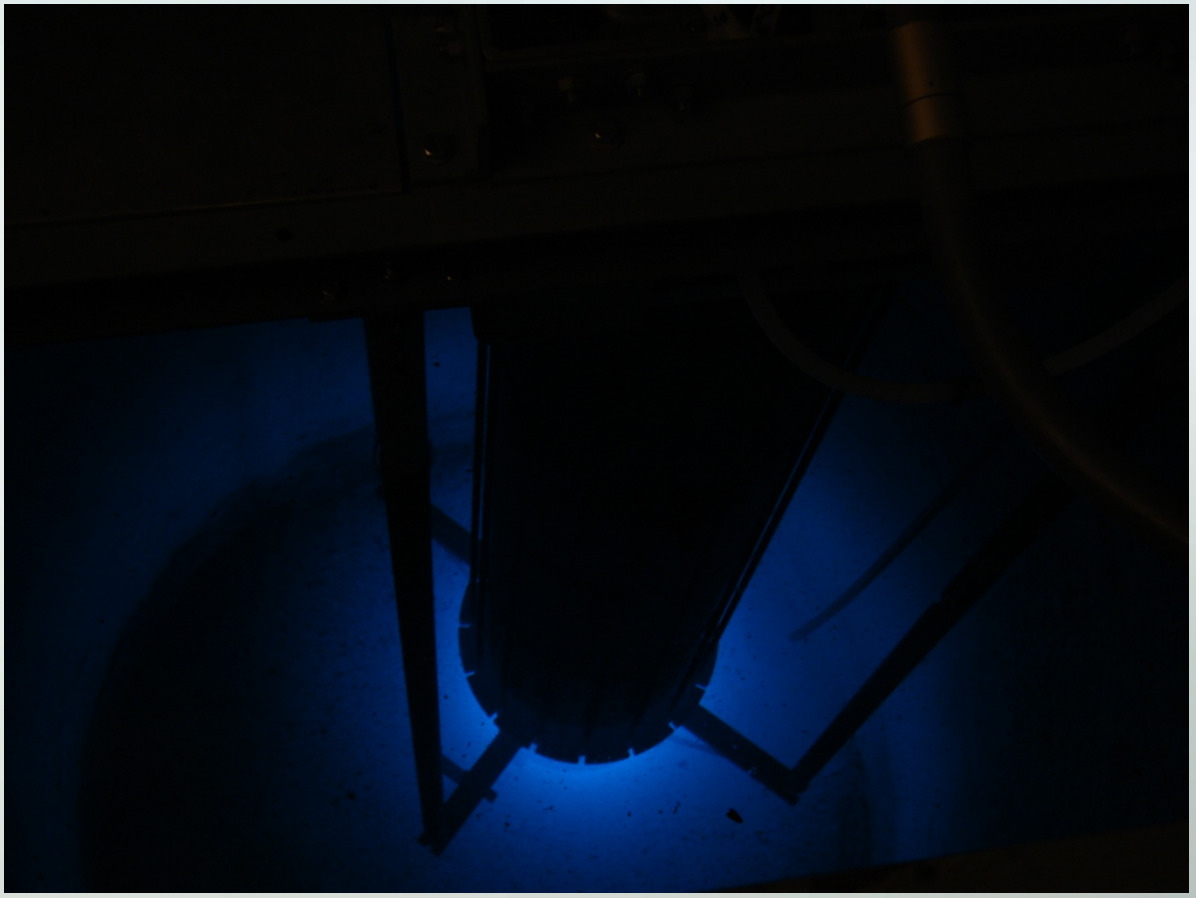
Remtech 2013

Safe LOW POwer Kritical Experiment

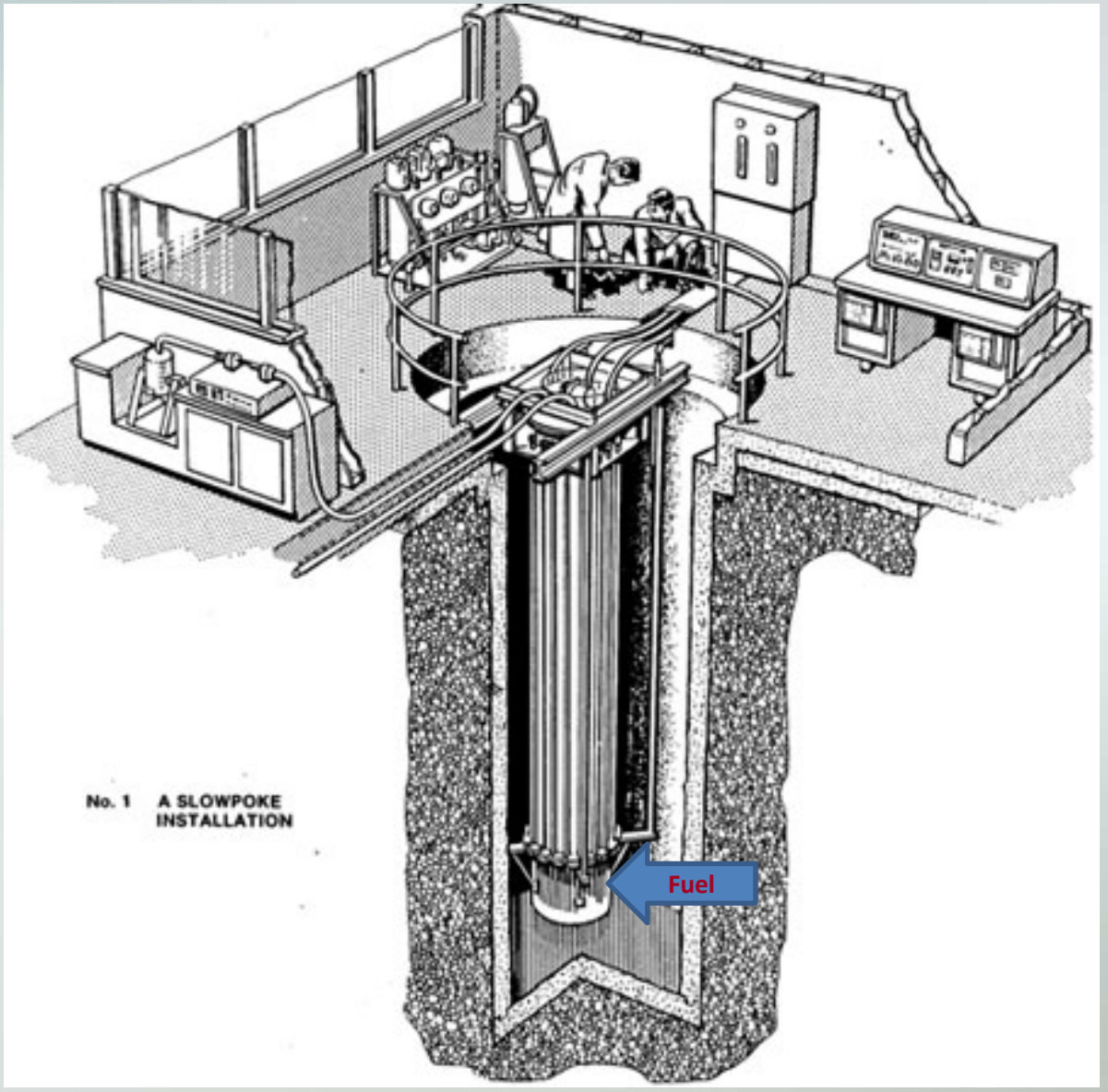


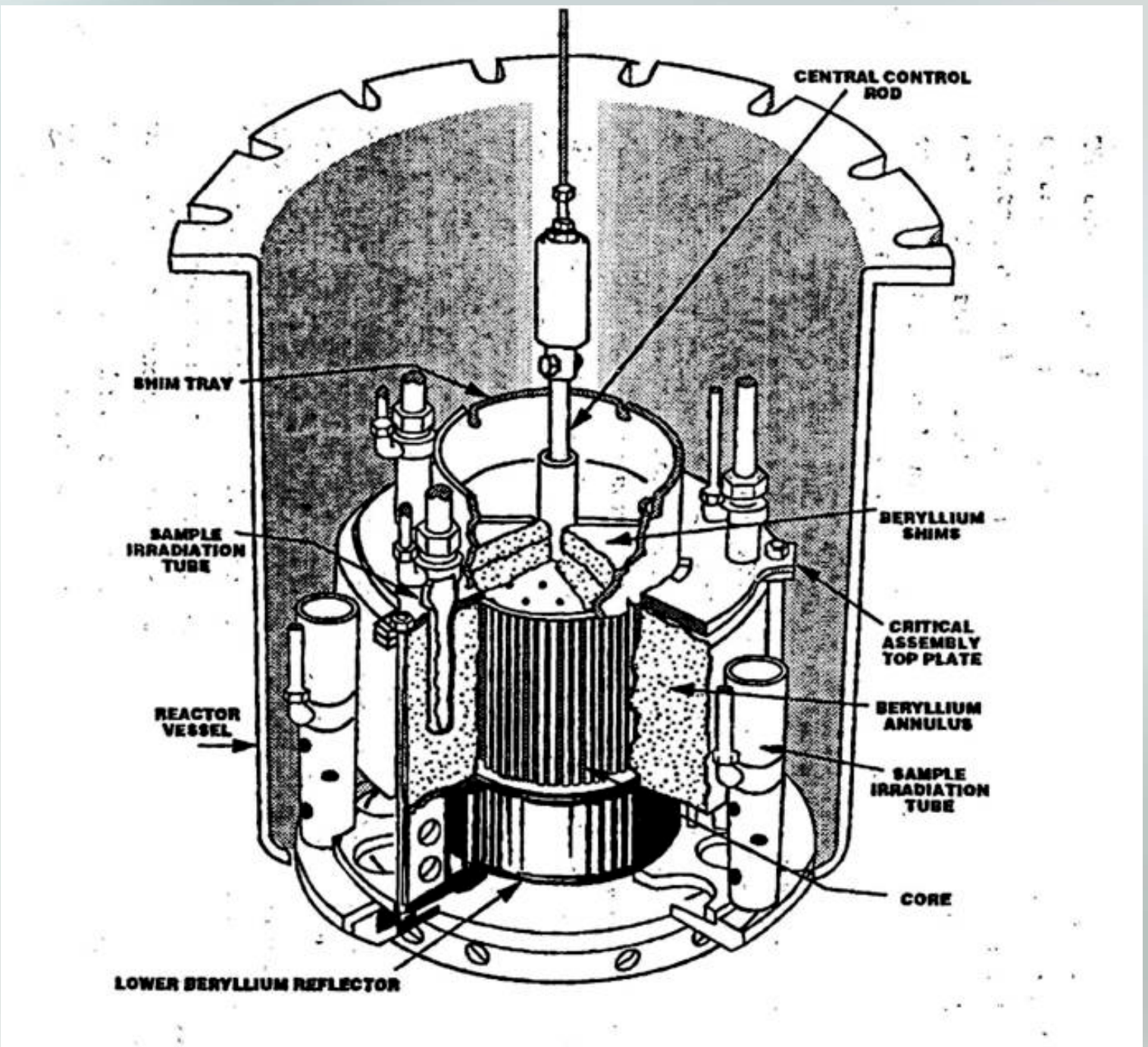
SLOWPOKE History

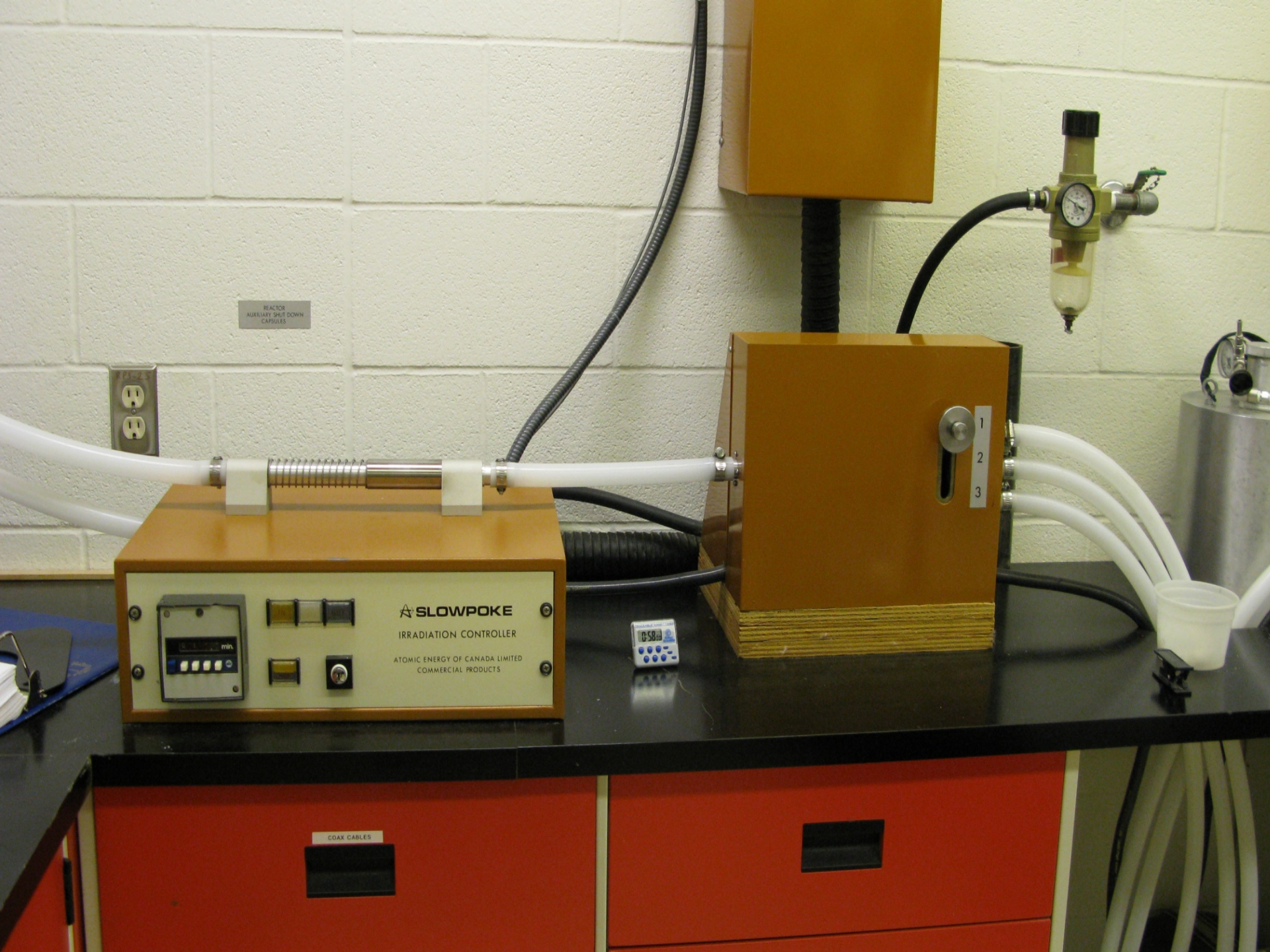
- 1967 Conceived
- 1970 Prototype (AECL)
- 1971 SLOWPOKE-1 at U of T
- 1976 SLOWPOKE-2 at U of T
- 1976-1984 7 units
- 1981 SRC
- 1985 LEU unit at RMC, Kingston, Ont.
- Mid-1980's SLOWPOKE-3

SLOWPOKE-2s still in operation:

- SRC
- University of Alberta
- RMC
- Ecole Polytechnique
- Kingston, Jamaica




CENTRAL CONTROL ROD
SHIM TRAY
SAMPLE IRRADIATION TUBE
BERYLLIUM SHIMS
CRITICAL ASSEMBLY TOP PLATE
REACTOR VESSEL
BERYLLIUM ANNULUS
SAMPLE IRRADIATION TUBE
CORE
LOWER BERYLLIUM REFLECTOR


REACTOR
AUXILIARY SHUT DOWN
CAPSULES
SLOWPOKE
IRRADIATION CONTROLLER
ATOMIC ENERGY OF CANADA LIMITED
COMMERCIAL PRODUCTS
min
1
2
3
COAX CABLES

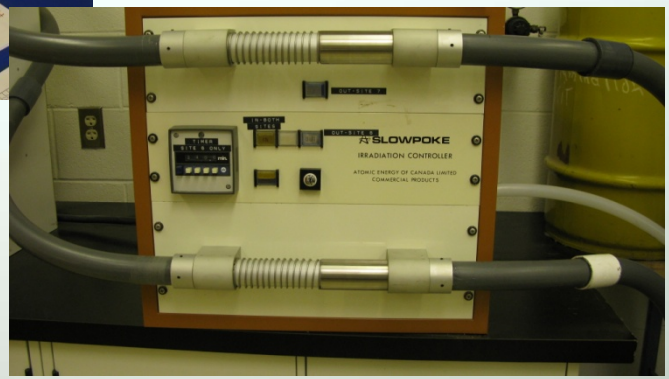

SRC Analytical: Delayed Neutron Uranium Analysis
Repeats
Hot

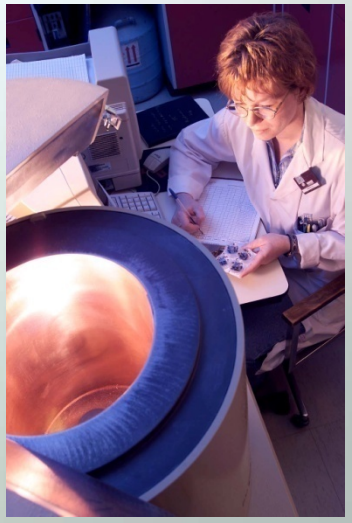
SLOWPOKE-2 Applications

- Radioisotope Production for tracers
- Neutron Radiography
- Neutron Activation Analysis (NAA)
- Teaching and research

Neutron Activation Analysis

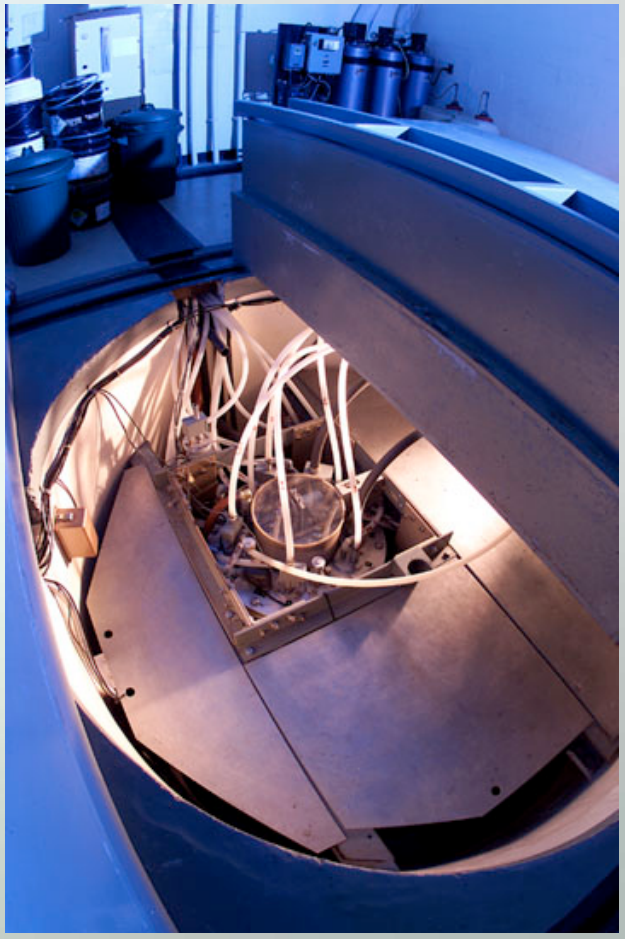
- SLOWPOKE reactor used to irradiate sample with neutrons





Advantages of NAA

- Little sample preparation required
- Non-destructive technique
- Multi-element technique
- Not compound specific



NAA Applications

- Neutron Activation Analysis for elemental analysis
  -Mainly for Organic Halogens (Cl, Br, I)
- Thorium-232 by mass using NAA
- Uranium by Delayed Neutron Counting

Halogenated Organic Compounds

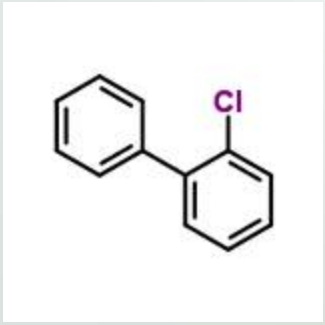
Bromine, Chlorine, Iodine

Examples: PCB's

Di, tri, tetrachloroethylene

Carbon tetrachloride

Halogenated pesticides and herbicides



Methods for Organic Halogens (TOX, EOX, AOX)

EPA 9020

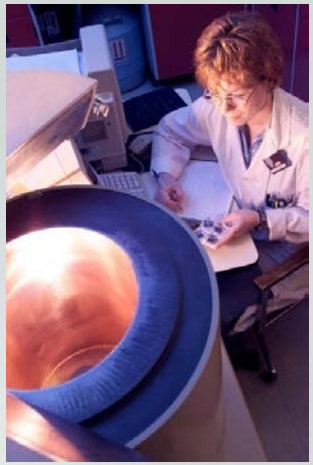
EPA 9023

EPA 9077

ASTM D808

EPA 9022 (NAA)

EOX in Soil and Sediment



-samples are extracted with toluene

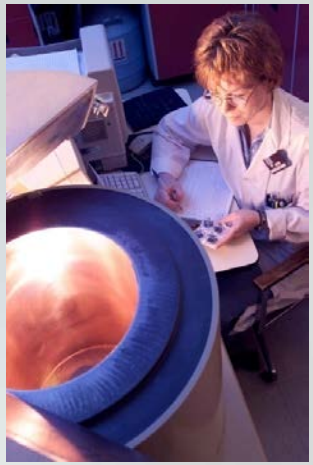
-toluene is washed with water

-irradiated in a SLOWPOKE-2 reactor

-counted using gamma spectroscopy

-detection limit ~ 1 ppm

EOX in Water



-samples are extracted with toluene

-toluene is washed with water

-irradiated in a SLOWPOKE-2 reactor

-counted using gamma spectroscopy

-detection limit ~ 30 ppb

TOX in Organic Liquids

-samples are diluted with toluene

-toluene is washed with water

-irradiated in a SLOWPOKE-2 reactor

-counted using gamma spectroscopy

-detection limit ~2 ppm

Summary

- SLOWPOKE useful analytical tool for screening remediation samples
- Gamma spectroscopy another analysis tool (NORM analysis)
- Analytical tool suitable for a variety of remediation sites