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CANDU Reactor Fuel Cycle Flexibility:

- *CANDU Fuel Cycle Advantages*
- *Operational Reactors (NUE)*
- *CANDU Reactor Inherent Safety Features*
- *New Build Reactors (AFCR)*
- *Future With Water Coolant*

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Workshop on Advanced Reactors, NEA/OECD
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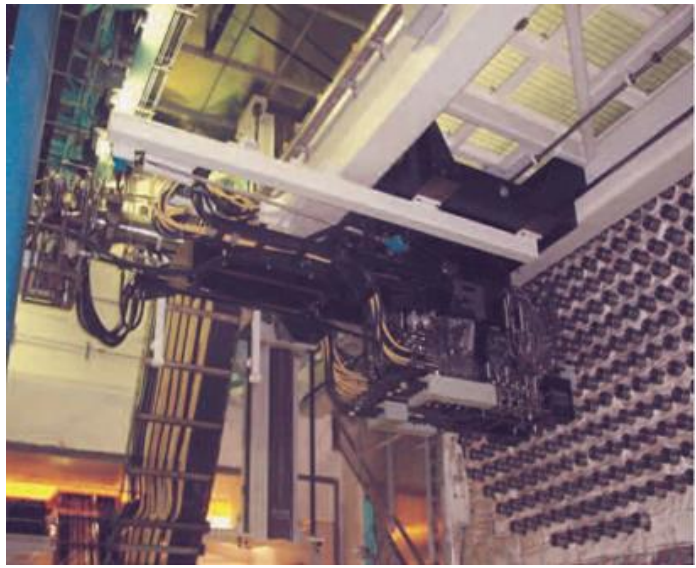
CANDU Fuel Cycle Advantages & Differentiators

- Reactor physics
  - Heavy water moderator
  - Softer (thermalized) spectra
  - High neutron economy
- On-power fuelling
  - Low excess reactivity
  - Highest uranium utilization
- Simple and small fuel bundle
  - Enabling on-power fuelling
  - Flexible design
  - Easier transition between fuel types
- Versatile pressure tube design
  - Capability to have different fuel mixes
- Minimal changes in reactor design to use different fuels

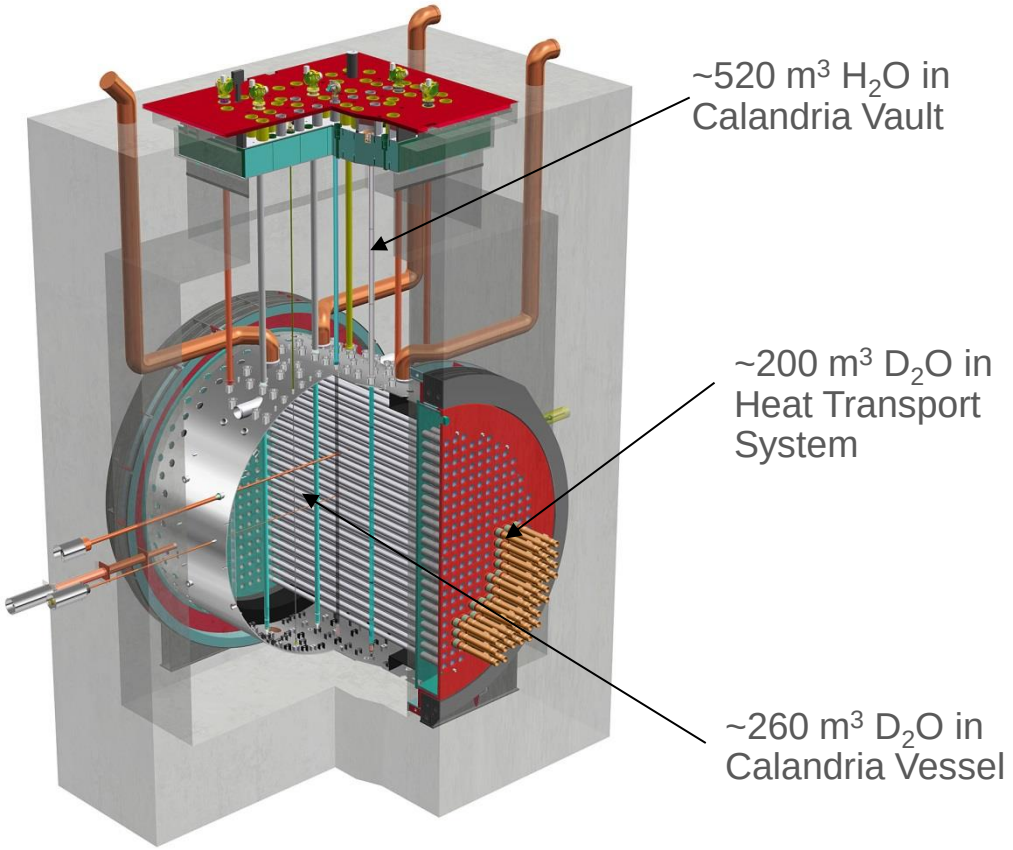


Operational Reactors: Natural Uranium Equivalent (NUE) Fuel

- Combination of Reprocessed Uranium (RU) & Depleted Uranium (DU) in standard CANDU fuel bundle:
  - Behaves similar to Natural Uranium
  - Stays within the NU licensing and operational basis for use in existing CANDUs
- RU and DU resources are available in great quantities:
  - 90,000 tonnes of RU reprocessed to date, reprocessing capacity ~4,000 ton/year
  - ~1.2 million ton of DU from enrichment and growing
  - Vast majority of RU & DU treated as waste and maintained in storage
  - Reprocessed used fuel from LWRs used in CANDU reactors, synergistic relationship
- Significant economic and environmental benefits
  - DU costs are negligible
  - RU is generally higher in fissile content and lower in cost compared to NU
- Fuel developed, designed, tested in China CANDU reactors (Qinshan), jointly by SNC-Lavalin of Canada and CNNC of China, licensed and awaiting fuel plant modifications for full core implementation.
- NUE offers the simplest, quickest & lowest cost path to RU/DU utilization
- NUE is a potential replacement for NU fuel used in all CANDU type reactors

CANDU Reactor Inherent Passive Safety Features

- Two passive and independent safety shutdown systems
- Shutdown systems in low temperature & pressure moderator
- No need for excess reactivity due to on-power fuelling
- No poison in HTS & moderator
- Inherent passive sources of decay heat removal following reactor shutdown (original CANDU design)



Advanced Fuel CANDU Reactor (AFCR) leverages two CANDU features to:

- Enhance unique safety features by incorporating new passive and active features
- Utilize core and fuelling capability to introduce new RU and Th based fuels

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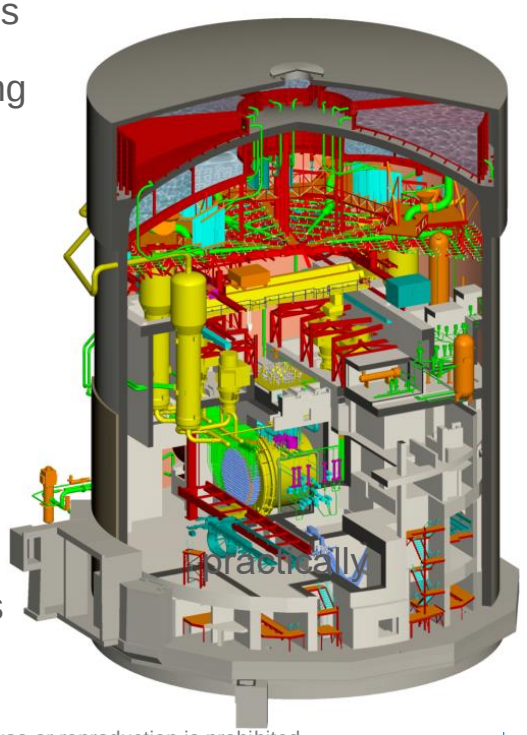
New Build CANDU: Advanced Fuel CANDU Reactor (AFCR)

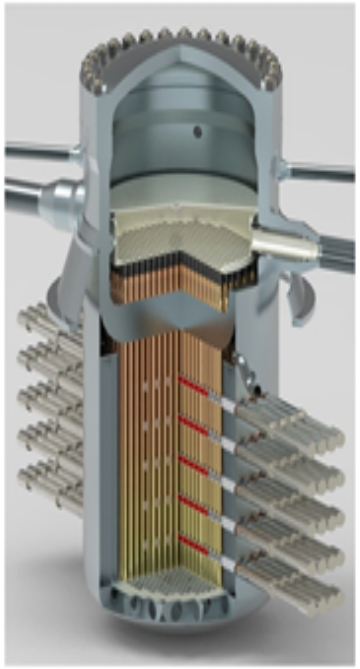
- Jointly SNC-Lavalin & CNNC are designing AFCR, based on C6 and EC6
- No major core or HTS changes, except for longer life and fuel adaptation requirements
- Commercially tested, enhanced thermalhydraulic featured new bundle with either RU or Th fuel
- Modern computer systems including DCS and an updated control room
- A new and thicker steel lined containment for increased internal, external & seismic loads
- Various on site fixed/mobile power sources and water sources/connections
- Maintains defence-in-depth features inherent to CANDU reactors, including dousing, but also incorporates:
  - An active Complementary Core Heat Removal System
  - A Passive Calandria Vessel Make-up Systems
  - A Passive Calandria Vault Make-up System
  - A Passive Containment Heat Removal System
- On-line hydrogen monitoring and active/passive mitigation features
- AFCR's inherent safety with new passive and active features eliminate plant states that could lead to early or large radioactive releases



Nuclear Future With Water Coolant: The SCWR

Canadian SCWR Concept

- Thermal Power of 2540 MWth
  - Gross electric output of 1255 MWe with efficiency of 49.4%
  - Net electric output of 1177 MWe with efficiency of 46.3%
- Operating conditions
  - Pressure at 25 MPa
  - Inlet temperature at 350 °C
  - Outlet temperature at 625 °C
- Direct cycle
  - No steam generators, no steam separators
- 336 fuel channels
  - Zirconium pressure tube
- Core inside diameter of 5.5 m
- Low-pressure calandria vessel at ~0.3 Mpa
- Operating Life of 75 Years



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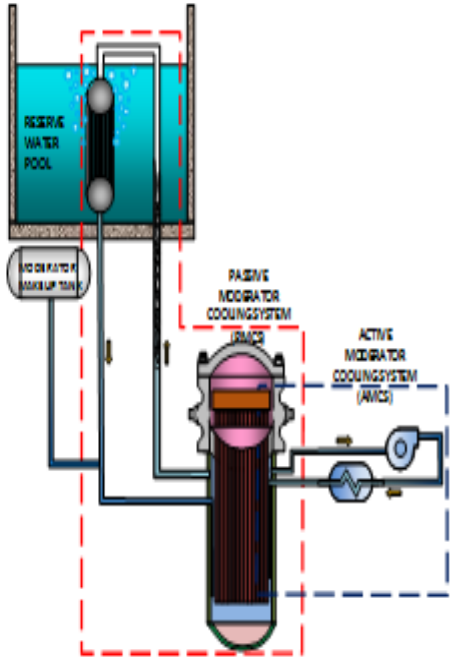
Moderator Cooling Systems

- Active System
  - Remove the majority of moderator heat during normal operation
  - Attached to a filtration system to clean the moderator
- Passive System
  - Remove moderator heat during long term cooling even without the active system in place
    - Heat transferred from fuel to moderator through radiation and conduction
  - Enhanced safety feature with reduction in core damage frequency at postulated severe accident events



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