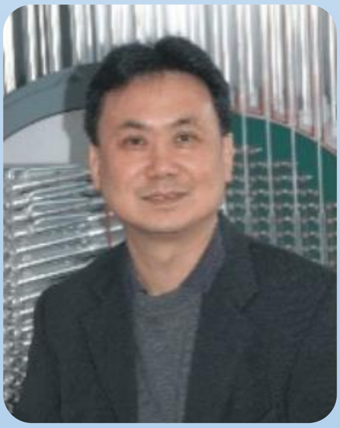
# Supercritical Water Cooled Reactors (SCWR)

## Summary / Objectives:

Supercritical Water-Cooled Reactors (SCWRs) are a class of high temperature, high pressure water-cooled reactors that operate above the thermodynamic critical point of water (374° C, 22.1 MPa). These concepts combine the design and operation experience gained from hundreds of water-cooled reactors with the experience from hundreds of fossil-fired power plants operated with supercritical water. The main goals of using supercritical water in nuclear reactors are to increase the efficiency of modern nuclear power plants, decrease capital and operational costs, and finally decrease electrical energy costs. This presentation describes SCWR concepts being pursued in the international community and highlights the technical advancements and challenges in the development.

## Meet the Presenter:



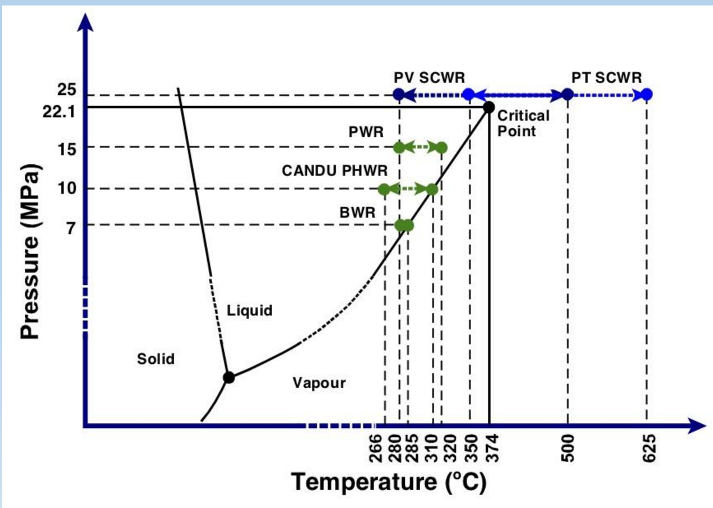
**Laurence Leung** has been working at Canadian Nuclear Laboratories (formerly Chalk River Laboratories of Atomic Energy of Canada Limited) since 1987 in the field of thermal-hydraulics. He completed his Ph.D. degree at University of Ottawa, Canada, in 1994. Laurence is currently Manager of R&D Facilities Operations and is also responsible for the development of the Canadian Super-Critical Water-cooled Reactor (SCWR) concept. He received 13 awards from AECL (CNL) and external organizations, and delivered short courses on thermal-hydraulics and SCWRs. Laurence is one of Canada's representatives to the GIF SCWR System, and is the Co-Chair of the System Steering Committee and the Thermal-hydraulics and Safety Project Management Board.

## 1. Why SCWR?

- Merging proven advanced technologies of nuclear and fossil-fuel power plants
- Many utilities operate both nuclear and supercritical fossil plants
- Many years of design and operating experiences

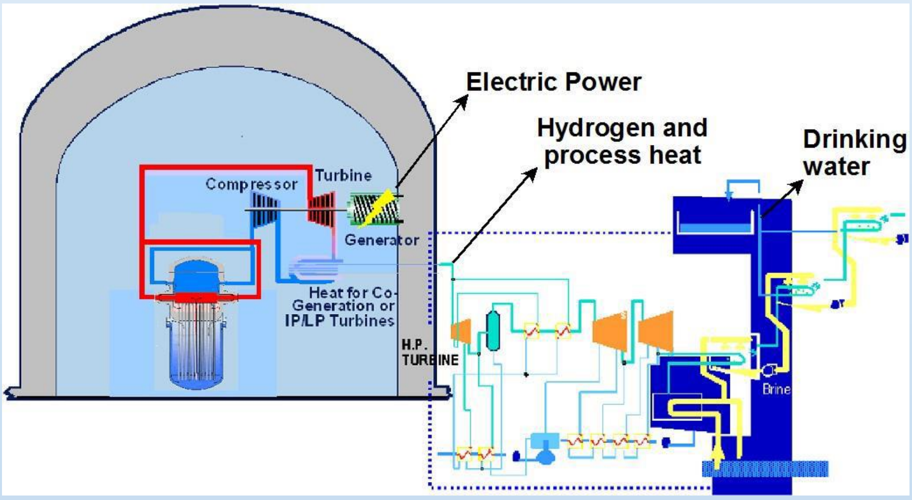

## 2. SCWR Main Features

- High efficiency with supercritical pressures and temperatures at core outlet
  - Increasing the power output for the same fuel input (specific fuel utilization)
  - Reducing waste heat from turbines and condensers (environmental discharges)
  - Building fewer plants for meeting demand (capital and operating cost savings)
- Simplification of plant components and layout
  - Direct cycle eliminating heat exchangers, steam generators, steam dryers, and moisture separator reheaters
  - Reduction in capital and operational costs
- Design flexibility
  - Thermal or fast spectrum
  - Advanced fuel cycles and fuel design optimization
  - Reduction in electrical energy costs
  - Opportunities for co-generation



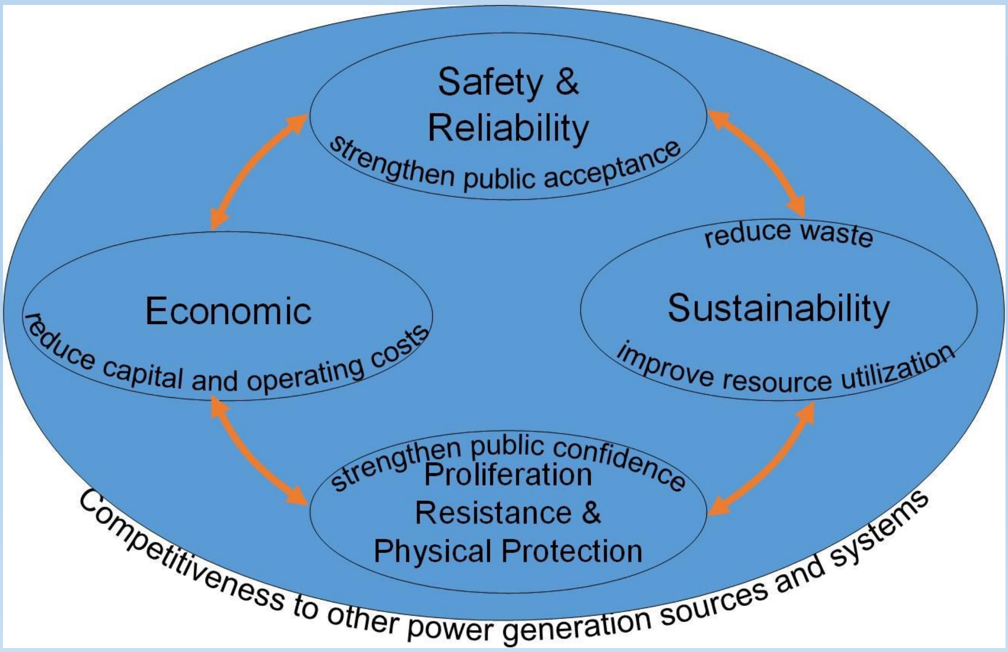
## 3. SCWR Applications

- Primarily for electric power generation
- Heat can be extracted for co-generation
    - Hydrogen production
    - Oil extraction (Steam-Assisted Gravity Drainage process)
    - Desalination
    - Process heat




## 4. GIF Technology Goals

A pressure-tube-type SCWR concept can potentially meet key technology goals of the GIF (i.e., improving economics and sustainability, as well as enhancing safety and proliferation resistance).



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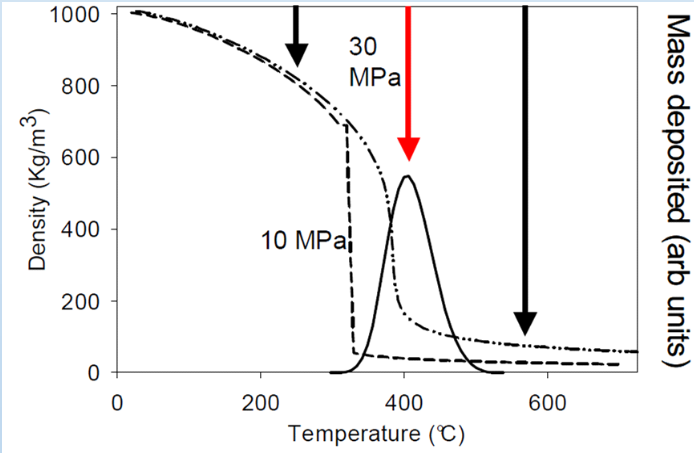
**5. SCWR Design Challenges: Chemistry**

- Changes in chemical properties due to marked change in SCW density through the critical point
- SCWR In-core radiolysis is markedly different from those of conventional water-cooled reactors
  - Extrapolation of the behavior is inappropriate
  - Strong impact on corrosion and stress corrosion cracking
- Identification of an appropriate water chemistry to minimize
  - Corrosion rates
  - Stress corrosion cracking
  - Deposition of deposits on fuel cladding and turbine blades
- Establish a chemistry-control strategy




**6. Collaborations**

- Leverage resources and expertise to expedite the development
  - Generation-IV International Forum (GIF)
  - International Atomic Energy Agency (IAEA)
  - Bilateral agreements
- Exchange of technical information
  - International Symposium on SCWRs
  - Information Exchange Meetings
  - IAEA Coordinated Research Projects and Technical Meetings