

International Association for the Properties of Water and Steam

An Introduction

Peter Tremaine

University of Guelph

Past President (1999-2000) and Workshop Chair



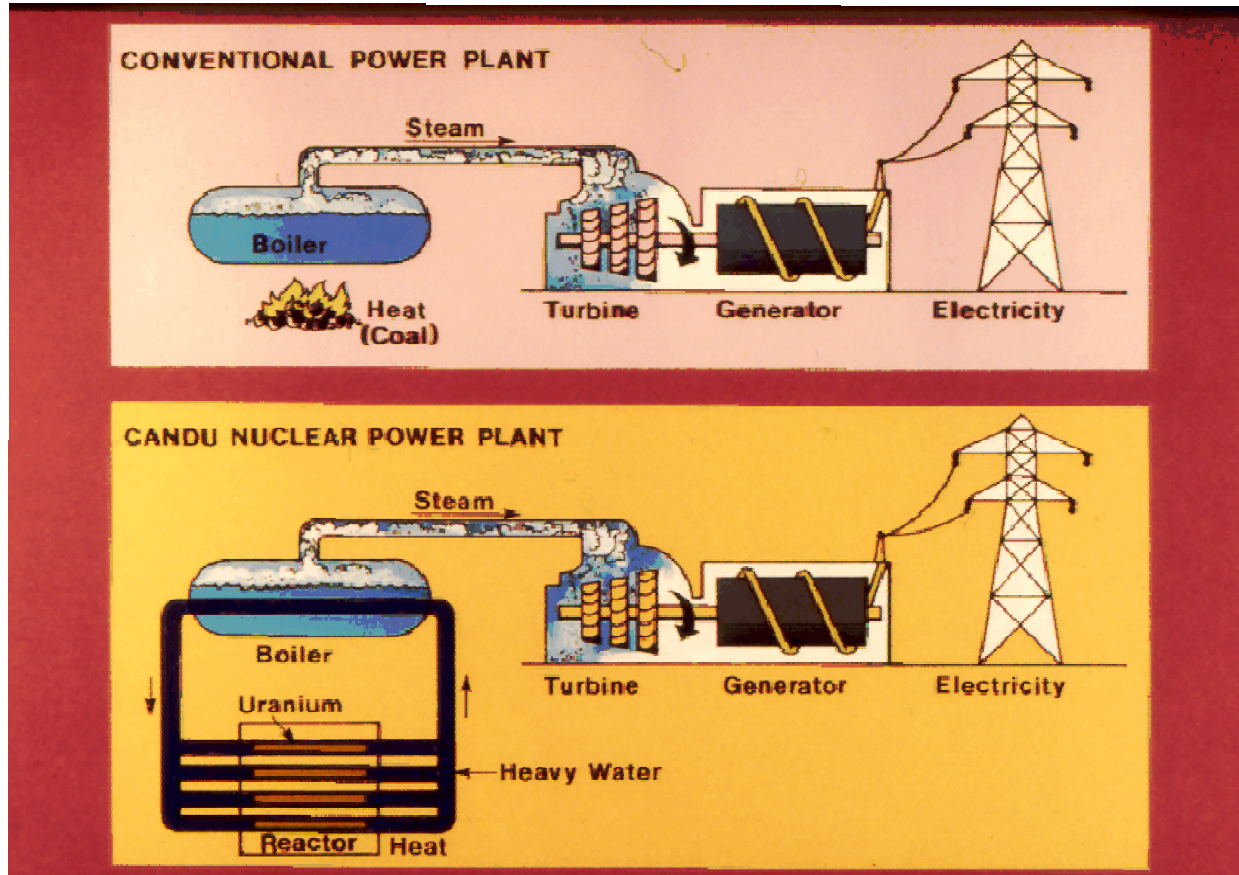


What is IAPWS?

- IAPWS is an international non-profit association of national organizations concerned with
 - thermophysical properties,
 - and other aspects of high-temperature steam, water and aqueous mixtures that are relevant to thermal power cycles and other industrial applications.

The Need

**-Internationally accepted high quality PVT data
-for power station design -**



1929

- PVT of H₂O to ~300 °C, 10 MPa

1950s

- H₂O to higher T, P
- PVT of D₂O to 300 °C

1970s

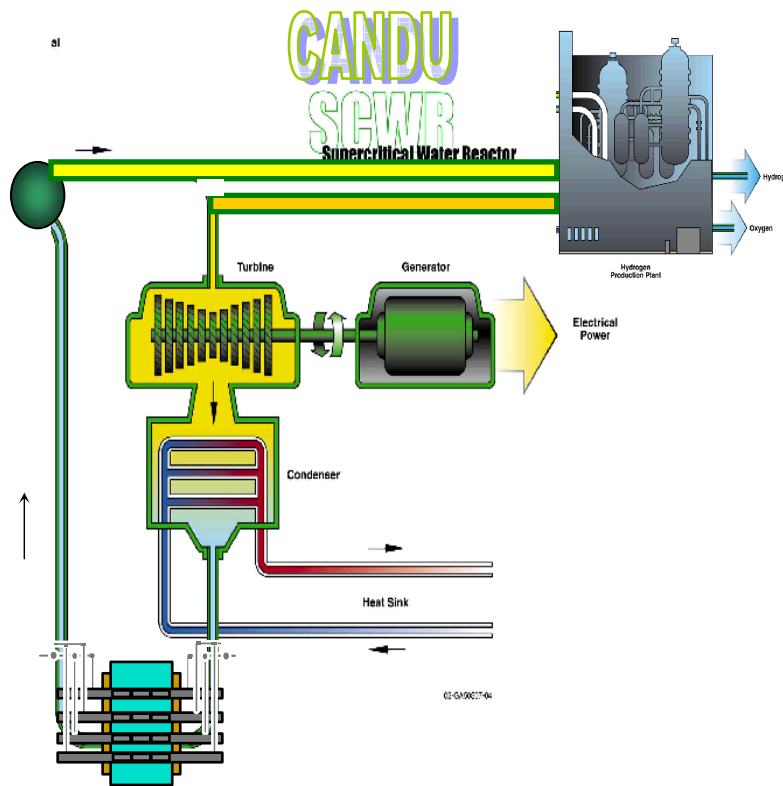
- Boiler & primary coolant chemistry

1990s

- fast, accurate formulations

Modern Needs

-Internationally accepted high quality thermophysical and thermochemical data at high T and P-



Supercritical Water Chemistry

- K_w , pH formulations
- Ultra-supercritical thermal stations

Operating Station Chemistry

- CANDU, PWR, BWR
- Thermal 100 – 300 °C

PVT Properties for seawater

PVT properties for D₂O above 300 °C (scientific)



Mission Statement

- To provide internationally accepted formulations for the properties of light and heavy steam, water and selected aqueous solutions for scientific and industrial applications.
- To define research needs and promote and coordinate research on steam, water and selected aqueous systems important in thermal power cycles
- To collect and evaluate the resulting data, and to communicate and promulgate the findings
- To provide an international forum for exchange of experiences, ideas and results of research on high-temperature aqueous media



Guiding Principles

Face-to-face meetings between research scientists, design engineers from industry, and operating station chemists

*Research funding from member countries
.....with support and technology transfer
through IAPWS*



10 Member Countries

- Britain & Ireland
- Canada
- Czech Republic
- Denmark
- France
- Germany
- Greece
- Japan
- Russia
- United States
- Argentina & Brazil (Assoc)
- Italy (Assoc.)
- Switzerland (Assoc.)



Recent “Deliverables”

- “The IAPWS Formulation 1995 for the Thermodynamic Properties of Ordinary Water Substance for General and Scientific Use”
 - *J. Phys. Chem. Ref. Data*, **31**, 387-535 (2002)

- “The IAPWS Industrial Formulation 1997 for the Thermodynamic Properties of Water and Steam”
 - *ASME J. Eng. Gas Turbines and Power*, **122**, 150-182 (2000).

- "Aqueous Systems at Elevated Temperatures and Pressures : Physical Chemistry in Water, Steam and Aqueous Solutions"
 - *Elsevier Academic Press, Amsterdam, 2004.*

- Releases and Guidelines
 - *Electrical Conductivity of Liquid and Dense Supercritical Water From 0 to 800 °C and Pressures to 1000 MPa*

- Technical Guidance Documents
 - *Procedure for the Measurement of Carryover in Boiler Water And Steam*

- International Conference on the Properties of Water and Steam
 - Toronto, 1999
 - Kyoto, 2004
 - Berlin, 2008



Canadian Contributions to IAPWS

- National Research Council of Canada
 - 5-figure PVT properties of H₂O and D₂O
 - Scientific Formulation for H₂O 1984
 - Whalley and Kell (1960s)

- University of British Columbia
 - Scientific Formulations for H₂O and D₂O
 - Hill (1960s, 1991)

- Atomic Energy of Canada Ltd.
 - K_w for D₂O
 - Solubility of Magnetite
 - Shoesmith, Tremaine, 1970s

- Ontario Power Generation Ltd.
 - “Equilibrium Phosphate” Boiler Chemistry
 - Stodola, 1990s



The Canadian National Committee

- National Research Council of Canada
 - Pays annual dues
 - Liaison with government

- CANDU Owners Group
 - Technology transfer
 - Identifying research needs
 - “Matchmaking” between academic researchers, national labs and industry

- Companies and Universities
 - Participate on a volunteer basis



This Workshop

- To advance the science and engineering applications of high temperature water research:
 - Introduce researchers and users of research
 - Identify needs
 - Seed ideas for projects
- Agenda
 - Talks to *explain* research
 - Reception, dinner + lunchtime wrap-up discussions
- “Deliverables”
 - 1-page write-ups for “Certified Research Needs” submissions



Acknowledgements

1990-2009

- **CANDU Owners Group**
- **National Research Council of Canada**
- Ontario Power Generation Ltd.
- Atomic Energy of Canada Ltd.
- Canadian Electrical Association
- Universities
 - University of Guelph
 - University of New Brunswick
 - Trent University
 - Memorial University of Newfoundland
 - University of Toronto
 - UBC