

Reactor Thermal-Hydraulics Design and Analysis Test

<b>Student:</b>	<b>Test</b>
<b>Date:</b> <b>21 April 2006</b>	

1. **Design Requirements**

- Explain the requirements for materials for fuel sheath, list the usual materials used, and discuss how they meet the requirements.
- List and explain which design features are mostly influenced by the selection of reactor coolant.

2. **Power Reactor Types**

- Explain the refueling sequence and difference between CANDU and PWR reactors.

3. **Process Design Evolution**

- Capture the most important changes in the evolution of the CANDU reactor heat transport system.

4. **Flow Instabilities**

- Draw the flow instability diagram and explain the criteria of instability. Explain the impact of instability on in single channel configuration and parallel channel configuration.

5. **Thermal Efficiency**

- Define the thermal efficiency of NPPs and explain the factors of influence.

6. **Fuel-Coolant Heat Transfer**

- Draw a diagram of temperature distribution across the fuel element and coolant in radial direction, and explain the change of rate of heat transfer across different components.

7. **Two-phase Flow**

- State all possible boiling heat-transfer modes encountered in a heat-flux-controlled system with increasing heat flux from single-phase liquid flow at the same local flow conditions (i.e., pressure, mass flux and quality). What would be the difference in having a temperature-controlled system.
- Explain the most important features of homogeneous approach, separated approach, flow regime dependent approach, in modeling two-phase flow.
- List flow patterns that are possible in vertical flow in a channel, and explain relevance to heat transfer modeling.

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8. **Film Boiling**

- Identify the heat transfer media and heat transfer directions in film boiling.

9. **Basic Conservation Equations for Two-Fluid Models**

- What is the basic principle of conservation of a field variable?

10. **CATHENA Computer Code**

- Explain the most important features of the CATHENA heat transfer model (which models are available, which parameters are calculated, linkage to hydraulics, correlations etc.)

11. **CHF and Safety Margins**

- Explain difference between CHF, dryout, burnout and DNB (Departure from Nucleate Boiling)

12. **Heat Transport Pumps**

- Explain the operation of heat transport pumps in four quadrants

13. **Thermodynamics Laws**

- State the three laws of thermodynamics

14. **Pressure Drop**

- Explain the major sources of friction and associated pressure drop in CANDU heat transport system.
- Draw a diagram of pressure change along a pipe with three-step change of diameter ( $D1 > D2 < D3$ ).