Heat Transfer in Nuclear Systems

Steven J. Winston

Topics

- Principles
- Tools
- Complications
- Mechanisms
- Heat Sources
- Heat Paths and Sinks
- Tricks
- Nano Opportunities

Principles

- Conservation of Mass, Momentum, Heat
- Laws of Thermodynamics
  - 1st Law (you can't win)
  - 2nd Law (you can't break even)
  - 3rd Law (you can't get out of the game)

Tools

- Continuity Equation
- Navier-Stokes Special Case
- Bernard Simplification
- Numerical Methods
- CFD Codes
  - Relap
  - Retran

Complications

- Transients
- Two Phase Flow
- Approximations
- Geometry dependent empirical factors

Mechanisms

- Radiative
- Convective (Advective)
- Conductive

Heat Sources

- Fission
  - Gamma, neutrons
- Fission product decay
  - Gamma, neutrons
- Activation product decay
  - Gamma, neutrons

Heat Paths and Sinks

- Fuel meat to cladding, core internals, PV and work (damage)
- Cladding, CI, PV to PCS
- PCS to SG
- SG to TG
- TG to Work and to Environment

Tricks

- Laser Cooling
- Magnetic Cooling

Nano Opportunities

- Fluid characteristics
- Surface characteristics
- Path characteristics