Outline

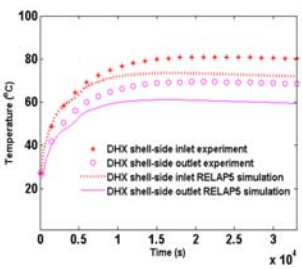
- FHR Thermal Hydraulics Analysis Tool Validation
  - FHR Thermal Hydraulics PIRT Panel
  - Thermal Hydraulics Code Validation
  - Experimental Facilities
- Tritium Mitigation and Control
  - Tritium Control System
  - Novel Heat Exchangers

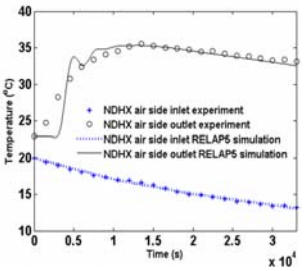
FHR Thermal Hydraulics PIRT Panel

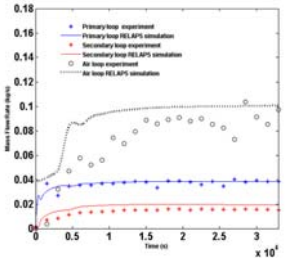
- A PIRT panel on thermal hydraulics is being organized by The Ohio State University and Oak Ridge National Laboratory to address the verification and validation of thermal hydraulics codes in support of licensing
  - PIRT panelists will cover a wide range of technical expertise in relation to FHRs (AHTR as the reference design) from national laboratory, industry, regulator, academia, and international collaborator
  - Planned on May 24 – 26, 2016 at Ohio State, Columbus, OH with a full report expected to be completed in August 2016
  - White paper is being prepared to provide information to facilitate the panel discussion
  - Findings will be published in appropriate form after the workshop
  - Interested parties are to be invited as observers (email X. Sun at sun.200@osu.edu)

Thermal Hydraulics Code Validation

- Validation of a System Analysis Code for FHRs
  - RELAP5 MOD 4.0
  - Benchmark study of the Low-temperature DRACS Test Facility (LTDF) at OSU, including startup and pump trip scenarios
  - Implementation of fluoride salt properties into RELAP5
  - Analysis of the High-temperature Fluoride Salt Test Facility (HTFSF) at OSU prior to the actual tests



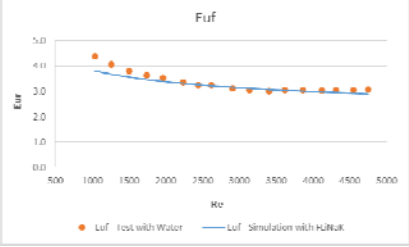


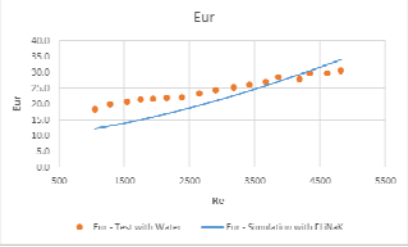


Lin et al., ICAPP2016

Thermal Hydraulics Code Validation (Cont'd)

- HTFSF Vortex Diode Design using ANSYS Fluent





- Validation of a Computational Fluid Dynamics (CFD) Code for FHRs
  - Planed for a certain multi-dimensional phenomena in FHRs
  - Salt mixing in upper plenum in AHTR
  - Salt flow in AHTR reactor core

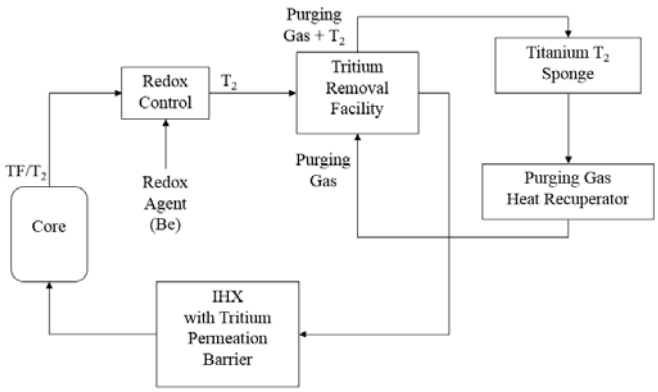
Experimental Facilities

- Low-temperature DRACS Test Facility (LTDF)
  - 1.0 MPa water as primary coolant
  - Steady state and Transients: Startup; Pump trip without IHX; Pump trip with IHX
- High-temperature Fluoride Salt Test Facility (HTFSF)
  - FLiNaK as primary coolant and KF-ZrF_4 as secondary coolant
  - Preliminary tests: leakage, instrumentation, insulation, etc.
  - Salt preparation: dehydration and impurity removal

Lv et al., NURETH16

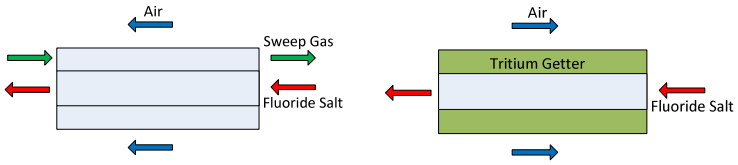
Tritium Control System

- Overall Technical Strategy



- Validation Experiment
  - To evaluate the performance and efficiency of our cross-flow tritium removal facility design

Wu et al., NURETH16

Novel Heat Exchangers

- Design HXs (NDHX, DHX, IHX, and SHX) for AHTR, considering tritium mitigation and heat transfer
- Ongoing design work for NDHX: Two preliminary designs being considered
  - Option 1: Double-wall NDHX with sweep gas in the annulus
    - » Inner tube: Allow tritium permeation
    - » Outer tube: Prevent tritium permeation (with surface treatment if necessary)
    - » Tritium: Trapped in the gap and removed by sweep gas
  - Option 2: Double-wall NDHX with tritium getter in the annulus
    - » A tritium getter (yttrium) pre-filled in the gap/annulus