

# Problem Description Report and Intro to Nek5000

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WORKING GROUP MEETING SPRING 2016  
TASK 2 BREAKOUT SESSION  
ANN ARBOR, MI

# Outline

- Task 2.1 Description and Schedule
- Problem Description Report Sections
- Nek5000 Modeling Approach
- Continuing Efforts

# Task 2.1 Description

Task #	Description	Owner
2.1	Sodium Loop	
2.1.1	Survey literature of existing sodium test data	B. Woods
2.1.2	Select two candidate problems	B. Woods
2.1.3	Organize and document data for two candidate problems	B. Woods
2.1.4	Identify and review industry needs for sodium loop data	B. Woods
2.1.5	Down-select to one problem for benchmark evaluation	B. Woods
2.1.6	Preliminary modeling with industry tool Star CCM+	K. Weaver
2.1.7	Preliminary modeling with NEAMS code Nek5000	D. Pointer
2.1.8	Comparison of experimental data & model results for problem	B. Woods
2.1.9	Benchmark level evaluation of problem	B. Woods
2.1.10	Evaluation of uncertainties in selected problem	B. Woods
2.1.11	Submission of benchmark for peer review	B. Woods

# Task 2.1 Schedule

Current Quarter

Task ID [#]	Year 1				Year 2				Year 3			
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4
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Two Candidate Problems Selected

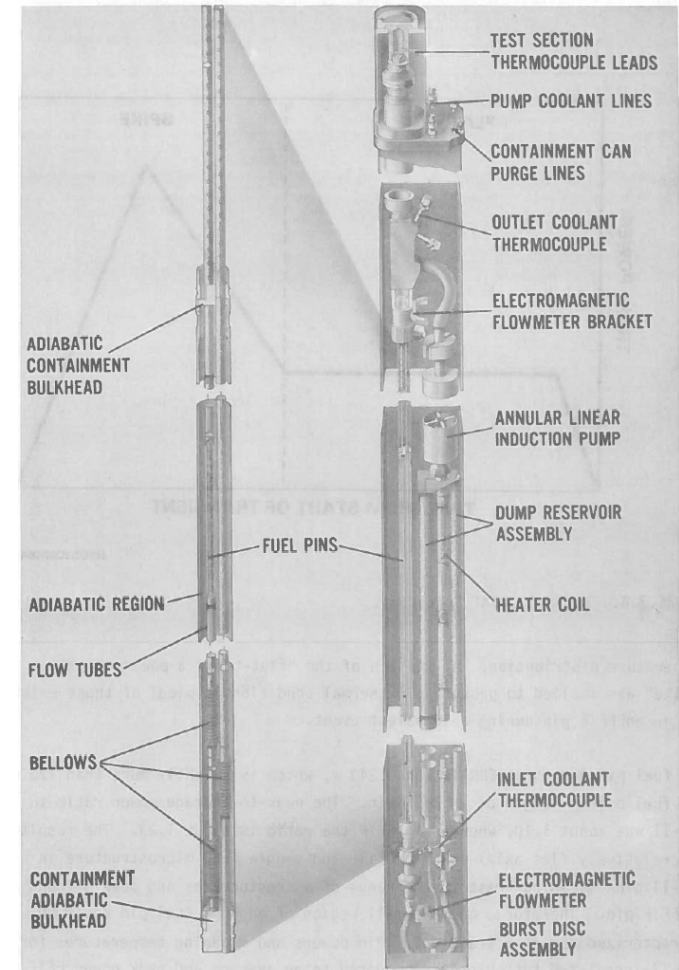
Down-selected to a Single Problem

# Problem Description Report Outline

- Introduction
  - Introduce the IRP, TREAT, and Task 2.1
  - Benefitting the Accident Tolerant Fuel initiative
  - Supports code validation and future experimental loop design
- Test Case Evaluation and Identification
  - Summary Report of HEDL Reference Fuel TREAT Tests
  - Down-selection process from 27 tests down to the benchmark test
  - Capsule vs. Loop Tests
  - Terminated vs. Unterminated Tests
  - Ranking Table of Tests
- Parameters of Interest
  - Pressure, Temperature, Sodium Flow Rate

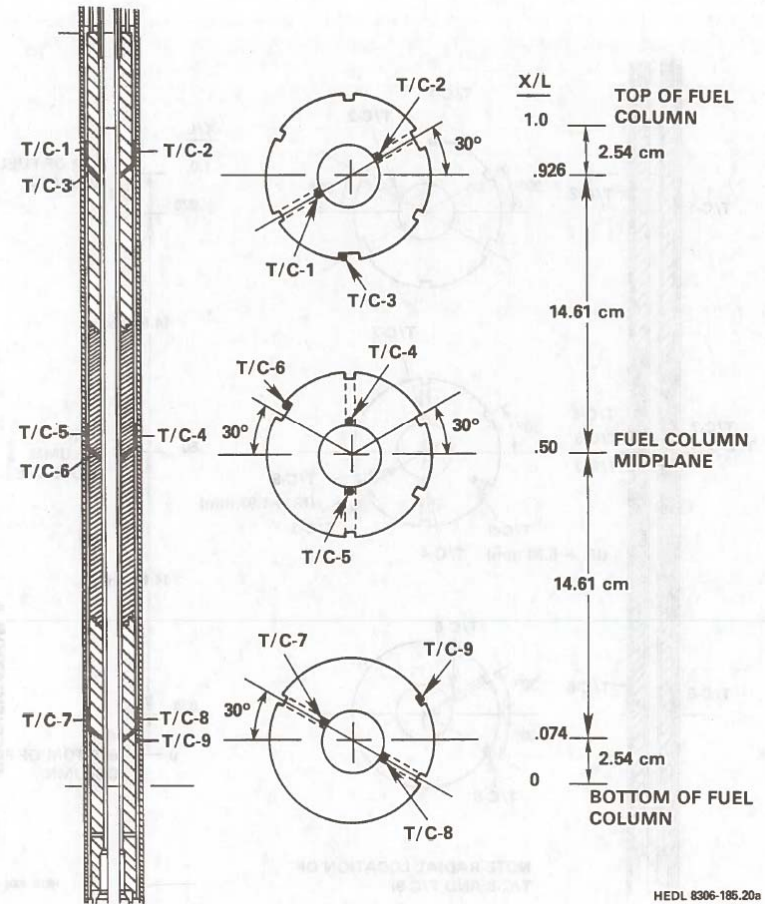
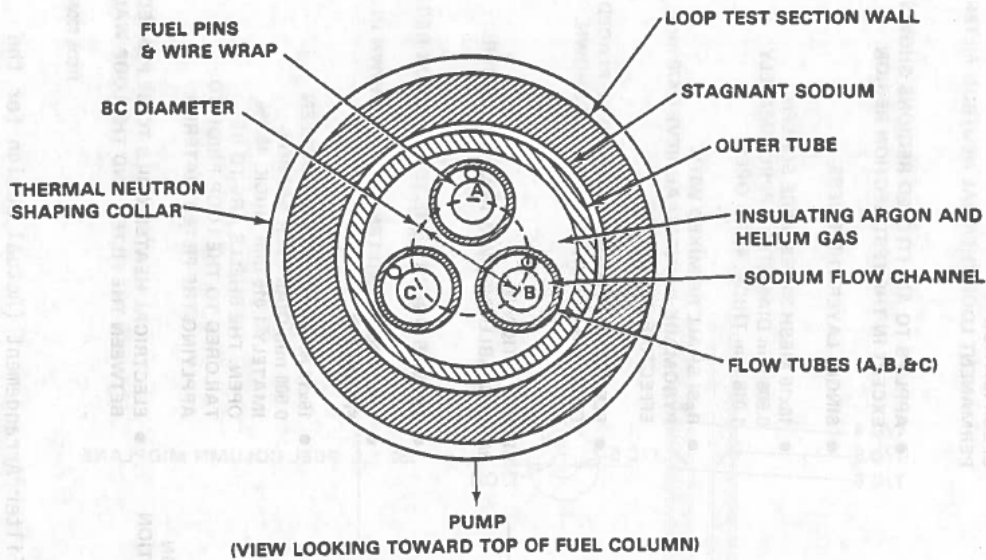
# Problem Description Report Outline

- Facility Geometry Description (Mark II Experimental Loop)
  - Components
    - Test Section (Three Pins)
      - Thermocouples located throughout the test section
    - Annular Linear Induction Pump (ALIP)
      - Located on the return leg
      - Constant or varying flow rates
    - Thermal Neutron Shaping Collar
      - Created to shape the axial power profile using a boron thermal neutron absorber
  - Dimensions of Flow Areas, Hydraulic Diameters, Wall Thickness, Fuel Dimensions, Test Facility Height



# Problem Description Report Cont.

- Facility Instrumentation Plan
  - Thermocouple locations, pressure tap locations, flow meter locations

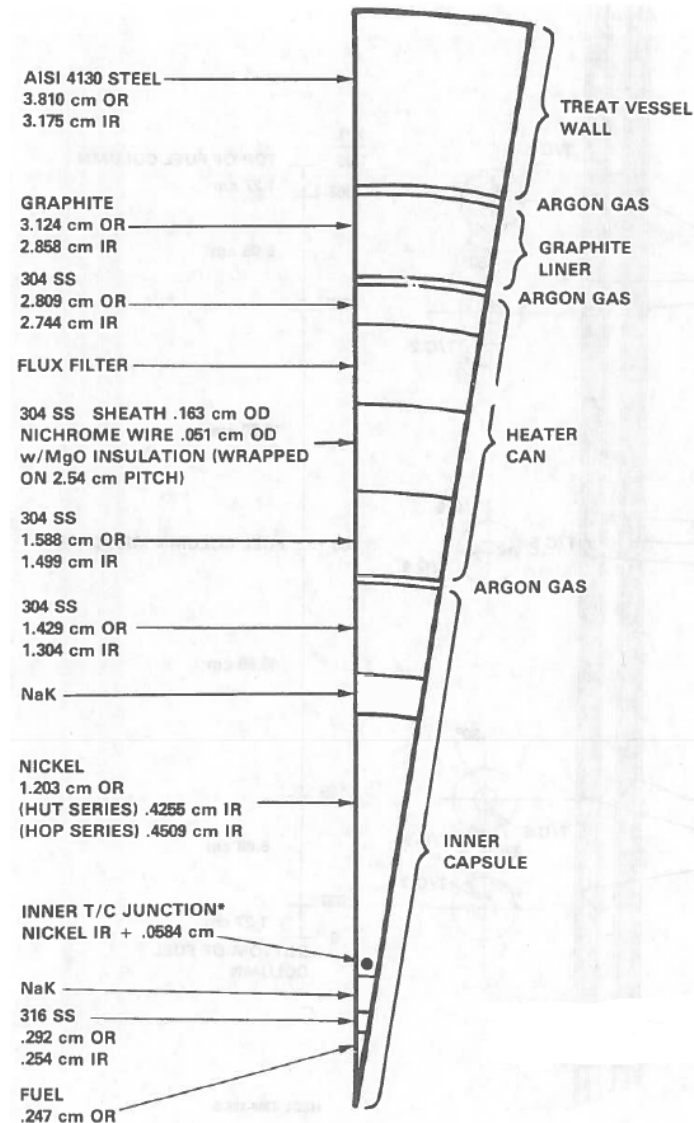


HEDL 8306-185.20a



# Problem Description Report Cont.

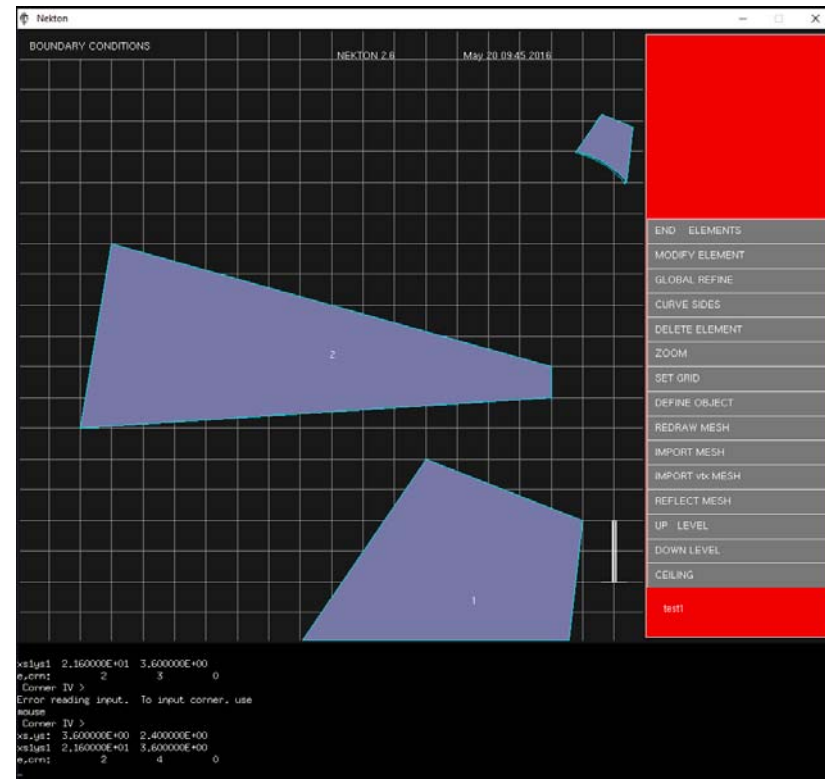
- Initial and Boundary Conditions
  - Adiabatic Boundary Condition in Test Section
- Material Data
  - Sodium fluid properties, thermal conductivity, density, and heat capacitance of the walls and fuel
- Submission of Results Format
  - Plan to follow prior OECD Benchmarks





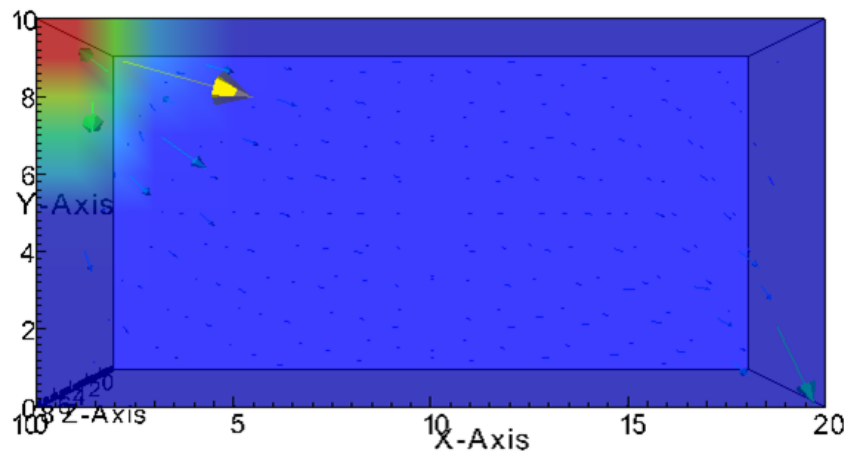
# CFD Modeling Approach

- Geometry Familiarization and Documentation
  - Flow Areas, Flow Connections, Shapes, etc.
- Geometry Building and Meshing
  - Meshing tools Include Prenek, Genbox, and Cubit
    - Prenek and Genbox are provided with Nek5000
    - Genbox and Prenek
      - Prenek has a user interface
      - Tutorial Slides Available online
      - No additional software necessary
    - Cubit is an aftermarket software
      - Read into Nek5000 using MOAB
      - Available at a fee



# CFD Modeling Approach

- Read in Geometry and Meshing Data
- Use the Nek5000 solver for the solution
- Post-Process Results using VisIt
  - VisIt used for visualization of Large CFD models
  - Allows for parameters of interest to be compared at discrete times or in video format
  - Recommended post-processing tool



# Continuing Efforts

- Continue working on the Problem Description Report
  - Input information related to the chosen problem once data is provided
  - Issue Description Report upon completion
- Begin building Nek5000 model
  - Follow the approach outlined as well as any suggestions to most efficiently build the model
- Compare results with the data and compile a new section in the description report with the results
- Full Benchmark level evaluation of each code (Star CCM+ and Nek5000) including documentation in the report