

# Coupled 3D Studies of Gas Cooled Reactor Systems

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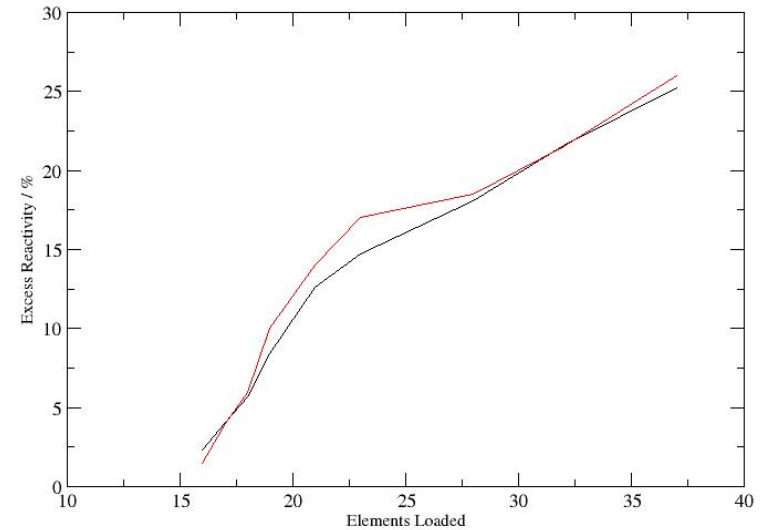
Earth Science and Engineering

Imperial College

- PhD Aims:
  - 3D asymmetric transient modelling of Gen IV GFR designs using coupled radiation-fluids code FETCH
  - Analyse performance and construct models to challenge GFR safety claims
- Courses and training so far:
  - FJOH Summer School 2006 (CEA Cadarache)
  - WIMS 9 Training Course (Serco Assurance)
  - RAPHAEL Project VHTR course (University of Stuttgart)
- Currently:
  - Studies of Dragon Reactor Experiment as lead into GFR

- Dragon Reactor Experiment (DRE)
  - Introduction to the use of AMCG codes (EVENT / FLUIDITY / FETCH)
  - Opportunity for benchmarking work using Dragon data
  - Forerunner of HTGRs (including GFR & VHTR)
- DRE in operation 1964-75, Winfrith
- Advances in HTR technology including:
  - Development of TRISO particles
  - Successful use of Helium collant
  - Sustained operation at high temperatures

- Excess reactivity calculations using EVENT:
- Other available data includes:
  - Core power distribution
  - Coolant behaviour
- Coupled studies:
  - Normal operation
  - Negative reactivity transient



- GFR Gas-cooled Fast Reactor Gen IV system
- Reference designs:
  - 600MWth modular or 2400MWth
  - Power density  $\sim 100\text{MWth/m}^3$
  - Pellet, particulate or dispersed fuel
  - Outlet temperature  $\sim 850^\circ\text{C}$
  - Core  $\sim 1200^\circ\text{C}$  (normal),  $\sim 1600^\circ\text{C}$  (accidents)
- Links with VHTR
  - Helium cooled
  - High operating temperatures
  - Hydrogen production

- Sustainability criteria:
  - Actinide management
  - Non-proliferation
  - Hydrogen production
- Development challenges:
  - High performance fuels
  - Material integrity under high temperatures & fast neutron flux
  - Fuel cycle technology
  - General safety issues

- Multiphysics analysis of generic GFR 3D models
- Accident scenarios & asymmetric transient modelling:
  - Control rod movement
  - Structural faults
  - Depressurisation
- Fuel / materials performance issues
- Integration of system codes into FETCH
- AMEC-NNC guidance in specific aspects of research

- Modelling of DRE as introduction to AMCG codes and HTGRs
- HMS Sultan KNOO meeting:
  - Present more detailed results from Dragon work
  - Steady state & preliminary coupled calculations
- Commence detailed GFR studies