

Contribution to the design of ATF by means of TRANSURANUS



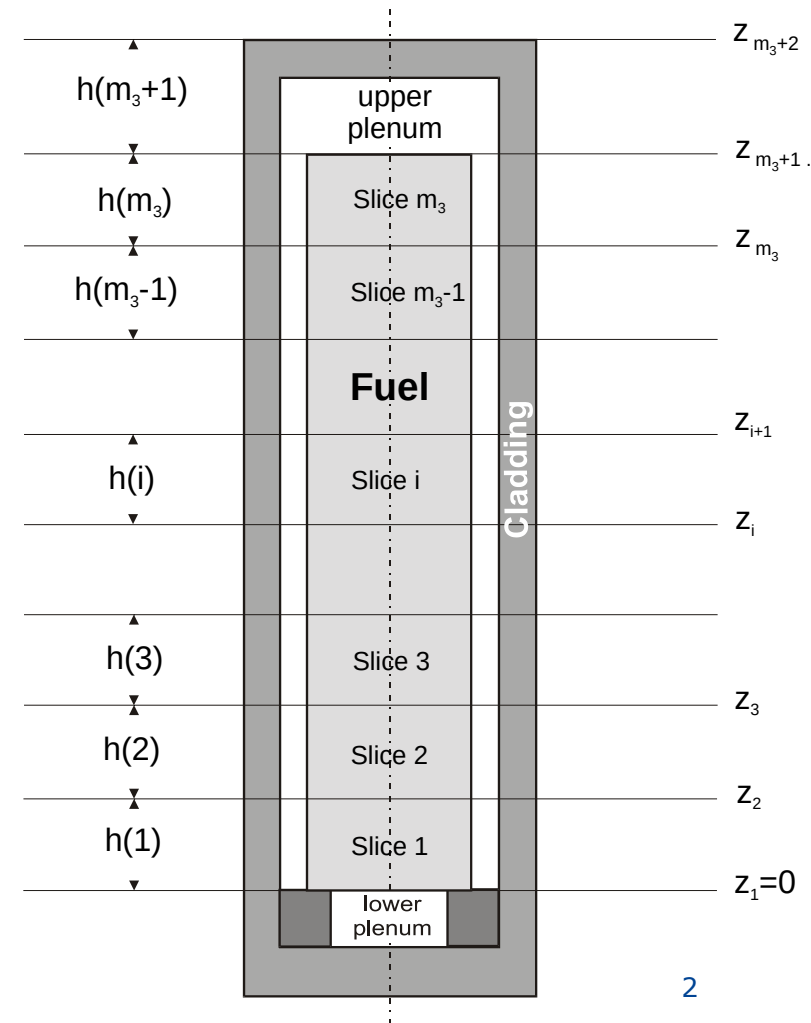
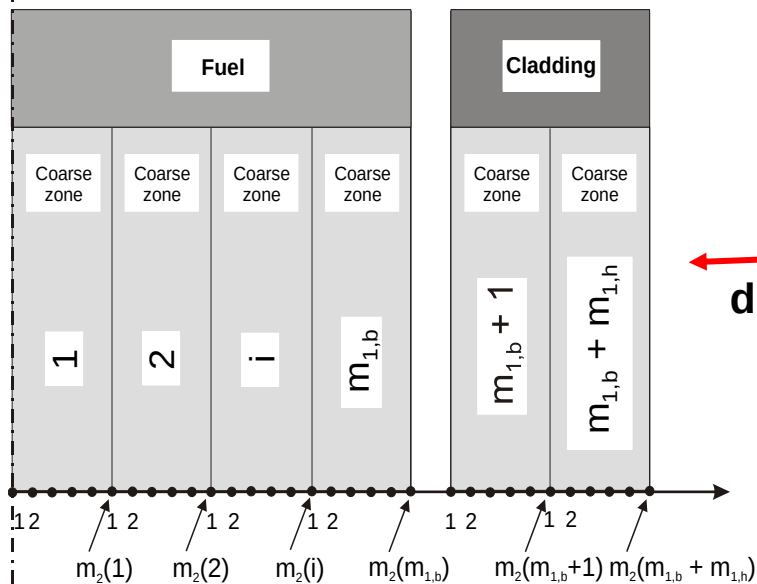
Joint Research Centre (JRC)

**ITU - Institute for
Transuranium Elements**
Karlsruhe - Germany

www.jrc.ec.europa.eu

Thermo-mechanical modelling of a cylindrical fuel rod in 1.5 D

stack of axially symmetric slices
covering: *pellet, gap, cladding, coolant*



General control parameters

Main model switches (e.g. FGR, corrosion)

Material properties

Coolant, cladding, fuel (per rod or per slice)

Geometry and composition of fuel rod

Axial nodalization

Input mode for radial nodalization (per rod or per slice)

radii of fuel and cladding

main isotopes in fuel (U-235, Pu-239...Pu-242)

fuel porosity and grain size

pressure and composition of fill gas

Time dependent input (MACRO-block)

e.g. linear power, fast neutron flux, coolant temperature

ATF: Required clad material properties



ATF Workshop, Paris, 10-12 Dec 2012

Creep anisotropy coefficients	Burst stress
Elasticity constant	Crystallographic phase transition
Poisson's ratio	Specific heat @ constant P
Swelling strain	Density
Thermal conductivity	Solidus-liquidus temperature
Creep strain	Heat of melting
Yield stress	Emissivity
Rupture strain	

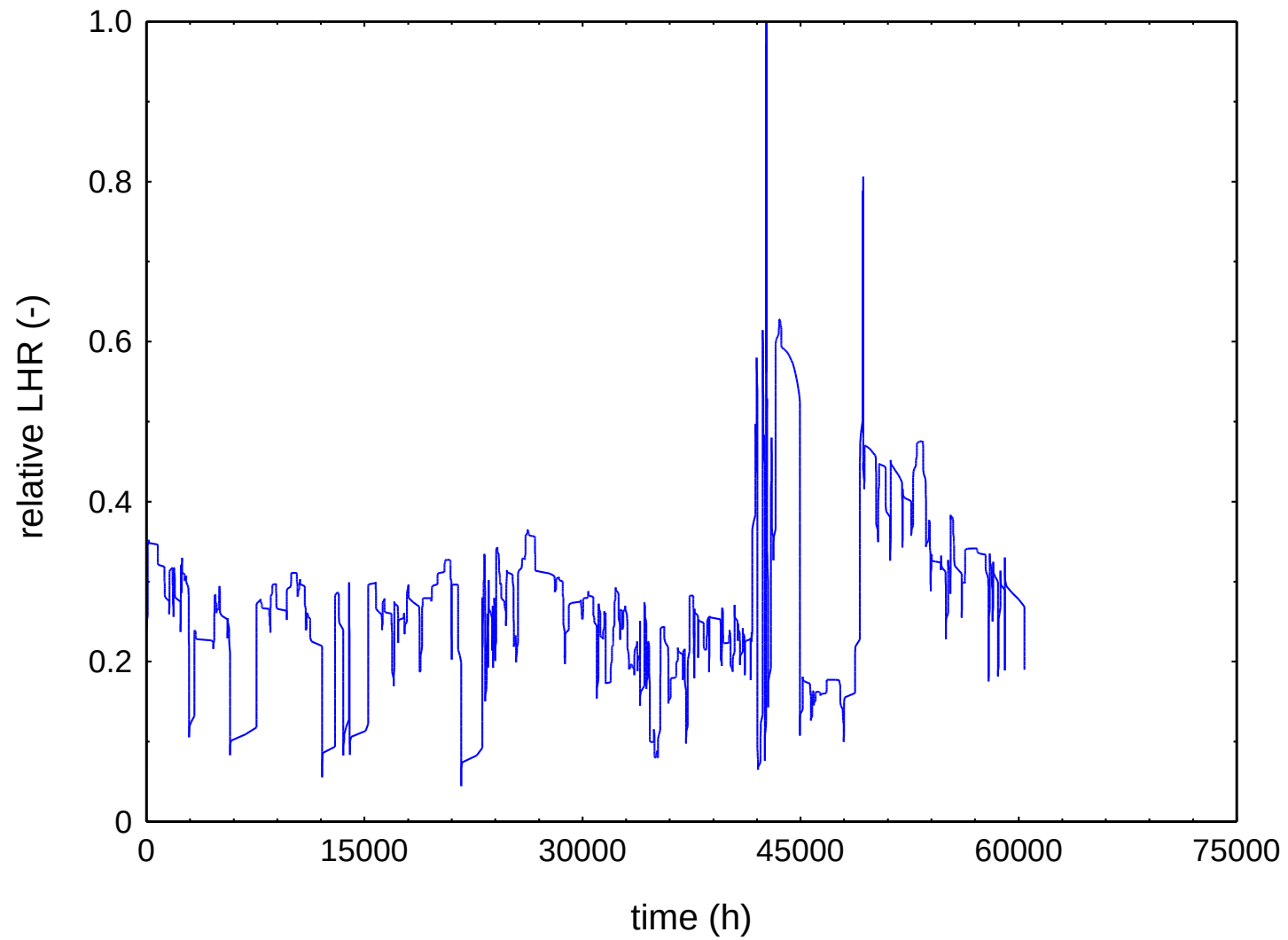
Example for ATF for LWR

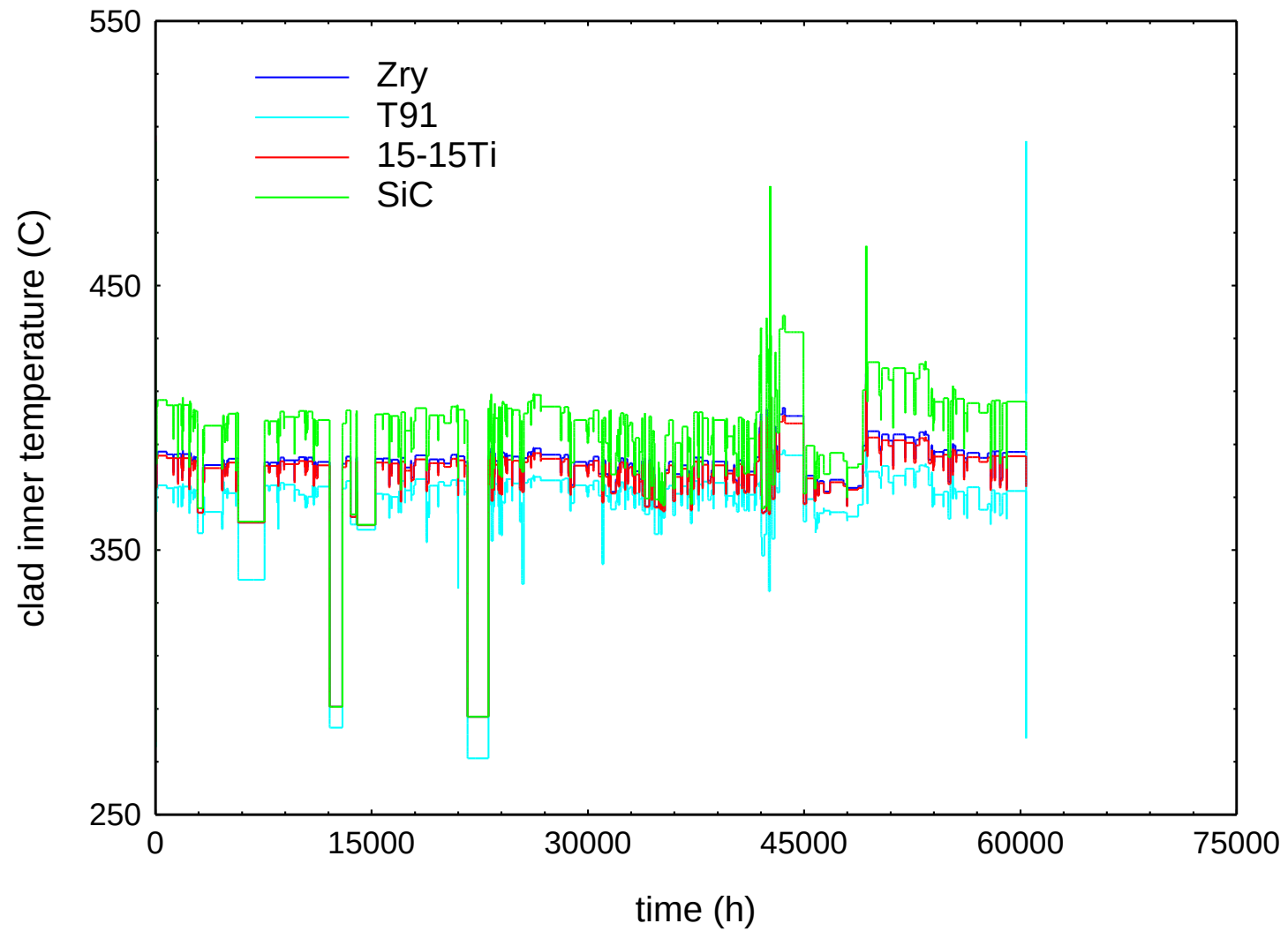
Steel

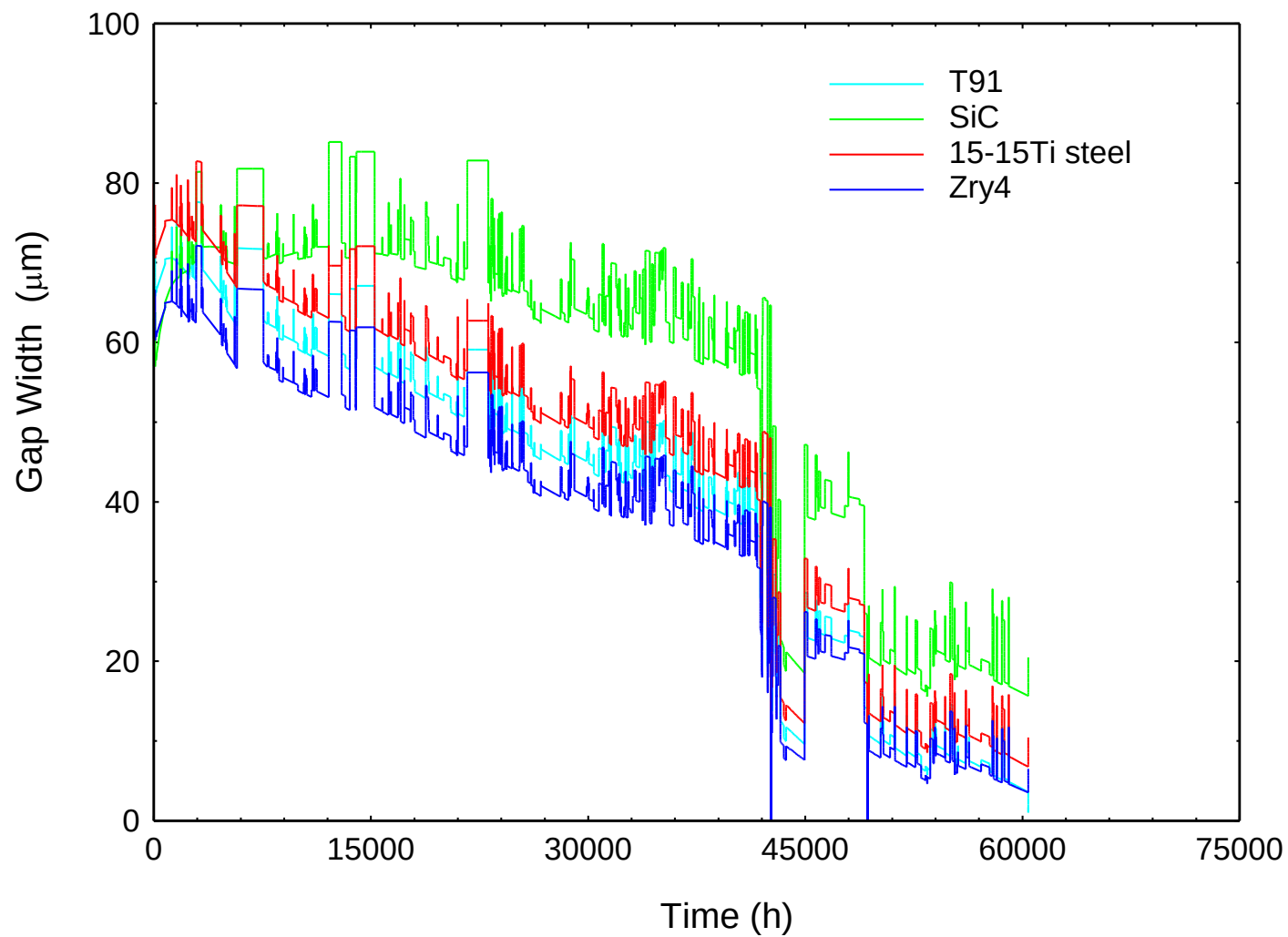
- 15-15Ti (AISI 316)
- T91

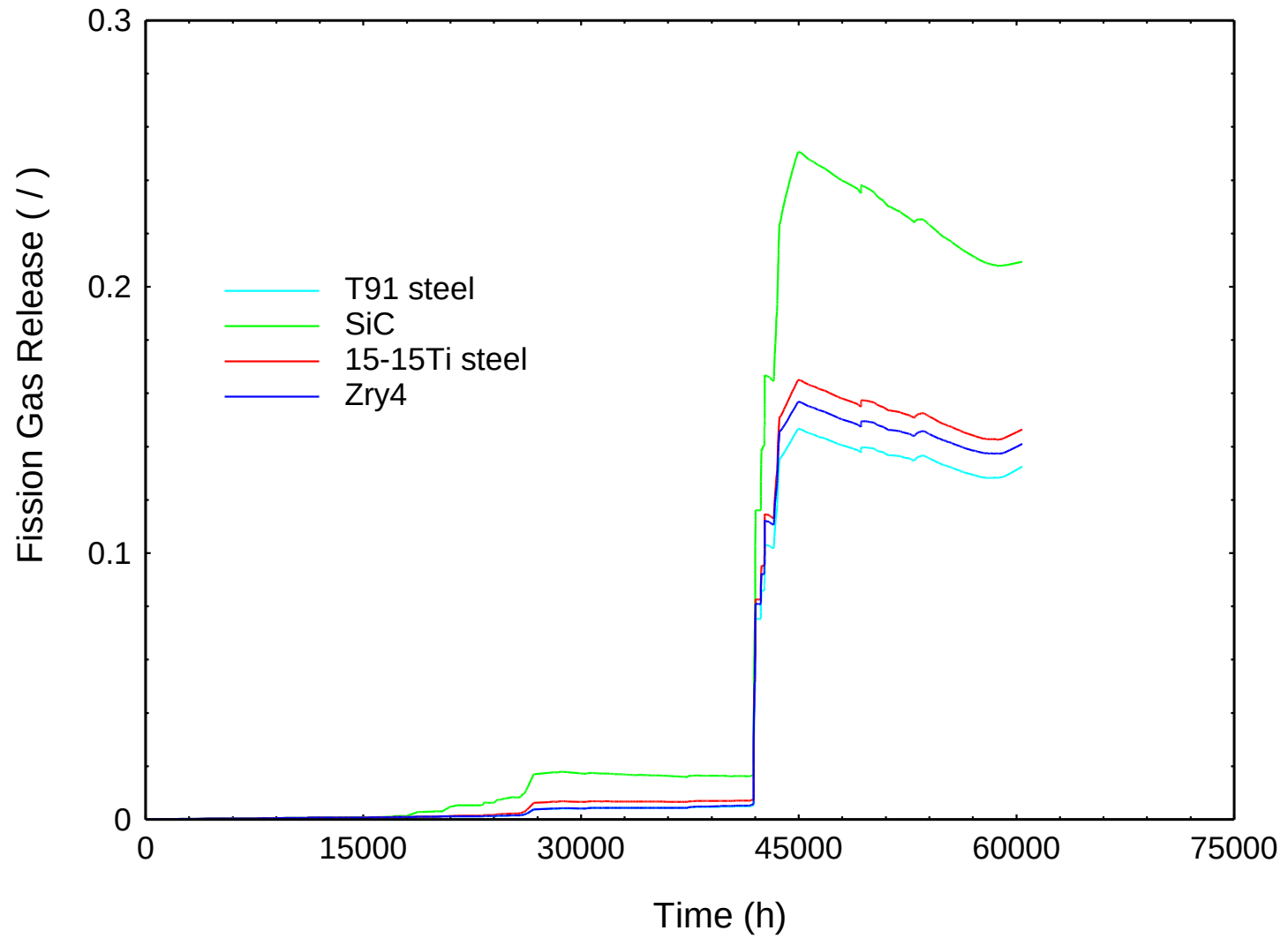
Ceramic composite material: SiC_f (CEA) treated as homogeneous layer

→ Compare with standard Zry









- TRANSURANUS Code originally developed for FBR, then for LWR
- Code structure enables
 - easy incorporation of material properties/models
 - analysis of normal operation (transients) and DBA
 - statistical analysis (MC or Numerical Noise)
- Large user group for development & validation
- Ongoing projects for Gen-IV fuel and LWR fuel, can benefit for ATF
 - New cladding materials (SiC, steels, etc.)

Useful for ATF
fuel design

Good (experimental) data for validation

- High T interactions for fuel-cladding-coolant
- Effect of irradiation
 - burnup/fluence (thermal properties, texture/anisotropy, etc.)
 - micro-cracking in CMC
- Anisotropy of creep