AppC

asnalb

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1 Introduction

Passive scalar transport solver for the DNP transport in OpenFOAM blue The equation solved for each DNP group:

$$\frac{\partial C_i}{\partial t} = -\nabla(uc_i) + \nabla D \nabla C_i - \lambda_i C_i + \beta_i \nu \Sigma_f \Phi \tag{1}$$

black

```
fvScalarMatrix neutronPreciEqn
(
    fvm::ddt(rhok,dnp1)
  + fvm::div(phi, dnp1)
  - rhok*fvm::laplacian(DT, dnp1)
  + fvm::Sp(lambda1,dnp1)
 == rhok*dnp1_s
);
```

Where $dnpi_s$ is the DNP production term written per mesh cell, so it has the same format as the dnp1 field itself. The production term is:

$$dnpi_s = \beta_i \Phi \times \nu \times \Sigma_f \tag{2}$$

where β_i is the DNP fraction, Φ is the scalar neutron flux, ν is the number of neutrons emitted per fission, Σ_f is the fission cross section.
On the other hand, we have the specific power written on the same mesh in Serpent:

$$\frac{P}{V} = \Phi \times \Sigma_f \times E_r \tag{3}$$

Where P/V is the specific power per unit volume, V is the volume, E_r is the heat produced per fission in Joules.
By expressing Φ in terms of specific power from the previous equation and using it to calculate the DNP production term, we get:

$$dnpi_s = \frac{\beta_i \times \nu \times P}{E_r V} \tag{4}$$

All neutronics constants and the initial DNP distributions are extracted from Serpent Monte-Carlo code developed at VTT (Leppänen, J., et al. (2015) ”The Serpent Monte Carlo code: Status, development and applications in 2013.” Ann. Nucl. Energy, 82 (2015) 142-150.).