

Water cooled Lead Ceramic Breeder blanket for fusion power plants

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Introduction

- Recently, research activities on an innovative alternative blanket concept (a Water cooled Lead Ceramic Breeder), in which Lead / Lead-alloy is used as neutron multiplier, ceramic pebbles as tritium breeder, pressurized water as coolant, are on-going.
- This concept avoids the potential safety issue (Be-Water reaction in case of water leakage) when Beryllium is used as neutron multiplier in a water cooled blanket concept.
- After many iterations of nuclear, thermal hydraulic and thermal mechanical analysis, a sound configuration was selected.

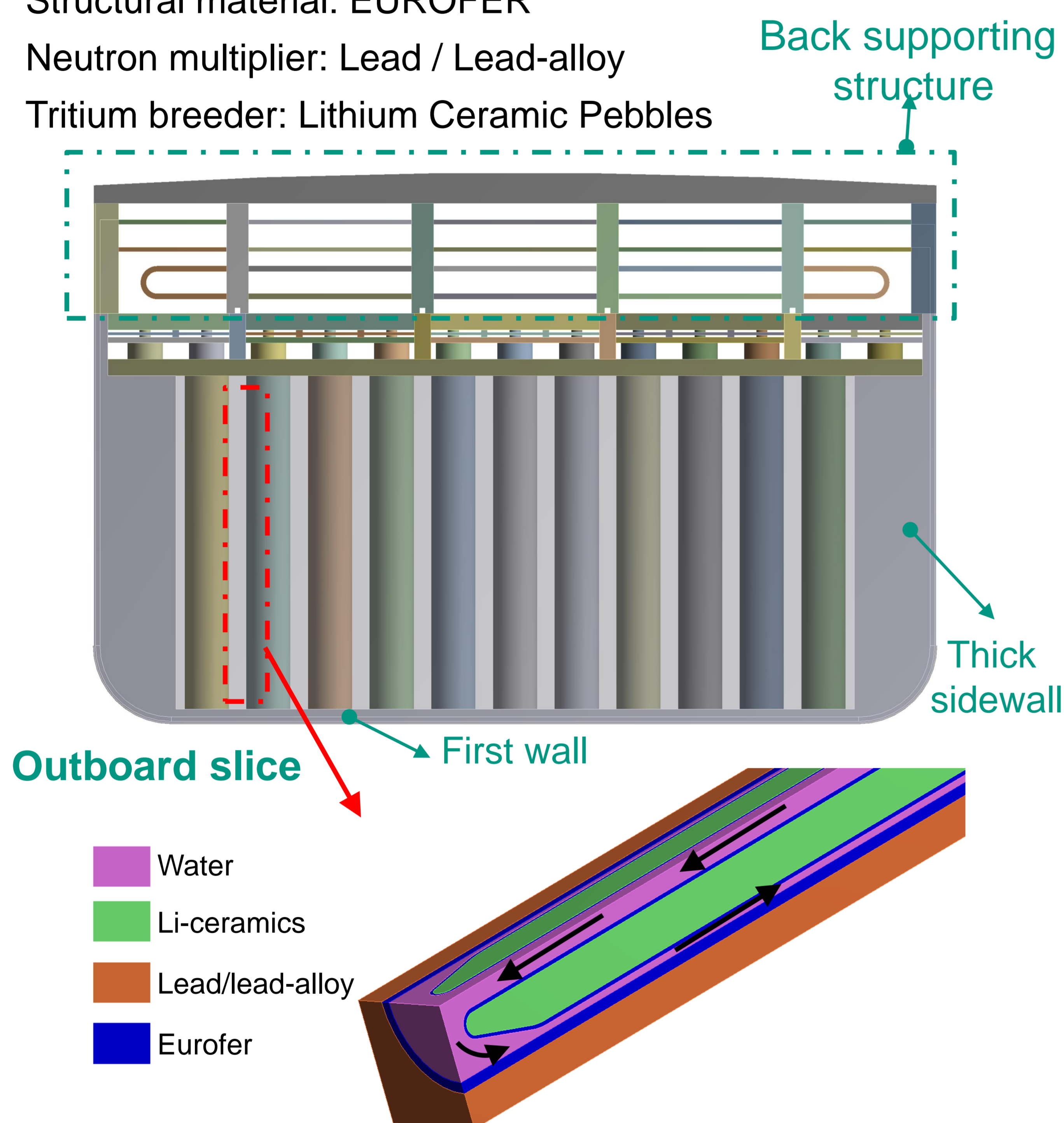
Design Features

Coolant: 15.5 MPa water with $T_{inlet}/T_{outlet}=295/325$ °C

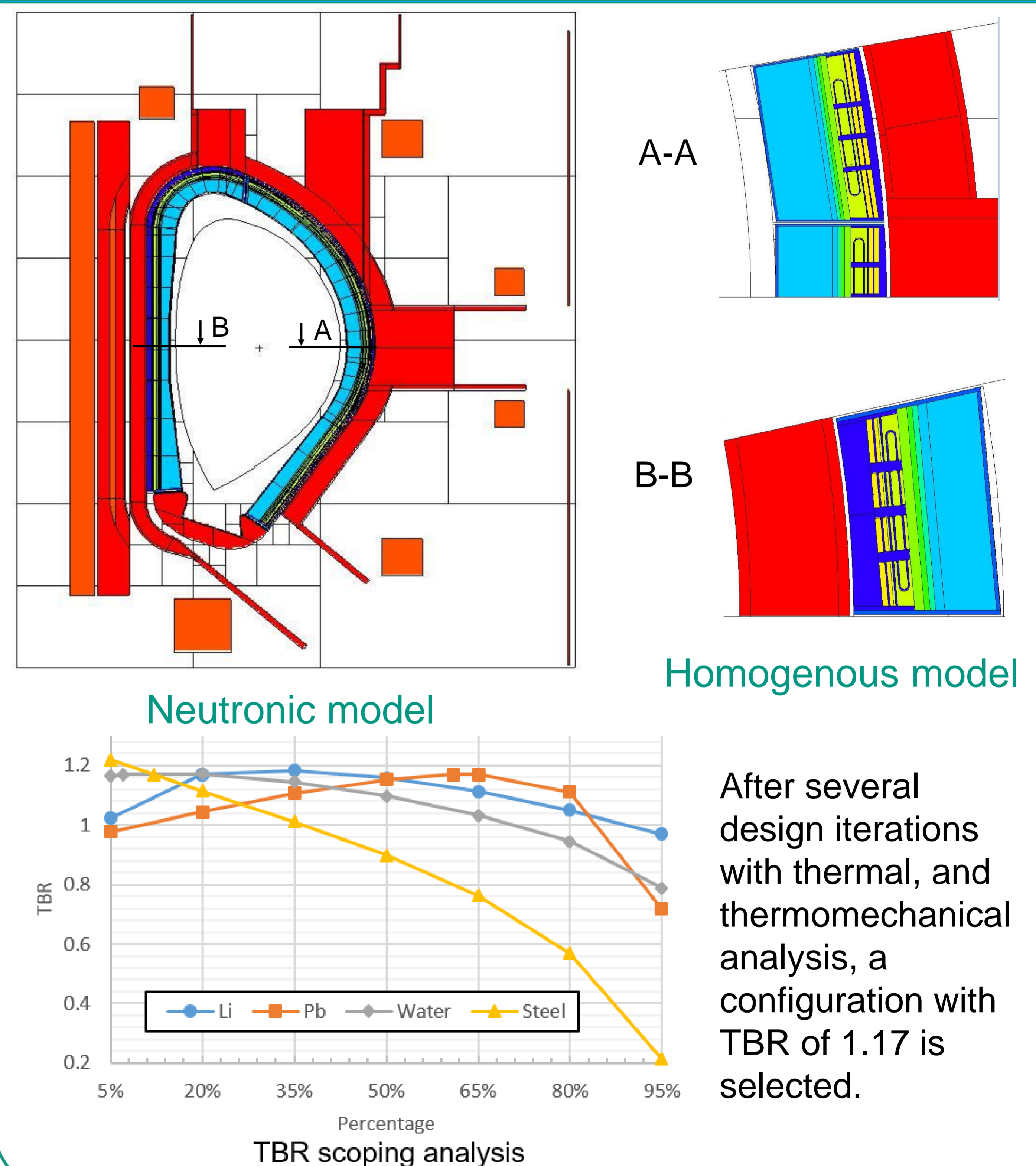
Structural material: EUROFER

Neutron multiplier: Lead / Lead-alloy

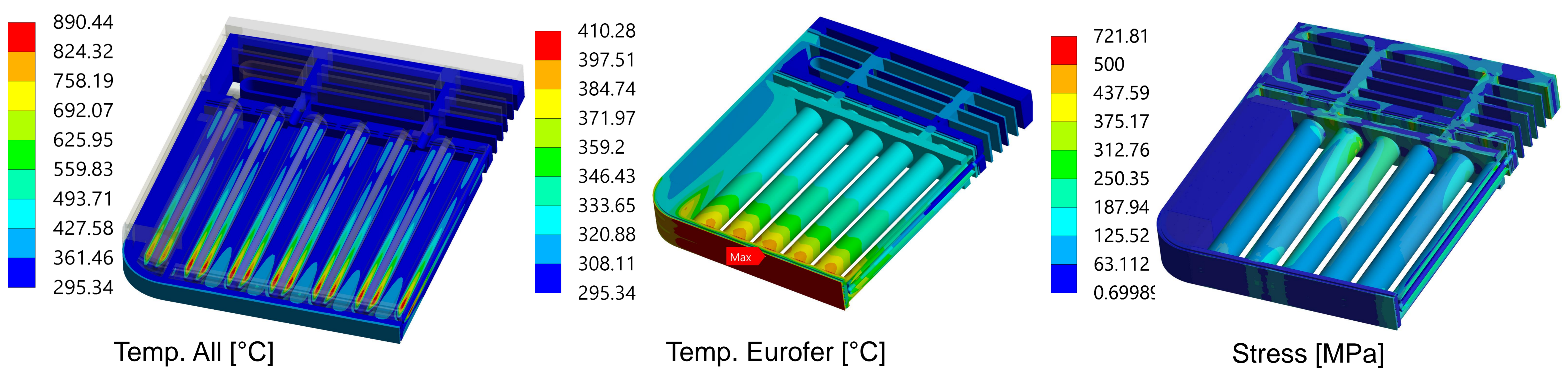
Tritium breeder: Lithium Ceramic Pebbles



Neutronics Analysis



Thermal and Thermo-mechanical Analysis



After several design iterations, temperature on materials are OK, stress level is acceptable.

Summary

- A water cooled lead ceramic breeder blanket was proposed to overcome the challenges, facing water-cooled blanket concept utilizing Beryllium.
- Nuclear, thermal-hydraulic and thermomechanical analysis iterations were performed, leading to a sound design with TBR 1.17 (temp. and stress level OK).