Porous modelling of AGRs pod boilers with *Code_Saturne*.

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Context

Life extension of AGRs in the framework of target 0/9/65:

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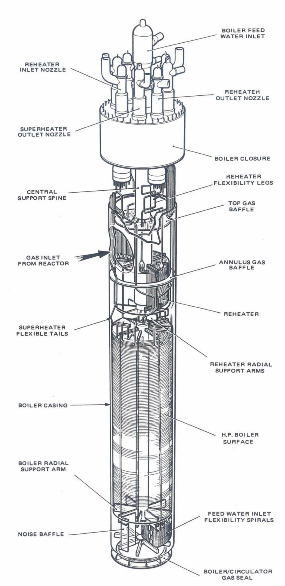
Critical components for life extension:

- graphite bricks in nuclear reactors;
- pod boilers.

Context - Pod Boilers

◂ Go Back



Context - Pod Boilers

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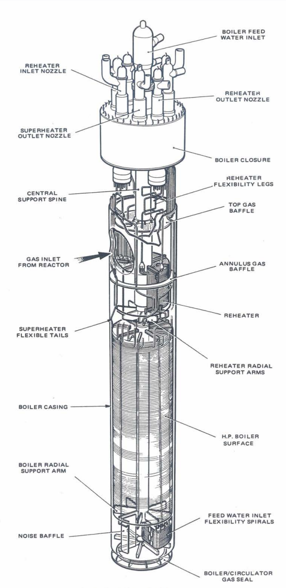

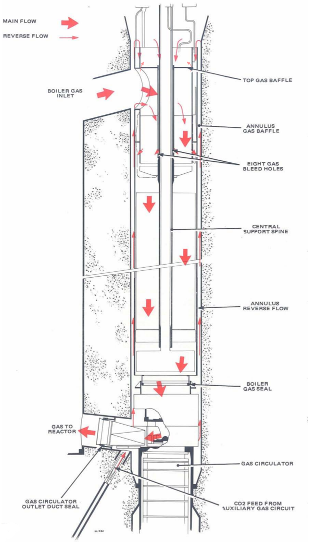

Context - Pod Boilers

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- **temperatures at material transitions welds**
- **temperatures of 9% Cr tubes fin tips**
- **steam superheat temperature difference**

Objectives

Development of a simplified 3D model of the gas side AGRs Pod Boilers.

Information provided by the model:

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- effect of modifications to original configuration.

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Very complex geometry, direct CFD simulation non viable
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Structure of the model:

- general modelling with Code Saturne;
- mesh and porosity information from plant data;
- correlations and detailed CFD submodels for drag coefficients and heat transfer;
- coupling between Code Saturne and NUMEL for heat exchange.

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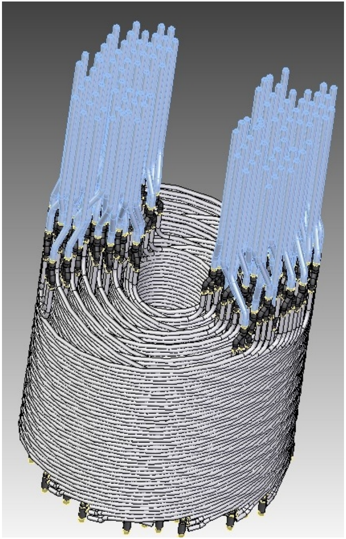
- each point must be given a gas temperature as a thermal boundary condition.

Coupling with NUMEL - Locating the tubes



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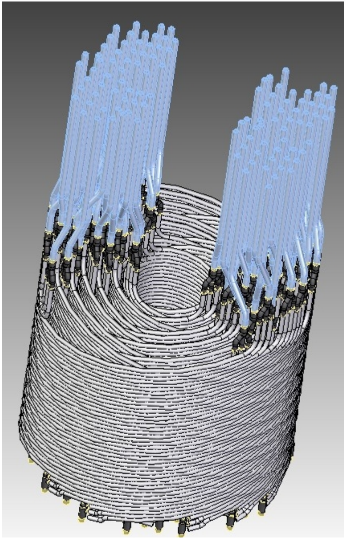

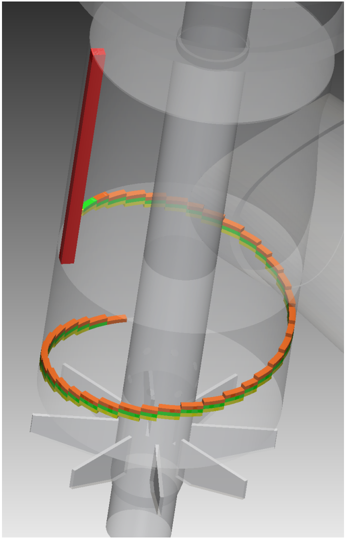

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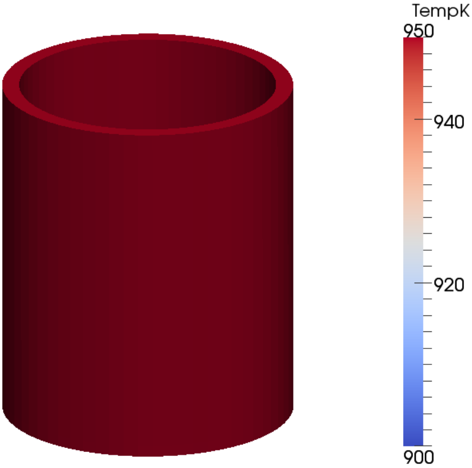
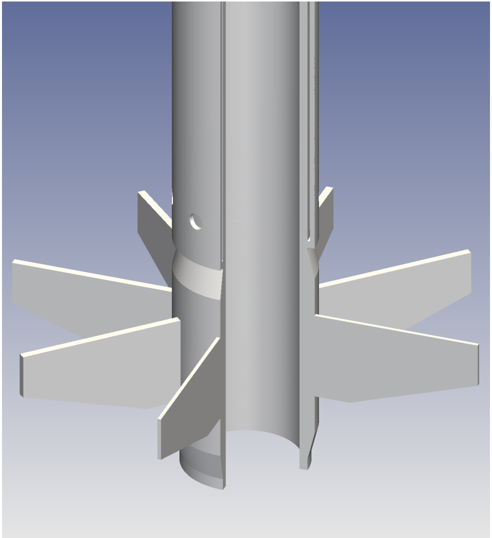
- reading the profiles of temperatures given by NUMEL, **tube by tube**;
- interpolate the temperatures and impose them in the cells touched by the tube;
- impose heat sinks proportional to the difference of temperature in the cells;
- compute temperatures to be used as gas boundary condition in NUMEL.

Coupling with NUMEL - Single tube case



Boiler Spine



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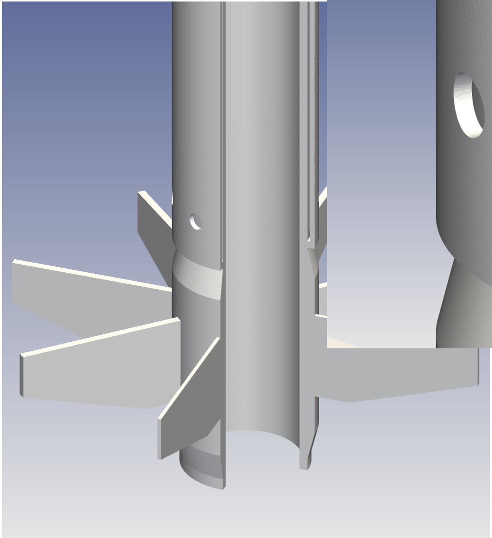

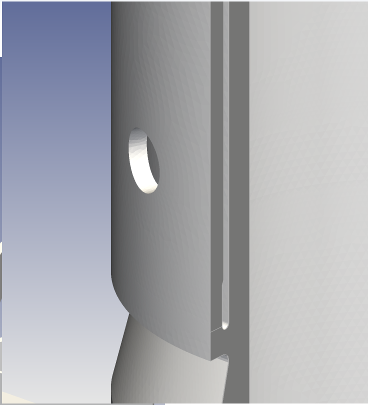

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- Heat conduction model with thermal radiation in SYRTHES;
- coupling of the porous model with a heat conduction model in SYRTHES.
- inclusion of an explicit CFD model of the spine gap.

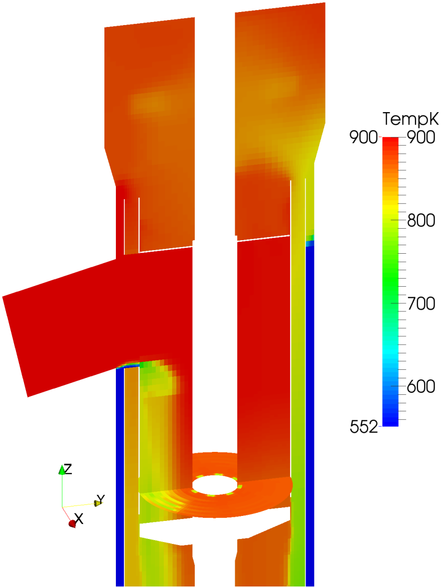
Main results

Cold plume effect:

hot main flow from the reactor;

cold side flow from the bottom of the boiler;

(Boundary conditions here used are not representive of the real conditions of the boilers)



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Cold plume effect:

liner flow entrained by main flow into Reheater;

colder gas up to the 4th row of the Reheater;

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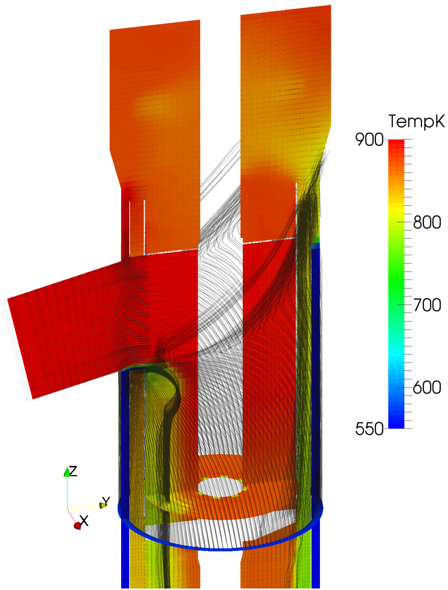

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Cold plume effect:

Cold plume dependent on the parameters of the model;

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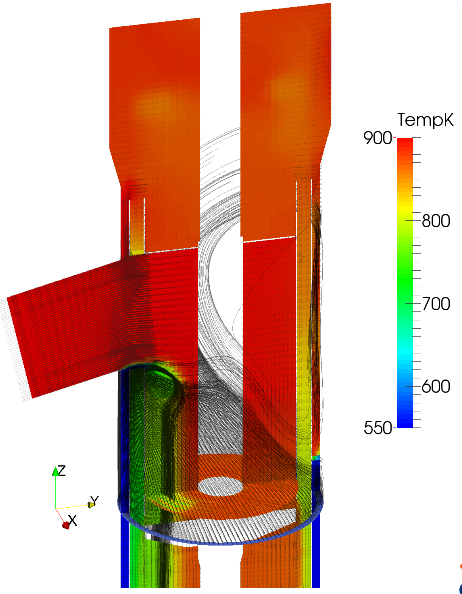

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limited impact of cold plume on the spine;

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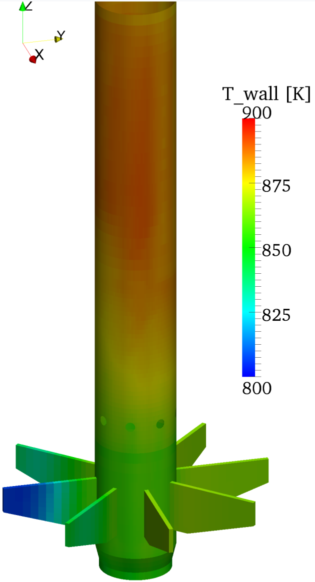

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spine flow important also at the bottom of the gap;

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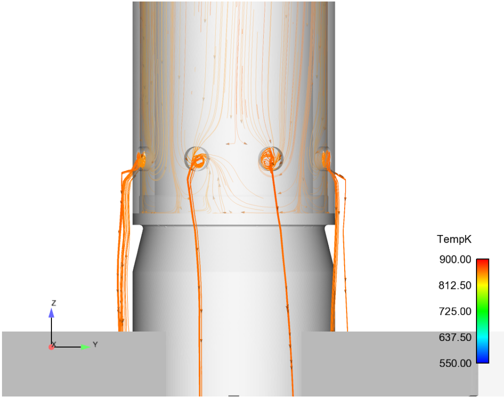

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- double coupling of *Code_Saturne* with NUMEL and SYRTHES;

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- extension of the model to other boiler configurations.

thank you