



Overview of the contributions to the JHR project from the Swedish universities

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Outline

- Introduction.
- Overview of the programme.
- Structure of the work.

Introduction

Overview of the CEA Cadarache site, France



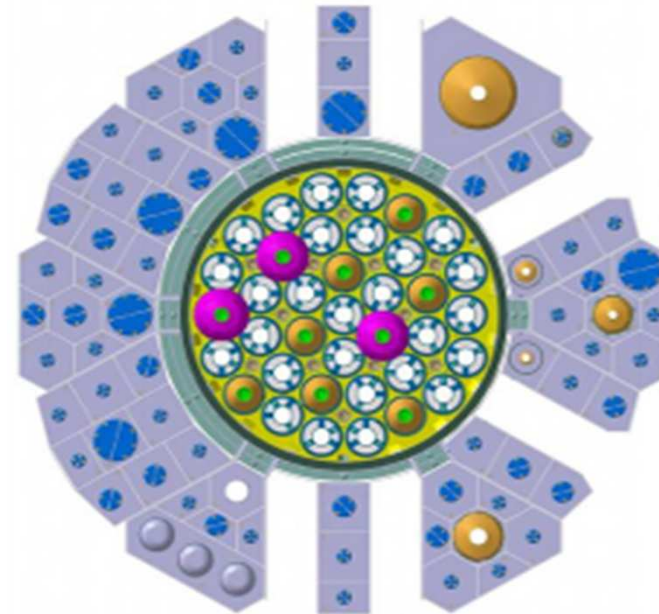
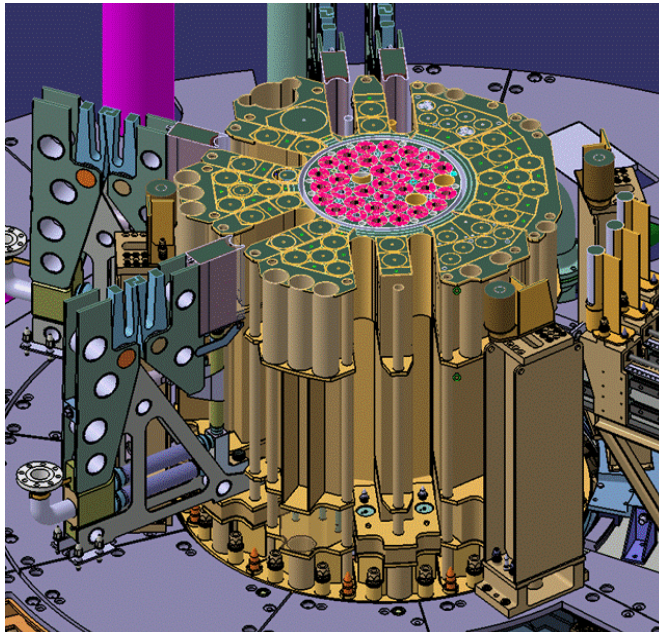
Introduction

Reactor under construction



Introduction

Unconventional MTR

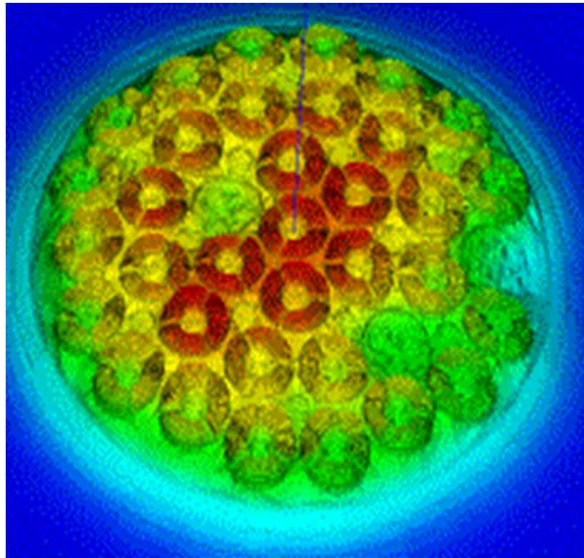


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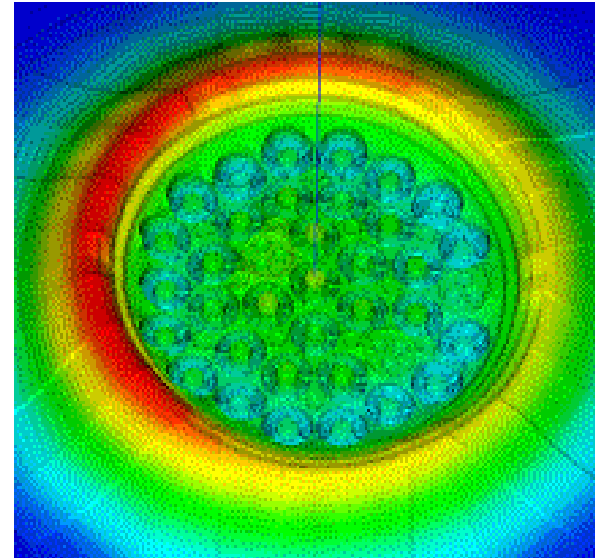
- Ca 100 MWth
- Core size of ca 60 cm
- Core flow of ca 15 m/s

Introduction

Challenging reactor modelling



Spatial distribution of the fast neutron flux (calculations)



Spatial distribution of the thermal neutron flux (calculations)

Overview of the programme

- **DEMO-JHR** = DEterministic MOdelling of the Jules Horowitz Reactor.
- **Multi-project grant** financed by the **Swedish Research Council** involving:
 - The **Division of Nuclear Engineering**, Department of Applied Physics, **Chalmers University of Technology** (also coordinator).
 - The **Division of Nuclear Reactor Technology**, Department of Physics, **The Royal Institute of Technology**.

Overview of the programme

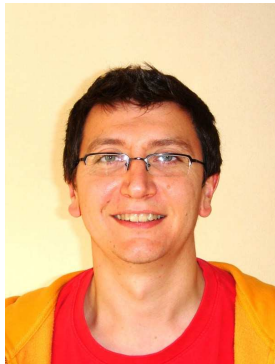
- Aimed at **further developing** and **improving** the **deterministic modeling** of the JHR:
 - Development of **new computational procedures**.
 - Evaluation of the **uncertainty of the results** (due to possible uncertainties in input parameters and models).

Overview of the programme

- **Work-packages** in form of **PhD projects**:
 - Improvement of the nuclear safety CATHARE code based on thermal-hydraulic experiments in the JHR (Chalmers).
 - Development of new procedures for thermal-hydraulic simulations of the JHR (KTH).
 - Uncertainty analysis in depletion calculations for the JHR (Chalmers).

Structure of the work

- **4-year project** running between 2012 and 2017 involving:
 - **3 senior scientists** (2 at Chalmers + 1 at KTH) at **Swedish universities**:



Prof. Christophe
Demazière
(Chalmers) – also
coordinator of
DEMO-JHR



Assist. Prof.
Paolo Vinai
(Chalmers)



Prof. Henryk
Anglart (KTH)

Structure of the work

- **4-year project** running between 2012 and 2017 involving:
 - **3 PhD students** at Swedish universities:
 - PhD student Fredrik Larsson (Chalmers).
 - PhD student Alberto Ghione (Chalmers).
 - PhD student Reijo Pegonen (KTH).
 - **4 senior scientists** at CEA, France:
 - Dr. Brigitte Noel.
 - Dr. Patricia Sireta and Dr. Claire Vaglio-Gaudard.
 - Dr. Serge Bourdon.

Structure of the work

- **MATHS-JHR: Models Accuracy of Thermal-Hydraulics**
Simulations of the JHR:
 - PhD student: **MSc. Alberto Ghione**
 - **Project goals:**
 - Test and implementation of new thermal-hydraulic correlations, based on past experiments.
 - Development of an uncertainty and sensitivity methodology, so that the effect of uncertain parameters and/or models on the code results can be better assessed.

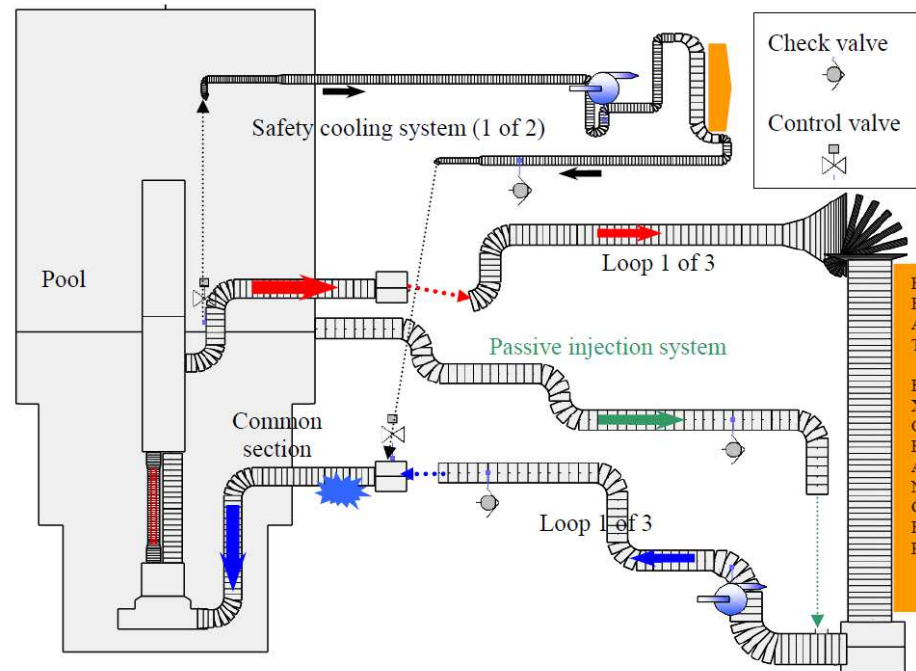


Structure of the work

- **MATHS-JHR: Models Accuracy of Thermal-Hydraulics Simulations of the JHR:**
 - **Project steps:**
 - Assessment of specific correlations available in CATHARE within the range of conditions of the JHR.
 - Investigation of possible improvements by evaluating other correlations and/or by developing new correlations.
 - Analysis of a transient scenario by making use of the CATHARE code validated in the project.
 - Uncertainty and sensitivity analysis for the simulation of the transient scenario.

Structure of the work

- **MATHS-JHR: Models Accuracy of Thermal-Hydraulics Simulations of the JHR:**



CATHARE nodalization scheme of the primary system of the JHR

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Structure of the work

- **UCODE-JHR:** Uncertainty in COre DEpletion simulations for the Jules Horowitz Reactor:
 - PhD student: **MSc. Fredrik Larsson**
 - **Project goals:**
 - Establishment of a new procedure for assessing the effect of uncertainties in depletion calculations.
 - Due to the high neutron flux considered in the JHR, the evaluation of such uncertainties is essential.



Structure of the work

- **UCODE-JHR:** Uncertainty in COre DEpletion simulations for the Jules Horowitz Reactor:
 - **Project steps:**
 - Statistical approach at the lattice code level (generation of macroscopic cross-sections).
 - Perturbation theory approach at the core depletion level.

Structure of the work

- **UCODE-JHR:** Uncertainty in COre DEpletion simulations for the Jules Horowitz Reactor:

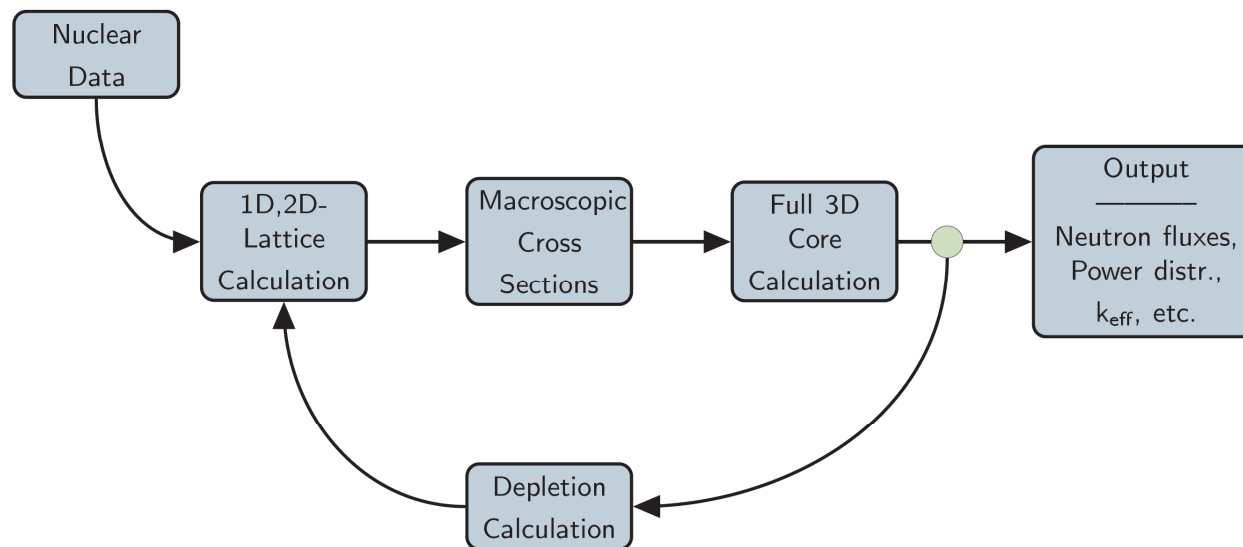


Illustration of deterministic neutronic calculations
© Fredrik Larsson, Chalmers

Structure of the work

- **DEPTHS-JHR: DEvelopment of Procedures of Thermal-Hydraulic Simulations for the JHR:**
 - PhD student: **MSc. Reijo Pegonen**
 - **Project goals:**
 - Development of a new procedure for determining the coarse distribution of the thermal-hydraulic variables in the entire facility, while obtaining detailed in-core information.

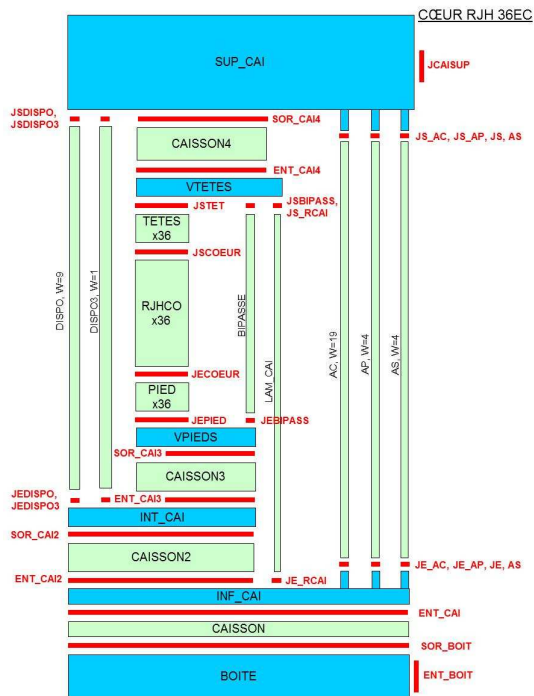


Structure of the work

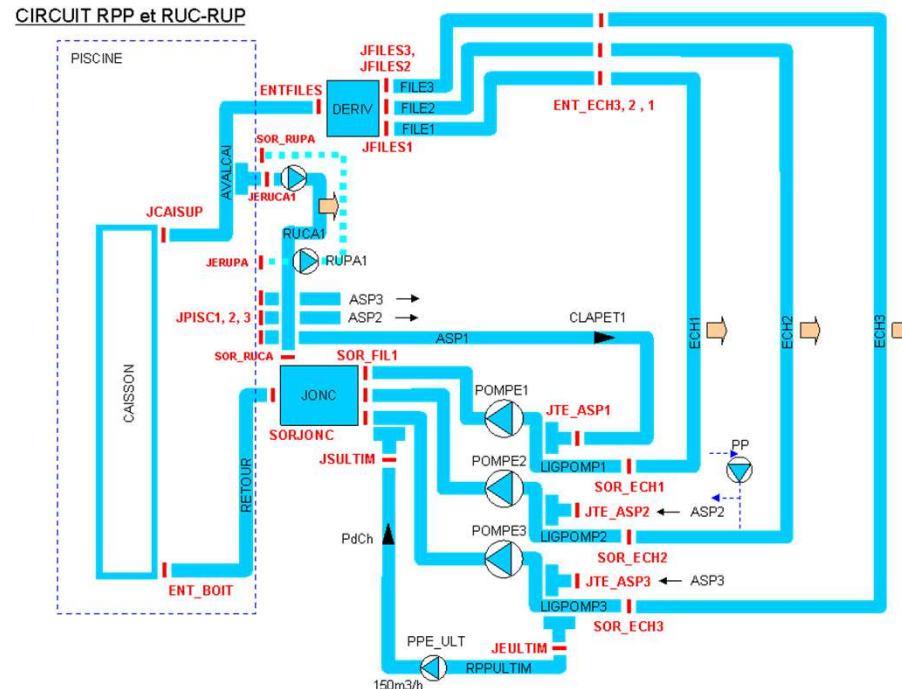
- **DEPTHS-JHR:** DEvelopment of Procedures of Thermal-Hydraulic Simulations for the JHR:
 - **Project steps:**
 - Optimization of the nodalization in the FLICA4 model.
 - Development of the improved CATHARE model of the JHR.
 - Application of the newly developed CATHARE code to transient calculations.

Structure of the work

- **DEPTHS-JHR**: DEvelopment of Procedures of Thermal-Hydraulic Simulations for the JHR:



CORE modelling (FLICA4)



Primary system modelling (CATHARE)
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Conclusions

- All PhD students will spend 1 year in Sweden, then 2.5 years in France, and finally 0.5 year in Sweden.
- 2 (out of 3) PhD students already on site in France.
- Entire project ending in 2017.
- Tight collaboration between the Swedish researchers and the French research teams.

