Code_Saturne user meeting

Wednesday –April 2nd, 2014 – EDF Lab Chatou

8:30	**Welcome – Breakfast**	
9:00	Foreword	M. Ferrand *Head of Code_Saturne project*
9:05	Invited Lecture	D. Banner *Head of simulation program*
9:20	Latest news and prospects in *Code_Saturne* from 3.0 to 3.3	Y. Fournier *EDF R&D - MFEE*
9:40	CFD activities at EDF China R&D center – focus on the support to local thermal plants	J. Min *EDF China R&D center*
10:00	CFD activities at EDF UK R&D centre	J. Uribe *EDF R&D UK centre*
10:20	**Break**	
10:50	Nuclear production optimization under severe winter conditions	C. Peyrard *EDF R&D - LNHE*
11:10	Application of the new turbo-machinery module in *Code_Saturne* to the study of a mixed flow compressor and co-visualization	S. Rolfo / B. Lorendeau *Daresbury Lab.- UK*
11:40	CFD simulations of the JULIETTE 1/5th-scale PWR model for external boron dilution studies with *Code_Saturne* V3.0	F. Lelong *EDF SEPTEN and R&D*
12:00	**Lunch**	
13:40	Three canonical flows, one geometry: Study of the turbulent flow structure in an annular space with inter-rod gapping	K. Newlands *Uni. Of Aberdeen - UK*
14:00	Lagrangian modeling of pulverized coal combustion - a post-processing approach	M. Charwath *EDF R&D - MFEE*
14:20	An overview of existing and future atmospheric simulations with *Code_Saturne*	B. Carissimo *EDF R&D- MFEE*
14:40	**Break - Poster session**	
15:30	Turbo-machinery computations with Lagrangian particle tracking: developments and validation	B. de Laage de Meux / T. Pasutto *EDF R&D - MFEE*
15:50	Recent developments in *Code_Saturne* for the simulation of lightning direct effects	L. Chemartin *ONERA*
16:10	Development and Use of *Code_Saturne* at Renuda	N. Tonello *RENUDA*
16:30	**Closure**	**F. Baron** ***Head of MFEE department***
End of the day		

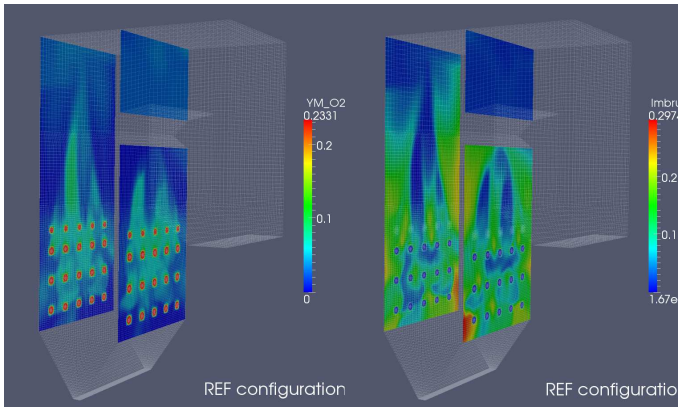
LIST OF POSTERS

A fast approach to compute atmospheric radioactive transfer in non scattering medium: Coupling emissivity functions with the Discrete Ordinates Method	L. Makke *EDF R&D - MFEE*
Aeroelastic investigation on a wind turbine airfoil by *Code_Saturne*	A. Bekhti *Centre de Développement des Energies Renouvelables*
Flow asymmetries across in-line tube banks & modelling strategies	H. Iacovides, B. Launder, D. Laurence, A.West *MaSC - University of Manchester*
Tidal channel modeling - preliminary results in turbulence	S. Tully *The University of Edinburgh*
Numerical simulation of an offshore wind farm	A. Defossez *EDF R&D - MFEE*
Validation of the Atmospheric Module of *Code_Saturne*	A. Chahine *EDF R&D - MFEE*
Modeling of particle deposition in turbulent flows with Lagrangian module of *Code_Saturne*	C. Caruyer *EDF R&D - MFEE*
Developing *Code_Saturne* for Multi-Billion Cell Mesh Simulations	C. Moulinec, Y. Fournier, J. Uribe, P. Vezolle, D. Emerson *Daresbury Lab. - UK*

CFD activities at EDF China R&D center – focus on the support to local thermal plants

J. Min - *EDF China R&D center*

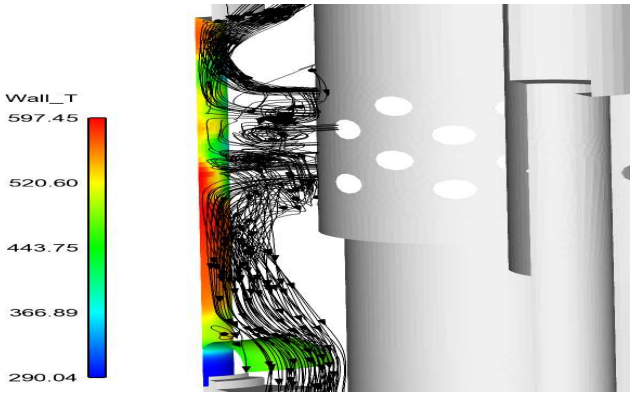
This presentation aims at giving a general idea about CFD activities with *Code_Saturne* conducted during the past 1.5 years at EDF China R&D center in different application fields. First, a brief presentation of EDF China R&D center will be given. This will be followed by a summary of CFD activities in which EDF China R&D center is involved, in the domain of Nuclear power plant, Thermal power plant and Concentrated Solar Power plant, with a close link to MFEE department. Then a special focus will be made on the technical supports to thermal power plants of EDF assets in China: three studies were performed for Laibin B power plant on combustion optimization with anthracite coal as well as on the assessment of high temperature corrosion risk, and for SMX 600MW super-critical power plant on boiler performance evaluation. Moreover, another study for Liaocheng W-flame type boiler on NOx reduction via in-furnace combustion is ongoing. These studies allow not only a R&D support to EDF assets in China, but also new applications of *Code_Saturne* on new boiler types of thermal plants.



CFD activities at EDF UK R&D centre

J. Uribe - *EDF R&D UK centre*

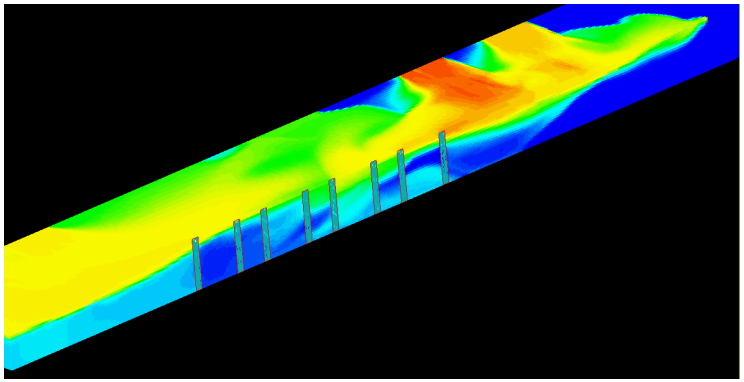
The presentation will show the CFD activities at the R&D UK Centre. The projects that the centre is involved in deal with gas flows in the Advanced Gas-cooled Reactors (AGRs) that are specific to the UK. They are part of the Plant Lifetime Extension program of EDF Energy which aims to extend the life of the reactors on average by 9 years. The work carried out in the past year involves different part of the gas path from the core to the boilers and steam penetrations.



Nuclear production optimization under severe winter conditions

C. Peyrard - *EDF R&D - LNHE*

In this presentation, the disponibility of a seaside nuclear power plant under severe winter conditions is studied.
When the sea water temperature becomes low (around 0°C), a risk of frazil ice formation on the grids before the nuclear power plant pumps occurs.
The consequence is that the production has to be stopped. In order to optimize the disponibility of the NPP, different systems can be used.
Among those systems, the so-called "batardeaux" system consists in lowering trap doors above the channel to inject hot water. The goal of the presented study was to use *Code_Saturne* to quantify the temperature elevation near the pumps due to "batardeaux" activation.



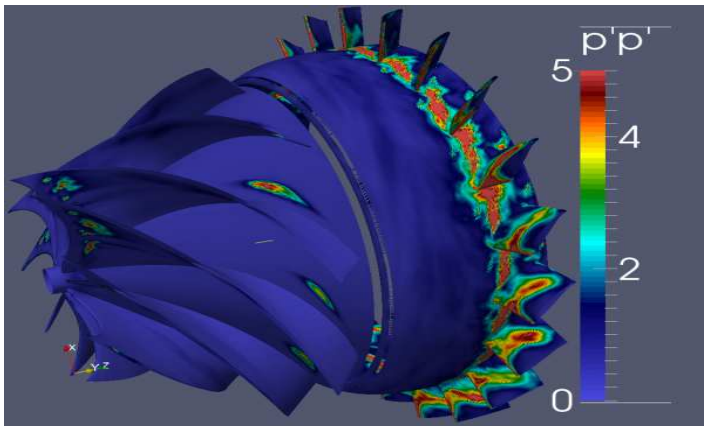
Application of the new turbo-machinery module in *Code_Saturne* to the study of a mixed flow compressor and co-visualization

S. Rolfo / B. Lorendeau - *Daresbury Lab.- UK*

In this work the new turbo-machinery module in *Code_Saturne* has been applied to the study of the flow inside a 9 blades mixed flow compressor, which is the core of the Dyson bladeless desk fan.

A validation of the of the turbo machinery module has also been performed using a simplified geometry, which consist of a pipe where a selected section is rotating around the central axis.

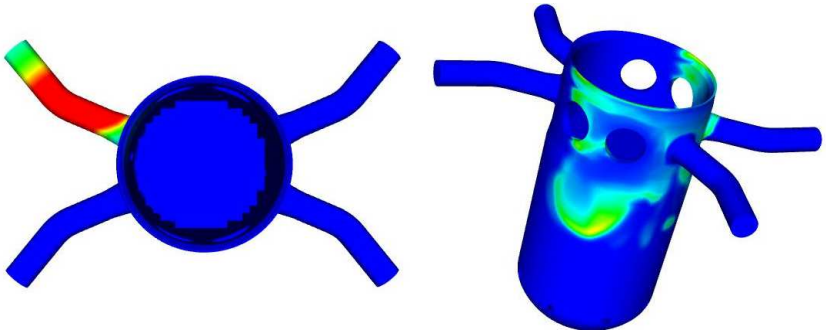
A comparison with the alternative code-code coupling will be also presented.



CFD simulations of the JULIETTE 1/5th-scale PWR model for external boron dilution studies with *Code_Saturne* V3.0

F. Lelong - *EDF SEPTEN and R&D*

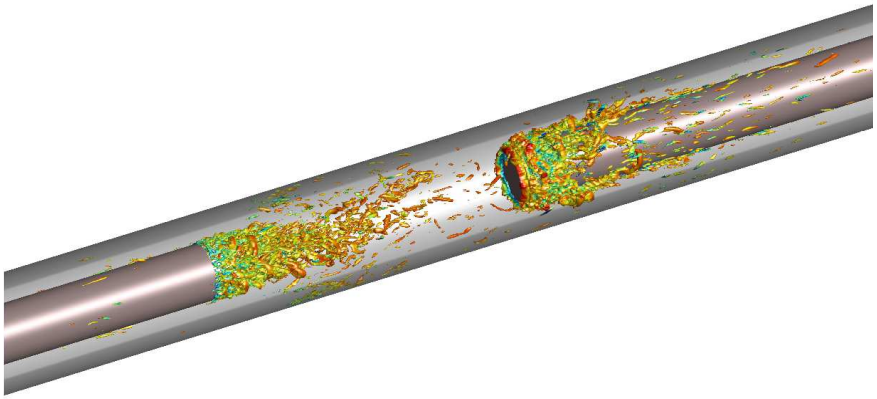
The subject of this presentation is *CFD* simulations of the *JULIETTE 1/5th*-scale *PWR* model for external boron dilution tests. These simulations allow the integral validation of *Code_Saturne* V3.0 with respect to the minimal value and to the boron concentration distribution in core inlet. Their sensitivity to turbulent models and to turbulent heat flux models is examined. Predicted transient boron distribution and its minimum concentration at the core inlet are close to the measured data.



Three canonical flows, one geometry: Study of the turbulent flow structure in an annular space with inter-rod gapping

K. Newlands - *University Of Aberdeen - UK*

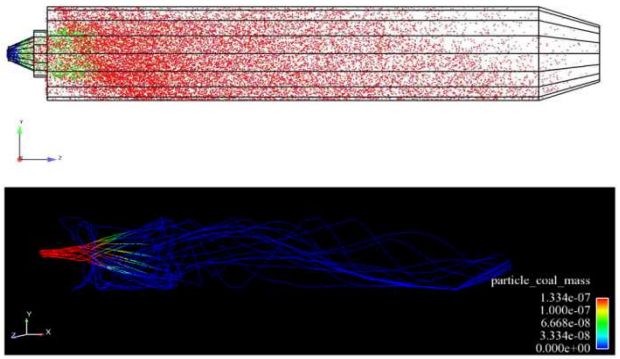
Component failures due to excessive flow-induced vibration in reactor cores have been observed in water and gas cooled reactors alike. The vortex shedding generated at the end of the fuel rods and its impingement onto the downstream rods is investigated as a potential source of vibration in the context of the unique AGR design. The calculations are performed using wall-resolved LES and the effects of the gap length between the rods as well as the misalignment of the downstream rod on the flow dynamics are also explored.



Lagrangian modeling of pulverized coal combustion - a post-processing approach

M. Charwath - *EDF R&D - MFEE*

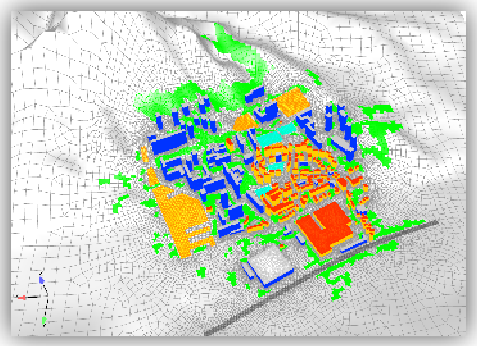
The co-combustion technology, i.e. the simultaneous combustion of two different types of fuel, is gaining popularity as an effective measure to reduce the emission of anthropogenic formed CO_2. However, depending on the fuels burned, co-combustion might lead to a decrease of the thermal efficiency (slagging of fuel particles) as well as severe material damages of the combustion system. In order to avoid these negative aspects a detailed knowledge of the processes occurring during co-combustion is indispensable. In this context, the co-combustion process (pulverized coal and biomass) has been simulated in a cylindrical shaped combustion chamber using a recently developed Eulerian-Lagrangian approach which accounts for thermal gradients inside large fuel particles. The obtained results give a detailed insight into the combustion process which can be used to improve its efficiency, whereas, an improved efficiency might yield to less severe material damages.



An overview of existing and future atmospheric simulations with *Code_Saturne*

B. Carissimo - *EDF R&D- MFEE*

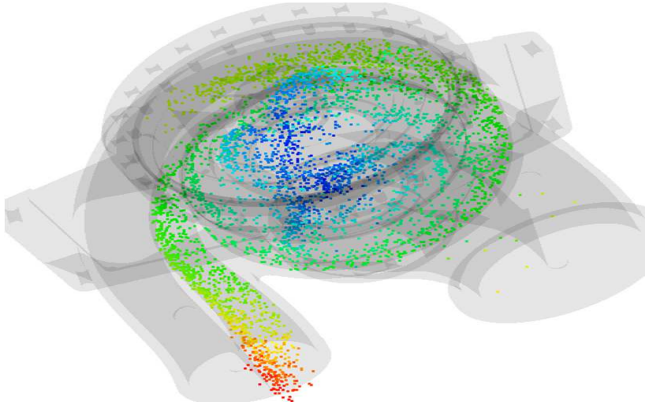
In this presentation, we first describe the existing specific features of *Code_Saturne* for the simulation of atmospheric flows. In particular we describe the special thermodynamical variable used to take into account pressure effects within the incompressible approximation and the possibility to take into account large scale wind direction changes at the lateral boundaries of the domain. A short description of the modifications of the turbulence model is also discussed. Finally we illustrate some future features presently under development.



Turbo-machinery computations with Lagrangian particle tracking: developments and validation

B. de Laage de Meux / T. Pasutto - *EDF R&D - MFEE*

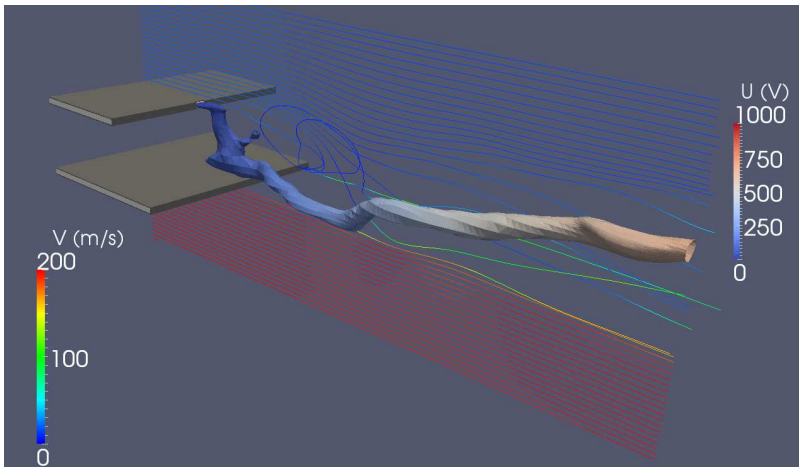
In order to deal with complex studies on emergency core cooling systems of PWR, *Code_Saturne* has recently been upgraded, allowing Lagrangian particle tracking in unsteady turbo-machinery computations. The presentation gives an overview of the methods and guidelines to use them. Several validation cases, of variable complexity, are presented. The future prospects of the code capabilities related to hydraulic machinery are also briefly examined.



Recent developments in *Code_Saturne* for the simulation of lightning direct effects

L. Chemartin - *ONERA*

ONERA have developed in *Code_Saturne* some specific features to simulate the interaction of lightning arcs with aeronautic materials. The dynamic of the arc and the thermal-electrical flux transferred to the material have been simulated thanks to the improvement of the gradient reconstructions in the case of heterogeneous media. The contact resistances between two different media have been also modeled to simulate the temperature or voltage drop in joints. Moreover, the radiative transfer module has been adapted for the thermal plasmas. Radioactive transfers are considered with several spectral bands and different geometric approaches (P1, DOM, SP3), which allows accurate calculation of the absorption in the plasma and radioactive flux on the material.



Development and Use of *Code_Saturne* at Renuda

N. Tonello - *RENUDA*

CFD specialists Renuda will present an overview of their activities using *Code_Saturne* encompassing both development and applications through a series of snapshots of research and industrial projects. The presentation will cover examples of both high-level *Code_Saturne* development using user-coding and in-depth development at kernel level for multiphase flow simulations. Examples of applications of *Code_Saturne* for modeling challenging flow physics and systems often encountered in industrial scenarios will also be presented.