ICAPP 2015
Nuclear Innovations for a Low-Carbon Future
May 3-6, 2015 - Nice - France

The ICAPP Congress is a unique platform for experts from all over the world to share about the latest innovations in nuclear energy for safety, environment, reliability and efficiency.

With more than 500 presentations and more than 40 nationalities, the ICAPP 2015 congress is a major opportunity for the international nuclear community to leverage its knowledge and know-how. For the 2015 edition (3rd time in Nice), two new workshops addressing today’s and tomorrow’s challenges of nuclear energy will enrich the traditional ICAPP program:

▷ Nuclear Power & Climate change: as a low-carbon energy, nuclear is a part of the solution to protect clean air and healthy communities. ICAPP 2015 is the opportunity to demonstrate the vital importance of nuclear to fight efficiently climate change.
▷ New & Rising Nuclear Countries: the increase of installed capacities in China, India, Korea, Russia and newcomers raises the question of conditions for success.

ICAPP 2015 will take place in Nice (French Riviera) from 3 to 6 May 2015.

ICAPP 2015 Overview: Plenaries and Panel Sessions - April 30
ICAPP 2015 Congress Floor Plan
Round Table: Technical and economic issues of long-term operation of NPPs
NITROGEN HOLD UP ESTIMATION IN MERCURY-NITROGEN LOOP BY ENHANCED VERSION OF FLUENT AND LIMITED VIEW TOMOGRAPHY ALGORITHM

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Abstract – This work focuses on the comparison of ANSYS Fluent versus Computerized Tomographic (CT) results for two component two phase flow system. Similar work has been reported earlier but with significant mismatch between results by Fluent 6.0 and CT algorithm (MART). The motivation of this work is to employ enhanced and better version of CT algorithm (smeared-MaxenT) as well as most updated ANSYS Fluent 14.0\textsuperscript{®} software with proper modeling. Three-dimensional simulation of two phase flow has been done by using software platform of ANSYS Fluent 14.0\textsuperscript{®}. The flow regimes considered in this work vary from churn-turbulent to bubbly flow. The changes in bubble diameter due to pressure are also considered. Improved and reliable estimation were reported using accurate CT algorithm and chord average projection data. Normalized logarithmic intensity ratio or a count per second (the beer-Lambert law) is used as a projection data. It has been observed that CT results are in agreement with the Euler-Euler model when nitrogen hold-ups more than 10 percent. Mixture model shows negligible mismatch with CT result for low (less than 10 percent) nitrogen hold up. There is a mismatch in the nitrogen distribution near the wall using Euler-Euler model.

I. INTRODUCTION

Multiphase systems are encountered widely in many industrial applications, e.g. nuclear reactors (BWR, PWR etc), chemical reactors (bubble column reactor) etc [1, 2]. Bubble columns are inexpensive reactors and easy to operate. One such set-up was developed at Bhabha Atomic Research Centre (Mumbai, India) and some results have already been reported by Saksena et al. [3]. It consists liquid metal magneto hydrodynamic (LMMHD) loop that incorporated two-phase flow of mercury and nitrogen in the riser leg of the flow loop. The flow regimes considered in this work vary from churn-turbulent to bubbly flow [3, 13]. Void fraction distribution is necessary to design such system. Experiments were performed to measure this parameter, non-invasively (gamma-ray tomography) in the riser leg of the loop. This distribution was at 1.1 m height of the riser leg and it was also determined numerically by commercially available CFD code ANSYS Fluent6.1\textsuperscript{®}. It was found that void fraction predictions by two approaches were different for higher flow rates. This work included the enhanced and better version of CT algorithm (spatially filtered-MaxenT) as well as most updated ANSYS Fluent 14.0\textsuperscript{®} software with proper modeling. These simulation results now are much closer to the experimental results as compared to the earlier work [1].

II. EXPERIMENTAL DETAILS

Schematic of the experimental set-up is shown in Fig. 1(a) and computational domain in Fig. 1(b). Nitrogen gas was injected at the bottom to circulate mercury through the entire loop. Mercury (liquid metal) passes through the strong poles of magnet (attached to the downcomer of the set-up) and produces the power [1,2 and 3]. The simulation has been done for the riser leg (length 1.9m and internal diameter 78mm) of the loop. Three different flow rates of nitrogen 20, 40 and 60 liter/min (2.39×10\textsuperscript{-3}, 4.48×10\textsuperscript{-3} and 6.94×10\textsuperscript{-3} kg/s) were considered. The corresponding mercury flow rates were 20.5, 25.5 and 27.5 kg/s.
Operating pressure was 5.69 bars. We refer to earlier published works [3, 14] for more details about experimental setup and data collection geometry. Void fraction and its distribution has been determined at a height of 1.1m from the inlet.

III. COMPUTATIONAL DETAILS

Schematic of the experimental set-up is shown in Fig. 1(a) and computational domain in Fig. 1(b).

Commercially available software ANSYS Fluent 14.0® has been used for the 3D simulation in unsteady Euler-Euler framework. Parallel processing on Intel(R) core(TM) i7-2600K CPU @ 3.40 GHz has been used to perform the simulations. Usually 6-8 processors have been used.

Lapin and Lubbert [4] proposed Euler-Euler and Euler-Lagrange models to predict the multiphase flow structure in bubble columns. Euler-Lagrange model is suitable for low discrete phase volume fraction (less than 10%) cases and Euler-Euler model is suitable for high discrete phase volume fraction cases [6,7]. Euler-Euler model has been used in the present work due to high discrete phase volume fraction. A single pressure is shared by all the phases in this model. Momentum and continuity equations [6] are solved for each phase.

$k$-$\varepsilon$ turbulence model has been used in the present work. ANSYS Fluent 14.0® has three options for $k$-$\varepsilon$ turbulence model: mixture turbulence model, dispersed turbulence model and turbulence model for each phase. $k$-$\varepsilon$ mixture turbulence model is applicable when the density ratio between the phases is close to 1 [6]. This model is not applicable in the present work because this model is an appropriate model when the turbulence transfer among the phases plays a dominant role.

$k$-$\varepsilon$ turbulence model for each phase accounts for the effect of the turbulence field of one phase on the other. This is done by modeling of turbulent drag term in momentum equations. Drift velocity (results from turbulent fluctuations in the volume fraction) when multiplied by exchange coefficient, it serves as a correction to the momentum exchange term for turbulent flows [6].

To take into account the effect of pressure on the bubble diameter following formula [4] is implemented through User Defined Function (UDF) in ANSYS Fluent 14.0®

\[
d = d_{\text{ref}} \left( \frac{P_{\text{ref}}}{P} \right)^{1/3}
\]

where $d_{\text{ref}}$ is the bubble diameter at the reference pressure $P_{\text{ref}}$.

Three-dimensional geometry of the upcomer was created using the grid generation tool Gambit2.4. The domain is meshed with unstructured grid, and the volume elements are of hexahedral shape to minimize skewness [8], by cooper algorithm. A wall type of boundary condition has been used for the pipe wall. Mass flow inlet type of boundary condition has been used to specify the flow rate at the inlet. Pressure outlet type of boundary condition has been used to specify the flow at the outlet. Typical grid used in the present work is shown in Fig. 2.

Pressure-velocity coupling has been done by the scheme coupled [6]. Quadratic Upwind Interpolation for Convective Kinetics (QUICK) is used to spatially discretize the volume fraction. 2nd order upwind scheme is used to spatially discretize the other physical quantities (momentum, $k$, $\varepsilon$). Transient formulation has also been
done by 2nd order upwind scheme and symmetric drag law [6] is used.

Grid independent study has been done [9]. It has been found that a grid with grid size of 0.007 m (33201 volume elements) is suitable for the problem under study.

IV. COMPUTERIZED TOMOGRAPHIC (CT) DETAILS

Seven gamma ray detectors (NaI(Tl)) were used to create an arc shaped array. Source to object center distance was equal to 184 cm, pipe diameter was equal to 78 mm. This arrangement projects a 22° fan angle from source to detector array. Measurements were possible for 9 views only due to the surrounding space restrictions. This algorithm is already validated for a known data [10]. Same algorithm is used here for mercury-nitrogen flow.

Method of moving asymptotes is used to maximize the entropy function [11]. Algorithm, combination of PI grid with entropy maximization with smearing imbedded (PI + sMaxent) converges after 40 iterations [11]. This is expected to support the algorithm for more realistic handling of mercury- nitrogen projection data during the reconstructions process. Smearing window R = 5.382 is used. Mercury phase fraction is found equal to 90 % and maximum attenuation coefficient in the reconstruction is 0.0279 mm$^{-1}$. The loss in the recovery (1/0.9) is utilized as a normalization factor for other cases [10].

V. RESULTS AND DISCUSSION

Phase fraction distribution throughout the column has been simulated by using ANSYS Fluent 14.0®. Nitrogen phase fraction distribution at a cross-sectional plane of the bubble column at a height of 1.1 m from the inlet has been presented. Contour plots of nitrogen phase fraction distribution for all the three cases (20 LPM, 40 LPM and 60 LPM) are shown in the Fig. 3. Red colour shows the maximum value and blue colour shows minimum value of the nitrogen phase fraction.

The results analyzed by the computerized tomography (CT) for the similar conditions are also presented in Fig. 4. Contour plots of mercury and nitrogen phase fractions for all the three cases (20 LPM, 40 LPM and 60 LPM) are shown in Fig. 4(a) and Fig. 4(b) respectively.

It is clear from Fig. 3 and Fig. 4(b) that the nitrogen phase fraction is higher in the off centre region. There is a mismatch between the results by the two techniques in the near wall region. Computerized Tomographic results shows the highest nitrogen phase fraction near the wall while the simulation results by ANSYS Fluent 14.0® shows the peak of nitrogen phase fraction in the annular region. The reasons for this mismatch may be the following:
1. Standard wall function k-ε turbulence model has been used in the present work. The wall functions also affects the flow behavior.
2. In simulations we have assumed that the nitrogen is homogeneously distributed at the inlet. But in actual experimental setup the nitrogen is inhomogeneously distributed at the inlet.

![Fig. 3. Contour plots of nitrogen phase fraction for nitrogen flow rates (A) 20 LPM, (B) 40 LPM, (C) 60 LPM](image-url)

![Fig. 4. Reconstruction of Nitrogen-Mercury Flow (a) Mercury Phase Fraction, (b) Nitrogen Phase Fraction](image-url)
suitable for the low phase (less than 10 %) fraction (of the secondary phase) case [6]. Euler-Lagrange model is suitable for such a case (area average of the secondary phase less than 10 %) but it is computationally expansive [6,12].

<table>
<thead>
<tr>
<th>Flow rate (LPM)</th>
<th>AA of $N_2$ (Fluent14.0)</th>
<th>AA of $N_2$ (CT)</th>
<th>% mismatch</th>
</tr>
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<tbody>
<tr>
<td>20</td>
<td>0.081</td>
<td>0.108</td>
<td>25.0</td>
</tr>
<tr>
<td>40</td>
<td>0.138</td>
<td>0.129</td>
<td>7.0</td>
</tr>
<tr>
<td>60</td>
<td>0.189</td>
<td>0.176</td>
<td>7.4</td>
</tr>
</tbody>
</table>

TABLE I
Nitrogen area average comparison table

Simulated results of radial distribution of velocity magnitude of mercury (Hg) and nitrogen ($N_2$) at different flow rates at a height of 1.1 m from the inlet are shown in Fig. 5. Comparison of these results with the experimental results is not presented here due to the unavailability of the corresponding experimental results. Velocity magnitude is maximum at the centre and it is zero near the wall (no slip wall). Magnitude of the velocity increases with the increase of the flow rates. Velocity of nitrogen is always greater than the velocity of mercury.

Fig. 5. Radial distribution of velocity magnitudes of mercury (Hg) and nitrogen ($N_2$) at a height of 1.1 m from the inlet for different flow rates of nitrogen

VI. CONCLUSIONS

Following are the major findings:

1. There is a distinct relationship between computerized tomography (measurement technique) and numerical simulation (simulation) techniques. Correlation can be obtained within acceptable limits of accuracy for real time applications provided if accurate modeling is considered.

2. Grid parameters (number of nodes and location of nodes) play a significant role in outcomes. Similar grid parameters are recommended for simulation as well as for computerized tomography analysis. It is expected that this factor will further alleviate the mismatch between two approaches.

3. Measurement results from computerized tomography provide profile distribution as well as the parameters values (void fraction here). However, in practical situations its employments are not possible every time. Numerical simulation tools (FLUENT) may be an alternative for these situations.

NOMENCLATURE

d$_{ref}$ : bubble diameter at reference pressure m
LPM : liter per minute
P$_{ref}$ : reference pressure, N/m$^2$
CT : computerized tomography
AA : area average or phase fraction

REFERENCES


7. M.A. Behbahani, M. Edrisi, F. Rashidi, E. Amani, “Tuning a multi-fluid model for gas lift simulations in


PERIOD 1 3:30pm >> 5:10pm

**TRACK 6. Reactor Physics and Analytics**

3:30pm 1E16 - Jeff E. Lilley-Vaidya - Impact of the New Law on Fuel for New Nuclear Power Plants

Room 12

Session Chair: Yvonne panda, CEA, France

**TRACK 7. Thermal Hydraulics Analysis and Testing**

3:50pm 1E17 - Colley, G. Lehaut, N. Marie (LPC Caen, ENSICAEN, CNRS-IN2P3, Université de Paris-Sud), F. -R. Le-A. Kochetkov, A. Krasa, P. Baeten (SCK/CEN), G. and Near-Critical Fast Neutron Reactors,

Room 13

Session Chair: Fredrik Dalén, CEA, France

3:50pm 1E18 - The Application of Finet in the Propagation of Uncertainties as Applied to the IAEA MTR-10 MW Steady State Reactor Core Model, V. M. Streb, K. A. Motzkuy, F. G. Rousseau (North-West University)

Room 13

Session Chair: Freida Nielsen, CEA, France

4:00pm 1E19 - Advanced Modeling of LWR Containment and Systems Analysis, A. A. Gómez Torres, F. Puente Espel (ININ), A.M. Gómez Torres, F. Puente Espel (ININ)

Room 14

Session Chair: Katsuyuki Takezane, Japan Atomic Energy Agency, Japan

**TRACK 8. Fuel Cycle and Waste Management**


Room 3

Session Chairs: Roald Wigeland, Idaho National Laboratory, USA, Sun V. Sadasiva, Japan Atomic Energy Agency, Japan

3:30pm 1E18 - Decontamination and Sterilization of T echnology Bombay

Room 3

Session Chairs: Francisco Troobel, CEA, France, Fanny Balbédien, CEA, France

4:00pm 1E19 - A Futuristic View of Nuclear Science and Technology, Yong Hun Jung, Yong Hoon Jeong, Jeong Suk Suh (KAIST)

Room 3

Session Chair: Gustavo Aires, Madrid Polytechnic University, Spain

**TRACK 9. Materials and Structural Analysis**

3:30pm 1E17 - The Latest Achievements of the EUR Organization (European Utility Requirements For the Nuclear Power Industry), Y. V. Dukhovnaya, Y. Ania (EDF), Antoine Guelfi (EDF), Johan Engström (Vattenfall)

Room 1

Session Chair: Jukka Laaksonen, Rusatom Overseas, Finland

3:30pm 1E18 - Recent Achievements of the EUR Or- ganization (European Utility Requirements For the Nuclear Power Industry), J. V. Lavacolom, E. C. Kaufer (WNA)

Room 1

Session Chair: Augustin Alonso, Madrid Polytechnic University, Spain


Room 1

Session Chair: Barry Stoker, F. H. Kaufer (WNA)

**TRACK 10. Nuclear Energy and Climate Change Mitigation**

3:30pm 1E17 - Transmutation of Actinides in a Supernova, C. Schäfer, A. Baig (CEA, Cadarache), O. Cooper, J. Poussard, K. Scardos, A. Tominaga, L. Zanini, K. Sato (Japan Atomic Energy Agency)

Room 5

Session Chair: Anja Halsemann, Rosatom Overseas, Finland

3:30pm 1E18 - Waste Management, E. W. Stichling (Idaho National Laboratory)

Room 5

Session Chair: Jürgen Krämer (IAEA-Nuclear Energy Agency)

4:00pm 1E19 - Advanced Design of Nuclear Plants for Nuclear Applications, P. W. Stoker, F. H. Kaufer (WNA)

Room 5

Session Chair: Roland Blunden (IAEA-Nuclear Energy Agency)

**TRACK 12. Plant Licensing and International Regulatory Issues**

3:30pm 1E17 - Safety Aspects of Nuclear Power Plants in the Context of the Fukushima Accident, Y. Saito, K. Nagai (Japan Atomic Energy Agency)

Room 5

Session Chair: Y. Saito, K. Nagai (Japan Atomic Energy Agency)

3:30pm 1E18 - The Experience of the Russian and Chinese Nuclear Industry in the Context of the Fukushima Accident, Y. Saito, K. Nagai (Japan Atomic Energy Agency)

Room 5

Session Chair: Y. Saito, K. Nagai (Japan Atomic Energy Agency)

4:00pm 1E19 - International / Regulatory Organizations, Yong Hun Jung, Yong Hoon Jeong, Jeong Suk Suh (KAIST)

Room 5

Session Chair: Gustavo Aires, Madrid Polytechnic University, Spain

4:00pm 1E19 - Regional Achievements of the EUR Organization (European Utility Requirements For the Nuclear Power Industry), J. V. Lavacolom, E. C. Kaufer (WNA)

Room 5

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**TRACK 11. International Organizations**

3:30pm 1E17 - The Latest Achievements of the EUR Organization (European Utility Requirements For the Nuclear Power Industry), Y. V. Dukhovnaya, Y. Ania (EDF), Antoine Guelfi (EDF), Johan Engström (Vattenfall)

Room 2

Session Chair: Jukka Laaksonen, Rusatom Overseas, Finland

3:30pm 1E18 - Recent Achievements of the EUR Or- ganization (European Utility Requirements For the Nuclear Power Industry), J. V. Lavacolom, E. C. Kaufer (WNA)

Room 2

Session Chair: Augustin Alonso, Madrid Polytechnic University, Spain


Room 2

Session Chair: Barry Stoker, F. H. Kaufer (WNA)

5:00pm 1E19 - Advanced Design of Nuclear Plants for Nuclear Applications, P. W. Stoker, F. H. Kaufer (WNA)

Room 2

Session Chair: Roland Blunden (IAEA-Nuclear Energy Agency)
**TUESDAY, MAY 5**

**TECHNICAL SESSIONS**

**PERIOD 2** 8:00am -> 10:00am

**SESSION 1. Reactor Physics and Reactor Analysis**

- **Room 12**
  - Analysis of Vibration-induced Neutron Noise using Chosen-dimension Noise Diffusion Theory, Amelie Reaction (CEA, France)

- **Room 13**
  - Reactivity Analysis of Nuclear Reactors using Artificial Neural Networks, Laboratory of Artificial Intelligence and Control (INER, France)

- **Room 14**
  - Experimental Investigation of Core Dynamics in Light Water Reactors, S. K. Yoon, J. Kim, G. Kong, K. Kang, H. Kim, K. Seo, G. Kim (Korean Atomic Energy Research Institute)

**SESSION 2. Reactor Hydraulics Analysis and Testing**

- **Room 15**
  - Numerical Simulation of Flow in a PWR Primary Loop, J. Kim, K. Lee, J. Park (Korea Hydro & Nuclear Power Co., Ltd.)

- **Room 16**
  - Reliability of Advanced Reactor Systems, S. Han, J. Park, J. Lee, D. Park (Korea Atomic Energy Research Institute)

- **Room 17**
  - Advanced Reactor Concepts for Small Modular Reactor in Nuclear Power Plants, J. Lee, J. Kim, M. Seo, K. Kim, B. Kim, J. Park (Korea Hydro & Nuclear Power Co., Ltd.)

**SESSION 3. Reactor Cycle and Power Management**

- **Room 18**

- **Room 19**
  - Fuel Cycle Strategies for Small Modular Reactor, S. Han, J. Park, J. Lee, D. Park (Korea Atomic Energy Research Institute)

- **Room 20**
  - Advanced Reactor Concepts for Small Modular Reactor in Nuclear Power Plants, J. Lee, J. Kim, M. Seo, K. Kim, B. Kim, J. Park (Korea Hydro & Nuclear Power Co., Ltd.)

**SESSION 4. Materials and Structural Issues**

- **Room 21**
  - Advanced Reactor Concepts for Small Modular Reactor in Nuclear Power Plants, J. Lee, J. Kim, M. Seo, K. Kim, B. Kim, J. Park (Korea Hydro & Nuclear Power Co., Ltd.)
**TUESDAY, MAY 5**

**PERIOD 3**
3:00pm >> 4:40pm

**TECHNICAL SESSIONS**

**TRACK 1. Water-Cooled Reactor Programs and Issues**

- **Room 15**
  Session Chair: Jean-Philippe Fromenty, AREVA, France
  Session Chair: Frieder Rehbein, IAEA, Austria; James W. Sterbentz, WSU, USA

**3:00pm**
- I-04 Stakeholders’ Assessment

**3:20pm**
- Session 15: Design of the EU-supported ELAPRIV, Christian Boudet, Stephan Schubert, Christian Blum, Christian Blum, Institute of Heavy Industries (IHI)

**TRACK 2. High Temperature Reactors**

- **Room 16**
  Session Chair: Daniel Blanc, IRSN, France

**3:05pm**
- I-03 Sodium-cooled Fast Reactor Safety

**3:20pm**
- I-06 Fast Reactor Safety

**3:35pm**
- I-07 Sodium-cooled Fast Reactor Safety

**TRACK 3. Fast Neutron and Innovative Reactors**

- **Room 17**
  Session Chair: Hiroshi Ohara, Japan Atomic Energy Agency, Japan

**3:05pm**
- I-08 Fast Reactor Safety

**3:20pm**
- I-10 Fuel-sodium Interaction Modelling

**3:35pm**
- I-11 Fuel-sodium Interaction Modelling

**TRACK 4. Operation, Performance and Reliability Management**

- **Room 18**
  Session Chair: Hidemasa Gozai, GE, Canada

**3:05pm**
- I-12 Sodium-cooled Fast Reactor Safety

**3:20pm**
- I-14 Protection and Reliability Management

**3:35pm**
- I-16 Plant Safety Assessment and Regulatory Issues

**3:50pm**
- I-17 Fuel-sodium Interaction Modelling

**TRACK 5. Plant Safety Assessment and Regulatory Issues**

- **Room 19**
  Session Chair: Domenico Paladino, PSI, Switzerland

**3:05pm**
- I-13 Sodium-cooled Fast Reactor Safety

**3:20pm**
- I-15 Experiments on the Assessment and Monitoring of a Gas Mixture under the Conditions of a Severe Accident with the Use of Interactive Processes of the EUCROMA Project

**3:35pm**
- I-18 Hydrogen

**3:50pm**
- I-19 Core Confinement

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**4:40pm**

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Wednesday, May 6

Period 4: 8:00am - 10:00am

Technical Sessions

Track 1: Water-Cooled Reactor Programs and Issues

Room 15

- 8:00am - 9:00am: Sensitivity Study of the Crossflow Loss Coefficient in the Very High Temperature Reactor Core, Sung Ho Lee, Seok Tae Kim, Heon Jae Kim (KAERI)
- 9:00am - 10:00am: Achieving Sub-Cooled Reactor Goals: Economics, Variability, No Major Fuel Failures, Charles Fields (Massachusetts Institute of Technology)

Track 2: High Temperature Reactors

Room 16

- 8:00am - 9:00am: A Methodology for the Characterization of Heat Transfer in the Near-wall Region of a Packed Bed Reactor, P.C. Rosenau, C.G. Tadie, D.D. da Beir (North-West University)
- 9:00am - 10:00am: The Effects of Variations of UO2 Fuel, Flibe and Graphite Moderator Composition and Proportion on a Small Fluidized Sub-critical Reactor, Hans-Joerg Mabey, Geir G. Park, Eugene Shavgulidze (University of Cambridge)

Track 3: Fast Neutron and Other Innovative Reactors

Room 9

- 8:00am - 9:00am: Evaluation of the Behaviors of the SFRs and DFT+V Core during an LOF with SIBS: II-B, S. Pommereau (EDF), D. Plan (Ecole des Mines de Paris), A. Baczka (CEA)
- 9:00am - 10:00am: Improved Modelling of Sodium-Spray Fires and Sodium-Combustion Aided Chemical Evolution, Embraan Mothe, C. Dieter (University of Technology, Australia)

Track 4: Plant Safety Assessment and Reliability/Management

Room 10

- 8:00am - 9:00am: Neutronic Analysis of a Small BPR in View of Burn-up Dependent Heating, Dori Hinders, Yinghong Kim (Department of Nuclear & Quantum Engineering, KAIST)
- 9:00am - 10:00am: A System CFD Model of the Heat Exchanger (SGHE) Development for the Near-wall Region of a Packed Bed Reactor, E. Mathe, G. Habel, H. Siegert, C. Batenier (CEA)

Track 5: Plant Safety Assessment and Reliability/Management

Room 11

- 8:00am - 9:00am: High Temperature Reactors
- 9:00am - 10:00am: Fast Neutron and Other Innovative Reactors
Wednesday, May 6

**Period 4**
8:00am >> 10:00am

**Track 5**
Plant Safety Assessment and Regulatory Issues

- Room 8
  - Session Chair: Christophe Hanor, IRSN, France

- Room 12
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- Room 14
  - Session Chair: Cecilia Martin-del-Campo, Universidad Nacional Autónoma de Mexico, Mexico

- Room 15
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**Track 6**
Reactor Physics and Analysis

- Room 10
  - Session Chair: Derrick Martin-del-Campo, University of Minnesota, USA

- Room 11
  - Session Chair: Casper Fregel, PINBNIAS, USA

**Track 7**
Thermal Hydraulics Analysis and Testing

- Room 12
  - Session Chair: Stefano Passerini, Argonne National Laboratory, USA

- Room 13
  - Session Chair: Vladimir Kuznetsov, AECL, Canada; Tepppei Iwata, Argonne National Laboratory, USA

**Track 8**
Fuel Cycle and Waste Management

- Room 14
  - Session Chair: Matteo Biagi, EDF R&D, France; Pr. Housiaux-Rac, ISEC, India

- Room 15
  - Session Chair: Sara Bilbao y León, Virginia Commonwealth University, USA

**Track 9**
Materials and Structural Issues

- Room 16
  - Session Chair: Vladimir Kuznetsov, AECL, Canada; Tepppei Iwata, Argonne National Laboratory, USA

- Room 17
  - Session Chair: Matthias Mayrhofer, IFM-IEK, Germany; R. K. R. Mahendran, India

**Track 10**
Nuclear Energy and Climate Change Mitigation

- Room 18
  - Session Chair: Eron Best, Natural Resources Canada, Canada

- Room 19
  - Session Chair: Edward Williams, Idaho National Laboratory, USA

**Period 5**
10:00am >> 12:00pm

- Session Chair: Christophe Hanor, IRSN, France

- Session Chair: Jean-François Vital, CEA, France
3:30pm

**TRACK 1**: Water-Cooled Reactor Programs and Issues

**Session Chair**: Jean-Philippe Frontigny, AREVA, France

- Continuous Improvement
  - Room 15

**2:30pm**

**Track 2**: High Temperature Reactors

**Session Chair**: Carl Sink, Office of Nuclear Energy, USA; Henry Pillaris, NEA, France

- Applications
  - Room 16

**2:50pm**

**Track 2**: Fast Neutron and Other Innovative Reactors

**Session Chair**: Laurent Buiten, CEAC, France

- General
  - Room 10

**3:10pm**

**Track 3**: Operation, Performance and Reliability

**Session Chair**: Didier De Bruyne, SCH-CEC, Belgium

- Equipment Testing and Maintenance
  - Room 17

**4:30pm**

**Track 4**: Plant Safety Assessment and Regulatory Issues

**Session Chair**: Mees Beruth, EDF, France

- Reflood and Fuel Coolant Interaction
  - Room 6

**4:50pm**

**Track 5**: Plant Safety Assessment and Regulatory Issues

**Session Chair**: Jiri Zitek, UJV Rez, a. s., Czech Republic; Jean-Pierre Van Doremaele, IRSN, France

- In-Vessel Retention
  - Room 7
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<td>Room 1</td>
<td>Reactor Analysis</td>
<td>Jean Luiz Franco, National Autonomous University of Mexico</td>
</tr>
<tr>
<td>Room 2</td>
<td>Thermal Hydraulics and Testing</td>
<td></td>
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