BEPU 2018

BEST ESTIMATE PLUS UNCERTAINTY INTERNATIONAL CONFERENCE

Multi-Physics Multi-Scale Simulations with Uncertainty

PROGRAM BOOK

MAY 13-18, 2018

Real Collegio - Lucca, Italy

2018

Editorial team: A. Schiavetti, V. Parrinello, D. De Luca, A. Pop, A. Petruzzi

Welcome to BEPU 2018

THE BEST ESTIMATE PLUS UNCERTAINTY INTERNATIONAL CONFERENCE
MULTI-PHYSICS MULTI-SCALE SIMULATIONS WITH UNCERTAINTY

Welcome to the BEST ESTIMATE PLUS UNCERTAINTY INTERNATIONAL CONFERENCE – BEPU 2018. Fourteen years after the last topical meeting specifically dedicated to best estimate methods in safety analyses the ancient city of Lucca is providing the venue for the follow-up conference. The city of Lucca with its rich and long history, clearly visible in the well preserved streets, buildings and squares, provides clear, but pleasant contrast to the Conference that addresses the most modern multi-physics and multi-scale methods in support of nuclear power safety.

The Conference serves as international forum for exchange of experience and views among professionals in the nuclear industry in the development and use of Best Estimate Plus Uncertainty (BEPU) methods in safety analyses and design of nuclear installations. The Conference addresses in its plenary and more than 50 technical sessions, the multi-physics problem of simulation of the nuclear plant performance in normal operation and accident conditions as well as the methods for assessment of accuracy and uncertainty, of these simulations.

The 176 technical papers and key-notes, plenary and panel discussions of the Conference provide an overview of state of the art of BEPU methods. The Conference shall identify problems related to development of BEPU methods; provide insights into use of BEPU in licensing; design and safety evaluation; highlight issues related to verification and validation, including supporting experimental programmes; and finally we also expect some practical views and guidance on the future of BEPU methods.

S. Michael Modro

BEPU 2018 Honorary Chair

A. Petruzzi

BEPU 2018 Technical Program Chair

THE BEST ESTIMATE PLUS UNCERTAINTY INTERNATIONAL CONFERENCE
MULTI-PHYSICS MULTI-SCALE SIMULATIONS WITH UNCERTAINTY

We gladly welcome all participants to the 2018 Best Estimate Plus Uncertainty (BEPU-2018) International conference in the beautiful and historic city of Lucca, Italy.

The BEPU-2018 meeting marks the resumption of this important international conference sponsored by the American Nuclear Society that specifically focuses on the development, application and advancement of best estimate plus uncertainty methods as applied to nuclear reactor design and safety. While the ANS-sponsored BEPU meeting was last held in 2004, significant progress has been made in the development, application and regulation of best estimate methods. This conference provides an ideal forum for discussing the state of the development and use of BEPU methods as well as the challenges in applying these methods beyond traditional system thermal-hydraulic applications to higher fidelity, multi-physics modeling and simulation methods. The need for and role of validation experiments as it pertains to BEPU methods will also be discussed at this conference.

The conference has been designed to provide historic, current and future perspectives for BEPU methodologies through plenary presentations, keynote lectures, panel discussions as well as contributed works by many participants. The conference includes 13 plenary lectures that provide the participants with high level discussions of the technical regulatory requirements of BEPU methods, the role of validation and verification in BEPU methods, as well as application of BEPU methods. Over 20 keynote lectures are interspersed within the contributed talks to further focus the discussion of BEPU methods. The conference also includes 6 panel discussions by leaders in the field and will hopefully stimulate discussions among the conference participants on the issues and challenges in the application of various aspects of the BEPU methods. The technical program includes 175 technical papers that will be delivered from Monday (May 14, 2018) until the afternoon of Friday (May 18, 2018).

During the conference various workshops and expert group meetings will be held in conjunction with the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD). These workshops include thermal hydraulic and multi-physics benchmarks of the Expert Group on Uncertainty Analysis Methods and the Expert Group on Multi-physics Experimental Data, Benchmarks and Validation. Several of these workshops focus on on-going efforts while others will be kick-off meetings of new initiatives that directly relate to the BEPU conference. In addition, there will be a COBRA TF workshop.

In addition to the technical presentations and workshops, the local organizers have arranged for several social events, guided tours and technical tours that will allow the participants to enjoy Italian hospitality and the ambiance of the heart of Tuscany.

The conference program represents significant effort by the reviewers, session organizers and chairs, keynote and plenary lecturers, panel participants and not the least the local organizers. We would like to thank all of these individuals for their countless hours of work on this conference and their efforts to ensure the success of the event. We would like to extend our sincere appreciation to the Steering Committee, the Local Organizing Committee (LOC), the Technical Program Committee (TPC), and the Honorary Chair. We would personally like to thank Drs. Alessandro Petruzzi and Marco Cherubini of NINE for their dedication, devotion, and leadership for the success of this conference. Dr. Alessandro Petruzzi worked tirelessly in all facets of the preparation and execution of the conference and the associated workshops and social events.

In conclusion, we are hopeful that all participants will find the meeting very productive and informative and that it will serve as the spark to reignite further interest in the development and application of BEPU methods. We hope that the participants can also find time to enjoy the historical city of Lucca and the beautiful Tuscan surroundings.

Nam Dinh, Tim Valentine

BEPU 2018 General Chairs

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THE BEST ESTIMATE PLUS UNCERTAINTY INTERNATIONAL CONFERENCE
MULTI-PHYSICS MULTI-SCALE SIMULATIONS WITH UNCERTAINTY

Past events organized by the American Nuclear Society (ANS) that were focused on Best Estimate Plus Uncertainty (BEPU) had been embedded in other meetings or conferences, and their scope was limited to Thermal-Hydraulic aspects only. In the light of the importance that such technology has recently gained within the nuclear community, NINE decided to submit to the ANS a proposal for organizing a conference fully dedicated to BEPU methodologies applied to various disciplines. The idea of BEPU-2018 was thus shaped.

As soon as NINE's proposal for BEPU-2018 was accepted, we felt honored and ready to face challenges.

We chose Lucca, a small and charming historical town in the center of Italy, as the conference location. A key issue was to find an appropriate venue inside the ancient city wall that could accommodate an event structured with several plenary and parallel sessions.

In order to make BEPU-2018 a successful conference, we have done our best to provide attractive offers from both technical and social viewpoints. We are proposing several extras such as panel discussions, technical tours, conference tours and a rich program of social events. All in all, fitting all those opportunities in the conference program has noticeably increased the organizational and managerial efforts, but we hope it will make this experience in Lucca even more pleasant and interesting.

In parallel to the conference sessions, six OECD-NEA workshops and two additional workshops are held, so as to give the possibility to interested scientists to combine their participation in multiple events within a single trip.

The Conference is about to start and we deeply hope that we will meet the participants' expectations, satisfy all their needs and ensure the high quality level that they deserve.

We engaged with enthusiasm in making BEPU-2018 a remarkable and enjoyable event and we wish to express our deep gratitude to all the people that have faced this challenge with us.

M. Cherubini, V. Parrinello

BEPU 2018 Organizing Committee Chairs

General Information

BEPU History

2000	BEST ESTIMATE	Washington DC	USA
2004	BEST ESTIMATE	Washington DC	USA

Lucca, Tuscany, Italy

Lucca is one of the most loved cities of all Tuscany, fully representing the soul of the Region itself. It is located on a plain at the foot of the Apuan Alps and less than half an hour from the coast of Versilia.

Most of the attractions are related to its ancient history: traces of the Roman amphitheatre, archeological remains under the 12th century church of Saints Giovanni and Reparata, extremely charming villas and towers dating back to 12-16th century and many more.

As the city grew and modernised, the walls that surrounded the old town were maintained (on the contrary, they were lost in all other Tuscan cities, including Florence) and they are nowadays a fascinating pedestrian promenade that can be walked all around the city. Climate is normally very pleasant, particularly during Spring and Summer season.

Climate

In this season of the year the climate is normally very pleasant in Lucca (min. 12°C, max 25°C).

Currency

Italian currency is the Euro (EUR; symbol €), which is divided into 100 cents. Notes are in denominations of €500, 200, 100, 50, 20, 10 and 5. Coins are in denominations of €2 and 1, and 50, 20, 10, 5, 2 and 1 cents.

Electricity

Electricity in Italy, as in the rest of Europe, comes out of the wall socket at 220 volts alternating at a 50 cycles per second.

To use small electrical appliances, you may need a plug adapter or power converter.

Entry Formalities (Passport, Visa and Invitation)

To enter Italy, a passport valid for at least six months beyond the length of stay is required by all non-EU nationals.

EU citizens should hold a valid national ID card. The invitation letter is intended to help potential attendees obtain travel funds or a visa, and does not constitute any financial commitment on the part of the conference.

First Aid and Emergency

In the event of a medical emergency, please go directly to the Registration desk.

The medical emergency number in Italy is 118.

The emergency Police number is 113.

Health Insurance

It is recommended that participants arrange their own health and accident coverage before leaving home through a local travel agent or medical association.

Liability

The BEPU-2018 registration fees DO NOT include provisions for the insurance of participants against personal injuries, sickness and theft or property damage. This also applies to any event held during the conference period.

Participants and accompanying persons are advised to arrange for insurance they consider necessary. Neither the BEPU-2018 Organizing Committee, nor its sponsors nor committee members assume any responsibility for loss, injury or damage to persons or belongings, however caused.

Lost and Found

Lost and found articles may be taken to the conference Registration Desk. Any items left at the Registration Desk upon completion of the conference, will be stored by BEPU-2018 Organizing Committee.

Meals and Refreshments

Lunch will be served in Pisa Congress Palace (Catering Area) every day from Monday to Friday. Coffee breaks will also be served in Pisa Congress Palace. Dinners with typical Italian foods will be organized during the conference in exclusive Tuscany places:

- The Reception Banquet at Real Collegio (Sunday, May 13, 18:30-23:00)
- Conference Dinner Banquet with Historical Representation at Real Collegio (Monday, May 14, 19:30-23:00)
- Dinner above the Lucca city walls at Caffé delle Mura (Tuesday, May 15, 19:30-23:00)
- Social Dinner in Historical Lucca's Palace at Pfanner Palace (Wednesday, May 16, 19:30-23:00)
- Closing Dinner on the Lucca's hills at Tenuta San Pietro (Thursday, May 17, 19:30-23:00)

Transportation

Lucca is easily reachable both by car and public transport, thanks to its position on the main highways and railroad lines that connect Florence to Pisa and Viareggio. Moreover, bus and train stations are close to the heart of the city.

By Car

The old center of the city is closed off to traffic. So once you get there, you need to park outside the walls - there are a few parking areas inside the walls but be sure to read the signs and look for indications that it is parking open to everyone.

- Lucca is located on the highway A11 Firenze - Mare. If you're coming from either the North or South, you need to take A11 and exit at Lucca Est.
- If you're coming from the coast, on the highway A12 Genova - Roma, you will first connect at Viareggio then proceed to Lucca Est.
- If you're coming from the Pisa or Florence airports and have a rented car, follow indications to A11 in both cases.

Both Lucca highway exits (Est and Ovest) are located about 1 km from the city center. There is a toll to be paid on A11 and A12.

By Train

Train is the simplest and easiest way to get to Lucca. You have to follow train schedules but they run fairly regular. Lucca is situated on the train lines that connect Florence with Viareggio and Florence (or Pistoia) with Pisa, so there are many daily trains leaving to and from Lucca.

Lucca Station, Piazzale Ricasoli, 1
Tel. +39 0583 467013 – +39 848 888088
Website: www.trenitalia.com

By Plane

Lucca is served by two airports:

- Pisa Airport: **Galileo Galilei International Airport**
  Tel. +39 050 849111
  E-mail: sat@pisa-airport.com
  Website: www.pisa-airport.com
- Florence Airport: **Amerigo Vespucci Airport**
  Tel. +39 055 3061300
  Website: www.aeroporto.firenze.it

From Pisa Airport:

- Train: about 50-60 minutes with one stop in Pisa Centrale Station (Piazza Della Croce Rossa, 1) www.trenitalia.com/tcom-en
- Bus: about 1 hour, Autolinee CTT Nord – VAIBUS https://www.pisa-airport.com/en/the-passengers/transport/bus.html
- Taxi: about 30 minutes and about € 50 https://www.pisa-airport.com/en/the-passengers/transport/taxi.html

From Florence Airport

- Bus: about 1 hour, Autolinee CTT, LINEA EXTRAURBANA REGIONALE LUCCA-FIRENZE http://www.lucca.cttnord.it/Lucca_Firenze/P/533
- Train: you need to reach the train station in Florence center (Firenze S.M.N. Station, Piazza della Stazione, 1 - www.trenitalia.com/tcom-en) and then take a train or bus (bus station closeby) heading to Lucca. There are buses leaving every 30 minutes from the airport to the train station in the city center of Florence or you can take a taxi (Tel. +39 050 541600).
- Taxi: taxis are stationed in front of the terminal or can be called by radiotaxi (Tel. +39 050 541600). It takes about 50 minutes and about € 90 http://www.aeroporto.firenze.it/en/the-passengers/transport/taxi.html

Car Rental

The following main car rental agencies operate at the airport (arrival terminal):

Auto Europa / Sicily by Car
Website: www.autoeuropa.it

Avis
Website: www.avisautonoleggio.it

Budget Autonoleggio
Website: www.budgetautonoleggio.it

Europcar
Website: www.europcar.it

Hertz
Website: www.hertz.it

Taxi in Lucca

Taxis in Lucca can be called by radiotaxi:
Tel. +39 0583 1745
Website: www.luccataxi.it

Conference Information

Conference Venue

Date: May 13-18, 2018

Location: Lucca, Italy
Real Collegio Palace – Piazza del Collegio, 13,
55100 Lucca (LU)
http://www.realcollegiolucca.it/
Tel. 0583 494543

Registration Hours

Location: Real Collegio Palace – Piazza del Collegio, 13, 55100 Lucca (LU) - Ground Floor (please see the map - page 12).

Registration desk will be open to provide advance registrants with their materials and to process on-site registration. Advanced online registration through the BEPU-2018 website (http://www.nineeng.com/bepu/) is required both for advance and for on-site registrants.

Date	Time
Sunday, May 13	16.30 – 19.00
Monday, May 14	07.45 – 18.30
Tuesday, May 15	07.45 – 17.00
Wednesday, May 16	07.45 – 17.00
Thursday, May 17	07.45 – 17.00

Late and On-Site Registration Fees

	Package	Registration Fees*
ANS Members**	Basic	€ 950
	Full	€ 1100
Not-ANS Members	Basic	€ 1100
	Full	€ 1250
Students	Student	€ 600
	Student Basic	€ 750
	Student Full	€ 900

* All listed prices are excluding VAT (22% Italian rate)
** ANS Members need to indicate the ANS membership card number at the moment of the on-line registration and to show a valid ANS card at the registration desk.

Info Point

Location: Real Collegio Palace – Piazza del Collegio, 13, 55100 Lucca (LU) - Ground Floor (please see the map - page 12).

Info point will be open to provide additional conference information.

Date	Time
Sunday, May 13	16.30 – 19.00
Monday, May 14	07.45 – 18.30
Tuesday, May 15	07.45 – 18.30
Wednesday, May 16	07.45 – 18.30
Thursday, May 17	07.45 – 18.30
Friday, May 18	07.45 – 16.30

Technical Presentations

- Conference Papers will be presented in Regular Oral Sessions. Each Author has 30 minutes to present his paper, including 5 minutes for questions from the audience
- Student Papers will be presented in Student Sessions. Each Student has 30 minutes to present the paper, including 5 minutes for questions from the audience

Conference Publications

All delegates are entitled to the Book of Abstracts and to an electronic copy of Conference Proceedings.

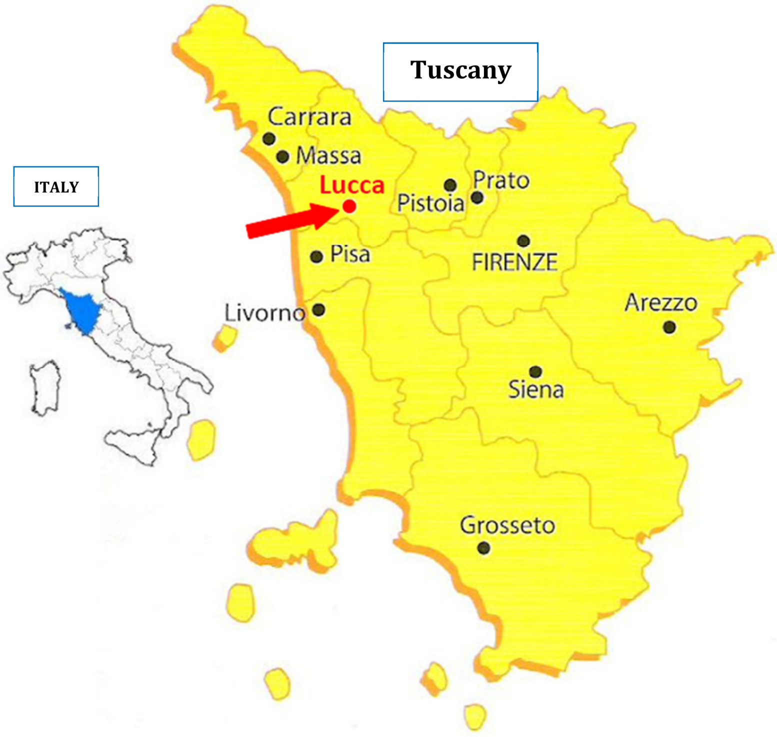
Name Badges

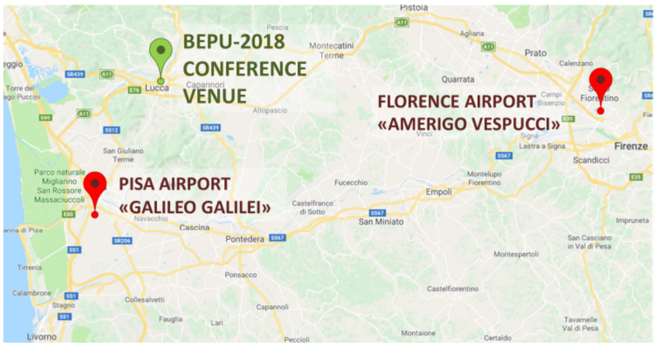
Please wear your name badge all the time. Admission to the technical sessions, tours, meals and refreshment breaks is by badge only.

Audio Visual Equipment

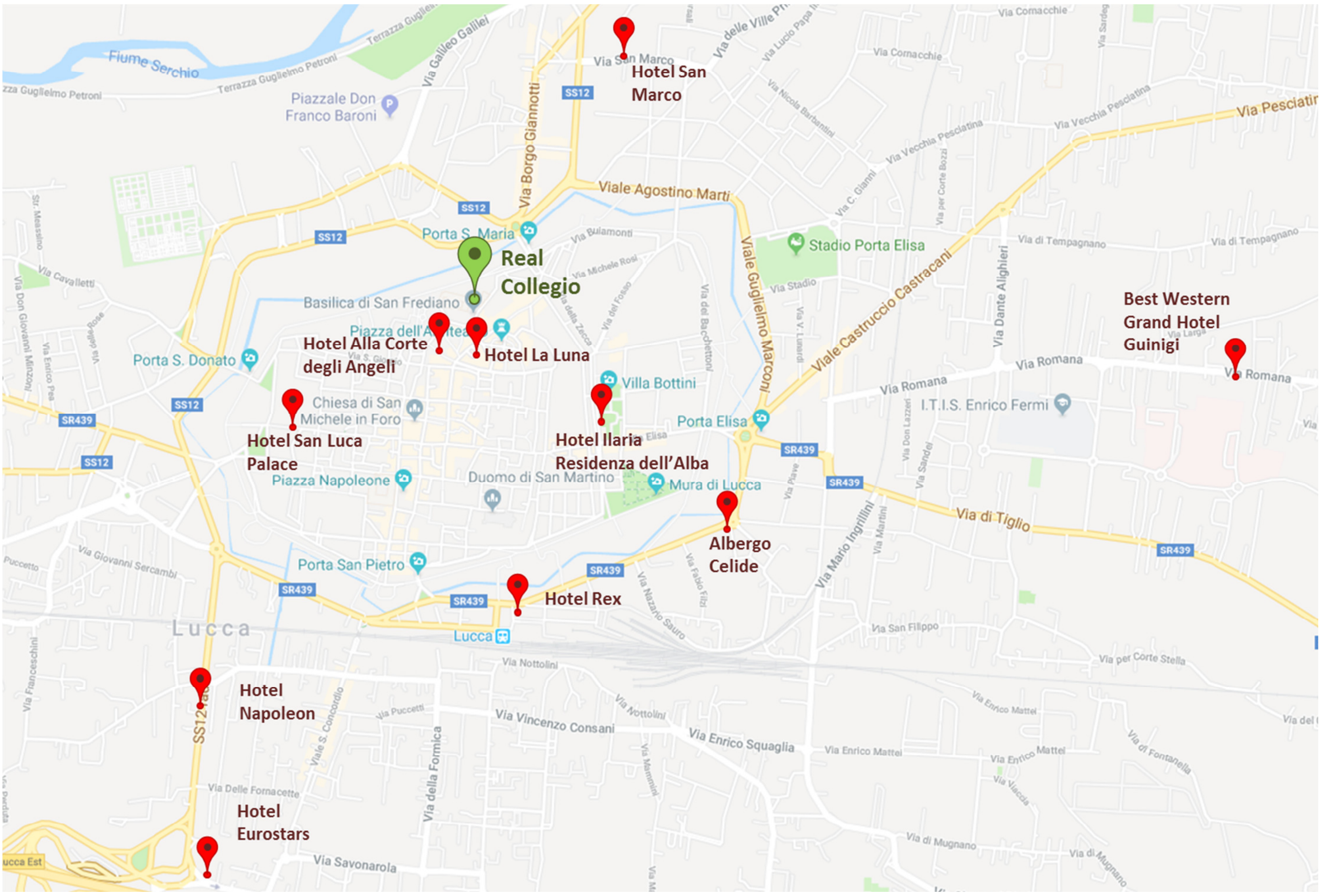
All participants should upload their presentation on the conference room pc at least 30 minutes before their session. This should be done during lunch breaks or coffee breaks.

Where is Lucca?





BEPU2018 Venue and Hotels' Location



Conference Venue

The Venue of the conference is the **Real Collegio**, which is located inside the city walls of Lucca.

The Real Collegio was the old monastery of the S. Frediano church (dating back to VI century). The old monastery has been deeply modified and transformed during XVII century with the development of two main cloisters. The building has over 500-years of history on its shoulders. In 1779 the Republic of Lucca decided to use the building as a "university institute" and thus, Pope Pius VI disposed the S. Frediano community patrimony to the construction of the new institute.

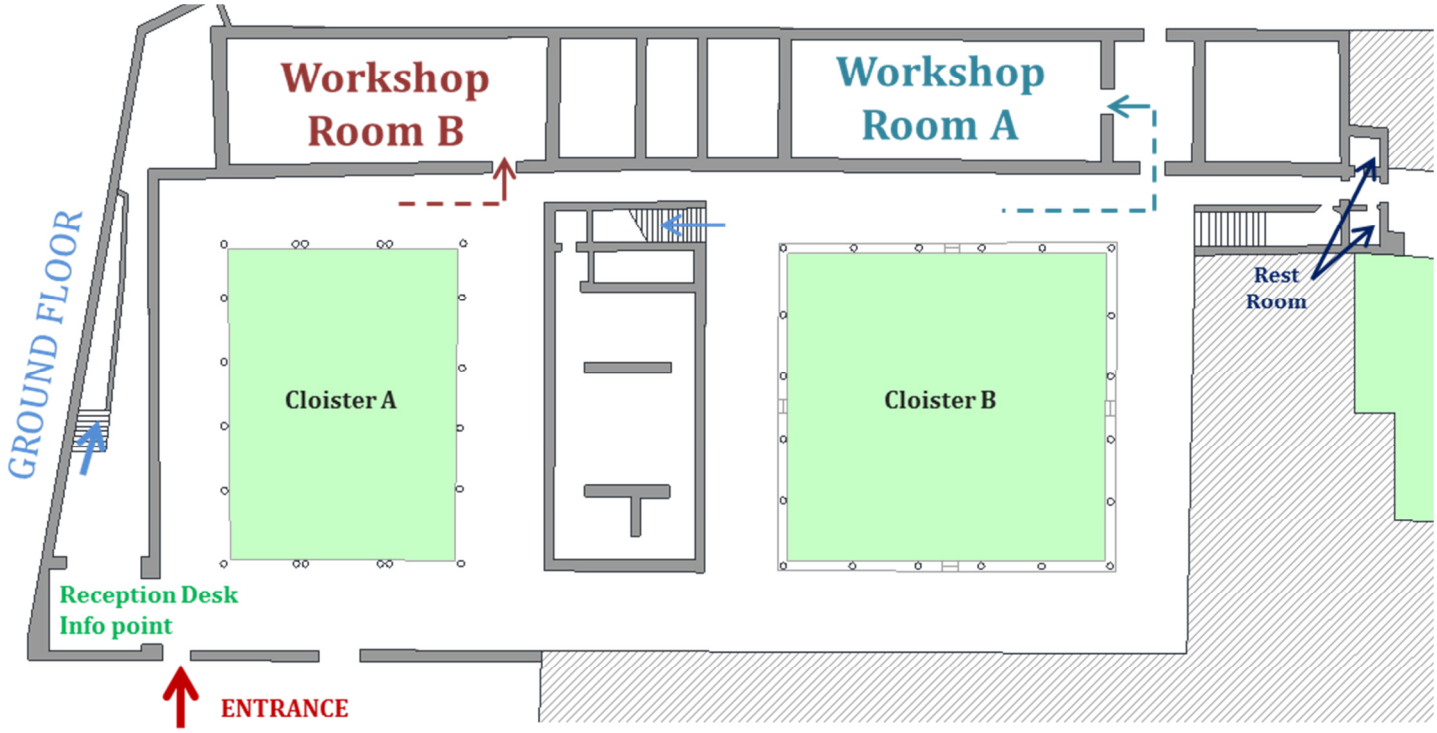
In the 19th century the institute received the name as "Real Collegio Carlo Lodovico" from Charles Louis of Bourbon- Parma, Duke of Lucca. After a huge restoration, the complex is one of the most prestigious venues in the historic center of Lucca. Every year, it hosts important cultural events, exhibitions and conferences.

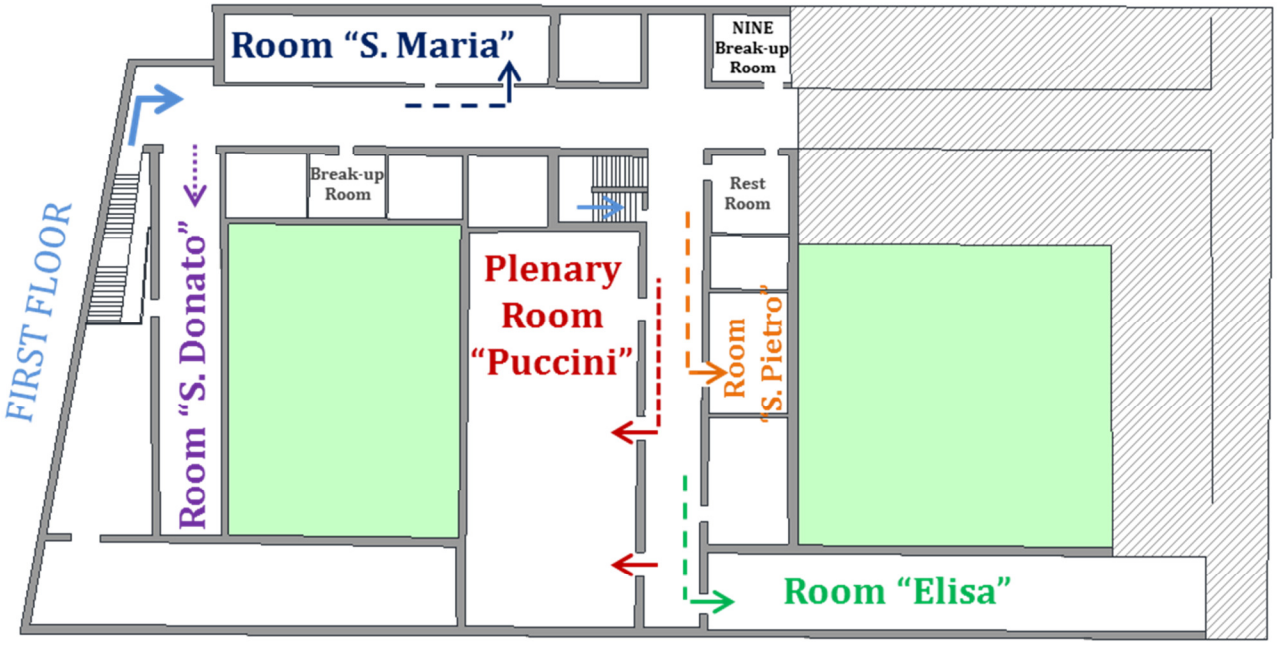
The Builging is divided in two levels and three cloisters. There are three halls able to host up to 400, 250 and 150 seats, and in addition several rooms able to host from 50 to 80 seats, where regular technical sessions will be played. Each room will be equipped with projectors, laptop for the presentations and decorated with appropriate flowers.

Conference Sessions

The Conference Registration Desk and Info Point are at the ground-level of the Real Collegio, at the left side of the main entrance hall. The Workshops embedded into the BEPU-2018 Conference will be held in the ground floor Workshop Rooms A and B. Welcome Session of the Workshops will be in the Workshop Room A, which is the beautiful "Sala degli Affreschi" ("the paintings' room") of the Real Collegio.

The Oral Conference Sessions and Oral Student Sessions will take place in the Rooms of the first floor, that just for the present occasion have been named after the four main "Doors" of the walls surrounding the Lucca city centre: Santa Maria, Elisa, San Pietro and San Donato. Instead, the Plenary Room has been named "Puccini" as a tribute to the world-famous Italian composer native of Lucca.





Plenary "Puccini"
200 seats

Room "S. Maria"
50 seats

Room "S. Pietro"
40 seats

Room "Elisa"
50 seats

Room "S. Donato"
50 seats

Location of Social Events

Every evening of the Conference, a Social Event will be organized.

We will welcome you to the ANS BEPU-2018 International Conference during the **Reception Banquet** on Sunday evening. The event will take place at the Real Collegio, i.e. the venue of the conference. The beautiful main cloister will be the perfect picture frame for meeting up with colleagues and students coming from many different affiliations all over the world.

The living history of Lucca recreated with care in each detail will amaze you during the second social event of the ANS BEPU-2018 International Conference. The Real Collegio with its 500-years of history on its shoulders will be the perfect location for this unique experience: the **Lucca Historical Representaion**. During the dinner,

A special dinner above the historic walls of Lucca. There is nothing more charming and unforgettable than a **Gala Dinner** in this magic setting with stunning views over the city.

The incomparable architectural design of Palazzo Pfanner will be the lovely location of the **Social Dinner**. With its grassy lawns, ornamental blossoms, tall shrubs and lemon trees in large earthenware pots interspersed among the monumental rows of eighteenth-century statues depicting the Olympian gods and the Four Seasons, the garden of Palazzo Pfanner represents a valuable example of a baroque garden set in the heart of the mediaeval town of Lucca.

The **last social event** will take place **on the beautiful hills sourrounding Lucca**. You will have the opportunity to have dinner with a stunning view on the world-wide famous Tuscany countryside.

Reception Banquet	Real Collegio Sunday, May 13, 18:30 – 23:00	
Dinner with Lucca Historical Representation	Real Collegio Monday, May 14, 19:30 – 23:00	***Conference Honors Ceremony***
Dinner on the Lucca City Walls	Caffè delle Mura Tuesday, May 15, 19:30 – 23:00	
BEPU-2018 Official Dinner in Historical Lucca Palace	Pfanner Palace Wednesday, May 16, 19:30 – 23:00	***Conference Awards Ceremony***
Closing Dinner on the Lucca Hills	Tenuta San Pietro Thursday, May 17, 19:30 – 23:00	

Contact person: Valeria Parrinello +39 3202338284. Please refer to the map provided at the Conference Info Point.

The Best Estimate Plus Uncertainty International Conference (BEPU-2018) is held under the co-sponsorship of NINE Nuclear and Industrial Engineering, American Nuclear Society (ANS), International Atomic Energy Agency (IAEA) and Nuclear Energy Agency (NEA).

Organization by

The Best Estimate Plus Uncertainty International Conference (BEPU-2018) is organized by NINE Nuclear and Industrial Engineering.

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- Development of innovative solutions
- EUR Compliance
- Compliance to emerging regulations

PLANT OPERATION SUPPORT
- Plant Modifications & Modernisation
- Plant Life Extension
- Ageing Management
- Safety Assessment
- Equipment Reliability
- Core & Fuel Studies

RADWASTE, DECONTAMINATION & DECOMMISSIONING
- Waste radiological characterization
- Waste treatment and conditioning
- Waste storage and disposal
- Radiation protection, ALARA studies
- Decommissioning scenarios & plans
- Cost & schedule optimization studies

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Honorary Chair

Mike Modro
(NINE, Italy)

Mr. Mike Modro has over 40 years of experience in research and engineering, including over 30 years in Nuclear Reactor Design, Licensing and Safety Research. His field of expertise includes: Analyses and Research related to Nuclear Power Plant behavior during accident conditions; Assessment and Validation of various Computer Codes used to simulate nuclear plant behavior; Development and conduct of Experimental programmes in support of nuclear safety needs; Programme and line Management, Business and Resource development. He worked over 25 years within the Idaho National Laboratory (United States) and 6 years as Senior Safety Assessment Officer for the International Atomic Energy Agency (for whom he is currently a Senior Consultant). He is a Guest Lecturer for the Imperial College of London (UK). He has a background in Physics from the University of Bern (Switzerland) and the University of Warsaw (Poland).

General Chairs

Dr. Tim Valentine
(ORNL, USA)

Dr. Timothy E. Valentine is the director of the Radiation Safety Information Computational Center (RSICC) As director of RSICC, he is responsible directing and expanding the services and operations of the center as well as being responsible for international collaborations with the Nuclear Energy Agency of the Organization for Economic Cooperation and Development (OECD-NEA) as well as Japanese Research Organization for Information Science and Technology (RIST). Dr. Valentine has twice served as a science and nuclear policy advisor in the U.S Senate on the Committee on Energy and Natural Resources and for Senators Bingaman and Alexander. Dr. Valentine has held various line, program management and technical research positions with a focus on energy R&D and nuclear safety, security and nonproliferation.

Prof. Nam Dinh
(NSCU, USA)

Dr. Nam Dinh is a professor of nuclear engineering at North Carolina State University, and a joint faculty appointment with the Oak Ridge National Laboratory. Prior to NCSU, Dr. Dinh was a professor of nuclear power safety at Sweden's Royal Institute of Technology, and a Laboratory Fellow at the Idaho National Laboratory. Professor Dinh research in nuclear reactor thermal hydraulics contributed to severe accident management in LWRs and ALWS plants. Professor Dinh's current research is focused on data-driven modeling and validation of advanced simulation codes. He is a Fellow of the American Nuclear Society and a recipient of the ANS-THD Technical Achievement Award.

Technical Program Committee Chairs

Dr. A. Petruzzi
(NINE, Italy)
Chair

Dr Alessandro Petruzzi is President of the Board of Directors of Nuclear and INdustrial Engineering (NINE) since 2011. He received Ph.D. in Nuclear and Industrial Safety from University of Pisa where he worked on development of Uncertainty Methods for system thermal-hydraulics codes and application of BEPU methodology to Safety Analysis in Licensing framework. From 2007 to 2013 he acted as deputy manager of GRNSPG (University of Pisa) working on the preparation of Chapter 15 of FSAR of Atucha-2 NPP in Argentina. His current research concentrates on thermal-hydraulics, multi-physics methods for reactor safety analysis, forward and inverse methods for uncertainty quantification and he is member of several NEA working group both at NSC and CSNI. In 2013 he was the main organizer of NURETH-15 in Pisa.

Prof. K. Ivanov
(NSCU, USA)
Co-chair

Professor Kostadin Ivanov has been working in the Nuclear field for over 34 years. His field of expertise includes: Reactor Physics; Methods in Static and Dynamic Analysis; Nuclear Power Plant Modeling and Safety; Fuel Management and Core Design; Verification and Validation of Multi-Physics simulations. He has worked over ten years for the Pennsylvania State University as Distinguished Professor including Graduate Coordinator of Nuclear Engineering Programme, and for two years as Visiting Professor at the Karlsruhe Institute of Technology, Department of Mechanical Engineering, in Germany. Since 2015 he is Professor and Department Head of the Department of Nuclear Engineering at the North Carolina State University (USA). He was and currently is in charge as leading scientist of several international benchmarks organized under the umbrella of the Nuclear Energy Agency (NEA). His work has been published on hundreds of academic and international journals and conference proceedings. He holds a PhD in Reactor Physics from the Bulgarian Academy of Science.

Dr. H. Nakamura
(JAEA, Japan)
Co-chair

Dr. Hideo Nakamura got his MS in Material Engineering in 1981 and PhD in Nuclear Engineering in 1992 both from Nagoya University, Japan. In 1981, he joined former Japan Atomic Energy Research Institute (JAERI) at Tokai to work for the ROSA (Rig-of-Safety Assessment) program to study reactor accidents for both of BWR and PWR with large-scale experiments under reactor prototypical conditions. In 2001, he became Head of Thermo-hydraulic Safety Research Group dedicated both of Severe Accident and Beyond Design-basis Accidents. Since 2005, he was Head of Operating Agent of the OECD/NEA ROSA and ROSA-2 Projects with LSTF experiments. Now he is Senior Associate for Nuclear Safety Research Center of Japan Atomic Energy Agency (JAEA).

Dr. K. Muftuoglu
(GEH, USA)
Co-chair

Conference Organizers Committee

Dr. M. Cherubini (NINE, Italy), Chair

Ms. V. Parrinello (NINE, Italy), Co-Chair

Mr. A. Schiavetti (NINE, Italy)

Dr. A. Petruzzi (NINE, Italy)

Dr. J. Dyrda (OECD-NEA, France)

Steering Committee Chairs

Dr. G. Bruna
(IRSN, France)
Chair

Giovanni Bruna is a Dr. in Nuclear Physics and he has more than 40 years of experience in reactor safety, design and operation. He is the scientific director IRSN - French Institute for Radioprotection and Nuclear Safety. Previously, he was IRSN's Deputy Director for reactor safety, and AREVA group's manager nuclear reactor physics & senior international expert.

Prof. H. Ninokata
(POLIMI, Italy)
Co-chair

Dr. Hisashi Ninokata is a professor at Dipartimento di Energia, Politecnico di Milano, Italy. He received PhD from the University of Tokyo, 1977, and worked in Tokyo Electric Power Co., at O-arai Engineering Center of Power Reactor and Nuclear Fuel Development Corporation, Japan, and at Tokyo Institute of Technology from 1993 to 2012. He is Professor Emeritus since 2012 while he continues teaching at Politecnico. His major contributions are in the progress of computational modeling and methods in thermal hydraulics and safety of LMFBR and LWRs. He is Fellow of ANS and NURETH Fellow, and a recipient of the ANS Technical Achievement Award in Thermal Hydraulics.

Dr. C. H. Song
(KAERI, South Korea)
Co-chair

Dr. Chul-Hwa SONG is a distinguished tenured researcher of Korea Atomic Energy Research Institute (KAERI) since 2011. He has been working for KAERI since 1985. He was the former V.P. for Nuclear Safety Research Department at KAERI, dealing with nuclear safety R&D for nuclear installations. He was the former Director and General PM leading the Thermal-Hydraulic Safety Research division in KAERI for about ten years. He is the Chief Major Professor of 'Advanced Nuclear System Engineering' at the Korean University of Science and Technology (UST) since 2008. He is an Adjunct Research Professor at University of Illinois at Urbana-Champaign (UIUC), Dep't of Nuclear, Plasma and Radiological Eng. (NPRE) in 2018. He was a visiting Researcher at the French nuclear research center (CEA-Grenoble), France ('87-'89). He obtained his BS and MSc in Mechanical Engineering, and Ph.D. in Nuclear Engineering.

Prof. M. El-Shanawani
(NINE, Italy)
Co-chair

Professor Mamdouh El-Shanawany is an international expert on nuclear safety. For the last 40 years, he has provided leadership, design, research & development, analysis, management and critical safety assessment, applications of Statutory regulatory requirements and policy development for the nuclear industry in the UK, Canada and Internationally. He was a member of the IAEA team which was awarded the Nobel Prize for Peace in 2005. He was global Nuclear Technical Director at Lloyd's Register, and visiting Professor of Nuclear Safety Centre for Nuclear Engineering, at the Imperial College (London). He was the Head of the Safety Assessment Section at the IAEA. He represented the IAEA on the Commission of Nuclear Safety Standards, International Nuclear Safety Group, at the OECD/NEA, CSNI and the TSC of the Multinational Design Evaluation Programme. He is an Independent Expert Evaluator for research project allocations, UK Engineering & Physics Science Research Council and Euratom Nuclear Research and Training, European Commission. He was also a member of Generation IV Technical Advisory Committee of the UK Government's Department of Trade and Industry. Prior to joining the IAEA, he was employed by Her Majesty's Nuclear Installations Inspectorate, the UK Regulatory Body, where he was responsible for managing, assessing and formally agreeing and accepting the Licensees' arrangements and safety cases for faults studies and severe accidents analysis for the operating plants. He holds a PhD in Thermal Power Section from the Imperial College of Science and Technology (London).

Conference People

Technical Program Committee

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Conference People

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Z
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Tractebel
(Belgium)

Zhao B.
CNPE
(China)

Plenary Session Chairs & Invited Lecturers

- **Welcome Session**

Monday, 14 May 2018

Chair: **Y. A. Hassan**, Texas A&M University, Department Head and Professor, USA

Speakers:

M. Modro, NINE, NSAG chair, Italy
"Welcome to the 3rd international conference on BE methods"

A. Petruzzi, NINE, President, Italy
"BEPU2018 Opening Remarks"

T. Valentine, ORNL, Director RSICC, USA
"BEPU Current Perspective and Roles"

N. Dinh, NCSU, Professor, USA
"Short introduction to the Conference Program"

- **Plenary Opening Session**

Monday, 14 May 2018

Chair: **T. Valentine**, ORNL, USA

Lecturers:

M. Modro, NINE, NSAG chair, Italy
"BEPU What Else?" (PL-01)

U. Rohatgi, BNL, USA
"Historical Perspectives of BEPU Research" (PL-02)

Monday, 14 May 2018

Chair: **Y. A. Hassan**, TAMU, USA

Lecturers:

F. D'Auria, UNIPI, Italy
"BEPU Status and Perspectives?" (PL-10)

D. Bestion, CEA, France
"BEPU Methods Using CFD Codes - Progress Made within OECD-WGAMA CFD Activities" (PL-11)

Tuesday, 15 May 2018

Chair: **G. Bruna**, IRSN, France

Lecturers:

G. Rzentkowski, IAEA, Austria
"BEPU Methodologies and Requirements from the Perspective of IAEA Safety Standard?" (PL-03)

J. Kaneko, NRA, Japan
"Status of BEPU Study in NRA and Japan" (PL-04)

Wednesday, 16 May 2018

Chair: **H. Nakamura**, JAEA, Japan

Lecturers:

G. Bruna, IRSN, France
"Uncertainty in Design and Operation. How Dealing With?" (PL-05)

K.Y. Choi, KAERI, South Korea
"Application of BEPU Methodologies in V&V Process" (PL-06)

Thursday, 17 May 2018

Chair: **M. Modro**, NINE, Italy

Lecturers:

O. Mazzantini, NA-SA, Argentina
"Full BEPU Application for Chapter 15 of Atucha-2 NPP" (PL-07)

S. Mizokami, TEPCO, Japan
"Uncertainty Evaluation in Decommissioning-related Tasks on Fukushima Daiichi Accident" (PL-08)

L. Gerken, FRAMATOME, USA
"Realistic Large Break LOCA Methodology for Pressurized Water Reactors" (PL-09)

Friday, 18 May 2018

Chair: **K. Ivanov**, NCSU, USA

Lecturers:

J. Gulliford, OECD/NEA, France
"NEA Activities to Support Uncertainty Quantification, Validation and Verification for Nuclear Systems Modeling" (PL-12)

D. Kropaczek, NCSU, USA
"CASL, Experiences in Multi-Physics and Multi-Scale Simulation tool Development" (PL-13)

- **Summary and Closing Address**

Friday, 18 May 2018

Chair: **G. Bruna**, IRSN, Scientific Director, France

Speakers:

M. Modro, NINE, NSAG chair, Italy
"What next, what's BEPU future?"

T. Valentine, ORNL, Director RSICC, USA
"BEPU: Opportunities and Challenges in Multi-Scale, Multi-Physics Applications"

A. Petruzzi, NINE, President, Italy
"Closing Remarks and see you at BEPU2020 in Sicily"

Panel Moderators and Lecturers

Monday, 14 May 2018

PD-01 BEPU – Role of a Phenomenological Validation and Integral Experiments for Maturing the Predictive Simulations

Moderator: **E. Ivanov,** IRSN, France

Lecturers: B. Rearden, ORNL, USA
A. Bouloré, CEA, France
K. Velkov, GRS, Germany
J. Baccou, IRSN, France

PD-05 Margin Management: Intersection of I&C and Safety Analysis

Moderator: **S. Cetiner,** ORNL, USA

Lecturers: M. Cherubini, NINE, Italy
T. Quinn, Technology Resources, USA
S. Croft, ORNL, USA
J.P. Hudelot, CEA, France

Tuesday, 15 May 2018

PD-02 Methodologies for Uncertainty Evaluation of BE Results: Advantages and Disadvantages of different Approaches

Moderator: **T. Kozlowski,** Univ. of Illinois, USA

Lecturers: J. Hou, NCSU, US
H. Glaeser, Consultant, Germany
A. Petruzzi, NINE, Italy
E. Ivanov, IRSN, France

PD-04 Interrelations between Thermal- hydraulics, Reactor Physics and Fuel Behavior modelling in BEPU Methodology

Moderator: **N. Dinh,** NCSU, USA

Lecturers: K. Ivanov, NCSU, USA
A. Bouloré, CEA, France
K. Velkov, GRS, Germany
M. Avramova, NCSU, USA
E. Royer, CEA, France
C. Schneidesch, TE, Belgium

Thursday, 17 May 2018

PD-03 Are Best Estimate Methodologies also Best-Efforts?

Moderator: **A. Petruzzi,** NINE, Italy

Lecturers: C. Frepoli, FPoliSolutions, USA
J. Le Pallec, CEA, France

Thursday, 17 May 2018

PD-06 International Program Findings and Recommendations for BEPU

Moderator: **M. Avramova,** NCSU, USA

Lecturers: E. Royer, CEA, France
F. Reventos, UPC, Spain
M. Krause, IAEA, Austria
G. Rimpault, CEA, France
D. Novog, McMaster, Canada

Key-Note Invited Lecturers

Monday, 14 May 2018

J. Zhang, Tractebel, Belgium
"The Role of Verification & Validation Process in Best Estimate Plus Uncertainty Methodology Development" (KN-A2)

C. Frepoli, FPoliSolutions, USA
"Data Management, Statistics and Trends In Deploying BEPU Industry Applications: An Overview" (KN-B1)

L. Herranz, CIEMAT, Spain
"Historical Overview of Severe Accident Analysis and the Need for Uncertainty Quantification" (KN-C7)

M. Dzodzo, Westinghouse, USA
"Scaling Analysis and Relation to EMDAP and BEPU" (KN-A3a)

H. Nakamura, JAEA, Japan
"Considerations on Phenomena Scaling for BEPU" (KN-A3b)

Y. A. Hassan, TAMU, USA
"High Resolution Experiments for CFD Validation and Uncertainty Quantification" (KN-C5)

Tuesday, 15 May 2018

M. Panicker, NRC, USA
"Licensing and Regulatory Requirements for Best Estimate Plus Uncertainty (BEPU) Applications – An USNRC Perspective" (KN-A1)

H. Glaeser, Consultant, Germany
"Results and Recommendations of International OECD/CSNI BEPU Programs" (KN-F1)

E. Royer, CEA, France
"Combining Verification & Validation with Uncertainty Analysis for Reactor Thermal-Hydraulic Industrial Applications" (KN-C1)

S. Caruso, NAGRA, Switzerland
"From a Conservative Approach to a BEPU Implementation for Spent Nuclear Fuel Characterisation and Safety Assessment from the Perspective o Geological Disposal" (KN-E3)

Wednesday, 16 May 2018

M. Hursin, PSI, Switzerland
"The Importance of Experimental Uncertainty in the BEPU Approach" (KN-A4)

D. Novog, McMaster University, Canada
"Operating Nuclear Plant Dynamics: Examination of BEPU-Type Input Uncertainties Stemming from Plant Operations" (KN-B3)

G. Robertson, Westinghouse Electric, Sweden
"Bayesian Inverse Uncertainty Quantification for Fuel Performance Modelling" (KN-E8a)

A. Bouloré, CEA, France
"Importance of Uncertainty Quantification in Nuclear Fuel Behavior Modelling and Simulation" (KN-E8b)

B. Iooss, EdF, France
"Sensitivity Analysis of Model Outputs: Principles, Methods and Issues for the BEPU Methodology" (KN-B4)

D. Aumiller, BETTIS, USA
"Consideration of Uncertainty Propagation in Coupled Code Systems" (KN-C3)

Thursday, 17 May 2018

R. Mendizábal, CSN, Spain
"Bayesian Perspective in BEPU Licensing Analysis" (KN-B2)

J. Misak, NRI, Czech Republic
"Role and Importance of BEPU Safety Analysis in Licensing of LWRS" (KN-D1)

W. Zwermann, GRS, Germany
"Reactor Simulations with Nuclear Data Uncertainties" (KN-E7)

M. Krause, IAEA, Austria
"Thermalhydraulic Approaches and Needs for Advanced Water-Cooled, High-Temperature Gas-Cooled, and Molten Salt Reactors" (KN-E2)

Y. Parlatan, OPG, Canada
"Comparison between a BEAU and a Novel Non-Best-Estimate Method Applied to a Large Break LOCA in a Canadian Reactor" (KN-D2)

Honor Awards Ceremony

Chairs: **T. Valentine**, ORNL, USA
A. Petruzzi, NINE, Italy

The honor awards ceremony will be held on May 14 to assign the following awards:

- For the pioneering contribution to the establishment of the BEPU approach
- For the contribution to foster the BEPU approach in international environment
- For the contribution to the advancements in BEPU technology
- For BEPU safety application in licensing framework

Paper Awards Ceremony

Chairs: **N. Dinh**, NCSU, USA
M. Modro, NINE, Italy
K. Ivanov, NCSU, USA

The paper awards ceremony will be held on May 16 to assign the following awards:

- One Award for the best Conference Papers
- Three Awards for the best three Student Papers
- Three Awards for the best three Reviewers who contributed more to increase the quality level of the BEPU-2018 papers

Journal Publication Committee

Chairs: **N. Dinh**, NCSU, USA
M. Modro, NINE, Italy
T. Valentine, ORNL, USA
K. Ivanov, NCSU, USA
E. Ivanov, IRSN, France
A. Bouloré, CEA, France
B. Iooss, EdF, France
E. Royer, CEA, France
H. Nakamura, JAEA, Japan
A. Petruzzi, NINE, Italy

Workshop Organizers

K. Ivanov, NCSU, USA
OECD/NEA Light Water Reactor Uncertainty Analysis in Modelling benchmark (12th meeting) (LWR-UAM-12)

G. Rimpault, CEA, France
OECD/NEA Sodium Fast Reactor Uncertainty Analysis in Modelling benchmark (4th meeting) (SFR-UAM-4)

A. Petruzzi, NINE, Italy
Multiphysics Pellet Clad Mechanical Interaction Validation benchmark (Kick-off meeting) (MPCMIV)

M. Avramova, NCSU, USA
ROSTOV-2 VVER-1000 benchmark (Kick-off meeting) (ROSTOV-2)

D. Novog, McMaster University, Canada
Blind benchmark on CANDU THermal-hydraulics (Kick-off meeting) (CANDU-TH)

J. Hou, NCSU, USA
Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization (3rd meeting) (C5G7-TD-3)

M. Avramova, NCSU, USA
COBRA TF User's Group Meeting (5th meeting) (CTF-5)

J. Dyrda, OECD/NEA, France
Workshops Secretariat

I, Hill, OECD/NEA, France
Workshops Secretariat

Session Chairs

A

Aumiller D., *BETTIS (USA)*
C3 (1)

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E7 (1), SS E (2)

B

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E3 (1), E8 (1), E8 (2)

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SS E (1)

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A4 (2)

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C7 (2), SS E (1)

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A3 (1)

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B1 (1), E6 (3), SS B (1)

G

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B1 (1), B1 (2), F1 (1)

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C1 (2)

H

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C7 (1)

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A4 (2), SS A (2)

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A4 (1)

I

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B4 (1), SS B (1)

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A2 (1), E6 (1)

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C1 (1)

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Kozlowski T., *UIUC (USA)*
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E2 (1), E2 (2)

Kristof M., *NNEES (Slovakia)*
A1 (1), E6 (1), SS D (1), SS F (1)

Kropaczek D., *NCSU (USA)*
E7 (2)

L

Le Corre J.M., *Westinghouse (USA)*
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Le Pallec J. C., *CEA (France)*
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E7 (2)

M

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D1 (2), D1 (3), D2 (1), D2 (2), F3 (1)

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Nakamura H., *JAEA (Japan)*
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B3 (1), C7 (2)

O

Oh D. Y., *KINS (South Korea)*
A2 (3)

P

Panicker M., *NRC (USA)*
A1 (1)

Parlatan Y., *OPG (Canada)*
D1 (2), D2 (1), F3 (1)

Patel A., *NRC (USA)*
E6 (2)

Popov N., *UNENE & NINE (Canada)*
A2 (3), B1 (2),

R

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E8 (1), E8 (2), F1 (2)

Rohatgi U. S., *BNL (USA)*
A2 (2), D1 (1), D1 (3), D2 (2)

Royer E., *CEA (France)*
C1 (1), E7 (3)

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A1 (2), B3 (2)

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Zhang J., *Tractebel (Belgium)*
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Zwermann W., *GRS (Germany)*
E7 (1)

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Volkanovski Andrija

Y
Yamamoto Akio
Yang Bao-Wen

Z
Zwermann Winfried

Conference Structure

Conference Numbers

- One Welcome Session with four shorts Synopses and one Summary and Closing Session with three Synopses
- 5 Plenary Session (**PS**) with 13 Invited Lecturers who will present Plenary Lectures (**PL**)
- 6 Panel Discussion Sessions (**PDS**) conducted by six Moderators and with more than 20 speakers. Each PDS will consist one hour of presentations by the speakers and one hour of round table discussion.
- 21 Invited Key Note (**KN)** Lecturers who will open each Technical Conference Session
- 39 Oral Sessions (from **A** to **F**) with 141 Oral Papers (**OP**)
- 9 Student Sessions (**SS**) with 31 Student Papers (**SP**)
- 8 Parallel OECD/NEA Workshops

Parallel OECD/NEA Workshops

A total of 8 OECD/NEA workshops have been organized in parallel the Conference. Each workshop can last from half a day to two days. Please refer to pages 40 and 41 for more information.

Honor Awards Ceremony (Mon 14 May, 2018)

- For the pioneering contribution to the establishment of the BEPU approach
- For the contribution to foster the BEPU approach in international environment
- For the contribution to the advancements in BEPU technology
- For BEPU safety application in licensing framework

Paper Awards Ceremony (Wed 16 May, 2018)

- One Award for the best Conference Papers
- Three Awards for the best three Student Papers
- Three Awards for the best three Reviewers who contributed more to increase the quality level of the BEPU-2018 papers

Social Events

- May 13, 2018 – Welcome Reception (Real Collegio, 18:30-23:00)
- May 14, 2018 – Conference Dinner banquet with Lucca Historical Representation (Real Collegio, 19:30-23:00)
- May 15, 2018 – Dinner in Historical Lucca's Villa (Caffé delle Mura, 19:30-23:00)
- May 16, 2018 – BEPU 2018 Official Dinner in Historical Lucca's Palace (Pfanner Palace, 19:30-23:00)
- May 17, 2018 – Dinner on the Lucca's Hills (Tenuta San Pietro, 19:30-23:00)

Technical Tours

- Visit to Virgo Facility
- Visit to Gran Sasso National Laboratory
- Visit to the ENEA Brasimone Research Center
- Visit to TRIGA Research Reactor (LENA Laboratory)

Conference Tours

- Visit to Florence
- Visit to Pisa
- Visit to Livorno
- Visit to Siena
- Visit to Greve in Chianti
- Visit to Gorgona's Island
- Visit to Val d'Orcia
- Visit to Ferrari Museum
- Visit to Cinque Terre

Plenary Lecturers (Alphabetic order)

Dominique Bestion (CEA, France)

Dr. Dominique Bestion is Research Director at CEA, professor at Ecole Polytechnique and teaches at INSTN, ECP, ENSE3. He has been developing two-phase flow models for the CATHARE system code and coordinated modelling activities of the NEPTUNE multi-scale thermal hydraulic platform. He coordinated thermal hydraulic activities of the NURESIM, NURISP and NURESAFE European Projects for a reactor multi-physics and multi-scale simulation platform. He coordinates a Working Group of OECD/NEA for the application of CFD to nuclear safety. He is editor at the Nuclear Engineering and Design review and NURETH Fellow.

Giovanni Bruna (IRSN, France)

Giovanni Bruna is a Dr. in Nuclear Physics and he has more than 40 years of experience in reactor safety, design and operation. He is the scientific director IRSN - French Institute for Radioprotection and Nuclear Safety. Previously, he was IRSN's Deputy Director for reactor safety, and AREVA group's manager nuclear reactor physics & senior international expert.

Francesco D'Auria (UNIPI, Italy)

Prof. Francesco D'Auria is a professor at University of Pisa teaching Nuclear Thermalhydraulics. Since 1980 he has been cooperating with ANS, EC, IAEA and OECD/NEA; currently he is member of CSNI. He is: Foreign Member of Argentinean Academy of Science (Buenos Aires), Recipient of "N.A. Dollenzhal gold medal" by Nikiet (Moscow), NURETH fellow, Founder and Editor in Chief of Journal STNI, General Chair of International Conferences e.g. NURETH-15 and TopSafe, Editor of the Elsevier Book "Thermal Hydraulics in Water Cooled Nuclear Reactors".

Lisa Gerken (Framatome, USA)

Ms. Lisa Gerken is a Principal Engineer at Framatome. Ms. Gerken has made significant contributions for Framatome in the development and approval of EMF-2103PA Rev. 3, "Realistic Large Break LOCA Methodology for Pressurized Water Reactors." She was also involved in the development of new analyses and methodologies for the EPR reactor. Ms. Gerken was a Framatome Engineer of the Year in the US for 2016. Her expertise covers fuel cladding materials, fuel rupture models, and both deterministic and statistical applications for LOCA in the US region.

Jim Gulliford (OECD/NEA)

Jim Gulliford has over 30 years' experience in the Nuclear Industry, working in the UK, France and the USA. During that time he has led multinational research teams working on thermal and fast reactor systems. Since 2010 he has been working for the OECD/NEA in Paris, as Head of Nuclear Science and as Head of the Data Bank. Current projects include the development of the NEA Nuclear Education, Skills and Technology (NEST) activity, which is aimed at passing on key knowledge to a new generation of nuclear scientists and engineers by involving them in collaborative R&D projects. where they can work alongside leading international experts.

Junichi Kaneko (NRA-J, Japan)

Dr. Junichi Kaneko graduated from the Graduate School of Nuclear Engineering at Tokyo Institute of Technology in 2008. Since his graduation from the university, he has been working in the nuclear engineering field for 10 years. Now he is a researcher of the Regulatory Standard and Research Department at the Secretariat of the Nuclear Regulation Authority and responsible for several researches of thermal hydraulics including development of a safety analysis code.

Ki Yong Choi (KAERI, South Korea)

Dr. Ki Yong Choi earned his Ph.D. in nuclear thermal hydraulics at KAIST. He was awarded a Chevening Scholarship from British Council and worked as a research fellow at Manchester University, UK. Then he has been working at KAERI for more than 18 years. His major research interests include experimental and analytical works on thermal-hydraulic phenomena and model development related to the advanced LWR such as APR1400, APR+ and SMART. Currently he is responsible for the nuclear thermal-hydraulic safety and severe accident research.

David Kropaczek (NCSU, USA)

Dr. David Kropaczek joined NCSU in 2016 as the Duke Energy Distinguished Professor in Nuclear Engineering. He is the current Chief Scientist of the Consortium for Advanced Simulation of Light Water Reactors (CASL). Previous experience includes positions in both R&D and leadership within Westinghouse, General Electric, and Studsvik Scandpower where he most recently served as CEO. He has over 30 years' experience is in the field of nuclear energy with a focus on computational methods development in the areas of nuclear fuel cycle optimization, reactor physics and thermal-hydraulics for LWRs.. He also holds a Joint Faculty Appointment with ORNL.

Oscar Mazzantini (NA-SA, Argentina)

Mr. Oscar Mazzantini has over 35 years of experience in the Nuclear sector in Argentina and internationally. His field of expertise includes Safety Analysis, Licensing, Thermal-Hydraulics; specific expertise in Analyses related to Nuclear Power Plant behavior during accident conditions and the corresponding Assessment and Validation of used Computer Codes. He worked for 16 years at ENACE (a joint venture between Siemens-KWU and the CNEA-Argentina Nuclear Energy Commission) 7 of which he worked at Siemens-KWU in Germany. He also worked at NA-SA where he was responsible for the Safety and Licensing of Aucha2 NPP. At the present he is Safety Analysis and Core Design Manager for the new NPP at NA-SA.

Shinya Mizokami (TEPCO, Japan)

Dr. Shinya Mizokami is a Manager at Fukushima Daiichi Decontamination and Decommissioning Engineering Company, Tokyo Electric Power Company Holdings (TEPCO HD), and is assigned to work on Analysis of the Fukushima Dai-ichi accident since July 2011. He and his team have made great contributions to clarify plant behavior during the accident, such as uncontrolled longer term RCIC operation, unexpected ADS activation, etc. He earned a doctoral degree in nuclear engineering at the University of Tokyo in 2000. After joining TEPCO, he had been involved in safety analysis and its licensing work on AOO and DBA over 10 years.

Mike Modro (NINE, Italy)

Mr. Mike Modro has over 40 years of experience in research and engineering, including over 30 years in Nuclear Reactor Design, Licensing and Safety Research. His field of expertise includes: Analyses and Research related to NPP behavior during accident conditions; Assessment and Validation of various Computer Codes; Development and conduct of Experimental programmes; Programme and line Management, Business and Resource development. He worked over 25 years within the INL (USA) and 6 years as Senior Safety Assessment Officer for the IAEA. He is a Guest Lecturer for the Imperial College of London (UK). He has a background in Physics from the University of Bern (Switzerland) and the University of Warsaw (Poland).

Upendra Rohatgi (BNL, USA)

Dr. Upendra Rohatgi is on scientific staff of BNL since 1975 and is currently a senior scientist. He received his Ph.D from Case Western Reserve University, Cleveland, in Mechanical Engineering. He has been contributing to US NRC programs for thermal-hydraulic code development, validation, scaling methods and uncertainty analyses for different scenarios for LWR since 1975. He has consulted with AECL and OPG Canada for development of uncertainty methods for CANDU transients. In addition, he is leading a task force for developing guidelines for multi-physics code validation and uncertainty methods for OECD/NEA expert group. He is currently a thermal-hydraulic consultant to Advisory Committee for Reactor Safeguards of US NRC.

Grzegorz Rzentkowski (IAEA, Austria)

Dr. Greg Rzentkowski joined the IAEA as Director of Nuclear Installation Safety in 2015. He has over 35 years of experience in mechanical and nuclear engineering. He began his nuclear career in 1989 in Ontario Hydro, Canada, as a Senior Research Engineer. Since joining the CNSC in 1995, he has held progressively responsible positions in management of technical and regulatory programs. In 2008, he was named Director General of the Directorate of Power Reactor Regulation. He also chaired the Fukushima Task Force which developed Canada's action plan for implementation of safety improvements.
He holds a Ph.D in Mechanical Engineering and has served as Adjunct Professor at McMaster University, Canada.

Plenary Sessions (PS) and Panel Discussion Sessions (PDS)

	Monday, May 14	Tuesday, May 15	Wednesday, May 16	Thursday, May 17	Friday, May 18
Morning	**Welcome Address** *Chair: Y. A. Hassan (TAMU)* *Speakers: M. Modro (NINE)* *A. Petruzzi (NINE)* *N. Dinh (NCSU)* *T. Valentine (ORNL)* Room: Puccini: **08:00-08:30** **PS: BEPU Methodology: Technical and Regulatory Requirements** *Chair: T. Valentine (ORNL)* *Lecturers: M. Modro (NINE)* *U. Rohatgi (BNL)* Room: Puccini: **08:30-09:30** **PS: BEPU in Thermal-Hydraulics: Current Issues, Challenges and Future Perspectives** *Chair: Y.A. Hassan (TAMU)* *Lecturers: F. D'Auria (UNIPI)* *D. Bestion (CEA)* Room: Puccini: **09:30-10:30**	**PS: BEPU Methodology: Technical and Regulatory Requirements** *Chair: G. Bruna (IRSN)* *Lecturers: G. Rzentkowski (IAEA)* *J. Kaneko (NRA-J)* Room: Puccini: **10:00-11:00**	**PS: BEPU Methodologies and V&V Process** *Chair: H. Nakamura (JAEA)* *Lecturers: G. Bruna (IRSN)* *K. Y. Choi (KAERI)* Room: Puccini: **10:00-11:00**	**PS: BEPU Methodologies and Industrial Applications** *Chair: M. Modro (NINE)* *Lecturers: O. Mazzantini (NA-SA)* *S. Mizokami (TEPCO)* *L. Gerken (FRAMATOME)* Room: Puccini: **11:30-13:00**	**PS: Multi-Physics and Multi-Scale Simulation Tools** *Chair: K. Ivanov (NCSU)* *Lecturers: J. Gulliford (OECD-NEA)* *D. Kropaczek (NCSU)* Room: Puccini: **08:30-09:30** **Summary and Closing** *Chair: G. Bruna (IRSN)* *Speakers: M. Modro (NINE)* *T. Valentine (ORNL)* *A. Petruzzi (NINE)* Room: Puccini: **12:00-13:00**
Afternoon	**PDS: BEPU and V&V** *Moderator: E. Ivanov (IRSN)* *Lecturers: B. Rearden (ORNL)* *A. Bouloré (CEA)* *K. Velkov (GRS)* *J. Baccou (IRSN)* Room: Santa Maria: **14:00-16:00** **PDS: Multi-Physics BEPU** *Moderator: S. Cetiner(ORNL)* *Lecturers: M. Cherubini (NINE)* *T. Quinn (Tech. Res.)* *S. Croft (ORNL)* *J.P. Hudelot (CEA)* Room: San Donato: **14:00-16:00**	**PDS: BEPU Methodologies** *Moderator: T.Kozlowski (UIUC)* *Lecturers: J. Hou (NCSU, US)* *H. Glaeser (Consultant)* *A. Petruzzi (NINE)* *E. Ivanov (IRSN)* Room: Santa Maria: **14:00-16:00** **PDS: Multi-Physics BEPU** *Moderator: N. Dinh (NCSU)* *Lecturers: K. Ivanov (NCSU)* *A. Bouloré (CEA)* *K. Velkov (GRS)* *M. Avramova (NCSU)* *E. Royer (CEA)* *C. Schneidesch (TE)* Room: San Donato: **14:00-16:00**		**PDS: BEPU Methodologies** *Moderator: A. Petruzzi (NINE)* *Lecturers: C. Frepoli (FPoliSolutions)* *J.C. Le Pallec (CEA)* Room: Santa Maria: **14:00-16:00** **PDS: International Programs Devoted to BEPU** *Moderator: M. Avramova (NCSU)* *Lecturers: E. Royer (CEA)* *F. Reventos (UPC)* *M. Krause (IAEA)* *G. Rimpault (CEA)* *D. Novog (McMaster)* Room: San Donato: **14:00-16:00**	

Panel Moderators (Alphabetic order)

Maria Avramova (NCSU, USA)

Dr. Maria Avramova is Associate Professor at North Carolina State University (NCSU). She serves as Director of the Consortium for Nuclear Power at NCSU, Director of Reactor Dynamics and Fuel Modeling Group, and Coordinator of the CTF Users' Group. Avramova earned Ph.D. in nuclear engineering from the Pennsylvania State University. Between 1994 and 2001, she held a research scientist position at the Institute of Nuclear Research and Nuclear Energy, Bulgarian Academy of Science, Bulgaria. Avramova is a coordinator of the OECD LWR Uncertainty Analysis in Modeling Benchmark, and a member of OECD NEA Expert Group on Multi-Physics Experimental data, Benchmarking, and Validation.

Sacit Cetiner (ORNL, USA)

Dr. Sacit Cetiner is a research scientist in the Reactor and Nuclear Systems Division at Oak Ridge National Laboratory (ORNL). His current research activities include instrumentation and control system design and development for advanced reactors, autonomous control systems, system-level modeling and simulation.
Dr. Cetiner received his B.S. degree in Nuclear Engineering from Hacettepe University in Turkey, M.S. degree in Electrical Engineering and Ph.D. in Nuclear Engineering from Penn State University. He is a member of American Nuclear Society, and is currently the Chair of the Human Factors, and Instrumentation and Controls Division.

Prof. Nam Dinh (NSCU, USA)

Dr. Nam Dinh is a professor of nuclear engineering at North Carolina State University, and a joint faculty appointment with the Oak Ridge National Laboratory. Prior to NCSU, he was a professor of nuclear power safety at Sweden's Royal Institute of Technology, and a Laboratory Fellow at the Idaho National Laboratory. Professor Dinh's current research is focused on data-driven modeling and validation of advanced simulation codes. He is a Fellow of the American Nuclear Society and a recipient of the ANS-THD Technical Achievement Award.

Evgeny Ivanov (IRSN, France)

Dr. Evgeny Ivanov has PhD degree in mathematical physics and over 27 years of experience in nuclear engineering being graduated from National Research Nuclear University MEPhI (Moscow Engineering Physics Institute).
Working for long term on scientific management positions in leading Russian institutions (Institute for Physics and Power Engineering and National Research Centre "Kurchatov Institute") he led and coordinated numerous projects from feasibility studies and conceptual design to deployment of advanced and innovative nuclear power systems.
Nowadays he is working for French TSO "Institut de Radioprotection et de Surete Nucleaire" being involved in research programmes on experimental validation of numerical tools and evidence-based simulations.

Tomasz Kozlowski (UIUC, USA)

Dr. Tomasz Kozlowski is an Associate Professor of Nuclear, Plasma, and Radiological Engineering at the University of Illinois at Urbana-Champaign, where he works since 2011. He received Ph.D. in Nuclear Engineering from Purdue University in 2005, where he worked on spatial homogenization methods for transport calculation and PARCS code development. He received Docent in Nuclear Power Safety at the Royal Institute of Technology in Stockholm, Sweden in 2011, where he worked on BWR stability, BWR safety and multi-physics coupling. His current research concentrates on reactor physics and thermal-hydraulics, multi-physics methods for reactor safety analysis, forward and inverse methods for uncertainty quantification.

Alessandro Petruzzi (NINE, Italy)

Dr Alessandro Petruzzi is President of the Board of Directors of Nuclear and INdustrial Engineering (NINE) since 2011. He received Ph.D. in Nuclear and Industrial Safety from University of Pisa where he worked on development of Uncertainty Methods for system thermal-hydraulics codes and application of BEPU methodology to Safety Analysis in Licensing framework. From 2007 to 2013 he acted as deputy manager of GRNSPG (University of Pisa) working on the preparation of Chapter 15 of FSAR of Atucha-2 NPP in Argentina. His current research concentrates on thermal-hydraulics, multi-physics methods for reactor safety analysis, forward and inverse methods for uncertainty quantification and he is member of several NEA working group both at NSC and CSNI. In 2013 he was the main organizer of NURETH-15 in Pisa.

Key-Note Lecturers (Alphabetic order)

David Aumiller
(BETTIS, USA)

Dr. David Aumiller has been employed at the Bettis Atomic Power Laboratory site of the Naval Nuclear Laboratory for more than 20 years as a thermal-hydraulic code and methods developer. He is a co-inventor of the R5EXEC software system which provides stable and well defined interfaces for reactor kinetics, T-H and control system coupling. He has published in the areas in the development of integrated code systems, numerically stable T-H coupling methods, uncertainty quantification, advanced verification techniques.

Antoine Bouloré
(CEA, France)

Dr Antoine Bouloré obtained his PhD in Material Science at Ecole des Mines de Saint Etienne on MOX fuel behaviour modelling. He works since 2001 at CEA Cadarache in the Fuel Research Department, he is an expert in Fuel behavior modelling and simulation. He is also Deputy Project Manager in "Fuel Behaviour Modelling Activities". He is a contributor to several international projects and benchmarks for OECD and IAEA mixing fuel modelling and uncertainty quantification/sensitivity analysis.

Stefano Caruso
(NAGRA, Switzerland)

Dr. Stefano Caruso is Principal Project Manager of the Radioactive Materials "Inventories and Logistics" Section of the National Cooperative for the Disposal of Radioactive Waste. He is responsible for spent fuel and high-level waste assessment and developing and leading research programs for operational and long-term safety analysis. He obtained his PhD in Reactor Physics at the École polytechnique fédérale de Lausanne. He worked for five years at the Beznau Nuclear Power Plant on core monitoring.

Milorad Dzodzo
(Westinghouse, USA)

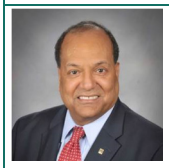
Dr. Milorad B. Dzodzo is a fellow engineer in Engineering Analysis Group in Westinghouse, USA. He obtained his Ph.D. from University of Belgrade, Serbia. Academic experience includes teaching and mentoring at University of Belgrade, Serbia, University of Akron, USA, and Carnegie Mellon, USA. Industry research experience started at Westinghouse USA, in 1996. Research expertise and interests include analysis, numerical modeling and experimental testing in a variety of fields.

Cesare Frepoli
(FPoliSolutions, USA)

Dr. Cesare Frepoli (PhD, 2001, Penn State) is the founder and CEO of FPoliSolutions, LLC. Areas of expertise include numerical modelling and simulation of fluid systems, TH processes and data analysis for computer codes development and validation. He is the inventor and developer of important uncertainty analysis methodologies currently used in the industry. He acquired a vast knowledge in legacy thermal-hydraulic test programs and participated in several key experimental campaigns in support to the licensing NPP.

Horst Glaeser
(Consultant, Germany)

Dr. Horst Glaeser got his PhD in Process Engineering from Technical University Berlin, Germany. He worked in the design and construction of chemical plants and nuclear reprocessing plants at UHDE GmbH in Dortmund, Germany. He joined the GRS in in 1980. Since 2002 he was Head of Cooling Systems Department at GRS up to his retirement in July 2014. He was lead manager of the development and application of the statistical GRS uncertainty analysis method. Now he is Senior Consultant in nuclear reactor safety analysis.



Yassin Hassan
(TAMU, USA)

Professor Yassin Hassan is a professor in the Department of Nuclear Engineering and of Mechanical Engineering at TAMU. He got his Ph.D. from University of Illinois. He was principal engineer at B&W Company's Nuclear Power Division in Virginia. He is a registered professional engineer in Texas and a Fellow of the ASME and the ANS. He was the recipient of the George Westinghouse Gold Medal of ASME and Arthur Holly Compton Award of ANS. Hassan's research interest is in the areas of computational and experimental fluid mechanics and turbulence.

Luis E. Herranz
(CIEMAT, Spain)

Dr. Luis E. Herranz got his PhD from the Polytechnich University of Madrid. He is the head of the research group on nuclear safety in CIEMAT since 1999. His investigation has addressed severe accidents, fuel thermo-mechanics, thermal-hydraulics of passive safety systems and power cycles for Gen IV reactors. He is the chairman of the NEA Working Group on Analysis and Management of Accidents (WGAMA). He is also a professor at the Department of Mechanical Engineering of UPCO-ICAI since 10 years.

Mathieu Hursin
(PSI, Switzerland)

Dr. Mathieu Hursin obtained his Master of Nuclear Engineering from the Purdue University in 2005 and a PhD in Nuclear Engineering from the U.C. Berkeley in 2010 in the field of neutronics computational methods development. He works since 2011 at the Paul Scherrer Institut in Switzerland in the domain of Sensitivity and Uncertainty analysis. He moved in 2014 to the École Fédérale Polytechnique de Lausanne to lecture and focus on experimental activities related to the field of neutron transport.

Bertrand Iooss
(EdF, France)

Dr. Bertrand Iooss obtained his PhD at the Paris School of Mines. He was a research-engineer at the Nuclear Energy Division of CEA. He is currently a senior researcher at EDF R&D, managing a CEA-EDF-AREVA research project called "Uncertainty and validation of computer models". His research interests include computer experiments modelling, uncertainty and sensitivity analysis, geostatistics, sampling techniques, nuclear safety.

Matthias Krause
(IAEA, Austria)

Mr Matthias Krause leads the Heavy Water Reactor Technology Development activities in the Nuclear Energy department at the IAEA. He has worked at Whiteshell and Chalk River Laboratories of Atomic Energy of Canada, holding positions of Section Head for Containment and Severe Accident Behaviour, and Branch Manager of TH R&D. His expertise is in primary heat transport system and containment thermalhydraulics, safety analysis and experimental R&D related to CANDU reactors.

Rafael Mendizábal
(CSN, Spain)

Dr. Rafael Mendizábal obtained a PhD in Science from the Universidad Politécnica de Madrid. He works since 1986 at the Consejo de Seguridad Nuclear in Spain. His areas of expertise are: Deterministic Safety Analysis on Nuclear Power Plants, Thermohydraulic Modelling and Simulation, Nuclear Fuel design analysis, Uncertainty and Sensitivity analysis.

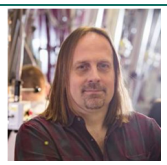
Key-Note Lecturers (Alphabetic order)

Jozef Misak
(NRI, Czech Republic)

Dr. Jozef Misak has 47 years of experience in nuclear engineering and nuclear safety. More than 30 years of managerial experience in non-governmental, governmental and international organisations in various posts up to general director of the Nuclear Power Plant Research Institute in Slovakia, and first chairman of the Nuclear Regulatory Authority of the Slovak Republic. He was Head of the IAEA Safety Development Unit. He is working in UJV Rez (NRI) as Vice-President for Strategy Development focusing mainly on management and coordination of nuclear safety matters in connection with major projects of the institute nationally and internationally.

Hideo Nakamura
(JAEA, Japan)

Dr. Hideo Nakamura got PhD in Nuclear Engineering from Nagoya University, Japan. He joined former JAERI at Tokai to work for the ROSA (Rig-of-Safety Assessment) program to study reactor accidents for both of BWR and PWR with large-scale experiments under reactor prototypical conditions. In 2001, he became Head of Thermo-hydraulic Safety Research Group dedicated both of Severe Accident and Beyond Design-basis Accidents. Since 2005, he was Head of Operating Agent of the OECD/NEA ROSA and ROSA-2 Projects with LSTF experiments. Now he is Senior Associate for Nuclear Safety Research Center of Japan Atomic Energy Agency (JAEA).



David Novog
(McMaster, Canada)

Dr. David Novog is a professor at McMaster University and an Industrial Research Chair in Nuclear Safety. He has over 20 years of experience in best estimate and uncertainty analysis working at utilities, in consulting, and academia. While in industry Dr. Novog piloted new uncertainty analysis methods for reactivity induced accidents with successful application in licensing, and has continued this work at McMaster by prototyping applications of multi-variate methods for safety analysis. He has been an invited expert reviewer for several best-estimate based safety-cases and has provided support to non-nuclear sectors such as defence and the insurance industries.

Mathew Panicker
(USNRC, USA)

Dr. Mathew Panicker is a Reactor Engineer at the Nuclear Performance and Code Review Branch at the Office of Nuclear Reactor Regulation (NRR) of US NRC with technical lead for fuel design/performance methodology, core physics and core thermal hydraulics. He was a nuclear design engineer at Fort Calhoun Nuclear plant (FCS) in Omaha, Nebraska. He taught engineering courses at Southern Company NPPs. He holds a Ph.D. and MS in Nuclear Engineering. He is a licensed professional engineer (PE). He was chosen as the Federal Engineer of the Year for the USNRC by National Society of Professional Engineers (NSPE) for 2018.

Yüksel Parlatan
(OPG, Canada)

Dr. Yuksel Parlatan is the manager of Safety Analysis Improvement Department at Ontario Power Generation in Canada. His primary responsibilities include safety analysis support for demonstrably safe operation of 10 CANDU reactors. He has spent more than a decade on improving and adopting safety analysis methods, including BEPU, to address adverse impacts of reactor ageing on safety margins with positive results; no derating of units. Prior to joining OPG in 1999, he worked at Atomic Energy of Canada in Ontario, and Brookhaven National Laboratory in New York. Dr Parlatan obtained his Ph.D. in Nuclear Engineering at MIT in 1993.

Gustav Robertson
(Westinghouse Electric, Sweden)

Mr. Gustav Robertson is a Senior Engineer at Westinghouse Electric Sweden. As a member of the Fuel Engineering Department, he has been engaged in different Fuel Rod Design analyses and is currently responsible for the maintenance of the software package for performing such thermo-mechanical evaluations. He is currently pursuing specific R&D work in advanced statistical methodologies, with particular focus on rigorous treatment of uncertainties.He has acquired significant experience in fuel performance modelling and related safety analyses. He got his Master's degree at Uppsala University.

Eric Royer
(CEA, France)

Mr. Eric Royer has a Nuclear Engineering Degree from Grenoble INP (now Phelma engineering school). First experience at AECL (Chalk River laboratories, Canada), on Critiacl Heat Flux look-up table and Steam Generator computation, 1993-94. Code development in reactor physics (neutronics and thermal-hydraulics) at EDF, R&D Division, 1994-96. Nuclear reactor simulation and modeling at CEA, Nuclear Energy Division, 1997-2008.
Professor in nuclear engineering and reactor physics (thermal-hydraulics), Head of Nuclear Engineering Unit at CEA/INSTN, 2009-14. Technical project management, Service for French navy nuclear reactors, CEA, 2015-now. CEA senior expert in reactor thermal-hydraulics, member of the Expert Group on Uncertainty Analysis in Modelling (OECD/NEA).

Jinzhao Zhang
(Tractebel, Belgium)

Dr. Jinzhao Zhang is Chief Engineer and Key Expert at Tractebel (ENGIE), in charge of the nuclear fuel modelling, safety analysis, design evaluation and licensing. He has over 40 years' experience in nuclear and thermal power plant thermal hydraulics, thermal mechanics, multi-physics, uncertainty analysis, safety analysis and licensing. He has extensive experience in development, review and licensing of BEPU methodology for safety analysis. He has provided consultancy to several international customers or organizations for fuel safety analyses and licensing. He holds a Ph. D. in mechanical engineering (Université catholic de Louvain, 1993). He is a member of various committees, working groups or expert groups at IAEA, OECD and PWROG, and is a co-leader of several international benchmark projects.

Winfried Zwermann
(GRS, Germany)

Dr Winfried Zwermann studied General Physics at the Technical University of Munich, where he obtained his degree in theoretical nuclear physics in 1986. For almost 30 years, he has been employed at Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) in Garching. His scientific work is mainly focussed on deterministic and Monte Carlo neutron transport for criticality and reactor core behaviour applications, as well as the development of methods for uncertainty and sensitivity analyses accompanying these simulations.

Key Note Lectures (KN)

	Monday, May 14	Tuesday, May 15	Wednesday, May 16	Thursday, May 17	Friday, May 18
Morning	**Key Note KN-A2** *Lecturer: J. Zhang* *(TE, Belgium)* Room: S. Maria **11:00-11:30** **Key Note KN-B1** *Lecturer: C. Frepoli* *(FPoliSolutions, USA)* Room: S. Donato **11:00-11:30** **Key Note KN-C7** *Lecturer: L. Herranz* *(CIEMAT, Spain)* Room: Elisa **11:00-11:30**	**Key Note KN-A1** *Lecturer: M. Panicker* *(NRC, USA)* Room: S. Donato **08:30-09:00** **Key Note KN-F1** *Lecturer: H. Glaeser* *(Consultant, Germany)* Room: Elisa **08:30-09:00**	**Key Note KN-A4** *Lecturer: M. Hursin* *(PSI, Switzerland)* Room: Elisa **08:30-09:00** **Key Note KN-B3** *Lecturer: D. Novog* *(McMaster Canada)* Room: S. Donato **11:30-12:00**	**Key Note KN-B2** *Lecturer: R. Mendizábal* *(CSN, Spain)* Room: S. Maria **08:30-09:00** **Key Note KN-D1** *Lecturer: J. Misak* *(NRI, Czech Republic)* Room: S. Donato **08:30-09:00** **Key Note KN-E7** *Lecturer: W. Zwermann* *(GRS, Germany)* Room: Elisa **08:30-09:00**	
Afternoon	**Key Note KN-A3a** *Lecturer: M, Dzodzo* *(Westinghouse, USA)* Room: S. Maria **16:30-17:00** **Key Note KN-A3b** *Lecturer: H. Nakamura* *(JAEA, Japan)* Room: S. Maria **17:00-17:30** **Key Note KN-C5** *Lecturer: Y.A. Hassan* *(TAMU, USA)* Room: Elisa **16:30-17:00**	**Key Note KN-C1** *Lecturer: E. Royer* *(CEA, France)* Room: S. Maria **16:30-17:00** **Key Note KN-E3** *Lecturer: S. Caruso* *(NAGRA, Switzerland)* Room: S. Donato **16:30-17:00**	**Key Note KN-E8a** *Lecturer: G. Robertson* *(Westinghouse, Sweden)* Room: S. Maria **14:00-14:30** **Key Note KN-E8b** *Lecturer: A. Bouloré* *(CEA, France)* Room: S. Maria **14:30-15:00** **Key Note KN-B4** *Lecturer: B. Iooss* *(EdF, France)* Room: S. Donato **14:00-14:30** **Key Note KN-C3** *Lecturer: D. Aumiller* *(Bettis, USA)* Room: S. Donato **16:30-17:00**	**Key Note KN-E2** *Lecturer: M. Krause* *(IAEA, Austria)* Room: S. Maria **16:30-17:00** **Key Note KN-D2** *Lecturer: Y. Parlatan* *(OPG, Canada)* Room: S. Donato **16:30-17:00**	

UAM - LWR (Light Water Reactor Uncertainty Analysis in Modelling benchmark)

The OECD/NEA UAM-LWR Benchmark is an international high-visibility benchmark for uncertainty analysis in best-estimate coupled code calculations for design, operation, and safety analysis of LWRs. The benchmark activities are coordinated by the NCSU faculty: Dr. Maria Avramova and Dr. Kostadin Ivanov in cooperation with Dr. Eric Royer from CEA, France.

UAM - SFR (Sodium-cooled Fast Reactors Uncertainty Analysis in Modelling benchmark)

One of the tasks of the OECD/NEA sub-group on Uncertainty Analysis in Modelling (UAM) of Sodium-cooled Fast Reactors (SFR-UAM) under the NSC/WPRS/EGUAM is to perform a code-to-code comparison on neutronic feedback coefficients and associated uncertainties calculated for transient analyses. G. Rimpault from CEA, France lead the benchmark activities in cooperation with ANL.

MPCMIV (Multi-physics Pellet Clad Mechanical Interaction Validation benchmark)

N.IN.E. in cooperation with Studsvik, has proposed the Multi-physics Pellet Cladding Mechanical Interaction Validation (MPCMIV) benchmark, that is fully consistent with the objectives of the OECD/NEA Expert Group on Multi-Physics Experimental Data, Benchmarks and Validation (EGMPEBV). The goals of the MPCMIV benchmark are:

- Methodologies for validation of single and coupled physics phenomena.
- Derivation of validation requirements.
- Derivation of an accuracy metric.
- Uncertainty methodologies to extrapolate beyond the validation domain.

CANDU T-H (Blind Benchmark on CANDU Thermal-hydraulics)

The BFBT benchmarks provided direct benefits to the industry for testing the capabilities for simulating void fraction, pressure drop and CHF and for the development and validation of new methods. It has been almost a decade since the initial benchmarks were performed and a considerable amount of development has been done since that time. CANDU geometry and conditions while different than BWR/PWR, cover some conditions of interest (e.g. some CHF occurs in annular film dryout conditions while other data covers nucleate boiling heat transfer). There is international interest in a new benchmark for full scale data in bundle geometries. The operators in Canada have agreed in principle to release some full scale data from their experimental data base for CHF and Post Dry Out phenomena.

ROSTOV-2 (VVER-1000 benchmark)

A large number of tests with a multitude of well-documented neutron-physics and thermal-hydraulics measurements data have been performed at Rostov - Unit 2 (Rostov-2) NPP (VVER-1000). Integral (plant) data and local (core) measured data were collected during the test, which will be used for the validation of both traditional and novel multi-physics codes. The measurement and recording of parameters was performed by the standard means available at NPP and by a special system of experimental control.

The benchmark team consisting from NCSU, GRS, VNIIAES and KI, elected a test (transient), which will allow validation of novel multi-physics codes developed last years in the frame of different national and international projects. The difference in comparison with all previous OECD/NEA Benchmarks for coupled code validation is the implementation of high fidelity multi-physics simulation codes that could predict pin-by-pin power distributions and flow mixing in the primary loop, in the reactor pressure vessel including its active core part.

C5G7-TD (Deterministic Time-Dependent Neutron Transport Benchmark without Spatial Homogenization)

Existing benchmark problems are not able to satisfy the demand for verifying codes/methods for performing the homogenization-free time-dependent transport calculations. On one hand, some of them are simplified diffusion benchmarks, in which the computational domain is composed of several homogeneous regions. On the other hand, some of them have a broad range of sources of uncertainties involved in the calculation, such as the nuclear data, group cross section preparation procedure, and potentially other computational simplifications, making it difficult to reveal methodical errors of space-time neutron kinetics codes. The current benchmark model is based on the well-studied steady-state C5G7 benchmark problems, which were developed to test the capabilities of radiation transport codes that do not utilize spatial homogenization above the fuel pin level. It is a miniature light water reactor (LWR) with sixteen fuel assemblies (mini-core): eight uranium oxide (UO2) assemblies and eight mixed oxide (MOX) assemblies, surrounded by a water reflector. It features a quarter-core radial symmetry in the 2-dimensional (2-D) configuration.

CTF (COBRA-TF User Group)

COBRA-TF is a thermal-hydraulic simulation code designed for Light Water Reactor (LWR) vessel and core analysis. It uses a two-fluid three-field modeling approach. CTF is the shortened name given to the version of COBRA-TF being developed and improved by the Reactor Dynamics and Fuel Modeling Group (RDFMG) at the North Carolina State University (NCSU).
CTF's User Group(UG) is established to maintain the so-called "gold-standard" of CTF and provide unified and up-to-date code version supplemented with extended verification and validation suite, automated test matrix, and application guidelines. The CTF UG holds annual meetings usually in May, which involve all interested users with objective to discuss on the progress in achieving a common version, and to review the contributions from different organizations to the common version (including code development, improvement, coupling with other models-multi-physics and multi-scale code systems, verification and validation, uncertainty quantifications, and applications).

OECD-NEA Workshops

	Monday, May 14	Tuesday, May 15	Wednesday, May 16	Thursday, May 17	Friday, May 18
Morning	**Opening** *Chairs: J. Dyrda (OECD-NEA, France)* *G. Rimpault (CEA, France)* *M. Avramova (NCSU, USA)* *D. Novog (McMaster, Canada)* *K. Ivanov (NCSU, USA)* Room: Workshop Room A **09:00-09:30** **SFR-UAM-4** *Coordinator: G. Rimpault (CEA, France)* Room: Workshop Room A **09:30-13:00** **CTF-5** *Coordinator: M. Avramova (NCSU, USA)* Room: Workshop Room B **09:30-13:00**	**SFR-UAM-4** *Coordinator: G. Rimpault (CEA, France)* Room: Workshop Room A **09:00-13:00** **CTF-5** *Coordinator: M. Avramova (NCSU, USA)* Room: Workshop Room B **09:00-13:00**	**Opening** *Chairs: J. Dyrda (OECD-NEA, France)* *M. Avramova (NCSU, USA)* *K. Ivanov (NCSU, USA)* *A. Petruzzi (NINE, Italy)* *K. Velkov (GRS, Germany)* *J. Hou (NCSU, USA)* Room: Workshop Room A **09:00-09:30** **LWR-UAM-12** *Coordinator: K. Ivanov (NCSU, USA)* Room: Workshop Room A **09:30-13:00** **MPCMIV** *Coordinator: A. Petruzzi (NINE, Italy)* Room: Workshop Room B **09:30-13:00**	**LWR-UAM-12** *Coordinator: K. Ivanov (NCSU, USA)* Room: Workshop Room A **09:00-13:00** **MPCMIV** *Coordinator: A. Petruzzi (NINE, Italy)* Room: Workshop Room B **09:00-13:00**	**ROSTOV2** *Coordinator: M. Avramova (NCSU, USA)* Room: Workshop Room A **09:00-13:00** **C5G7-TD-3** *Coordinator: J. Hou (NCSU, USA)* Room: Workshop Room B **09:00-13:00**
Afternoon	**SFR-UAM-4** *Coordinator: G. Rimpault (CEA, France)* Room: Workshop Room A **14:00-18:00** **CTF-5** *Coordinator: M. Avramova (NCSU, USA)* Room: Workshop Room B **14:00-18:00**	**SFR-UAM-4** *Coordinator: G. Rimpault (CEA, France)* Room: Workshop Room A **14:00-18:00** **CANDU-TH** *Coordinator: D. Novog (McMaster, Canada)* Room: Workshop Room B **14:00-18:00**	**LWR-UAM-12** *Coordinator: K. Ivanov (NCSU, USA)* Room: Workshop Room A **14:00-18:00** **MPCMIV** *Coordinator: A. Petruzzi (NINE, Italy)* Room: Workshop Room B **14:00-18:00**	**LWR-UAM-12** *Coordinator: K. Ivanov (NCSU, USA)* Room: Workshop Room A **14:00-18:00** **C5G7-TD** *Coordinator: J. Hou (NCSU, USA)* Room: Workshop Room B **14:00-18:00**	**ROSTOV2** *Coordinator: M. Avramova (NCSU, USA)* Room: Workshop Room A **14:00-18:00** **C5G7-TD-3** *Coordinator: J. Hou (NCSU, USA)* Room: Workshop Room B **14:00-18:00**

	Sunday, May 13	Monday, May 14	Tuesday, May 15	Wednesday, May 16	Thursday, May 17	Friday, May 18
Morning						**Closing Meeting of TPC & SC Chairs** *Chairs:* M. Modro (NINE) N. Dinh (NCSU) T. Valentine (ORNL) G. Bruna (IRNS) M. El-Shanawani (NINE) A. Petruzzi (NINE) K. Ivanov (NCSU) H. Nakamura (JAEA) Conference Break-up Room **10:00-10:30**
Afternoon		**Paper Awards Committee** *Chairs: A. Petruzzi (NINE)* *N. Dinh (NCSU)* *M. Modro (NINE)* *K. Ivanov (NCSU)* Conference Break-up Room Real Collegio **18:30-19:00**			**Journal Publication Committee** *Chairs: A. Petruzzi (NINE)* *N. Dinh (NCSU)* *M. Modro (NINE)* *K. Ivanov (NCSU)* *H. Nakamura (JAEA)* *B. Iooss (EdF)* *E. Royer (CEA)* *E. Ivanov (IRNS)* *T. Valentine (ORNL)* *A. Bouloré (CEA)* Conference Break-up Room **16:30-17:30**	
Dinner	**Welcome Reception** Real Collegio **18:30-23:00**	**Conference Dinner Banquet with Lucca Historical Representation** Real Collegio **19:30-23:00** **Acknowledgments for invited lecturers** *Chairs: M. Cherubini (NINE)* *V. Parrinello (NINE)* **20:30-20:45** **Honor Awards Ceremony** *Chairs: T. Valentine (ORNL)* *A. Petruzzi (NINE)* **21:30-21:45**	**Dinner above the Lucca City Walls** Caffé delle Mura **19:30-23:00**	**BEPU2018 Official Dinner in Historical Lucca Palace** Pfanner Palace **19:30-23:00** **Best Conference Papers** *Chairs: N. Dinh (NCSU)* *M. Modro (NINE)* *K. Ivanov (NCSU)* **21:30-21:45**	**Closing Dinner on the Lucca Hills** Tenuta San Pietro **19:30-23:00**	

Conference Sessions

A. BEPU Methodology: Technical and Regulatory Requirements

A1. Licensing and Regulatory Requirements for BEPU
A2. V&V and BEPU
A3. Scaling Issue and BEPU
A4. Experimental Measurement Uncertainties and BEPU

B. BEPU Methodologies Development

B1. Statistical Methods for Uncertainty Analysis
B2. Bayesian Methods for Uncertainty Analysis
B3. Hybrid Methods for Uncertainty Analysis
B4. Sensitivity Methods as supporting tools for Uncertainty Analysis

C. BEPU for Multi-Physics and Multi-Scale Applications

C1. Thermal-Hydraulics (including I&C systems) and Reactor Physics
C2. Reactor Physics and Fuel Behavior
C3. Thermal-Hydraulics, Reactor Physics and Fuel Behavior
C4. BEPU and Distributed Computing for MP
C5. Role of CFD and/or of Structural Mechanics for MP BEPU
C6. BEPU Challenges for MP Applications including Numerical Issues
C7. Best-Estimate and Uncertainty Evaluation for Design Extension Condition (DEC) including Severe Accidents

D. BEPU Applications in Safety Analysis and Licensing Framework

D1. Light Water Reactors (PWR, WWER and BWR)
D2. Heavy Water Reactors (CANDU, PHWR)
D3. Small Modular Reactors

E. Other BEPU Application Results

E1. BEPU Applications for Passive System Applications
E2. BEPU Applications for GEN-IV and Other New Designs
E3. BEPU Applications for Spent Fuel
E4. BEPU Applications for Research Reactor Safety Analysis
E5. BEPU Applications for Simulator Applications
E6. BEPU Applications for Single Physics - Thermal-hydraulics
E7. BEPU Applications for Single Physics - Reactor Physics
E8. BEPU Applications for Single Physics - Fuel Performance

F. Recommendations and Findings for Developing Future BEPU Methodologies

F1. International Program Findings and Recommendations for BEPU
F2. Methodologies for Uncertainty Quantification in Non-Nuclear Disciplines
F3. Requirements for BEPU from Multi-physics and Multi-scale Simulation Tools

Technical Program Overview

	Sunday, May 13	Monday, May 14	Tuesday, May 15	Wednesday, May 16	Thursday, May 17	Friday, May 18
08:00		**Welcome** Room: Puccini				
08:30		**Plenary Sessions** Room: Puccini **08:30-10:30**	**Technical Sessions & Key Note Lectures** 08:30-10:00	**Technical Sessions & Key Note Lectures** 08:30-10:00	**Technical Sessions & Key Note Lectures** **08:30-11:00**	**Plenary Sessions** Room: Puccini **08:30-09:30**
09:00						
09:30						Coffee Break
10:00			**Plenary Sessions** Room: Puccini **10:00-11:00**	**Plenary Sessions** Room: Puccini **10:00-11:00**		**Technical Sessions & Key Note Lectures** 10:00-12:00
10:30		Coffee Break				
11:00		**Technical Sessions & Key Note Lectures** **11:00-13:00**	Coffee Break			
11:30			**Technical Sessions & Key Note Lectures** **11:30-13:00**	**Technical Sessions & Key Note Lectures** **11:30-13:00**	**Plenary Sessions** Room: Puccini **11:30-13:00**	
12:00						**Summary & Closing** Room: Puccini
12:30						
13:00		Lunch				
13:30						
14:00		**Panel Discussion Sessions** Rooms S. Maria & S. Donato **14:00-16:00**	**Panel Discussion Sessions** Rooms S. Maria & S. Donato **14:00-16:00**	**Technical Sessions & Key Note Lectures** **14:00-16:00**	**Panel Discussion Sessions** Rooms S. Maria & S. Donato **14:00-16:00**	
14:30						
15:00						
15:30						
16:00		Coffee Break				
16:30	**Conference Registrations** Real Collegio **16:30-18:30**	**Technical Sessions & Key Note Lectures** **16:30-18:30**	**Technical Sessions & Key Note Lectures** **16:30-18:30**	**Technical Sessions & Key Note Lectures** **16:30-18:30**	**Technical Sessions & Key Note Lectures** **16:30-18:30**	
17:00						
17:30						
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18:30						
19:30	**Welcome Reception** Real Collegio **18:30-23:00**	**Conference Dinner Banquet with Lucca Historical Representation** Real Collegio **19:30-23:00**	**Dinner above the Lucca City Walls** Caffé delle Mura **19:30-23:00**	**BEPU2018 Official Dinner in Historical Lucca Palace** Pfanner Palace **19:30-23:00**	**Closing Dinner on the Lucca Hills** Tenuta San Pietro **19:30-23:00**	
20:30		**Acknowledgments for invited lecturers** **20:30-20:45**				
21:30		**Honor Awards Ceremony** **21:30-21:45**		**Best Conference Papers** **21:30-21:45**		
23:00						

Technical Program at-a-Glance

	Sunday 13 May 2018	Monday 14 May 2018				WS		Tuesday 15 May 2018				WS		Wednesday 16 May 2018				WS		Thursday 17 May 2018				WS		Friday 18 May 2018				WS	
		CONFERENCE SESSIONS						CONFERENCE SESSIONS						CONFERENCE SESSIONS						CONFERENCE SESSIONS						CONFERENCE SESSIONS					
8:00		Welcome						S. Maria	S. Pietro	S. Donato	Elisa	ROOM A	ROOM B	S. Maria	S. Pietro	S. Donato	Elisa	ROOM A	ROOM B	S. Maria	S. Pietro	S. Donato	Elisa	ROOM A	ROOM B	S. Maria	S. Pietro	S. Donato	Elisa	ROOM A	ROOM B
8:30		BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS **PL-01: BEPU What else?** M. Modro (NINE, Italy)						A2 ID-110	C7 ID-176	KN-A1 **M. Panicker** (NRC, US)	KN-F1 **H. Glaeser** (Consultant, Germany)			C1 ID-285	Student-C ID-203	E3 ID-229	KN-A4 **M. Hursin** (PSI, Switzerland)			KN-B2 **R. Mendizbal** (CSN, Spain)	Student-E ID-123	KN-D1 **J. Misak** (NRI, Czech Rep)	KN-E7 **W. Zwermann** (GRS, Germany)			MULTI-PHYSICS AND MULTI-SCALE SIMULATION TOOLS **PL-12: NEA Activities to Support Uncertainty Quantification, Validation and Verification for Nuclear Systems Modeling** J. Gulliford (OECD/NEA)					
9:00		BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS **PL-02: Historical Perspectives of BEPU Research** U. Rohatgi (BNL, USA)				SFR-UAM-4	CTF-5	A2 ID-141	C7 ID-257	A1 ID-125	F1 ID-157	SFR-UAM-4	CTF-5	C1 ID-321	Student-C ID-204	E3 ID-290	A4 ID-244	LWR-UAM-4	MPCMIV Kick-off	B2 ID-096	Student-E ID-132	D1 ID-094	E7 ID-079	LWR-UAM-4	MPCMIV Kick-off	MULTI-PHYSICS AND MULTI-SCALE SIMULATION TOOLS **PL-13: CASL, Experiences in Multi-Physics and Multi-Scale Simulation Tool Development** D. Kropaczek (NCSU, USA)				ROSTOV 2 Kick-off	C5G7-TD-3
9:30		BEPU IN THERMAL-HYDRAULICS: CURRENT ISSUES, CHALLENGES AND FUTURE PERSPECTIVES **PL-10: BEPU Status and Perspectives** F. D'Auria (UNIPI, Italy)						A2 ID-187	C7 ID-276	A1 ID-201	F1 ID-310			C1 ID-291	Student-C ID-282	E3 ID-089	A4 ID-270			B2 ID-133	Student-E ID-205	D1 ID-103	E7 ID-092			Coffee Break					
10:00		BEPU IN THERMAL-HYDRAULICS: CURRENT ISSUES, CHALLENGES AND FUTURE PERSPECTIVES **PL-11: BEPU Methods using CFD Codes -Progress made within OECD-WGAM A CFD Activities** D. Bestion (CEA, France)						BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS **PL-03: BEPU Methodologies and Requirements from the Perspective of IAEA Safety Standard** G. Rzentkowski (IAEA, Austria)						BEPU METHODOLOGIES AND V&V PROCESS **PL-05: Uncertainty in Design and Operation How dealing with?** G. Bruna (IRSN, France)						B2 ID-166	Student-E ID-254	D1 ID-213	E7 ID-104			E2 ID-228	Student-E ID-160	D2 ID-280	E7 ID-239		
10:30		Coffee Break						BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS **PL-04: Status of BEPU study in NRA and Japan** J. Kaneko (NRA-J, Japan)						BEPU METHODOLOGIES AND V&V PROCESS **PL-06: Application of BEPU Methodologies in V&V Process** K.Y Choi (KAERI, South Korea)						B2 ID-171	Student-E ID-312	D1 ID-235	E7 ID-112			E2 ID-242	Student-E ID-186	D2 ID-313	E7 ID-241		
11:00		KN-A2 **J. Zhang** (TE, Belgium)	Student-A ID-165	KN-B1 **C. Frepoli** (FPoliSolutions, US)	KN-C7 **L. Herranz** (CIEMAT, Spain)			Coffee Break																		E2 ID-253	Student-E ID-246	D1 (ID-164)	E7 ID-174		Coffee Break
11:30		A2 ID-088	Student-A ID-118	B1 ID-114	C7 ID-102	SFR-UAM-4	CTF-5	A2 ID-188	Student-B ID-082	A1 ID-087	F1 ID-326	SFR-UAM-4	CTF-5	C7 ID-279	Student-D ID-075	KN-B3 **D. Novog** (McMaster, Canada)	A4 ID-305	LWR-UAM-4	MPCMIV Kick-off	BEPU METHODOLOGIES AND INDUSTRIAL APPLICATIONS **PL-07: Full BEPU Application for Chapter 15 of Atucha-2** O. Mazzantini (NASA, Argentina)				LWR-UAM-4	MPCMIV Kick-off		Student-E ID-295		E7 ID-322	ROSTOV 2 Kick-off	C5G7-TD-3
12:00		A2 ID-090	Student-A ID-120	B1 ID-127	C7 ID-149			A2 ID-262	Student-B ID-198	A1 ID-238	F1 ID-327			C7 ID-300	Student-D ID-156	B3 ID-143	A4 ID-323			BEPU METHODOLOGIES AND INDUSTRIAL APPLICATIONS **PL-08: Uncertainty Evaluation in Decommissioning related Tasks on Fukushima Daiichi Accident** S. Mizokami (TEPCO, Japan)						Summary & Closing					
12:30		A2 ID-108	Student-A ID-136	B1 ID-145	C7 ID-161			A2 ID-284	Student-B ID-231	A1 ID-299				C7 ID-325 (ID-261)	Student-F ID-129	B3 ID-172				BEPU METHODOLOGIES AND INDUSTRIAL APPLICATIONS **PL-09: Realistic Large Break LOCA Methodology for Pressurized Water Reactors** L. Gerken (Framatome, USA)											
13:00		LUNCH																													
14:00		BEPU AND V&V **PD-01: BEPU – Role of a Phenomenological Validation and Integral Experiments for Maturing the Predictive Simulations** **E. Ivanov (IRSN, France)** B. Rearden (ORNL, USA) A. Bouloré (CEA, France) K. Velkov (GRS, Germany) J. Baccou (IRSN, France)		MULTIPHYSICS BEPU **PD-05: Margin Management: Intersection of I&C and Safety Analysis** **S. Cetiner (ORNL, USA)** M. Cherubini (NINE, Italy) T. Quinn (Technology Resources, USA) S. Croft (ORNL, USA) J.P. Hudelot (CEA, France)		SFR-UAM-4	CTF-5	BEPU METHODOLOGIES **PD-02: Methodologies for Uncertainty Evaluation of BE Results: Advantages and Disadvantages of different Approaches** **T. Kozlowski (UIUC, USA)** J. Hou (NCSU, US) H. Glaeser (Consultant, Germany) A. Petruzzi (NINE, Italy) E. Ivanov (IRSN, France)		MULTIPHYSICS BEPU **PD-04: Interrelations between Thermal-hydraulics, Reactor Physics and Fuel Behavior modeling in BEPU Methodology** **N. Dinh (NCSU, USA)** K. Ivanov (NCSU, USA) A. Bouloré (CEA, France) K. Velkov (GRS, Germany) M. Avramova (NCSU, USA) E. Royer (CEA, France) C. Schneidesch (TE, Belgium)		SFR-UAM-4	CANDU-TH Kick-off	KN-E8a **G. Robertson** (WH, Sweden)	KN-B4 **B. looss** (EdF, France)	B3 ID-206	E6 ID-222	LWR-UAM-4	MPCMIV Kick-off	BEPU METHODOLOGIES **PD-03: Are Best Estimate Methodologies also Best-Efforts?** **A. Petruzzi (NINE, Italy)** C. Frepoli (FPS, USA) J. Le Pallec (CEA, France)		INTERNATIONAL PROGRAMS DEVOTED TO BEPU **PD-06: International Program Findings and Recommendations for BEPU** **M. Avramova (NCSU, USA)** E. Royer (CEA, France) F. Reventos (UPC, Spain) M. Kraus (IAEA, Austria) G. Rimpault (CEA, France) D. Novog (McMaster, Canada)		LWR-UAM-4	C5G7-TD-3					ROSTOV 2 Kick-off	C5G7-TD-3
14:30														KN-E8b **A. Bouloré** (CEA, France)	B4 ID-098	B3 ID-167	E6 ID-243													
15:00														E8 ID-085	B4 ID-236	B3 ID-286	E6 ID-245												
15:30														E8 ID-159	B4 ID-240	B3 (ID-314)	E6 ID-259												
16:00		Coffee Break																												Coffee Break	
16:30	Conference Registrations	KN-A3a **M. Dzodzo** (Westinghouse, US)	Student-A ID-232	B1 ID-191	KN-C5 **Y. Hassan** (TAMU, USA)	SFR-UAM-4	CTF-5	KN-C1 **E. Royer** (CEA, France)	Student-B ID-197	KN-E3 **S. Caruso** (NAGRA, Switzerland)	E6 ID-099	SFR-UAM-4	CANDU-TH Kick-off	E8 ID-297	F3 ID-309	KN-C3 **D. Aumiller** (BETTIS, US)	E6 ID-265	LWR-UAM-4	MPCMIV Kick-off	KN-E2 **M. Krause** (IAEA, Austria)	Student-E ID-139	KN-D2 **Y. Parlatan** (OPG, Canada)	E7 ID-147	LWR-UAM-4	C5G7-TD-3				ROSTOV 2 Kick-off	C5G7-TD-3
17:00		KN-A3b **H. Nakamura** (JAEA, Japan)	Student-A ID-255	B1 ID-207	C5 ID-162			C1 ID-128	Student-B ID-202	E3 ID-083	E6 ID-109			E8 ID-281	F3 ID-209	C3 ID-124	E6 ID-289			E2 ID-107	Student-E ID-196	D2 ID-278	E7 ID-148								
17:30		A3 ID-298	Student-A ID-304	B1 ID-234	C5 ID-211			C1 ID-226		E3 ID-126	E6 ID-130			E8 ID-311	F3 ID-194	C3 ID-178	E6 (ID-264)			E2 ID-247	Student-E ID-216	D1 ID-249	E7 ID-277								
18:00		A3 ID-190		B1 ID-251		ROOM A	ROOM B	C1 ID-252		E3 ID-182	E6 ID-195	ROOM A	ROOM B			C3 ID-319		ROOM A	ROOM B	E2 ID-250	Student-E ID-101	D1 ID-267	E7 ID-208	ROOM A	ROOM B						
18:30	Reception Banquet	S. Maria	S. Pietro	S. Donato	Elisa			S. Maria	S. Pietro	S. Donato	Elisa			S. Maria	S. Pietro	S. Donato	Elisa			S. Maria	S. Pietro	S. Donato	Elisa								
19:30		Conference Dinner Banquet with Lucca Historical Representation Real Collegio						Dinner above the Lucca City Walls Caffè delle Mura						BEPU 2018 Official Dinner in Historical Lucca Palace Pfanner Palace						Closing Dinner on the Lucca Hills Tenuta San Pietro											
23:00		Real Collegio																													

PL: Plenary Lecture — Room Puccini

KN: Key Note Lecture

PD: Panel Discussion — Rooms: S. Maria & S. Donato

Conference Paper ID

Student Paper ID

ROOMS

08:00-08:30	**Welcome Address (Room: Puccini)** *Session Chair: Y.A. Hassan (TAMU)* *Speakers: M. Modro (NINE), A. Petruzzi (NINE), T. Valentine (ORNL), N. Dinh (NCSU)*				
08:30-09:30	**Plenary Session (PS): BEPU Methodology: Technical and Regulatory Requirements (Room: Puccini)** *Session Chair: T. Valentine (ORNL)* *Invited lecturer: M. Modro (NINE), "BEPU What Else?" (PL-01)* *Invited lecturer: U. Rohatgi (BNL), "Historical Perspectives of BEPU Research in US" (PL-02)*				
09:30-10:30	**Plenary Session (PS): BEPU in Thermal-Hydraulics: Current Issues, Challenges and Future Perspectives (Room: Puccini)** *Session Chair: Y.A. Hassan (TAMU)* *Invited lecturer: F. D'Auria (UNIPI), "BEPU Status and Perspectives?" (PL-10)* *Invited lecturer: D. Bestion (CEA), "BEPU Methods Using CFD Codes - Progress Made Within OECD-WGAMA CFD Activities" (PL-11)*				
10:30-11:00	**Coffee Break**				
11:00-13:00	**Session ID**	**A2 (1)**	**SS A (1) - Student**	**B1 (1)**	**C7 (1)**
	Session Title	**BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS** **V&V and BEPU**	**BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS**	**BEPU METHODOLOGIES DEVELOPMENT** **Statistical Methods for Uncertainty Analysis**	**BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS** **BE and Uncertainty Evaluation for DEC including Severe Accidents**
	Session Chair	*Z. Zhang (TE)*	*A. Kaliatka (LEI)*	*C. Frepoli (FPoliSolutions)*	*L.E. Herranz (CIEMAT)*
	Session Co-Chair	*E. Ivanov (IRNS)*	*W. Giannotti (NINE)*	*H. Glaeser (Consultant)*	*M. Modro (NINE)*
	Room	**S. Maria**	**S. Pietro**	**S. Donato**	**Elisa**
13:00-14:00	**Lunch**				
14:00-16:00	**Session ID**	**PD-01**		**PD-05**	
	Panel Title	**BEPU AND V&V** **BEPU – Role of a Phenomenological Validation and Integral Experiments for Maturing the Predictive Simulations**		**MULTIPHYSICS BEPU** **Margin Management: Intersection of I&C and Safety Analysis**	
	Panel Moderator	*E. Ivanov (IRSN)*		*S. Cetiner (ORNL)*	
	Room	**S. Maria**		**S. Donato**	
16:00-16:30	**Coffee Break**				
16:30-18:30	**Session ID**	**A3 (1)**	**SS A (2) - Student**	**B1 (2)**	**C5 (1)**
	Session Title	**BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS** **Scaling Issue and BEPU**	**BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS**	**BEPU METHODOLOGIES DEVELOPMENT** **Statistical Methods for Uncertainty Analysis**	**BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS** **Role of CFD and/or of Structural Mechanics for MP BEPU**
	Session Chair	*M. Dzodzo (Westinghouse)*	*F. D'Auria (UNIPI)*	*H. Glaeser (Consultant)*	*Y.A. Hassan (TAMU)*
	Session Co-Chair	*H. Nakamura (JAEA)*	*J.P. Hudelot (CEA)*	*N. Popov (UNENE & NINE)*	*F. Terzuoli (NINE)*
	Room	**S. Maria**	**S. Pietro**	**S. Donato**	**Elisa**
19:30-23:00	**Dinner with Lucca Historical Representation (Real Collegio)**				
20:30-20.45	Acknowledgments for invited lecturers *Chairs: M. Cherubini (NINE), V. Parrinello (NINE)*				
21:30-21.45	Honor Awards Ceremony *Chairs: T. Valentine (ORNL), A. Petruzzi (NINE)*				

Tuesday, 15 May

08:30-10:00	**Session ID**	**A2 (2)**	**C7 (2)**	**A1 (1)**	**F1 (1)**
	Session Title	**BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS**	**BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS**	**BEPU METHODOLOGIES DEVELOPMENT**	**RECOMMENDATIONS AND FINDINGS FOR DEVELOPING FUTURE BEPU METHODOLOGIES**
		V&V and BEPU	**BE and Uncertainty Evaluation for DEC including Severe Accidents**	**Licensing and Regulatory Requirements for BEPU**	**International Program Findings and Recommendations for BEPU**
	Session Chair	*U. S. Rohatgi (BNL)*	*N. Dinh (NCSU)*	*M. Panicker (NRC)*	*H. Glaeser (Consultant)*
	Session Co-Chair	*D. Bestion (CEA)*	*D. Novog (McMaster)*	*M. Kristof (NINE)*	*J. Baccou (IRSN)*
	Room	**S. Maria**	**S. Pietro**	**S. Donato**	**Elisa**
10:00-11:00	**Plenary Session (PS): BEPU Methodology: Technical and Regulatory Requirements (Room: Puccini)** *Session Chair: G. Bruna (IRSN)* *Invited lecturer: G. Rzentkowski (IAEA), "BEPU Methodologies and Requirements from the Perspective of IAEA Safety Standard" (PL-03)* *Invited lecturer: J. Kaneko (NRA), "Status of BEPU Study in NRA and Japan" (PL-04)*				
11:00-11:30	**Coffee Break**				
11:30-13:00	**Session ID**	**A2 (3)**	**SS B (1) - Student**	**A1 (2)**	**F1 (2)**
	Session Title	**BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS**	**BEPU METHODOLOGIES DEVELOPMENT**	**BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS**	**RECOMMENDATIONS AND FINDINGS FOR DEVELOPING FUTURE BEPU METHODOLOGIES**
		V&V and BEPU		**Licensing and Regulatory Requirements for BEPU**	**International Program Findings and Recommendations for BEPU**
	Session Chair	*D. Y. Oh (KINS)*	*B. Iooss (EdF)*	*M. Modro (NINE)*	*H. Nakamura (JAEA)*
	Session Co-Chair	*N. Popov (UNENE & NINE)*	*C. Frepoli (FPoliSolutions)*	*A. Viktorov (CNSC)*	*G. Robertson (Westinghouse)*
	Room	**S. Maria**	**S. Pietro**	**S. Donato**	**Elisa**
13:00-14:00	**Lunch**				
14:00-16:00	**Session ID**	**PD-02**		**PD-04**	
	Panel Title	**BEPU METHODOLOGIES**		**MULTI-PHYSICS BEPU**	
		Methodologies for Uncertainty Evaluation of BE Results: Advantages and Disadvantages of Different Approaches		**Interrelations between Thermal-Hydraulics, Reactor Physics and Fuel Behavior Modelling in BEPU Methodology**	
	Panel Moderator	*T. Kozlowski (UIUC)*		*N. Dinh (NCSU)*	
	Room	**S. Maria**		**S. Donato**	
16:00-16:30	**Coffee Break**				
16:30-18:30	**Session ID**	**C1 (1)**	**SS B (2) - Student**	**E3 (1)**	**E6 (1)**
	Session Title	**BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS**	**BEPU METHODOLOGIES DEVELOPMENT**	**OTHER BEPU APPLICATION RESULTS**	**OTHER BEPU APPLICATION RESULTS**
		Thermal-Hydraulics (including I&C Systems) and Reactor Physics		**BEPU Applications for Spent Fuel**	**BEPU Applications for Single Physics - Thermal-Hydraulics**
	Session Chair	*E. Royer (CEA)*	*T. Valentine (ORNL)*	*S. Caruso (NAGRA)*	*E. Ivanov (IRSN)*
	Session Co-Chair	*K. Ivanov (NCSU)*	*R. Mendizábal (CSN)*	*A. Bouloré (CEA)*	*M. Kristof (NINE)*
	Room	**S. Maria**	**S. Pietro**	**S. Donato**	**Elisa**
19:30-23:00	**Dinner above the Lucca City Walls (*Caffé delle Mura*)**				

08:30-10:00	Session ID	C1 (2)	SS C (1) - Student	E3 (2)	A4 (1)
	Session Title	BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS	BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS	OTHER BEPU APPLICATION RESULTS	BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS
		Thermal-Hydraulics (including I&C systems) and Reactor Physics		BEPU Applications for Spent Fuel	Experimental Measurement Uncertainties and BEPU
	Session Chair	*N. Müllner (BOKU)*	*J.C. Le Pallec (CEA)*	*S. Caruso (NAGRA)*	*M. Hursin (PSI)*
	Session Co-Chair	*W. Guodong (SNERDI)*	*P. Meloni (ENEA)*	*N.E. Bixler (SNL)*	*F. Moretti (NINE)*
	Room	S. Maria	S. Pietro	S. Donato	Elisa
10:00-11:00	**Plenary Session (PS): BEPU Methodologies and V&V Process (Room: Puccini)** *Session Chair: H. Nakamura (JAEA)* *Invited lecturer: G. Bruna (IRSN), "Uncertainty in Design and Operation. how dealing with" (PL-05)* *Invited lecturer: K. Y. Choi (KAERI), " Application of BEPU Methodologies in V&V Process" (PL-06)*				
11:00-11:30	**Coffee Break**				
11:30-13:00	Session ID	C7 (3)	SS - Student	B3 (1)	A4 (2)
	Session Title	BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS	D (1) BEPU APPLICATIONS IN SAFETY ANALYSIS AND LICENSING FRAMEWORK	BEPU METHODOLOGIES DEVELOPMENT	BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS
		BE and Uncertainty Evaluation for DEC including Severe Accidents	F (1) RECOMMENDATIONS & FINDINGS FOR DEVELOPING NEW BEPU METHODOLOGIES	Hybrid Methods for Uncertainty Analysis	Experimental Measurement Uncertainties and BEPU
	Session Chair	*W. Giannotti (NINE)*	*M. Kristof (NINE)*	*D. Novog (McMaster)*	*J.P. Hudelot (CEA)*
	Session Co-Chair	*C. Yang (CNPE)*	*F. Reventos (UPC)*	*J. Baccou (IRSN)*	*K.Y. Choi (KAERI)*
	Room	S. Maria	S. Pietro	S. Donato	Elisa
13:00-14:00	**Lunch**				
14:00-16:00	Session ID	E8 (1)	B4 (1)	B3 (2)	E6 (2)
	Session Title	OTHER BEPU APPLICATION RESULTS	BEPU METHODOLOGIES DEVELOPMENT	BEPU METHODOLOGIES DEVELOPMENT	OTHER BEPU APPLICATION RESULTS
		BEPU Applications for Single Physics - Fuel Performance	Sensitivity Methods as Supporting Tools for Uncertainty Analysis	Hybrid Methods for Uncertainty Analysis	BEPU Applications for Single Physics Thermal-Hydraulics
	Session Chair	*G. Robertson (Westinghouse)*	*B. Iooss (EdF)*	*A. Viktorov (CNSC)*	*J.M. Le Corre (Westinghouse)*
	Session Co-Chair	*A. Bouloré (CEA)*	*C. Schneidesch (Tractebel)*	*I. Kinoshita (INSS)*	*A. Patel (NRC)*
	Room	S. Maria	S. Pietro	S. Donato	Elisa
16:00-16:30	**Coffee Break**				
16:30-18:30	Session ID	E8 (2)	F3 (1)	C3 (1)	E6 (3)
	Session Title	OTHER BEPU APPLICATION RESULTS	RECOMMENDATIONS & FINDINGS FOR DEVELOPING NEW BEPU METHODOLOGIES	BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS	OTHER BEPU APPLICATION RESULTS
		BEPU Applications for Single Physics - Fuel Performance	Requirements for BEPU from Multi-physics and Multi-Scale Simulation Tools	Thermal-Hydraulics, Reactor Physics and Fuel Behavior	BEPU Applications for Single Physics Thermal-Hydraulics
	Session Chair	*A. Bouloré (CEA)*	*Y. Parlatan (OPG)*	*D. Aumiller (BETTIS)*	*C. Frepoli (FPoliSolutions)*
	Session Co-Chair	*G. Robertson (Westinghouse)*	*O. Mazzantini (NA-SA)*	*M. Modro (NINE)*	*A. Kaliatka (LEI)*
	Room	S. Maria	S. Pietro	S. Donato	Elisa
19:30-23:00	**BEPU-2018 Official Dinner in Historical Lucca Palace *(Pfanner Palace)***				
21:00-21:15	Conference Awards Ceremony *Chairs: N. Dinh (NCSU), M. Modro (NINE), K. Ivanov (NCSU)*				

Thursday, 17 May

08:30-11:00	Session ID	B2 (1)	SS E (1) - Student	D1 (1)	E7 (1)
	Session Title	BEPU METHODOLOGIES DEVELOPMENT	OTHER BEPU APPLICATION RESULTS	BEPU APPLICATIONS IN SAFETY ANALYSIS AND LICENSING FRAMEWORK	OTHER BEPU APPLICATION RESULTS
		Bayesian Methods for Uncertainty Analysis		Light Water Reactors (PWR, WWER and BWR)	BEPU Applications for Single Physics - Reactor Physics
	Session Chair	*R. Mendizábal (CSN)*	*G. Bruna (IRSN)*	*J. Misak (NRI)*	*W. Zwermann (GRS)*
	Session Co-Chair	*T. Skorek (GRS)*	*N. Dinh (NCSU)*	*U. S. Rohatgi (BNL)*	*M. Avramova (NCSU)*
	Room	S. Maria	S. Pietro	S. Donato	Elisa
11:00-11:30	Coffee Break				
11:30-13:00	**Plenary Session (PS): BEPU Methodologies and Industrial Applications (Room: Puccini)** *Session Chair: M. Modro (NINE)* *Invited lecturer: O. Mazzantini (NA-SA) "Full BEPU Application for Chapter 15 of Atucha-2 NPP"(PL-07)* *Invited lecturer: S. Mizokami (TEPCO) "Uncertainty Evaluation in Decommissioning-Related Tasks on Fukushima Daiichi Accident"(PL-08)* *Invited lecturer: L. Gerken (Framatome) "Realistic Large Break LOCA Methodology for Pressurized Water Reactors"(PL-09)*				
13:00-14:00	Lunch				
14:00-16:00	Session ID	PD-03		PD-04	
	Panel Title	BEPU METHODOLOGIES		INTERNATIONAL PROGRAMS DEVOTED TO BEPU	
		Are Best Estimate Methodologies also Best-Efforts?		International Program Findings and Recommendations for BEPU	
	Panel Moderator	*A. Petruzzi (NINE)*		*M. Avramova (NCSU)*	
	Room	S. Maria		S. Donato	
16:00-16:30	Coffee Break				
16:30-18:30	Session ID	E2 (1)	SS E (2) - Student	D2(1) & D1 (2)	E7 (2)
	Session Title	OTHER BEPU APPLICATION RESULTS	OTHER BEPU APPLICATION RESULTS	BEPU APPLICATIONS IN SAFETY ANALYSIS AND LICENSING FRAMEWORK	OTHER BEPU APPLICATION RESULTS
		BEPU Applications for GEN-IV and Other New Designs		Heavy and Light Water Reactors (CANDU, PHWR, PWR, WWER and BWR)	BEPU Applications for Single Physics - Reactor Physics
	Session Chair	*M. Krause (IAEA)*	*T. Valentine (ORNL)*	*Y. Parlatan (OPG)*	*D. Kropaczek (NCSU)*
	Session Co-Chair	*L. Buiron (CEA)*	*M. Avramova (NCSU)*	*O. Mazzantini (NA-SA)*	*D. Lee (UNIST)*
	Room	S. Maria	S. Pietro	S. Donato	Elisa
19:30-23:00	Closing Dinner on the Lucca Hills (Tenuta San Pietro)				

08:30-09:30	**Plenary Session (PS): Multi-Physics and Multi-Scale Simulation Tools (Room: Puccini)** *Session Chair: K. Ivanov (NCSU)* *Invited lecturer: J. Gulliford (OECD/NEA) "NEA Activities to Support Uncertainty Quantification, Validation and Verification for Nuclear Systems Modeling"(PL-12)* *Invited lecturer: D. Kropaczek (NCSU)"CASL: Consortium for the Advanced Simulation of Light Water Reactors-Experiences in Multi-Physics and Multi-Scale Simulation Tool Development"(PL-13)*				
09:30-10:00	**Coffee Break**				
10:00-12:00	**Session ID**	**E2 (2)**	**SS E (3) - Student**	**D2(2) & D1 (3)**	**E7 (3)**
	Session Title	**OTHER BEPU APPLICATION RESULTS**	**OTHER BEPU APPLICATION RESULTS**	**BEPU APPLICATIONS IN SAFETY ANALYSIS AND LICENSING FRAMEWORK**	**OTHER BEPU APPLICATION RESULTS**
		BEPU Applications for GEN-IV and Other New Designs		**Heavy and Light Water Reactors (CANDU, PHWR, PWR, WWER and BWR)**	**BEPU Applications for Single Physics - Reactor Physics**
	Session Chair	*M. Krause (IAEA)*	*J.C. Le Pallec (CEA)*	*O. Mazzantini (NA-SA)*	*J. Gulliford (OECD/NEA)*
	Session Co-Chair	*W. Giannotti (NINE)*	*T. Kozlowski (UIUC)*	*U. S. Rohatgi (BNL)*	*E. Royer (CEA)*
	Room	**S. Maria**	**S. Pietro**	**S. Donato**	**Elisa**
12:00-13:00	**Plenary Session (PS): Summary and Closing (Room: Puccini)** *Session Chair: G. Bruna (IRSN)* *Speakers: M. Modro (NINE), "What next, what's BEPU future?"* *Speakers: T. Valentine (ORNL), "BEPU: Opportunities and Challenges in Multi-Scale, Multi-Physics Applications"* *Speakers: A. Petruzzi (NINE), "Closing Remarks and see you at BEPU2020 in Sicily"*				
13:00-14:00	**Lunch**				

Sunday May 13

16:30-19:00 **Conference Registrations**
Real Collegio

18:30-22:00 **Reception Banquet**
Real Collegio

Monday May 14

08:00-08:30 **Conference Welcome**

Room: Puccini
Session Chair: Y.A. Hassan (TAMU, USA)
Speakers:

- M. Modro (NINE, Italy): *"Welcome to the 3rd international conference on BE methods!"*
- A. Petruzzi (NINE, Italy): *"Opening Remarks"*
- T. Valentine (ORNL, USA): *"BEPU Current Perspective and Roles"*
- N. Dinh (NCSU, USA): *"Short introduction to the Conference Program"*

08:30-09:30 **PS** **BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS**

Room: Puccini
Session Chair: T. Valentine (ORNL, USA)

PL-01 **BEPU WHAT ELSE?**
Lecturer: *M. Modro (NINE, Italy)*

PL-02 **HISTORICAL PERSPECTIVES OF BEPU RESEARCH IN US**
Lecturer: *U. Rohatgi (BNL, USA)*

09:30-10:30 **PS** **BEPU IN THERMAL-HYDRAULICS: CURRENT ISSUES, CHALLENGES AND FUTURE PERSPECTIVES**

Room: Puccini
Session Chair: Y.A. Hassan (TAMU, USA)

PL-10 **BEPU STATUS AND PERSPECTIVES**
Lecturer: *F. D'Auria (UNIPI, Italy)*

PL-11 **BEPU METHODS USING CFD CODES -PROGRESS MADE WITHIN OECD-WGAMA CFD ACTIVITIES**
Lecturer: *D. Bestion (CEA, France)*

10:30-11:00 **Coffee Break**

11:00-13:00 **A** **BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS**
A2 (1) V&V and BEPU

Room: S. Maria
Session Chair: J. Zhang (Tractebel, Belgium)
Session Co-Chair: E. Ivanov (IRNS, France)

KN-A2: **THE ROLE OF VERIFICATION & VALIDATION PROCESS IN BEST ESTIMATE PLUS UNCERTAINTY METHODOLOGY DEVELOPMENT**
Lecturer: *J. Zhang (Tractebel, Belgium)*

088: **Code Validation for the Reactor Physics Based on the Technique of the Sensitivity and Uncertainty Analysis,** *C. Wan, L. Cao, H. Wu, Y. Zheng, L. Qiao*
Presenter: *C. Wan (Xi'an Jiaotong University, China)*

090: **Best-Estimate Plus Uncertainty in Thermal-Hydraulic Mixing Calculations Using KWU-MIX for Pressurized Thermal Shock,** *R. Trewin, P. Brocheny*
Presenter: *R. Trewin (Framatome, Germany)*

108: **Validation of the Uncertainty Propagation Method for the Decay Heat within the DARWIN2.3 Package,** *V. Vallet*
Presenter: *L. Buiron (CEA, France)*

11:00-13:00 **SS A (1)** **BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS**

Room: S. Pietro
Session Chair: A. Kaliatka (LEI, Lithuania)
Session Co-Chair: W. Giannotti (NINE, Italy)

165: **Proposal of a BEPU Methodology for Containment Safety Analysis**, *R. Bocanegra, G. Jimenez*
Presenter: *R. Bocanegra (Universidad Politécnica de Madrid, Spain)*

118: **A Study on the Applicability of Adjoint Based Optimization Method for Nuclear Thermal Hydraulic System Analysis Code Nodalization,** *J.J. Lee, M.G. Kim, M.G. Son, J.I. Lee*
Presenter: *J. Lee (KAIST, South Korea)*

120: **Comparison of Wall Heat Transfer Models between US TRACE Code and Korean MARS-KS Code,** *S.G. Shin, J.I. Lee*
Presenter: *S.G. Shin (KAIST, South Korea)*

136: **BEPU-FSAR: Discussion of V&V Principles to non Thermal-Hydraulic Codes,** *F. Menzel, F. D'Auria, G. Sabundjian*
Presenter: *F. Menzel (IPEN, Brazil)*

11:00-13:00 B BEPU METHODOLOGIES DEVELOPMENT

B1 (1) Statistical Methods for Uncertainty Analysis

Room: S. Donato
Session Chair: C. Frepoli (FPoliSolutions, USA)
Session Co-Chair: H. Glaeser (Consultant, Germany)

KN-B1: DATA MANAGEMENT, STATISTICS AND TRENDS IN DEPLOYING BEPU INDUSTRY APPLICATIONS: AN OVERVIEW
Lecturer: *C. Frepoli (FPoliSolutions, USA)*

114: Proposal of a Statistical Evaluation Method for the Criticality of the Fukushima Daiichi Nuclear Power Plants, *Y. Morimoto, M. Akaike, S. Takeo, K. Ishii, H. Maruyama*
Presenter: *Y. Morimoto (Hitachi-GE Nuclear Energy, Japan)*

127: On the Methodological Treatment of Input Uncertainty Quantification: Illustration in the RIA Framework, *J. Baccou, E. Chojnacki, S. Marais, V. Georgenthum*
Presenter: *J. Baccou (IRSN, France)*

145: Efficient Uncertainty Quantification in Nuclear Thermal-Hydraulic Simulations by means of Polynomial Chaos Expansion, *J.L. Muñoz-Cobo, A. Miquel, A. Escrivá, C. Berna, Y. Rivera*
Presenter: *J.L. Muñoz-Cobo (Universitat Politecnica de Valencia, Spain)*

11:00-13:00 C BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS

C7 (1) Best-Estimate and Uncertainty Evaluation for Design Extension Condition (DEC) including Severe Accidents

Room: Elisa
Session Chair: L. E. Herranz (CIEMAT, Spain)
Session Co-Chair: M. Modro (NINE, Italy)

KN-C7: HISTORICAL OVERVIEW OF SEVERE ACCIDENT ANALYSIS AND THE NEED FOR UNCERTAINTY QUANTIFICATION
Lecturer: *L. E. Herranz (CIEMAT, Spain)*

102: Probabilistic Approach of Re-criticality Behavior in the Fukushima Daiichi Nuclear Power Plants by the PORCAS-F Code, *R. Kimura, Y. Takeuchi, Y. Hayashi*
Presenter: *R. Kimura (IRID/Toshiba, Japan)*

149: Uncertainty Analysis of Small Break LOCA with HPI Failure in PWRs: A Comparison of Uncertainty Quantification between Monte Carlo Method and Wilks' Formula Approach, *I. Kinoshita, M. Murase*
Presenter: *I. Kinoshita (INSS, Japan)*

161: BEPU Evaluations in IVMR for VVERs: Melt Pool Behaviour and Thermomechanics of the Ablated Vessel, *A.S. Filippov, DD.. Kamenskay, E.V. Moiseenko, V.F. Strizhov, D.K. Valetov*
Presenter: *A.S. Filippov (IBRAE RAN, Russia)*

13:00-14:00 Lunch

14:00-16:00 PDS BEPU AND V&V

Room: Santa Maria

PD-01 BEPU – ROLE OF A PHENOMENOLOGICAL VALIDATION AND INTEGRAL EXPERIMENTS FOR MATURING THE PREDICTIVE SIMULATIONS

Moderator: ***E. Ivanov (IRSN, France)***
Lecturers: *B. Rearden (ORNL, USA)*
A. Bouloré (CEA, France)
K. Velkov (GRS, Germany)
J. Baccou (IRSN, France)

14:00-16:00 PDS MULTIPHYSICS BEPU

Room: San Donato

PD-05 MARGIN MANAGEMENT: INTERSECTION OF I&C AND SAFETY ANALYSIS

Moderator: ***S. Cetiner (ORNL, USA)***
Lecturers: *M. Cherubini (NINE, Italy)*
T. Quinn (Technology Resources, USA)
S. Croft (ORNL, USA)
J.P. Hudelot (CEA, France)

16:00-16:30 Coffee Break

16:30-18:30 A BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS

A3 (1) Scaling Issue and BEPU

Room: S. Maria
Session Chair: M. Dzodzo (Westinghouse, USA)
Session Co-Chair: H. Nakamura (JAEA, Japan)

KN-A3A: SCALING ANALYSIS AND RELATION TO EMDAP AND BEPU
Lecturer: *M. Dzodzo (Westinghouse, USA)*

KN-A3B: CONSIDERATIONS ON PHENOMENA SCALING FOR BEPU
Lecturer: *H. Nakamura (JAEA, Japan)*

298: Application of the Dynamical System Scaling Methodology to NIST-1 Testing, *S. Heagy, C. Frepoli, J. Reyes*
Presenter: *S. Heagy (FPoliSolutions, USA)*

190: Kv-Scaling Analysis to support the Validation of Atucha-2 Evaluation Model, *A. Petruzzi, W. Giannotti, O. Mazzantini*
Presenter: *A. Petruzzi (NINE, Italy)*

16:30-18:30 SS A (2) BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS

Room: S. Pietro
Session Chair: F. D'Auria (UNIPI, Italy)
Session Co-Chair: J. P. Hudelot (CEA, France)

232: Modeling of Measurement Uncertainty in Inverse Uncertainty Quantification of TRACE Physical Model Parameters Using BFBT Benchmark, *K. Borowiec, T. Kozlowski*
Presenter: *K. Borowiec (University of Illinois, USA)*

255: Assessment of The Newly Developed Fuel Solver Code CTFFUEL, *A. Toptan, R. Salko, M. Avramova, D. Kropaczek, K. Clarno*
Presenter: *R. Salko (ORNL, USA)*

304: Generation of Experimental Data for the Validation of Computer Models: Reactivity Worth Case Study, *A. Rais, M. Hursin, A. Pautz*
Presenter: *A. Rais (EPFL, Switzerland)*

16:30-18:30 B BEPU METHODOLOGIES DEVELOPMENT
B1 (2) Statistical Methods for Uncertainty Analysis

Room: S. Pietro
Session Chair: H. Glaeser (Consultant, Germany)
Session Co-Chair: N. Popov (UNENE & NINE, Canada)

191: A Robust Implementation of Extreme Value Statistics Methodology and its Application to Compute Required NOP Trip Setpoints, *P. Sermer, F. Hoppe, J. Rogers, D. Pun-Quach, I. Cheng, O. Nainer*
Presenter: *J. Rogers (Kinectrics NSS, Canada)*

207: Robust Analysis of Epistemic Uncertainties Propagation Studies in LOCA Assessment Thermal-Hydraulic Model, *T. Delage, R. Sueur, B. Iooss*
Presenter: *R. Sueur (EdF, France)*

234: A Transient EVS Methodology that Provides Accurate Time Dependent Tolerance Limits, *P. Sermer, I. Cheng, D. Pun-Quach, F. Hoppe, J. Rogers*
Presenter: *P. Sermer (Amec Foster Wheeler, Canada)*

251: RIPS, a Statistical Method for Characterizing the Limiting Scenario in a BEPU Approach, *J.Y. Sauvage, J.C. Lecoy, C. Charignon*
Presenter: *J.C. Lecoy (AREVA, France)*

16:30-18:30 C BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS
C5 (1) Role of CFD and/or of Structural Mechanics for MP BEPU

Room: Elisa
Session Chair: Y.A. Hassan (TAMU, USA)
Session Co-Chair: F. Terzuoli (NINE, Italy)

KN-C5: HIGH RESOLUTION EXPERIMENTS FOR CFD VALIDATION AND UNCERTAINTY QUANTIFICATION
Lecturer: *Y.A. Hassan (TAMU, USA)*

162: BEPU Application to CFD Benchmark, *A. Prošek, B. Končar, M. Leskovar*
Presenter: *B. Končar (Jožef Stefan Institute, Slovenia)*

211: Preliminary Study of Condensation Heat Transfer Uncertainty Quantification, *H. Zhang, Y. Li, J. Xiao, T. Jordan*
Presenter: *H. Zhang (KIT, Germany)*

19:30-23:00 Dinner with Lucca Historical Representation
Real Collegio

Conference Ceremonies

20:30-20:45 Acknowledgments for invited lecturers
Chairs: M. Cherubini (NINE, Italy)
V. Parrinello (NINE, Italy)

21:30-21:45 Honor Awards Ceremony
Chairs: T. Valentine (ORNL, USA),
A. Petruzzi (NINE, Italy)

Tuesday May 15

08:30-10:00 A BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS
A2 (2) V&V and BEPU

Room: S. Maria
Session Chair: U. Rohatgi (BNL, USA)
Session Co-Chair: D. Bestion (CEA, France)

110: **V&V and Uncertainty Quantification of Code Models**, *T. Skorek*
Presenter: *T. Skorek (GRS, Germany)*

141: A Study of Thermally Induced Flow Instability and Critical Heat Flux on Two Parallel Channels, *X. Liu, X. Wu, Y. Huang*
Presenter: *X. Liu (NPIC, China)*

187: Quantified Validation with Uncertainty Analysis for Turbulent Single Phase Friction Models, *N. Porter, V. Mousseau, M. Avramova*
Presenter: *N. Porter (NCSU, USA)*

08:30-10:00 C BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS
C7 (2) Best-Estimate and Uncertainty Evaluation for Design Extension Condition (DEC) including Severe Accidents

Room: S. Pietro
Session Chair: N. Dinh (NCSU, USA)
Session Co-Chair: D. Novog (McMaster University, Canada)

176: **Application of Sensitivity Analysis Method to Passive Containment Pressure Response under Large Break LOCA**, *W. Guodong, H. Benxue, W. Zhe, L. Xin*
Presenter: *W. Guodong (SNERDI, China)*

257: Best Estimate Approach for the Simulation of Reactor Core Overheating and Quenching Experiments, *A. Kaliatka, T. Kaliatka, V. Vileiniskis, E. Uspuras*
Presenter: *A. Kaliatka (LEI, Lithuania)*

276: Numerical and Experimental Investigation of Melt Jet Breakup in a Water Pool, *J. Zhao, H. Cheng*
Presenter: *J. Zhao (City University of Hong Kong, Hong Kong)*

08:30-10:00 A BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS
A1 (1) Licensing and Regulatory Requirements for BEPU

Room: S. Donato
Session Chair: M. Panicker (NRC, USA)
Session Co-Chair: M. Kristof (NINE, Italy)

KN-A1: LICENSING AND REGULATORY REQUIREMENTS FOR BEST ESTIMATE PLUS UNCERTAINTY (BEPU) APPLICATIONS – AN USNRC PERSPECTIVE
Lecturer: *M. Panicker (NRC, USA)*

125: Some Insights on the Fulfilment of Acceptance Criteria by Finite Mixtures, *R. Mendizábal*
Presenter: *R. Mendizábal (CSN, Spain)*

201: A Conceptual Study on Uncertainty and Conservativeness in DBA Evaluations Based on a BEPU Approach, *S. Mizokami, S. Suehiro, A. Hayakawa, Y. Kudo*
Presenter: *S. Mizokami (TEPCO, Japan)*

08:30-10:00 F RECOMMENDATIONS AND FINDINGS FOR DEVELOPING FUTURE BEPU METHODOLOGIES
F1 (1) International Program Findings and Recommendations for BEPU

Room: Elisa
Session Chair: H. Glaeser (Consultant, Germany)
Session Co-Chair: J. Baccou (IRSN, France)

KN-F1: RESULTS AND RECOMMENDATIONS OF INTERNATIONAL OECD/CSNI BEPU PROGRAMS
Lecturer: *H. Glaeser (Consultant, Germany)*

157: Uncertainty Analysis in Modeling for Light Water Reactors - Consistent Approach for Multi-scale Modelling, *K. Ivanov, M. Avramova, C. Schneidesh, A. Boulore, E. Royer*
Presenter: *E. Royer (CEA, France)*

310: Numerical Benchmarks for Multi-Physics Simulation of Pressurized Heavy Water Reactor Transients, *M. Krause, A. Trottier*
Presenter: *M. Krause (IAEA, Austria)*

10:00-11:00 PS BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS

Room: Puccini
Session Chair: G. Bruna (IRSN, France)

PL-03 BEPU METHODOLOGIES AND REQUIREMENTS FROM THE PERSPECTIVE OF IAEA SAFETY STANDARD
Lecturer: *G. Rzentkowski (IAEA, Austria)*

PL-04 STATUS OF BEPU STUDY IN NRA AND JAPAN
Lecturer: *J. Kaneko (NRA, Japan)*

11:00-11:30 Coffee Break

11:30-13:00 A BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS
A2 (3) V&V and BEPU

Room: S. Maria
Session Chair: D.Y. Oh (KINS, South Korea)
Session Co-Chair: N. Popov (UNENE & NINE, Canada)

188: **Common Uncertainty Quantification Assumptions: A Critical Analysis and Application to Convective Heat Transfer**, *N. Porter, V. Mousseau, M. Avramova*
Presenter: *N. Porter (NCSU, USA)*

262: SCCRED Methodology for V&V: Application to ATLAS A5.1 Test Benchmark, *V. Parrinello, M. Cherubini*
Presenter: *V. Parrinello (NINE, Italy)*

284: Uncertainty Quantification for Critical Flow Model, *D.Y. Oh, I.S. Lee, Y.S. Bang, C.Y. Yang*
Presenter: *D.Y. Oh (KINS, South Korea)*

11:30-13:00 SS B (1) BEPU METHODOLOGIES DEVELOPMENT

Room: S. Pietro
Session Chair: B. Iooss (EdF, France)
Session Co-Chair: C. Frepoli (FPoliSolutions, USA)

082: **Analytic Imprecise-Probabilistic Structural Reliability Analysis**, *J. Sadeghi, E. Patelli, M. de Angelis*
Presenter: *E. Patelli (University of Liverpool, UK)*

198: Validation and Uncertainty Quantification of DNB Closures in MCFD Solver Using Inverse Bayesian Inference Method, *Y. Liu, N. Dinh, Y. Sato, B. Niceno*
Presenter: *N. Dinh (NCSU, USA)*

231: Surrogate-Based Bayesian Calibration of Thermal-Hydraulics Models Based on PSBT Time-Dependent Benchmark Data, *C. Wang, X. Wu, T. Kozlowski*
Presenter: *T. Kozlowski (University of Illinois, USA)*

11:30-13:00 A BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS
A1 (2) Licensing and Regulatory Requirements for BEPU

Room: S. Donato
Session Chair: M. Modro (NINE, Italy)
Session Co-Chair: A. Viktorov (CNSC, Canada)

087: **The History and the Future of Credibility Assessment Frameworks: from CSAU to EMDAP and Beyond**, *J.S. Kaizer, A. Patel*
Presenter: *A. Patel (NRC, USA)*

238: Challenges in Application of BEPU for Risk Evaluations, *D. Serghiuta, J. Tholammakkil*
Presenter: *D. Serghiuta (CNSC, Canada)*

299: Evaluation of Calculation Inaccuracy in Safety Analysis of Nuclear Facilities, *D. Yashnikov, S. Bogdan, N. Kozlova, O. Kovalevich, S. Shevchenko*
Presenter: *D. Yashnikov (SEC NRS, Russia)*

11:30-13:00 F RECOMMENDATIONS AND FINDINGS FOR DEVELOPING FUTURE BEPU METHODOLOGIES
F1 (2) International Program Findings and Recommendations for BEPU

Room: Elisa
Session Chair: H. Nakamura (JAEA, Japan)
Session Co-Chair: G. Robertson (Westinghouse, Sweden)

326: **SAPIUM: A Systematic Approach for Input Uncertainty Quantification**, *J. Baccou, D. Bestion, M. Couplet, G. Damblin, P. Fillion, F. Fouet, J. Freixa, B. Iooss, R. Mendizábal, D.Y. Oh, A. Petruzzi, P. Probst, F. Reventos, T. Skorek, T. Takeda, J. Zhang*
Presenter: *J. Baccou (IRSN, France)*

327: Validation of Multi-Physics Simulation Tools Using Fuel Ramp Test in R2 Reactor: the MPCMIV Benchmark, *A. Petruzzi, D. De Luca, J. Karlsson, T. Valentine*
Presenter: *A. Petruzzi (NINE, Italy)*

13:00-14:00 Lunch

14:00-16:00 **PDS BEPU METHODOLOGIES**

Room: Santa Maria

PD-02 **METHODOLOGIES FOR UNCERTAINTY EVALUATION OF BE RESULTS: ADVANTAGES AND DISADVANTAGES OF DIFFERENT APPROACHES**

Moderator: ***T. Kozlowski (UIUC, USA)***
Lecturers: *J. Hou (NCSU, USA)*
H. Glaeser (Consultant, Germany)
A. Petruzzi (NINE, Italy)
E. Ivanov (IRSN, France)

14:00-16:00 **PDS MULTIPHYSICS BEPU**

Room: San Donato

PD-04 **INTERRELATIONS BETWEEN THERMAL- HYDRAULICS, REACTOR PHYSICS AND FUEL BEHAVIOR MODELLING IN BEPU METHODOLOGY**

Moderator: ***N. Dinh (NCSU, USA)***
Lecturers: *K. Ivanov (NCSU, USA)*
A. Bouloré (CEA, France)
K. Velkov (GRS, Germany)
M. Avramova (NCSU, USA)
E. Royer (CEA, France)
C. Schneidesch (TE, Belgium)

16:00-16:30 **Coffee Break**

16:30-18:30 **C BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS**
C1 (1) Thermal-Hydraulics (including I&C Systems) and Reactor Physics

Room: S. Maria
Session Chair: E. Royer (CEA, France)
Session Co-Chair: K. Ivanov (NCSU, USA)

KN-C1: **COMBINING VERIFICATION & VALIDATION WITH UNCERTAINTY ANALYSIS FOR REACTOR THERMAL-HYDRAULIC INDUSTRIAL APPLICATIONS**
Lecturer: *E. Royer (CEA, France)*

128: **Uncertainty Quantification in Nuclear Core Design Simulations using Metamodel Approaches: Application to Thermal-Hydraulic Design and Low DNBR Online Algorithm,** *M. Segond, R. Spaggiari, L. Lefebvre*
Presenter: *M. Segond (Framatome, France)*

226: **Three-Dimensional Coupled Neutronics Thermal-Hydraulics Safety Analysis Methods using TRACE/PARCS,** *A. Bielen, P. Yarsky*
Presenter: *A. Bielen (NRC, USA)*

252: **Developing the Control Logic of Thermal-Hydraulic Model for Dynamic Event Tree Generation with RAVEN-MAAP5-EDF,** *C. Picoco, V. Rychkov, T. Aldemir*
Presenter: *V. Rychkov (EdF, france)*

16:30-18:30 **SS B (2) BEPU METHODOLOGIES DEVELOPMENT**

Room: S. Pietro
Session Chair: T. Valentine (ORNL, USA)
Session Co-Chair: R. Mendizábal (CSN, Spain)

197: **An Adjoint Sensitivity Analysis to the Two-Phase Two-Fluid Model Based on an Explicit Upwind Numerical Solver**, *G. Hu, T. Kozlowski*
Presenter: *K. Borowiec (University of Illinois, USA)*

202: **Sensitivity Analysis Applied to LOCA Integral Effects Tests for the Justification of the BEPU Approach,** *H. Geiser, J.L. Vacher, P.R. Rubiolo*
Presenter: *H. Geiser (EdF, France)*

16:30-18:30 **E OTHER BEPU APPLICATION RESULTS**
E3 (1) BEPU Applications for Spent Fuel

Room: S. Donato
Session Chair: S. Caruso (NAGRA, Switzerland)
Session Co-Chair: A. Bouloré (CEA, France)

KN-E3: **FROM A CONSERVATIVE APPROACH TO A BEPU IMPLEMENTATION FOR SPENT NUCLEAR FUEL CHARACTERISATION AND SAFETY ASSESSMENT FROM THE PERSPECTIVE OF GEOLOGICAL DISPOSAL**
Lecturer: *S. Caruso (NAGRA, Switzerland)*

083: **Best Estimate Plus Uncertainty Analysis for the ^{244}CM Prediction in Spent Fuel Characterization,** *D. Rochman, A. Vasiliev, H. Ferroukhi, M. Seidl, D. Janin*
Presenter: *A. Vasiliev (PSI, Switzerland)*

126: **Comparison of Uncertainty Assessment Methods Applied to the Thermo-Mechanical Characterization of Fuel at the Beginning of Dry Storage,** *F. Feria, C. Aguado, L.E. Herranz*
Presenter: *L.E. Herranz (CIEMAT, Spain)*

182: **Assessment of K-eff Bias and Bias Uncertainty Due to Isotopic Biases and Bias Uncertainties for WWER Type Spent Nuclear Fuel,** *S. Bznuni, N. Baghdasaryan, A. Amirjanyan*
Presenter: *S. Bzuni (NRSC, Armenia)*

16:30-18:30 E OTHER BEPU APPLICATION RESULTS
E6 (1) BEPU Applications for Single Physics - Thermal-Hydraulics

Room: Elisa
Session Chair: E. Ivanov (IRSN, France)
Session Co-Chair: M. Kristof (NINE, Italy)

099: **Deterministic Sampling and Gaussian Process Metamodel Approach Applied to a Station Black Out Accident Model**, *G. Perret, S. Rahman, D. Wicaksono*
Presenter: *G. Perret (PSI, Switzerland)*

109: Neural Network Control of Acceptance Criteria of VVER-1000 in case of Thermal Hydraulic Parameters Uncertainties, *E. Katkovskiy, I. Pasichnyk, A. Sintsov, K. Velkov, M. Kuznetsov*
Presenter: *I. Pasichnyk (GRS, Germany)*

130: Comparison of Uncertainty Qualification Methods Based on the Simplified PCT Estimation Model in LB LOCA, *Z. Li, W. Chen, W. Wang, S. Ding, Y. Gao, J. Deng, X. Song*
Presenter: *Z. Li (NPIC, China)*

195: Implementation of a Grid Heat Transfer Hi2lo Reconstruction Capability into the Thermal Hydraulics Subchannel Code CTF, *R. Salko, K. Clarno, D. Pointer, M. Delchini, S. Slattery, W. Gurecky, V. Petrov, A. Manera*
Presenter: *R. Salko (ORNL, USA)*

19:30-23:00 Dinner above the Lucca City Walls
Caffé delle Mura

Wednesday May 16

08:30-10:00 C BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS
C1 (2) Thermal-Hydraulics (including I&C systems) and Reactor Physics

Room: S. Maria
Session Chair: N. Müllner (BOKU, Austria)
Session Co-Chair: W. Guodong (SNERDI, China)

285: **Effect of Nuclear Data on the DNBR Prediction with Subchannel Code COBRA-TF**, *R. Mukin D. Rochman, I. Clifford, A. Vasiliev, H. Ferroukh*
Presenter: *R. Mukin (PSI, Switzerland)*

321: Uncertainty Quantification on Pressurized Water Reactor Coupled Core Simulation Using Stochastic Sampling Method, *K. Zeng, J. Hou, K. Ivanov, M. Jessee*
Presenter: *K. Zeng (NCSU, USA)*

291: Analytical Model and Methods Study of Three Dimensional Reactivity Accidents Analysis Based on Multidisciplinary Coupled, *W. Wang, J. Pan, Y. Liu, J. Deng*
Presenter: *W. Wang (NPIC, China)*

08:30-10:00 SS C (1) BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS

Room: S. Pietro
Session Chair: J.C. Le Pallec (CEA, France)
Session Co-Chair: P. Meloni (ENEA, Italy)

203: **Evaluation of a BEPU Methodology with State-Of-The-Art Tools in a Non-Realistic Turbine Trip with ATWS for a BWR**, *P. Hidalga, A. Abarca, R. Miró, A. Sekhri, W. Zhe*
Presenter: *P. Hidalga (ISIRYM-UPV, Spain)*

204: Uncertainty and Sensitivity Analysis in Void Fraction Prediction with CTF-UPVIS of the PSBT and BFBT Fuel Models for Transient Cases, *P. Hidalga, A. Abarca, R. Miró*
Presenter: *P. Hidalga (ISIRYM-UPV, Spain)*

282: Uncertainty Analyses Using the RAVEN Software Tool Coupled With MELCOR Severe Accident Code, *F. Giannetti, M. D'Onorio, F. Mascari, G. Caruso*
Presenter: *M. D'Onorio (Sapienza University, Italy)*

08:30-10:00 E OTHER BEPU APPLICATION RESULTS
E3 (2) BEPU Applications for Spent Fuel

Room: S. Donato
Session Chair: S. Caruso (NAGRA, Switzerland)
Session Co-Chair: N.E. Bixler (SNL, USA)

229: **Criticality Safety Evaluations for the Concept of Swiss PWR Spent Fuel Geological Repository**, *A. Vasiliev, D. Rochman, M. Pecchia, H. Ferroukhi, S. Caruso, J. Herrero*
Presenter: *A. Vasiliev (PSI, Switzerland)*

290: Uncertainty Quantification of Isotopic Densities in Depleted Fuel, *S. Lahaye, J. Luo, P. Bellier, T.D. Huynh, A. Tsilanizara*
Presenter: *S. Lahaye (CEA, France)*

089: Spent Fuel Pool BEPU Analysis using TRACE with Wilks and GAM Surrogate Methods, *F. Sanchez-Saez, S. Martorell, S. Carlos, J.F. Villanueva A.I. Sanchez*
Presenter: *J.F. Villanueva (Universitat Politècnica de València, Spain)*

08:30-10:00 A BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS

A4 (1) Experimental Measurement Uncertainties and BEPU

Room: Elisa
Session Chair: M. Hursin (PSI, Switzerland)
Session Co-Chair: F. Moretti (NINE, Italy)

KN-A4: THE IMPORTANCE OF EXPERIMENTAL UNCERTAINTY IN THE BEPU APPROACH
Lecturer: *M. Hursin (PSI, Switzerland)*

244: Challenges and Uncertainties in Providing Validation Data for Fission Product Transport Modelling, *M. Freitag, B. von Laufenberg, S. Gupta, M. Colombet, G. Poss*
Presenter: *M. Freitag (Becker Technologies, Germany)*

270: Experimental Investigation of Post-BT Heat Transfer and Rewetting Phenomena, *A. Satou, Y. Wada, D.T. Le, Y. Shibamoto, T. Yonomoto*
Presenter: *A. Satou (JAEA, Japan)*

10:00-11:00 PS BEPU METHODOLOGIES AND V&V PROCESS

Room: Puccini
Session Chair: H. Nakamura (JAEA, Japan)

PL-05 UNCERTAINTY IN DESIGN AND OPERATION. HOW DEALING WITH?
Lecturer: *G. Bruna (IRSN, France)*

PL-06 APPLICATION OF BEPU METHODOLOGIES IN V&V PROCESS
Lecturer: *K.Y. Choi (KAERI, South Korea)*

11:00-11:30 Coffee Break

11:30-13:00 C BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS

C7 (3) Best-Estimate and Uncertainty Evaluation for Design Extension Condition (DEC) including Severe Accidents

Room: S. Maria
Session Chair: W. Giannotti (NINE, Italy)
Session Co-Chair: C. Yang (CNPE, China)

279: Sequoyah SOARCA Best-Estimate and Uncertainty Analysis of a Short-Term Station Blackout Accident, *N.E. Bixler, M. Dennis, K. Ross, D. Brooks, D.M. Osborn, R. Gauntt, K. Wagner, S. Ghosh, A. Hathaway, H. Esmaili*
Presenter: *N.E. Bixler (SNL, USA)*

300: Effects of Heat Transfer Models on RPV Failure during a Station Blackout Scenario at a VVER1000 in MELCOR 1.8.5 and MELCOR 1.8.6, *M. Kraxberger, N. Arnold, N. Müllner*
Presenter: *M. Kraxberger (BOKU, Austria)*

325: Uncertainty Studies on Severe Accident Source Term for Typical NPP with PWR, *J. Sun, X. Shi, C. Yang*
Presenter: *C. Yang (CNPE, China)*

261: Risk-Informed External Hazards Analysis by EEVE Toolkit, *C. Parisi, S. Prescott, Z. Ma, J. Coleman, R. Szilard, C. Smith*
Presenter: *C. Parisi (INL, USA)*

11:30-12:30 SS D (1) BEPU APPLICATIONS IN SAFETY ANALYSIS AND LICENSING FRAMEWORK

Room: S. Pietro
Session Chair: M. Kristof (NINE, Italy)
Session Co-Chair: F. Reventos (UPC, Spain)

075: Uncertainty Analysis of the Early Stages of a Station Blackout in a CANDU6 Reactor using RELAP/SCDAPSIM, *R.M. Nistor-Vlad, D. Dupleac, I. Prisecaru, M. Perez, C.M. Allison*
Presenter: *R.M. Nistor-Vlad (Politehnica University of Bucharest, Romania)*

156: Uncertainty Analysis of PWR LBLOCA with TRACE and DAKOTA, *T.Y. shen, J.H. Yang, S.W. Chen, J.R. Wang, C. Shih*
Presenter: *T.Y. Shen (National Tsing Hua University, Taiwan)*

12:30-13:00 SS F (1) RECOMMENDATIONS AND FINDINGS FOR DEVELOPING FUTURE BEPU METHODOLOGIES

Room: S. Pietro
Session Chair: M. Kristof (NINE, Italy)
Session Co-Chair: F. Reventos (UPC, Spain)

129: Reliability Evaluation of Piping by Using Capability Balance on Prediction, Inspection and Repair for Improvement of Maintenance Management, *M. Kojima, H. Kikura, S. Uchida, H. Okada, H. Takahashi*
Presenter: *M. Kojima (Tokyo Institute of Technology, Japan)*

11:30-13:00 B BEPU METHODOLOGIES DEVELOPMENT
B3 (1) Hybrid Methods for Uncertainty Analysis

Room: S. Donato
Session Chair: D. Novog (McMaster University, Canada)
Session Co-Chair: J. Baccou (IRSN, France)

KN-B3: OPERATING NUCLEAR PLANT DYNAMICS: EXAMINATION OF BEPU-TYPE INPUT UNCERTAINTIES STEMMING FROM PLANT OPERATIONS
Lecturer: *D. Novog (McMaster University, Canada)*

143: Application of the Maximum Entropy and the Maximum Relative Entropy Principles in BEPU Methodologies Including Plant Technical Specifications, *J.L. Muñoz-Cobo, R. Mendizábal, A. Miquel, A. Escrivá, C. Berna*
Presenter: *J.L. Muñoz-Cobo (Universitat Politecnica de Valencia, Spain)*

172: Advanced Methodology for Uncertainty Propagation in Computer Experiments with Large Number of Inputs, *A. Marrel, B. Iooss*
Presenter: *B. Iooss (EdF, France)*

11:30-13:00 A BEPU METHODOLOGY: TECHNICAL AND REGULATORY REQUIREMENTS
A4 (2) Experimental Measurement Uncertainties and BEPU

Room: Elisa
Session Chair: J.P. Hudelot (CEA, France)
Session Co-Chair: K.Y. Choi (KAERI, South Korea)

305: Promoting Cooperation and Technical Exchange in the Area of TH Experimentation: SILENCE Network & SWINTH Workshops, *F. Moretti*
Presenter: *F. Moretti (NINE, Italy)*

323: Experimental Characterization of a Thermocoax Water Level Detector for In-Core Measurements, *R. Ferri, A. Achilli, C. Congiu, S. Gandolfi, R. Albaut, D. Lecharpentier, G. Helleux*
Presenter: *R. Ferri (SIET, Italy)*

13:00-14:00 Lunch

14:00-16:00 E OTHER BEPU APPLICATION RESULTS
E8 (1) BEPU Applications for Single Physics - Fuel Performance

Room: S. Maria
Session Chair: G. Robertson (Westinghouse, Sweden)
Session Co-Chair: A. Bouloré (CEA, France)

KN-E8A: BAYESIAN INVERSE UNCERTAINTY QUANTIFICATION FOR FUEL PERFORMANCE MODELLING
Lecturer: *G. Robertson (Westinghouse Electric, Sweden)*

KN-E8B: IMPORTANCE OF UNCERTAINTY QUANTIFICATION IN NUCLEAR FUEL BEHAVIOR MODELLING AND SIMULATION
Lecturer: *A. Bouloré (CEA, France)*

085: A BEPU Method for Design a Limiting Curve for the Permissible Power Ramp in the Fuel Rod, *A. Krupkin, V. Kuznetsov, V. Novikov*
Presenter: *A. Krupkin (SC VNIINM, Russia)*

159: Uncertainty Quantification of Calculated Fuel Temperature for the AGR-3/4 Irradiation Experiment, *B.T. Pham, N.J. Lybeck, G.L. Hawkes, J.J. Einerson*
Presenter: *B.T. Pham (INL, USA)*

14:00-16:00 B BEPU METHODOLOGIES DEVELOPMENT
B4 (1) Sensitivity Methods as Supporting Tools for Uncertainty Analysis

Room: S. Pietro
Session Chair: B. Iooss (EdF, France)
Session Co-Chair: C. Schneidesch (Tractebel, Belgium)

KN-B4: SENSITIVITY ANALYSIS OF MODEL OUTPUTS: PRINCIPLES, METHODS AND ISSUES FOR THE BEPU METHODOLOGY
Lecturer: *B. Iooss (EdF, France)*

098: Global Sensitivity Analysis and Registration Strategy for Temperature Profiles of Reflood Experiment Simulations, *G. Perret, D. Wicaksono*
Presenter: *G. Perret (PSI, Switzerland)*

236: Atucha-I NPP Containment Sensitivity Calculations to Support Uncertainty Evaluations, *A. Pop, W. Giannotti, A. Petruzzi, O. Mazzantini*
Presenter: *A. Pop (NINE, Italy)*

240: Collision-History Based Sensitivity-Perturbation Calculation Capabilities in Serpent 2.1.30, *V. Valtavirta, M. Aufiero, J. Leppänen*
Presenter: *V. Valtavirta (VTT, Finland)*

14:00-16:00 B BEPU METHODOLOGIES DEVELOPMENT
B3 (2) Hybrid Methods for Uncertainty Analysis

Room: S. Donato
Session Chair: A. Viktorov (CNSC, Canada)
Session Co-Chair: I. Kinoshita (INSS, Japan)

206: **The CASUALIDAD Method for Uncertainty Evaluation of Best-Estimate System Thermal-Hydraulics Calculations**, *A. Petruzzi*
Presenter: *A. Petruzzi (NINE, Italy)*

167: Propagation of Epistemic Uncertainties using Dempster-Shafer Theory in BEPU Evaluation, *M. Marquès, Y. Hou, A. Marrel*
Presenter: *M. Marques (CEA, France)*

286: Robust On-Line LOCAs Diagnostics with Neural Networks, *S. Tolo, T.V. Santhosh, G. Vinod, U. Oparaji, E. Patelli*
Presenter: *E. Patelli (University of Liverpool, UK)*

314: Adaptive Surrogates within the RAVEN Framework for Dynamic Probabilistic Risk Assessment Analysis, *A. Alfonsi, C. Wang, D. Mandellig, C. Rabiti*
Presenter: *A. Alfonsi (INL, USA)*

14:00-16:00 E OTHER BEPU APPLICATION RESULTS
E6 (2) BEPU Applications for Single Physics - Thermal-Hydraulics

Room: Elisa
Session Chair: J.M. Le Corre (Westinghouse, Sweden)
Session Co-Chair: A. Patel (NRC, USA)

222: **BEPU Application and Simplify on NPP Safety Review**, *S. Wei, Z. Jiye, F. Jinjun, F. Hao*
Presenter: *S. Wei (NRSC, China)*

243: Sensitivity Study for Uncertainty Range and Distribution by Using TRACE Code, *B.G. Huh, D.Y. Oh, Y.S. Bang, C.Y. Yang*
Presenter: *B.G. Huh (KINS, South Korea)*

245: Quantification of Key Model Parameters Uncertainty for Passive Containment Pressure Analysis by using Tests, *H. Benxue, Z. Wang, G. Wang, Z. Wang, X. Liu*
Presenter: *H. Benxue (SNERDI, China)*

259: Comparison of Parametric and Non-Parametric Methods for Analysis of SBLOCA Accidents in Nuclear Power Plants, *J.F. Villanueva, A. Sánchez, F. Sánchez-Sáez, S. Carlos, S. Martorell, R. Mendizábal*
Presenter: *J.F. Villanueva (U. Politècnica València, Spain)*

16:00-16:30 Coffee Break

16:30-18:30 E OTHER BEPU APPLICATION RESULTS
E8 (2) BEPU Applications for Single Physics - Fuel Performance

Room: S. Maria
Session Chair: A. Bouloré (CEA, France)
Session Co-Chair: G. Robertson (Westinghouse, Sweden)

297: **TRANSURANUS Analysis on the Effect of the Isotopic Composition on Fuel Response to Ramp Test**, *M. Cherubini, L. Lampunio*
Presenter: *M. Cherubini (NINE, Italy)*

281: Predicting Fuel Rod Failures and their Contributing Factors with Surrogate Support Vector Machines in Statistical LOCA Analysis, *A. Arkoma*
Presenter: *A. Arkoma (VTT, Finland)*

311: Uncertainty and Sensitivity Analysis of Nuclear Fuel Performance during a LOCA Test Case on the Basis of the TRANSURANUS Code, *.A Schubert, Z. Soti, P. Van Uffelen*
Presenter: *Z. Soti (European Commission DG Joint Research Centre-JRC, Germany)*

16:30-18:30 F RECOMMENDATIONS AND FINDINGS FOR DEVELOPING FUTURE BEPU METHODOLOGIES
F3 (1) Requirements for BEPU from Multi-physics and Multi-Scale Simulation Tools

Room: S. Pietro
Session Chair: Y. Parlatan (OPG, Canada)
Session Co-Chair: O. Mazzantini (NA-SA, Argentina)

309: Best Estimate Plus Uncertainty (BEPU): Why It Is still not Widely Used, *E. Ivanov, A. Sargeni, F. Dubois , G. Bruna*
Presenter: *E. Ivanov, (IRSN, France)*

209: Requirements for Experimental Data and Associated Uncertainties in order to Validate Multi-Physics Simulation Tools: Case of the Experiments in the CABRI Reactor, *J.P. Hudelot, O. Clamens, J. Lecerf, J.M. Labit, E. Stratta*
Presenter: *J.P. Hudelot (CEA, France)*

194: Specific Requirements for BEPU Methods Using System Thermalhydraulic Codes with 3D-Pressure Vessel Modelling, *D. Bestion*
Presenter: *D. Bestion (CEA, France)*

16:30-18:30 C BEPU FOR MULTIPHYSICS AND MULTISCALE APPLICATIONS
C3 (1) Thermal-Hydraulics, Reactor Physics and Fuel Behavior

Room: S. Donato
Session Chair: D. Aumiller (BETTIS, USA)
Session Co-Chair: M. Modro (NINE, Italy)

KN-C3: CONSIDERATION OF UNCERTAINTY PROPAGATION IN COUPLED CODE SYSTEMS
Lecturer: *D. Aumiller (BETTIS, USA)*

124: Fuel Thermo-Mechanical Simulations with Uncertainty Quantification and Sensitivity Analysis of the OECD/NEA RIA Code Benchmark using FALCON and URANIE, *R. Ngayam-Happy, C. Cozzo, G. Khvostov, M. Krack, H Ferroukhi*
Presenter: *R. Ngayam-Happy (PSI, Switzerland)*

178: A Mutual Information-Based Framework to Use High-Fidelity Nuclear Reactor Codes to Calibrate Low-Fidelity Codes, *R. Smith, N. Gordon, L. Gilkey, I. Michaud, B. Williams, V. Mousseau, C. Jones, R. Hooper*
Presenter: *N. Porter (NCSU, USA)*

319: Development and Application of Statistical Uncertainty Analysis Method to Multi-Physics Modelling to Support Reactor Core Design and Operation, *J. Zhang, A. Dethioux, T. Drieu, C. Schneidesch*
Presenter: *J. Zhang (Tractebel, Belgium)*

16:30-18:30 E OTHER BEPU APPLICATION RESULTS
E6 (3) BEPU Applications for Single Physics - Thermal-Hydraulics

Room: Elisa
Session Chair: C. Frepoli (FPoliSolutions, USA)
Session Co-Chair: A. Kaliatka (LEI, Lithuania)

265: A Comparison between Methods of Uncertainty Assessments for Thermal-Hydraulic Calculations, *L. Ishay, E. Rabinovich, N. Hazenshprung*
Presenter: *L. Ishay (Nuclear Research Center, Israel)*

289: Reduction of Pessimism in Thermal Hydraulic Performance Assessments of Nuclear Steam Raising Plants, *K Jarman, A. Wallis, J. Adams S. Treasure*
Presenter: *K. Jarman (Rolls Royce, UK)*

264: Automatic Limit Surface Search for PWR transients by RELAP5-3D/RAVEN codes, *C. Parisi, A. Alfonsi, D. Mandelli, C. Rabiti*
Presenter: *C. Parisi (INL, USA)*

19:30-23:00 BEPU2018 Official Dinner in Historical Lucca Palace
Pfanner Palace

Conference Awards Ceremony

21:30-21:45 Best Conference Papers
Chairs: N. Dinh (NCSU, USA)
M. Modro (NINE, Italy)
K. Ivanov (NCSU, USA)

Thursday May 17

08:30-11:00 B BEPU METHODOLOGIES DEVELOPMENT
B2 (1) Bayesian Methods for Uncertainty Analysis

Room: S. Maria
Session Chair: R. Mendizábal (CSN, Spain)
Session Co-Chair: T. Skorek (GRS, Germany)

KN-B2: BAYESIAN PERSPECTIVE IN BEPU LICENSING ANALYSIS
Lecturer: *R. Mendizábal (CSN, Spain)*

096: A Bayesian Framework for Quantifying the Uncertainty of Physical Models Integrated into Thermal-Hydraulic Computer Codes, *G. Damblin, P. Gaillard*
Presenter: *G. Damblin (CEA, France)*

133: Inverse Uncertainty Quantification using the Modular Bayesian Approach in the Presence of Model Discrepancy, *X. Wu, T. Kozlowski, K. Shirvan*
Presenter: *T. Kozlowski (University of Illinois, USA)*

166: Applications of Multivariate Normal Bayesian Models in Nuclear Engineering, *A. Hoefer, O. Buss, M. Schmid*
Presenter: *A. Hoefer (Framatome, Germany)*

171: Estimation of Modeling Uncertainties for Multi-Scale Reflood Tests Using Neural Network Based Surrogate Models, *J. Heo, H.M. Park, K.D. Kim*
Presenter: *J. Heo (KAERI , South Korea)*

08:30-11:00 SS E (1) OTHER BEPU APPLICATION RESULTS

Room: S. Pietro
Session Chair: G. Bruna (IRSN, France)
Session Co-Chair: N. Dinh (NCSU, USA)

123: Uncertainty Quantification in the MHGTR-350 Fuel Compact and Block Using TSUNAMI-3D CLUTCH method and Sampler, *S.F. Sihlangu, V.V. Naicker, J. Hou, F. Reitsma*
Presenter: *S. Sihlangu (North-West University, South Africa)*

132: Impact of Nuclear Data Uncertainties on Lead Cooled Fast Reactors, *I. Trivedi, J. Hou, J. Li, G. Grasso, F. Franceschini, K. Ivanov*
Presenter: *I. Trivedi (NCSU, USA)*

205: Uncertainty Analyses of Transients on the ALLEGRO Reactor, *B. Batki, B. Kvizda, A. Keresztúri, I. Panka*
Presenter: *B. Batki (MTA EK, Hungary)*

254: Development of the Nuclear Data Sensitivity Calculations with the GPT Method of SVRE Central Components. Transferability from the PRE-RACINE Cores to the ASTRID Core, *P. Dufay, G. Rimpault*
Presenter: *P. Dufay (CEA, France)*

312: Impact of Analysis Parameters on the Seismic Response of Free-Standing Spent Fuel Racks, *A Gonzalez Merino, L. C. de la Pena, A. Gonzalez*
Presenter: *A. Gonzalez Merino (Equipos Nucleares S.A., Spain)*

08:30-11:00 D BEPU APPLICATIONS IN SAFETY ANALYSIS AND LICENSING FRAMEWORK
D1 (1) Light Water Reactors (PWR, WWER and BWR)

Room: S. Donato
Session Chair: J. Misak (NRI, Czech Republic)
Session Co-Chair: U. Rohatgi (BNL, USA)

KN-D1: ROLE AND IMPORTANCE OF BEPU SAFETY ANALYSIS IN LICENSING OF LWRS
Lecturer: *J. Misak (NRI, Czech Republic)*

094: Application of the BE Approach for the Analysis of Design and Beyond Design Basis Accidents, *A. Kaliatka, E. Uspuras*
Presenter: *A. Kaliatka (Lithuanian Energy Institute, Lithuania)*

103: BEPU Approach for BWR Licensing Safety Analyses with the Best-Estimate Code TRAC Toshiba Version, *T. Fukunaga, A. Mototani*
Presenter: *T. Fukunaga (TOSHIBA Energy Systems & Solutions Corporation, Japan)*

213: Uncertainty Analysis of PWR LBLOCA with RELAP5/MOD3.3 and DAKOTA, *J.T. Chen, J.R. Wang, J.H. Yang, Y.M. Ferng, S.W. Chen, C. Shih*
Presenter: *J.T. Chen (National Tsing Hua University, Taiwan)*

235: Validation of Modeling of Steam Line for Pressurization Transient Analysis in BWR, *T. Yamada, R. Kagiyama, Y. Jinguji, T. Takii*
Presenter: *T. Yamada (Hitachi-GE Nuclear Energy, Japan)*

08:30-11:00 E OTHER BEPU APPLICATION RESULTS
E7 (1) BEPU Applications for Single Physics - Reactor Physics

Room: Elisa
Session Chair: W. Zwermann (GRS, Germany)
Session Co-Chair: M. Avramova (NCSU, USA)

KN-E7: REACTOR SIMULATIONS WITH NUCLEAR DATA UNCERTAINTIES
Lecturer: *W. Zwermann (GRS, Germany)*

079: Verification of Multi-group Covariance Data Processing Module in RXSP Code, *J. Yu, S. Choi, Y. Jo, P. Zhang, W. Li, K. Wang, D. Lee*
Presenter: *D. Lee (UNIST, South Korea)*

092: Uncertainty Analysis for the Core Simulation of Cycle 1 of the BEAVRS Benchmark Problem, *L. Cao, C. Wan, H. Wu, W. Shen*
Presenter: *C. Wan (Xi'an Jiaotong University, China)*

104: Sensitivity Indices for Nuclear Data Uncertainty Analysis with XSUSA and TSUNAMI, *F. Bostelmann, B. Krzykacz-Hausmann, A. Aures, W. Zwermann, K. Velkov*
Presenter: *W. Zwermann (GRS, Germany)*

112: Propagation of Nuclear Data Uncertainties for Isotope-Reaction Pairs to Core Calculations in WIMS-PANTHER, *B. Lindley, H. Prudden, D. Powney, G. Hosking, T. Fry, P. Smith, D. Long*
Presenter: *B. Lindley (Wood, UK)*

11:00-11:30 Coffee Break

11:30-13:00 PS BEPU METHODOLOGIES AND INDUSTRIAL APPLICATIONS

Room: Puccini
Session Chair: M. Modro (NINE, Italy)

PL-07 **FULL BEPU APPLICATION FOR CHAPTER 15 OF ATUCHA-2 NPP**
Lecturer: *O. Mazzantini (NA-SA, Argentina)*

PL-08 **UNCERTAINTY EVALUATION IN DECOMMISSIONING-RELATED TASKS ON FUKUSHIMA DAIICHI ACCIDENT**
Lecturer: *S. Mizokami (TEPCO, Japan)*

PL-09 **REALISTIC LARGE BREAK LOCA METHODOLOGY FOR PRESSURIZED WATER REACTORS**
Lecturer: *L. Gerken (Framatome, USA)*

13:00-14:00 Lunch

14:00-16:00 PDS BEPU METHODOLOGIES

Room: Santa Maria

PD-03 **ARE BEST ESTIMATE METHODOLOGIES ALSO BEST-EFFORTS?**

Moderator: ***A. Petruzzi (NINE, Italy)***
Lecturers: *C. Frepoli (FPoliSolutions, USA)*
J.C. Le Pallec (CEA, France)

14:00-16:00 PDS INTERNATIONAL PROGRAMS DEVOTED TO BEPU

Room: San Donato

PD-06 **INTERNATIONAL PROGRAM FINDINGS AND RECOMMENDATIONS FOR BEPU**

Moderator: ***M. Avramova (NCSU, USA)***
Lecturers: *E. Royer (CEA, France)*
F. Reventos (UPC, Spain)
M. Krause (IAEA, Austria)
G. Rimpault (CEA, France)
D. Novog (McMaster, Canada)

16:00-16:30 Coffee Break

16:30-18:30 E OTHER BEPU APPLICATION RESULTS
E2 (1) BEPU Applications for GEN-IV and Other New Designs

Room: S. Maria
Session Chairs: M. Krause (IAEA, Austria)
Session Co-Chair: L. Buiron (CEA, France)

KN-E2: **THERMALHYDRAULIC APPROACHES AND NEEDS FOR ADVANCED WATER-COOLED, HIGH-TEMPERATURE GAS-COOLED, AND MOLTEN SALT REACTORS**
Lecturer: *M. Krause (IAEA, Austria)*

107: **A Two-step Approach for Sensitivity and Uncertainty Analysis of Fast Reactor Simulation,** *L. Cao, Y. Liu, C. Wan, W. Shen*
Presenter: *L. Qiao (Xi'an Jiaotong University, China)*

247: **Uncertainty Quantification of ABR Transient Safety Analysis – Nuclear Data Uncertainties,** *N.E. Stauff, K. Zeng, G. Zhang, G. Aliberti, J. Hou, T.H. Fanning, T.K. Kim*
Presenter: *K. Zeng (NCSU, USA)*

250: **Uncertainty Quantification of ABR Transient Safety Analysis,** *G. Zhang, K. Zeng, N.E. Stauff, J. Hou, T.H. Fanning, T.K. Kim*
Presenter: *K. Zeng (NCSU, USA)*

16:30-18:30 SS E (2) OTHER BEPU APPLICATION RESULTS

Room: S. Pietro
Session Chair: T. Valentine (ORNL, USA)
Session Co-Chair: M. Avramova (NCSU, USA)

139: **Analysis of LOFT LBLOCA with Best Estimate Plus Uncertainty,** *Q. Xiong, J. Gou, J. Huang, J. Shan*
Presenter: *Q. Xiong (Xi'an Jiaotong University, China)*

196: **Effect of Discretization Error on the Quantification of Model Uncertainty in Two-Phase Flow Simulations,** *G. Hu, L. Zou, T. Kozlowski*
Presenter: *K. Borowiec (University of Illinois, USA)*

216: **Performance Evaluation of 1-D Nuclear System Analsysis Code Using Moving Mesh Method,** *W.W. Lee, J.I. Lee*
Presenter: *W.W. Lee (KAIST, South Korea)*

101: **Optimisation of Code Parameters on the Multiplication Eigenvalue with its Associated Uncertainties for the Kozloduy-6 VVER-1000 Fuel Assembly,** *G.P. Nyalunga, V.V. Naicker, K. Ivanov*
Presenter: *G.P. Nyalunga (North-West University, South Africa)*

16:30-18:30 **D BEPU APPLICATIONS IN SAFETY ANALYSIS AND LICENSING FRAMEWORK**
D1 (2) Light Water Reactors (PWR, WWER and BWR)
D2 (1) Heavy Water Reactors (CANDU, PHWR)

Room: S. Donato
Session Chair: *Y. Parlatan (OPG, Canada)*
Session Co-Chair: O. Mazzantini (NA-SA, Argentina)

KN-D2: **COMPARISON BETWEEN A BEAU AND A NOVEL NON-BEST-ESTIMATE METHOD APPLIED TO A LARGE BREAK LOCA IN A CANADIAN REACTOR**
Lecturer: *Y. Parlatan (OPG, Canada)*

278: **BEAU Analysis of Darlington Single Pump Trip Loss of Flow Event,** *Y. Parlatan, N. Popov, D. Naundorf*
Presenter: *Y. Parlatan (OPG, Canada)*

249: **Application of a Full-Core Statistical Approach in LB-LOCA Analysis,** *A. Knoll, D. Deuble, A. Wensauer*
Presenter: *A. Knoll (Framatome, Germany)*

267: **The Uncertainty and Sensitivity Analysis of Large-Break Loss-of-Coolant Accident for 1000 MW Pressurized Water Reactor,** *Y. Wang, J. Zhan, C. Yang*
Presenter: *Y. Wang (CNPE, China)*

16:30-18:30 **E OTHER BEPU APPLICATION RESULTS**
E7 (2) BEPU Applications for Single Physics - Reactor Physics

Room: Elisa
Session Chair: D. Kropaczek (NCSU, USA)
Session Co-Chair: D. Lee (UNIST, South Korea)

147: **Uncertainty Analysis of OECD/NEA/NSC UAM Benchmark Phase I Using CASMO5/SIMULATE5 with JENDL-4.0 Library and Covariance Data,** *T. Fujita, T. Sakai*
Presenter: *T. Fujita (Secretariat of Nuclear Regulation Authority, Japan)*

148: **Evaluation of Cross Section Uncertainty Considering Critical Spectrum with Generalized Adjoint B1 Equation,** *T.Y. Han, J.Y. Cho, C.K. Jo*
Presenter: *T.Y. Han (KAERI , South Korea)*

277: **Representativity Analysis of the LWR-PROTEUS Phase II Experiments Using SHARKX Stochastic Sampling Method,** *M. Hursin, D. Siefman, G. Perret, A. Pautz*
Presenter: *M. Hursin (PSI, Switzerland)*

208: **Developing an Evaluation Procedure for Uncertainty on Distribution Calculation of Neutron Flux,** *K.I. Tanaka, J. Ueno, K. Ishitani*
Presenter: *K.I. Tanaka (The Institute of Applied Energy, Japan)*

19:30-23:00 **Closing Dinner on the Lucca Hills**
Tenuta San Pietro

Friday May 18

08:30-09:30 **PS MULTI-PHYSICS AND MULTI-SCALE SIMULATION TOOLS**

Room: Puccini
Session Chair: K. Ivanov (NCSU, USA)

PL-12 **NEA ACTIVITIES TO SUPPORT UNCERTAINTY QUANTIFICATION, VALIDATION AND VERIFICATION FOR NUCLEAR SYSTEMS MODELING**
Lecturer: *J. Gulliford (OECD/NEA)*

PL-13 **CASL: CONSORTIUM FOR THE ADVANCED SIMULATION OF LIGHT WATER REACTORS – EXPERIENCES IN MULTI-PHYSICS AND MULTI-SCALE SIMULATION TOOL DEVELOPMENT**
Lecturer: *D. Kropaczek (NCSU, USA)*

09:30-10:00 **Coffee Break**

10:00-12:00 **E OTHER BEPU APPLICATION RESULTS**
E2 (2) BEPU Applications for GEN-IV and Other New Designs

Room: S. Maria
Session Chair: M. Krause (IAEA, Austria)
Session Co-Chair: W. Giannotti (NINE, Italy)

228: **GRS Uncertainty and Sensitivity Evaluations of an Unprotected Transient Overpower (UTOP) in a TWR Design,** *E. Bates, B. Truong, T. Al Hashmi*
Presenter: *E. Bates (TerraPower, USA)*

242: **NEA SFR Subassembly Benchmark: Sensitivity/Uncertainty Propagation with Depletion,** *L. Buiron, G. Rimpault*
Presenter: *L. Buiron (CEA, France)*

253: Current Status and Perspectives of the OECD/NEA Sub-group on Uncertainty Analysis in Modelling (UAM) for Design, Operation and Safety Analysis of SFRs (SFR-UAM), *G. Rimpault, L. Buiron, N.E. Stauff, T.K. Kim, T.A. Taiwo, Y.K. Lee, W. Zwermann, F. Bostelmann, K. Velkov, N. Guilliard, E. Fridman, A. Kereszturi, B. Batki, I.A. Kodeli, K. Mikityuk, R. Lopez, A. Gomez, F. Puente-Espel, E. del Valle, A. Peregudov, M. Semenov, G. Manturov, M. Avramova, I. Trivedi, K. Ivanov, A. Pautz, A. Yamaji, I. Hill, T. Ivanova*
Presenter: *L. Buiron (CEA, France)*

10:00-12:00 SS E (3) OTHER BEPU APPLICATION RESULTS

Room: S. Pietro
Session Chair: J.C. Le Pallec (CEA, France)
Session Co-Chair: T. Kozlowski (University of Illinois, USA)

160: Multi-physics Uncertainties Propagation in a PWR Rod Ejection Accident Modeling – Analysis Methodology and First Results, *G. Delipei, J. Garnier, J.C. Le Pallec, B. Normand*
Presenter: *G. Delipei (CEA, France)*

186: Sensitivity and Uncertainty Analysis of UAM BWR Benchmark Model with RMC Code, *G. Shi, Y. Qiu, K. Wang, Q. Cheng*
Presenter: *Q. Cheng (Tsinghua University, China)*

246: Sensitivity and Uncertainty Analysis of the Fundamental Delayed Neutron Data in LWRs, *M.I. Radaideh, W.A. Wieselquist, T. Kozlowski*
Presenter: *T. Kozlowski (University of Illinois, USA)*

295: Methodology for Cross-Section Generation with Burn-up Dependence with TXT2NTAB Program and Uncertainty Quantification, *A. Labarile, C. Mesado, T. Barrachina, R. Miró, P. Hidalga, G.Verdú*
Presenter: *P. Hidalga (ISIRYM-UPV, Spain)*

10:00-12:00 D BEPU APPLICATIONS IN SAFETY ANALYSIS AND LICENSING FRAMEWORK
D1 (3) Light Water Reactors (PWR, WWER and BWR)
D2 (2) Heavy Water Reactors (CANDU, PHWR)

Room: S. Donato
Session Chair: O. Mazzantini (NA-SA, Argentina)
Session Co-Chair: U. Rohatgi (BNL, USA)

280: CANDU PIRT for Postulated In-Core LOCA in the Darlington NPP, *N. Popov, Y. Parlatan*
Presenter: *N. Popov (UNENE, Canada)*

313: Development of a Best-Estimate Thermal Hydraulics Model of the HPR-1000 NPP for Developing/Verifying EOP, *D. De Luca, V. Parrinello, S. Huang, A. Petruzzi, M. Cherubini, C. Yang*
Presenter: *D. De Luca (NINE, Italy)*

164: Best-Estimate Plus Uncertainty Thermal-Hydraulic Stability Analysis of the 2015 Fermi Thermal-Hydraulic Instability Event, *L. Ibarra, J. Vedovi, J. Lamy, P. Kiel*
Presenter: *L. Ibarra (Hitachi-GE, USA)*

10:00-12:00 E OTHER BEPU APPLICATION RESULTS
E7 (3) BEPU Applications for Single Physics - Reactor Physics

Room: Elisa
Session Chair: J. Gulliford (OECD/NEA, France)
Session Co-Chair: E. Royer (CEA, France)

239: BEPU and Evaluation of Predictive Capability of Physics Simulations of CANDU Transients, *D. Serghiuta, J.Tholammakkil, H. Abdel-Khalik*
Presenter: *D. Serghiuta (Canadian Nuclear Safety Commission, Canada)*

241: MCNP6 Uncertainty Quantification Applied to UAM-Exercise I-1, *V. Giusti, L. Lampunio, V. Parrinello, A. Petruzzi*
Presenter: *L. Lampunio (NINE, Italy)*

174: Sensitivity and Uncertainty Analysis for Online Power-Distribution Monitoring for Power Reactors, *Z. Li, L. Cao, W. Shen*
Presenter: *W. Shen (Xi'an Jiaotong University, China)*

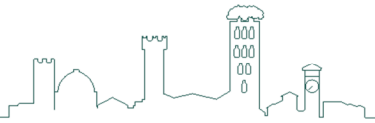
322: Reduction of Channel Power Uncertainty in CANDU-9 Reactors Due to Spatial Control Modelled Using SCALE-6.2.2, Serpent 2 and PARCS, *D. Novog, M. Tucker*
Presenter: *M. Tucker (McMaster University, Canada)*

12:00-13:00 Summary & Closing

Room: Puccini
Session Chair: G. Bruna (IRSN, France)
Speakers:

- M. Modro (NINE, Italy): "*What next, what's BEPU future?*"
- T. Valentine (ORNL, USA): "*BEPU: Opportunities and Challenges in Multi-Scale, Multi-Physics Applications*"
- A. Petruzzi (NINE, Italy): *"Closing Remarks and see you at BEPU2020 in Sicily"*

13:00-14:00 Lunch



BEPU 2018

MAY 13-18, 2018

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