



UNIVERSITÀ DI PISA



11th International Symposium on Supercritical Water-Cooled Reactors

Pisa, Italy - February 3-5, 2025

University of Pisa
Dipartimento di Ingegneria Civile
e Industriale



VENUE

POLO FIBONACCI

Aula Magna Pontecorvo - Edificio E
Largo Bruno Pontecorvo, 3 - 56127 Pisa

Pisa, Italy - February 3-5, 2025

Monday, February 3, 2025

10.00 - 11.00 **Registration**

11.00 - 11.30 **Welcome addresses**

11.30 - 13.00 **INVITED LECTURES**

Aula Magna

Chairpersons: Igor Piore, Thomas Schulenberg, Walter Ambrosini

- 25 YEARS OF SUPERCRITICAL WATER-COOLED REACTOR RESEARCH IN EUROPE: LESSONS LEARNED AND FUTURE CHALLENGES

Thomas Schulenberg

- CURRENT STATUS OF NUCLEAR-POWER INDUSTRY OF THE WORLD

Igor Piore, Constantin Zvorykin, Ali Machrafi, Aryan Das

- BRIDGING RESEARCH AND EDUCATION: THE ROLE OF THE EUROPEAN NUCLEAR EDUCATION NETWORK (ENEN) IN BUILDING THE SYNERGY BETWEEN EURATOM PROJECTS

Kateryna Piliuhina, Camila Boix Mansilla

13.00 - 14.00 **Lunch**

14.00 - 16.00 **PROF. JOHN DEREK JACKSON MEMORIAL SESSION**

Aula Magna

Chairpersons: Shuisheng He, Peixue Jiang

- A BRIEF REVIEW OF PROFESSOR JACKSON'S CONTRIBUTIONS TO THE RESEARCH OF HEAT TRANSFER TO FLUIDS AT SUPERCRITICAL PRESSURE

Shuisheng He, Peixue Jiang, Walter Ambrosini

- WALL ROUGHNESS DESIGN FOR SUPERCRITICAL FLOWS

Emanuele Zanetti, Kamel Hooman

- EXPLORING SIMILARITY THEORIES FOR HEAT TRANSFER AT SUPERCRITICAL PRESSURES: COMPUTATIONAL INSIGHTS AND EXPERIMENTAL IMPLICATIONS

Sara Kassem, Andrea Pucciarelli, Walter Ambrosini

- SUPERCRITICAL FLOW AND HEAT TRANSFER OF HYDROCARBON FUELS

Dongsheng Wen and Hui Gao

- MODELLING SUPERCRITICAL HEAT TRANSFER USING A TWO FLUID APPROACH

Dariusz Mikielewicz

- EXPERIMENTAL AND MACHINE LEARNING STUDY ON MIXED CONVECTION HEAT TRANSFER TO SUPERCRITICAL PRESSURE CO₂ UNDER COUPLED BUOYANCY AND FLOW ACCELERATION EFFECTS

Yuli Cao, Ruina Xu, Zhenchuan Wang, Peixue Jiang

16.00 - 16.30 **Coffee Break**

16.30 - 18.30 **PARALLEL SESSIONS**

16.30 - 18.30 **SCWR DESIGN AND INTEGRATION - I**

Aula Magna

Chairpersons: Igor Pioro, Thomas Schulenberg

- **DESIGN CONCEPT OF A SUPER PRESSURIZED WATER REACTOR**
Thomas Schulenberg, Szabolcs Czifrus
- **DESIGN AND ANALYSIS OF A REACTOR PRESSURE VESSEL FOR THE SUPER PRESSURIZED WATER REACTOR**
Alvaro Juan Fernandez, Thomas Schulenberg
- **CORE DESIGN OF THE SMALL SUPER-FAST REACTOR TO REDUCE DEBRIS CRITICALITY**
Homare Sugimoto, Akifumi Yamaji
- **PROGRESS ON A PRE-CONCEPTUAL SUPERCRITICAL WATER-COOLED SMALL MODULAR REACTOR**
Armando Nava Dominguez, Xianmin Huang, Michael Gaudet, Alberto Mendoza, Jimmy Chow
- **IMPLEMENTATION OF THE ECC-SMART: JOINT EUROPEAN CANADIAN CHINESE DEVELOPMENT OF SMALL MODULAR REACTOR TECHNOLOGY**
Michaela Krýdová and Monika Šípová

16.30 - 18.30 **REACTOR PHYSICS AND COUPLING WITH THERMAL-HYDRAULICS**

Room PS1

Chairpersons: Czifrus Szabolcs, Valerio Giusti

- **COUPLING OF APROS AND SPNDYN TO ANALYSE THE SCW-SMR CONCEPT WITHIN ECC-SMART**
Tamás Varju, Zeno Bertessina, Boglárka Babcsány
- **HYBRID FINITE ELEMENT SPN ANALYSIS OF AN SCW-SMR CONCEPT WITHIN THE ECC-SMART PROJECT**
Gergely Illés, Boglárka Babcsány
- **MULTIPHYSICS ASSESSMENT OF THE SCW SMR HEAT GENERATING CHANNEL CONDITION USING DIFFERENTIAL METHOD OF THE HEAT TRANSFER INTENSITY AND RESISTANCE CALCULATION**
Vladislav Filonov, Olexander Kovalenko, Dmitriy Fedorov, Yuliia Filonova
- **NEUTRONIC ANALYSIS OF MICRO-HETEROGENEOUS DUPLEX THO₂-PUO₂ FUEL PIN WITH BURNUP CHARACTERISTICS FOR PT-SCWR**
Shuvendu Shivam, Satya Sekhar Bhogilla, Goutam Dutta

08.30 - 10.30 PARALLEL SESSIONS

08.30 - 10.30 SCWR DESIGN AND INTEGRATION - II

Aula Magna

Chairpersons: Thomas Schulenberg, Daniela Marusakova

- A VISION FOR SUPER CRITICAL WATER-COOLED REACTORS: AN OPINION PAPER

Armando Nava Dominguez, Alberto Sáez Maderuelo, Radek Novotny, Monika Šípová, Elena Poplavská, Lefu Zhang

- R&D PLATFORM FOR THE SCWR

Stanislav Pustovalov, Alexey Sedov, Anton Lapin

- A REVIEW OF STRATEGIES AND CHALLENGES OF SUPER CRITICAL WATER-COOLED REACTOR (SCWR) DEPLOYMENT AND TECHNOLOGY READINESS ASSESSMENT OF A SCWR - SMR DESIGN

Seyed Kamal Mousavibalgehshiri, Guglielmo Lomonaco, Reza Sadeghi

- APPLICATIONS OF ARTIFICIAL INTELLIGENCE (AI) TECHNOLOGIES FOR SUPERCRITICAL WATER REACTOR (SCWR) AND THERMAL HYDRAULIC MODELING OF SCWR USING DEEP LEARNING

Megha Mohite, Raghvendra Upadhyay, Santosh Trimbake

- PHYSICS-INFORMED NEURAL NETWORKS FOR SUPERCRITICAL PRESSURE FLUID CONVECTIVE HEAT TRANSFER

Qingyan Weng, Yuli Cao, Haowei Lu, Peixue Jiang and Ruina Xu

- PREDICTION OF HEAT TRANSFER DETERIORATION AND RECOVERY

Zewen Zou, Shuisheng He

08.30 - 10.30 LICENSING AND SAFETY AND OTHER TECHNOLOGY RELEVANT ISSUES

Room PS1

Chairpersons: Andrej Prošek, Armando Nava Dominguez

- DESIGN OF ACTIVE DISTURBANCE REJECTION CONTROL (ADRC) BASED CONTROL STRATEGY FOR SUPERCRITICAL CO₂ BRAYTON CYCLE-COOLED REACTOR SYSTEM

Ghulam Jillani, Jianqiang Shan, Xue Qi, Pan Wu

- ASSESSMENT OF THE FAILURE TIME OF THE ECC-SMART SUPERCRITICAL REACTOR VESSEL IN THE LATE PHASE OF A SEVERE ACCIDENT

Vladislav Filonov, Dmitriy Fedorov, Olexander Kovalenko, Yaroslav Dubyk, Yuliia Filonova

- GENERIC RESULTS OF THE SCW-SMR PRE-LICENSING STUDY IN THE FRAME OF ECC-SMART PROJECT

Andrej Prošek, Leon Cizelj, Ildikó Boros, Attila Kiss, Ivan Otić, Alberto Sáez-Maderuelo, Jiří Duspiva, Guido Mazzini, Monika Šípová, Gabriel Pavel, Oliver Martin, Radek Novotny, Yaroslav Dubyk

Pisa, Italy - February 3-5, 2025

- LSTM NETWORKS FOR COMPONENT DAMAGE PREDICTIONS

Ivan Otic

- PROGRESS ON A PRE-CONCEPTUAL SUPERCRITICAL WATER-COOLED SMALL MODULAR REACTOR – A DETERMINISTIC SAFETY ASSESSMENT

Armando Nava Dominguez, Xianmin Huang

10.30 - 11.00 **Coffee Break**

11.00 - 13.00 **PARALLEL SESSIONS**

11.00 - 13.00 **MATERIALS AND CORROSION RESISTANCE - I**

Room PS1

Chairpersons: Lefu Zhang, Jan Macák

- ASSESSMENT OF CORROSION BEHAVIOR OF CLADDING MATERIALS FOR SCW-SMR IN STATIC CONDITIONS: RESULTS OBTAINED IN ECC SMART PROJECT

Manuela Fulger, Valentin Lautaru, Daniel Petrescu, Aurel David, Catalin Marian Ducu

- MODELLING THE LONG-TERM CORROSION BEHAVIOUR OF CANDIDATE FUEL CLADDING ALLOYS FOR A SUPERCRITICAL WATER-COOLED REACTOR

Radek Novotny, David Guzonas

- CORROSION BEHAVIOUR OF ALLOY 800H AND STAINLESS STEEL 310S UNDER CONDITIONS RELEVANT TO SUPERCRITICAL-WATER SMALL MODULAR REACTOR CONCEPTS

Kittima Khumsa-Ang, Linhui Yao, Armando Nava-Dominguez

- IN-SITU ELECTROCHEMICAL CORROSION TESTING OF 310S STEEL IN SUPERCRITICAL WATER

Petr Roztočil, David Dašek, Jaromír Valtr, Petr Čech, Mariana Arnoult-Růžicková, Michal Novák, Radek Novotný, Petr Sajdl, Jan Macák

- LONG-TERM CORROSION BEHAVIOR AND STRESS CORROSION SENSITIVITY OF TUBULAR - CLADDING MATERIALS FOR SUPERCRITICAL WATER-COOLED REACTORS

Tao Huang, Yang Gao, Kai Chen, Lefu Zhang

- IN-SITU CORROSION STUDY OF 800H ALLOY IN SUPERCRITICAL WATER

Jaromír Valtr, Mariana Arnoult-Růžicková, Michal Novák, Radek Novotný, Xavier Arnoult, Daniela Marušáková, Petr Sajdl and Jan Macák

11.00 - 13.00 **THERMAL-HYDRAULICS - I**

Aula Magna

Chairpersons: Attila Kiss, Yaroslav Dubyk

- **INTRODUCTION OF BENCHMARK SPECIFICATIONS FOR SUPERCRITICAL WATER LOOP**

Alis Ruscak Musa, Guido Mazzini, Jakub Spacek, Rostislav Fukac

- **ANALYSES OF IBSCTH TESTS USING SYSTEM AND CFD CODES**

Guido Mazzini, Alis Ruscak Musa, Jakub Spacek, Walter Ambrosini, Andrea Pucciarelli, Sara Kassem

- **LOSS OF COOLANT FLOW ACCIDENT ANALYSIS OF CHINESE SMALL MODULAR SUPERCRITICAL WATER-COOLED REACTOR**

Pan Wu, Qi Xue, Min Feng, Lianjie Wang, Wei Liu, Hui Yu

- **THERMAL-HYDRAULIC DESIGN OF PRINTED CIRCUIT HEAT EXCHANGER BASED ON DECOUPLED POROUS MEDIUM MODEL**

Xiyan Guo, Zhouhang Li, Hua Wang

- **NUMERICAL SIMULATION OF A SUPERCRITICAL FLOW IN A MICROCHANNEL USING THE LATTICE BOLTZMANN METHOD**

Vinícius Matsuda, Julia Sassa, Ivan Martins, Luben Cabezas Gómez, Tiago Moreira

- **EXPERIMENTAL STUDY ON HEAT TRANSFER CHARACTERISTICS OF SUBCRITICAL CO₂/N₂ MIXTURES IN A VERTICAL CIRCULATION LOOP**

Yongchang Feng, Lin Chen, Dong Yang, Rufan Song, Igor Pioro

13.00 - 14.00 **Lunch**

14.00 - 16.00 **PARALLEL SESSIONS**

14.00 - 16.00 **MATERIALS AND CORROSION RESISTANCE - II**

Room PS1

Chairpersons: Monika Šípová, Jan Vit

- **NUMERICAL STUDY OF THE INTERGRANULAR STRESS CORROSION CRACKING OF NICKELBASED ALLOYS IN SUPERCRITICAL WATER**

Yule Wu, Jiamei Wang, Xianglong Guo, Lefu Zhang

- **A COMPARATIVE STUDY OF STRESS CORROSION CRACKING INITIATION BEHAVIOR OF ALUMINA-FORMING AUSTENITIC STEELS AND BASE STEELS IN SUPERCRITICAL WATER AT 600 °C**

Xianglong Guo, Yang Gao, Lefu Zhang

Pisa, Italy - February 3-5, 2025

- MONTE CARLO SIMULATIONS OF FAST NEUTRON RADIOLYSIS IN SUPERCRITICAL WATER AT TEMPERATURES OF 400–600 °C AND 25 MPa

MD Shakhawat Hossen Bhuiyan, Jintana Meesungnoen, Abida Sultana, Jean-Paul Jay-Gerin

- STUDY OF THE EFFECT OF NEUTRON IRRADIATION ON THE CORROSION AND MECHANICAL BEHAVIOUR OF CANDIDATE MATERIALS FOR SCW-SMR

Monika Šípová, Jitka Klaisnerová, Daniela Marušáková, Jan Vít

- IRRADIATION EFFECT ON THE CORROSION BEHAVIOR OF SIC IN ADVANCED REACTORS

Liyan qiu, jing qian, linhui yao

- EVALUATION OF LONG-TERM EXPOSURE OF 310S AND 800H UNDER CONDITIONS OF SCW-SMR

Daniela Marušáková, Jan Vít, Monika Šípová

14.00 - 16.00 THERMAL-HYDRAULICS - II

Aula Magna

Chairpersons: Guido Mazzini, Alis Ruscak Musa

- EXPERIMENTAL EVALUATION OF FLUID-TO-FLUID SCALING MODELS FOR DETERIORATED HEAT TRANSFER AT SUPERCRITICAL PRESSURES

Benjamin Sears, Stavros Tavoularis

- NON-MODAL STABILITY ANALYSIS OF A LUMPED MODEL OF THE SUPER-CRITICAL WATER REACTOR

Carolina Introini, Antonio Cammi, Eric Cervi, Laura Savoldi

- EFFECT OF DETERIORATED HEAT TRANSFER ON THE ONSET OF SUPERCRITICAL FLOW INSTABILITY IN HEATED CHANNELS

Vijay Chatoorgoon

- ASSESSMENT OF FLUID-TO-FLUID SIMILARITY CRITERIA TO EVALUATE DETERIORATION OF HEAT TRANSFER COEFFICIENTS IN FLOWS OF SUPERCRITICAL FLUIDS

Chukwudi azih

- ASSESSMENT OF LOOK-UP TABLES FOR THE PREDICTION OF HEAT TRANSFER COEFFICIENT DISTRIBUTION IN ROD BUNDLES COOLED BY SUPERCRITICAL WATER

Rashed MD Sardar, Akhmed Baisov, Ahmed Raouf Zakaria, Ras El Oued

- EXPERIMENTAL STUDY ON CRITICAL FLOW OF SUPERCRITICAL CARBON DIOXIDE AT TRANSIENT STATE

Dongxu Zhang, Weiqing Li, Minfu Zhao, Peng Liang

16.00 - 16.30 **Coffee Break**

16.30 - 18.30 **PARALLEL SESSIONS**

16.30 - 18.30 **MATERIALS AND WATER CHEMISTRY**

Room PS1

Chairpersons: Alberto Sáez-Maderuelo, Manuela Fulger

- BREAKAWAY OXIDATION OF AFA STEEL IN SUPERCRITICAL CARBON DIOXIDE

Qiyin Zhou, Huigang Shi, Jianye Chen, Xianglong Guo, Lefu Zhang

- REVEALING THE SUPERIOR OXIDATION RESISTANCE OF ALLOY 690 IN DEAERATED SUPERCRITICAL WATER AND SUPERCRITICAL CO₂ AT 600 °C

Jiamei Wang Jiamei, Kai Chen, Xianglong Guo, Lefu Zhang

- STUDY OF THE CORROSION BEHAVIOR IN SUPERCRITICAL WATER OF AN AUSTENITIC STAINLESS STEEL 316L MANUFACTURED BY COLD SPRAY

Alberto Sáez-Maderuelo, Francisco J. Perosanz, Ricardo Fernández-Serrano, Gaspar González Doncel, Radek Novotny, Michal Novak, thibaud De Terris, Gilles Rolland, Thomas Girard

16.30 - 18.30 **THERMAL-HYDRAULICS - III**

Aula Magna

Chairpersons: Stavros Tavoularis, Andrea Pucciarelli

- EXPERIMENTAL STUDY ON SUPERCRITICAL WATER HEAT TRANSFER IN A 2X2 ROD BUNDLE

Tiago Moreira, Mark Anderson

- FORCED-CONVECTION HEAT TRANSFER TO SCW WITH UPWARD FLOW IN SHORT VERTICAL BARE TUBES

Igor Pioro, Evgen N. Pis'Mennyi, Mehmet Kavalci, Marcus Cornelius, Mark Wspanialy, Laura Heyns

- HEAT TRANSFER IN SHORT VERTICAL 1- AND 3-ROD BUNDLES COOLED WITH SUPERCRITICAL WATER

Igor Pioro, Evgen N. Pis'Mennyi, Mark Wspanialy, Laura Heyns, Mehmet Kavalci, Marcus Cornelius

Pisa, Italy - February 3-5, 2025

- ANALYSIS OF HEAT TRANSFER AT SUPERCRITICAL CONDITIONS WITH MACHINE LEARNING ALGORITHM

Meiqi Song, Xiaojing Liu, Ting Yang

- RESEARCH ON LEAKAGE AND INJECTION OF HIGH-ENERGY FLUIDS FROM PIPELINES AND NARROW GAPS

Qincheng Bi, Tao Zhang, Jinle Zhao, Fan Feng

- NEW DEVELOPMENTS OF SUB-CHANNEL CFD FOR ROD BUNDLES WITH WIRE WRAPPED SPACERS

Chenxin Zhang, Bo Liu, Shuisheng He

20.30 Social Dinner

Restaurant La Clessidra

Via del Castelletto 26/30 - Pisa

Tuesday, February 4, 2025 - H 20.30



08.30 - 10.30 PARALLEL SESSIONS

08:30 - 10.30 SPECIAL TOPIC: ROUGHNESS EFFECTS

Aula Magna

Chairpersons: Ivan Otic, Fabian Wiltschko

- **MODELLING THE INFLUENCE OF SURFACE ROUGHNESS ON HEAT TRANSFER AT SUPERCRITICAL PRESSURE**
Sara Kassem, Andrea Pucciarelli, Walter Ambrosini
- **PREDICTION OF THE HEAT TRANSFER TO SUPERCRITICAL PRESSURE FLUID AT ROUGH SURFACE**
Fabian Wiltschko, Ivan Otic, Xu Xheng
- **A STUDY OF THE EFFECT OF PYRAMID ROUGHNESS ON TURBULENT HEAT TRANSFER IN SUPERCRITICAL WATER**
Kenneth Chinembiri, Shuisheng He, Wei Wang
- **CFD MODELING AND VALIDATION OF SUPERCRITICAL FLUID HEAT TRANSFER ALONG ROUGH WALL SURFACES**
Haipeng Li, Henryk Anglart
- **TREATMENT AND EVALUATION OF SURFACE ROUGHNESS OF FUEL CLADDING FOR HEAT TRANSFER EXPERIMENTS IN SUPERCRITICAL FLUIDS**
Jan Vít, Monika Šípová, David Bricín
- **ANALYSIS OF ROUGHNESS EFFECTS ON TURBULENT HEAT TRANSFER TO SUPERCRITICAL WATER IN A HORIZONTAL TUBE**
Yuhao Xu, Jivan Khatry, van Otic, Jie Zhu

08.30 - 10.30 CFD APPLICATIONS

Room PS1

Chairpersons: Pan Wu, Tiago Moreira

- **DISCUSSING CFD ANALYSIS OF HORIZONTAL AND VERTICAL UPWARD FLOW UNDER SUPERCRITICAL CONDITIONS**
Attila Kiss, Balázs Kiss
- **COMPARISON OF CFD ANALYSIS RESULTS OF HORIZONTAL FLOW IN SCW-SMR FUEL ASSEMBLY WITH AND WITHOUT WRAPPED WIRE SPACERS**
Attila Kiss, László Adorján

Pisa, Italy - February 3-5, 2025

- FLUID-TO-FLUID SIMILARITY AND CFD PREDICTIONS OF HEAT TRANSFER AT SUPERCRITICAL PRESSURE WITH INFLUENCES OF BUOYANCY AND TURBULENCE MODELS: VALIDATION AGAINST IAEA BENCHMARK

Youcef Bouaichaoui and Lin Chen

- TRANSIENT CFD ANALYSIS OF SUPERCRITICAL CO₂-BASED NATURAL CIRCULATION LOOP

Shubham Rajesh Vaidya, Goutam Dutta, Harish Pothukuchi

- COMPUTATIONAL INVESTIGATION OF SUPERCRITICAL FLOW OF WATER OVER EIGHT ROD BUNDLE IN A PRESSURE TUBE

Abhijeet Vaidya, Ritesh Bagul, Ananta Borgohain, S.K. Sinha

- NUMERICAL PREDICTION OF HEAT TRANSFER FOR SUPERCRITICAL FLUIDS FLOWING HORIZONTALLY AND VERTICALLY DOWNWARD USING A NEW TURBULENCE MODEL

Abdullah Alasif, Andrea Pucciarelli, Osman Siddiqui, Afaque Shams

10.30 - 11.00 **Coffee Break**

11.00 - 12.00 **WRAP UP OF SESSIONS**

Aula Magna *All Chairpersons*

12.00 - 13.00 **CLOSING PANEL: STATUS AND PERSPECTIVE OF SCWR CONCEPTS AND FUTURE COMMERCIALISATION**

Aula Magna

13.00 - 14.00 **Lunch**

Afternoon:

Side meetings to be communicated at the Symposium

Evening:

21.15 **Concert of the Orchestra dell'Università di Pisa in the San Frediano University Church**

The International Symposium on SCWRs is providing a forum for researchers, engineers, as well as industrial professionals to present their research results and development activities in SCWR areas covering core, fuel and reactor design, materials, coolant chemistry, corrosion, thermal-hydraulics, safety analysis, balance of the plant systems and other corresponding technologies.

IMPORTANT DATES

Abstract Submission - **April 30, 2024**
Communication of Abstract Acceptance - **May 31, 2024**
Early Bird Registration - **July 14, 2024**
Draft paper contribution - **July 31, 2024**
Communication of Draft Paper Acceptance - **September 30, 2024**
Final Author Registration Deadline - **October 15, 2024**
First Program Delivery - **October 20, 2024**
Final paper Submission - **October 31, 2024**

SIDE EVENTS HOSTED BY THE UNIVERSITY OF PISA

EU ECC-SMART Project Final Meeting - February 6, 2025 (only for project participants)
GIF SCWR Meetings - February 7, 2025 (only for working group participants)

TOPICS OF INTEREST

Reactor Physics
Core Design, Fuel and Fuel Assembly
Materials, Components and Manufacturing
Water Chemistry and Corrosion
Thermal-hydraulics
Balance of Plant and Economics
Safety Analysis and Passive Safety System
Small Modular Reactors
Licensing
Numerical Methods
Cross Cutting Issues with other GEN-IV Reactor Concepts
Other corresponding industrial applications

LOCAL ORGANISERS

Andrea Pucciarelli (andrea.pucciarelli@unipi.it)
Walter Ambrosini (walter.ambrosini@unipi.it)

In co-operation with:



ORGANISING SECRETARIAT

A.I.C. - ASTI INCENTIVES & CONGRESSI SRL

P.zza San Uomobono, 30 - Pisa ITALY
Ph. +39 050 598808 / 541402 - www.aicgroup.it
secretariat@isscwr11-pisa2025.com