Erik Cilia

PHD STUDENT IN NUCLEAR ENGINEERING

PERSONAL INFORMATION

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Date of birth 28/08/1994

Nationality Italian

RESEARCH EXPERIENCE

NOVEMBER 2024 - PRESENT

DOCTORATE IN DIMSAI (HTTPS://PHD.UNIBO.IT/DIMSAI/EN) 40TH CYCLE

RELIABILITY ANALYSIS OF PASSIVE SAFETY SYSTEMS IN SMR REACTORS

My research focuses on the reliability assessment of passive safety systems through deterministic thermal-hydraulic simulations using codes such as RELAP5 (Best-Estimate) and MELCOR (severe accident analysis). In particular, I apply the REPAS (Reliability Evaluation of Passive Safety systems) methodology to evaluate the thermal-hydraulic performance and reliability of passive systems operating in natural circulation, such as the Decay Heat Removal System. The objective is to characterize system behavior and identify potential functional failures.
I am actively involved in two European research projects: SASPAM-SA and EASI-SMR. In the SASPAM-SA project, I am responsible for conducting deterministic analyses of accident scenarios in Small Modular Reactors (SMRs). In the EASI-SMR project, I contribute to Work Package 4, focusing on the application of the REPAS methodology.

SEPTEMBER 2024 – OCTOBER 2024

SCHOLARSHIP - ENEA RESEARCH CENTER, BOLOGNA

Recipient of a scholarship on “Reliability Analysis of Passive Safety Systems in SMR Reactors”
During this period, I focused primarily on bibliographic research related to the main analytical methodologies used to assess the reliability of passive safety systems, such as REPAS, RMPS, and ASPRA. Particular attention was devoted to the REPAS methodology, examining its structure, theoretical foundations, and most relevant applications in the context of thermal-hydraulic passive systems operating in natural circulation.

SEPTEMBER 2023 – FEBRUARY 2024

THESIS INTERNSHIP (SASPAM-SA PROJECT) - ENEA RESEARCH CENTER, BOLOGNA

As part of my Master’s thesis, I carried out a research internship at the ENEA Research Centre in Bologna, within the framework of the Horizon Euratom SASPAM-SA project (Safety Analyses of SMR with Passive Mitigation Strategy – Severe Accidents). This European project aims to enhance the safety assessment of Small Modular Reactors (SMRs).My thesis work contributed directly to the objectives of the SASPAM-SA project, focusing on the safety analysis of a generic IRIS-type Small Modular Reactor (SMR). The activity involved performing thermal-hydraulic simulations using the MELCOR code, a state-of-the-art tool developed by Sandia National Laboratories for the analysis of Design Basis Accidents (DBAs) and Beyond Design Basis Accidents (BDBAs), including severe accidents. I carried out simulations of representative accident scenarios, in particular a loss-of-coolant accidents (LOCAs), to analyze the reactor system’s thermal-hydraulic response under various boundary conditions. Particular attention was devoted to the performance assessment of passive safety systems, such as the Decay Heat Removal System. Furthermore, I evaluated accident progression, core degradation phenomena, and containment behavior in BDBA conditions.

PUBLICATIONS & PRESENTATIONS

- **NURETH-21**, BEXCO - Busan, Republic of Korea (August 31 – September 5, 2025):

Conference Paper Submission: “Application of the REPAS methodology to analyse the reliability of the EHRS in the decay heat removal strategy for an SMR”.
As part of my research, I authored a paper accepted for presentation at the 21st International Topical Meeting on Nuclear Reactor Thermal Hydraulics (NURETH-21). The work presents a demonstrative application of the REPAS methodology to assess the functional reliability of the EHRS in the decay heat removal strategy of an SMR, using a complete reactor model developed in MELCOR. The objective of the study was not to quantify the actual reliability of the system, but rather to explore the methodology’s applicability in identifying functional failure conditions and analyzing system behavior under accident scenarios. This represents the first use of REPAS on a full MELCOR reactor model, highlighting its potential integration into deterministic safety analysis workflows.

- **2nd ENEA NUC-ENER Division Workshop**, University of Bologna, Bologna, Italy (June 17-18, 2025):

Presentation of the work: “Application of the REPAS methodology to assess the reliability of the EHRS in a generic iPWR SMR”.

- **16th EMUG European MELCOR User Group**, Brno University of Technology, Czech Republic (April 7-11, 2025):

Presentation of the work: “Analysis of DBA and different BDBA scenarios in a generic iPWR-type SMR”.
I presented my Master’s thesis work at the 16th European MELCOR User Group meeting, held at Brno University of Technology. The presentation focused on the analysis of Design Basis Accidents (DBA) and various Beyond Design Basis Accidents (BDBA) scenarios for a generic integral Pressurized Water Reactor (iPWR) type Small Modular Reactor (SMR). The study utilized the MELCOR code to perform detailed thermal-hydraulic and severe accident simulations, contributing to the safety assessment of advanced reactor designs.

- **SASPAM-SA Workshop**, IRSN Headquarters, Fontenay-aux-Roses, France (October 17- 18, 2024):

Poster: "Case Study of a BDBA in a Generic iPWR Reactor Using MELCOR Code".
I presented a poster during the “International Workshop on SMR Safety for a Sustainable Short-Term Deployment” as part of the SASPAM-SA project activities. The poster detailed a case study of a Beyond Design Basis Accident (BDBA) scenario in a generic iPWR reactor, simulated with the MELCOR code. This scenario, which was the most critical among those analyzed in my Master’s thesis, involved a Loss-of-Coolant Accident (LOCA) followed by the failure of the Emergency Heat Removal System (EHRS), leading to a severe accident progression. The study formed a key component of the comprehensive safety analyses conducted during my thesis research.

- **41st UIT International Heat Transfer Conference**, Naples, Italy (June 19-21, 2024):

"Analysis of Incident Sequences in Light Water SMR Reactors with the MELCOR Code" — Presented and published in the conference proceedings.

- **SASPAM-SA Second Annual Meeting**, Bologna, Italy (October 10-12, 2023):

Attended the project meeting as a thesis intern, gaining valuable insights and updates on the progress of the SASPAM-SA project focused on the safety analysis of SMR reactors. This experience provided important exposure to collaborative research activities within a European research framework.

EDUCATION

MARCH 2024 - UNIVERSITY OF BOLOGNA

MASTER'S DEGREE IN ENERGY AND NUCLEAR ENGINEERING

Graduated: March 2024 (Grade: 110 cum laude)
Thesis: "Analysis of Incident Sequences in Light Water SMR Reactors with the MELCOR Code"
Thesis Supervisor: Prof. Dr. Sandro Manservisi Thesis
Co-supervisor: Dr. Fulvio Mascari

OCTOBER 2020 - UNIVERSITY OF BOLOGNA

BACHELOR'S DEGREE IN ENERGY AND NUCLEAR ENGINEERING

Graduated: October 2020
Thesis: "Green Computing: monitoring and improving energy efficiency in astrophysical supercomputing with Countdown Slack"
Thesis Supervisor: Prof. Dr. Franco Vazza Thesis
Co-supervisors: Prof. Andrea Bartolini, Dr. Daniele Cesarini

TECHNICAL SKILLS

- **MELCOR** Accident Simulation Code
- **RELAP5** Thermal-Hydraulic system code
- **MATLAB** (Numerical analysis, simulations)
- **Python** (Programming, data analysis)
- **Thermal-hydraulic Analysis** of Nuclear Systems
- **Reactor Safety Analysis** (DBA & BDBA Scenarios)
- Reliability Analysis of Passive Safety Systems using **REPAS** Methodology
- MS Word, MS Excel, MS Power Point, MS Outlook
- **Operating Systems** Windows, Linux basics

PERSONAL SKILLS

- **Native language** Italian
- **Other language** English level B2 (Independent user)
- **Driving licence** B
- **Organisational skills** As a PhD student, I am motivated and well-organized, with a critical and curious approach to research. During my academic path, I have had the opportunity to work in international and multicultural environments, where I was exposed to collaborative research activities and current scientific challenges. These experiences have helped me develop a growing awareness of teamwork and interdisciplinary research dynamics.