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## **HVDC technologies, valuable connections and fika**

One of the primary objectives of the Inter-oPEn project is to educate and train highly qualified researchers to facilitate the interoperability of Power Electronics (PE) assets within modern power networks, thereby ensuring their safe and reliable operation.

In line with this goal, I recently had the valuable opportunity to attend the course on HVDC Technology and HVDC Grids (EES-UETP), held at the KTH Royal Institute of Technology in Stockholm, Sweden, from November 17 to 19. A consortium of prestigious institutions organized the course: KTH Royal Institute of Technology (Sweden), CITCEA-UPC (Technical University of Catalonia, Spain), Technical University of Denmark (Denmark), and KU Leuven (Belgium).

Over the three days, the attendees gained valuable insights from both academic and industrial speakers. The program was comprehensive, featuring not only relevant lectures on HVDC technologies but also hands-on training modules. These practical sessions covered critical areas such as offshore wind electrical design and grid code compliance, HVDC grid planning, VSC and MMC modeling, and HVDC protection.

Furthermore, the course provided an excellent occasion for networking and establishing valuable connections with colleagues from around the world who are actively engaged in this field. Their diverse perspectives and experiences were highly refreshing and served as an eye-opener, leading to a better understanding of the complexity of HVDC grids. It also highlighted the importance of areas beyond HVDC technology itself, such as grid planning, cable systems, and the current state of fault and stability analysis tools.

In addition to the technical program, immersing myself in Swedish culture greatly enhanced my overall experience. Even in the cold winter, the city was warm and friendly. On the first day, we were welcomed with a group dinner at the KTH Reaktorhallen. This was a truly unique event, not only for the excellent cuisine but also for the historical significance of the reactor, which began operating in 1954 to allow KTH engineers to study reactor physics and produce medical isotopes.

Moreover, we frequently experienced fika, a cherished Swedish cultural practice. Fika is a dedicated break from work where people relax, socialize, and recharge with coffee and light snacks. Throughout the three days of the course, these moments of fika allowed us to refresh our energy, not just with the sweets, but also through calm conversation and connection with our colleagues.

Finally, aside from the valuable technical knowledge and professional relationships gained, I take away from Sweden the philosophy of Lagom. This concept, meaning "not too much, not too little, but just the right amount", embodies balance, moderation, and sufficiency in all aspects of life. Connecting this philosophy to my research and professional life, I am inspired to put it into practice daily. Especially as an engineer working with renewable energies, I am committed to following the principles of sustainability and focusing my efforts on developing technologies that ensure the well-being of humanity with balance and moderation, recognizing that electrical energy is undoubtedly key to all societal development.

*Written by Alejandra Obando.*

More information on [\[LinkedIn\]](#) and [\[website\]](#).

## **Past Inter-oPEn events**

### **Training module 4 “Manoeuvring complex systems: On change management in critical infrastructure domains” and Mid-Term-Check (02.-04.12.2025 in Brussels, Belgium)**

The Inter-Open's fourth training module, titled "Managing Complex Systems: Change Management in the Critical Infrastructure Domain" was held in Brussels, Belgium, on December 2 and 3.

On the first day, the meeting opened with a series of research presentations from all doctoral candidates. Each of us had the opportunity to share progress and receive direct feedback from our industry partners. The constructive remarks from SIEMENS ENERGY and ELIA helped us reflect on how our research can respond to practical needs in European energy infrastructure. The day concluded with an interactive software workshop led by CRESYM, focused on good coding practices for collaborative modelling and research development.

The second day focused on understanding how complex infrastructures evolve and how interoperability can be achieved in practice. TU Braunschweig introduced key concepts of complex systems and highlighted how Model-Based Systems Engineering can support both the design of new grid architectures and the adaptation of existing ones. Siemens Energy then discussed the manufacturer's perspective on sharing information, addressing industrial constraints, and the risks associated with accelerating innovation. Elia followed with the TSO viewpoint, inviting doctoral candidates to reflect on what is technically ideal versus what can realistically be implemented in multi-vendor HVDC grids. The day concluded with a lively panel discussion involving SIEMENS ENERGY, ELIA, and CRESYM, where open questions were addressed and the practical challenges of interoperability were examined from multiple perspectives.

As the project progresses, our contributions as researchers to expanding knowledge of multi-vendor HVDC technologies within an interoperability framework increase. At this stage, as we become more deeply involved in our individual research, it becomes easier to identify collaboration opportunities within the group and direct our questions to different stakeholders, such as TSOs and vendors. The training module format, combined with workshops and open discussions, allowed us to maximize the benefits of this training for both the technical and legal aspects. This extensive learning experience brings us ever closer to our personal and group objectives.

Finally, on December 4th, the Mid-Term Check (MTC) with the European Research Executive Agency (REA) took place. The consortium reported on the project's progress and discussed the work ahead. The Project Officer acknowledged the achievements already made and gave encouraging feedback on the direction of the research activities, successfully concluding the Mid-Term Check.

The three-day visit to Brussels was a positive experience, combining valuable training with active participation in the MTC meeting. Aside from the new insights we gained, we greatly appreciated the opportunity to collaborate with all those who strive to accomplish the objectives of Inter-oPEn.

*Written by Alejandra Obando and Abdolhamid Farshadi.*

More information on [\[website\]](#).

### **Research Workshop (30.09.-01.10.2025 at UPC in Barcelona, Spain)**

The Research Workshop brought together researchers from different disciplines to collaborate on multi-vendor HVDC grids. The event included doctoral research presentations, a lab tour and a keynote lecture on harmonic impedance by Prof. Juan Velásquez from FH Dortmund.

More information on [\[website\]](#).

### **Training module 3 “Introduction to Regulation and Intellectual Property Law for Power Grids” (17.-18.06.2025 at RUG in Groningen, Netherlands)**

Training module 3 focused on power grid regulation and intellectual property. It highlighted the critical need for detailed, interdisciplinary communication between engineers and lawyers in order to navigate EU legal frameworks effectively and protect technical innovations.

More information on [\[website\]](#).

## Publications

### - Internal Power Flow Control For Modular Multilevel Converter During Submodule Failure

T. B. Hashfi, H. Vahedi, P. Palensky and A. Lekić, "Internal Power Flow Control For Modular Multilevel Converter During Submodule Failure," *2025 IEEE Kiel PowerTech*, Kiel, Germany, 2025, pp. 1-7, doi: 10.1109/PowerTech59965.2025.11180269.

More information on [\[website\]](#).

## Ongoing Publications

### - Conceptualizing the protection properties of DC networks: Requirements engineering and system design

Within the Inter-oPEn doctoral network, Abdolhamid Farshadi contributed as a co-author to a collaborative paper titled "Conceptualizing the protection properties of DC networks: Requirements engineering and system design" with his colleague Fabian Benedikt Witt at the elenia Institute of TU Braunschweig, together with their supervisors Prof. Michael Kurrat and Dr. Melanie Hoffmann, as well as Dr. Geraint Chaffey from KU Leuven.

This work closes a gap in the planning process at concept level by illustrating how functional requirements derived from stakeholder needs can be interfaced with the design process. Constraints imposed by connected onshore and offshore AC grids are considered as boundary conditions for DC grid protection. The derived requirements are characterised using a power-flow interruption perspective and formulated to align with the Continued Operation (CO), Temporary Stop (TS), and Permanent Stop (PS) operating modes defined in IEC TS 63291.

In order to compare different protection designs in a technology-agnostic manner, affected power-flow interruption and affected isolation zones are proposed. Additionally, the HVDC concept is transferred to LVDC systems, where the operating modes must be redefined to reflect local constraints and DC-voltage stability considerations.

The paper contributes a requirement-driven approach to early-stage DC protection design and supports more transparent decision-making for future multi-vendor grid architectures. This paper has been presented at the DC=IN 2025 conference in Lemgo, Germany and will be soon published through IEEE Xplore.

Kind regards,

Your Inter-oPEn Team

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Published on behalf of the Rector of RWTH Aachen University.

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Institute for Automation of Complex Power Systems and Division 4.2 - Management of Third-Party Funds

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Funded by the European Union under Grant Agreement No. 101119349. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or REA. Neither the European Union nor the granting authority can be held responsible for them.