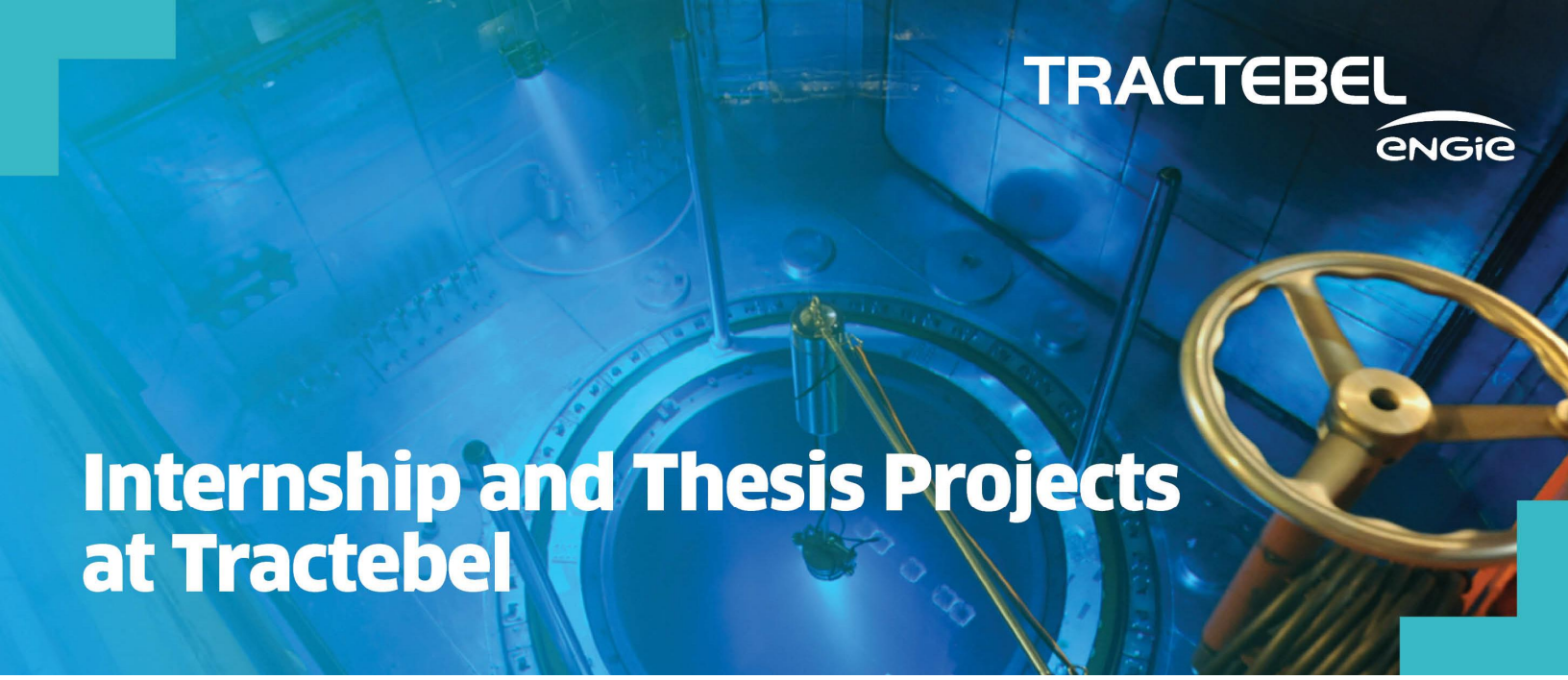

Internship and Thesis Projects at Tractebel

Enhanced PSA models for wider applications

Probabilistic Safety Assessment

Business line: Nuclear – Nuclear Safety and Engineering – Probabilistic Safety Assessment

Duration: from 2 to 6 months

Period: January – December 2024

Site: Brussels Engie Tower

Who is Tractebel?

Tractebel, part of the Engie group, has over 150 years of experience and is one of the world's largest engineering companies. Tractebel offers its customers multidisciplinary solutions in the fields of energy, nuclear, hydraulic and infrastructure. Our teams are involved in all phases of a project, from feasibility studies to implementation.

With who will you be working with?

You will work with the Level 1 Probabilistic Safety Assessment (PSA) team which is responsible for the PSA of the Belgian Nuclear Power Plants. The group also performs reliability analyses for other industrial applications.

What will you be working on?

Context

The PSA is a tool that analyzes the risks associated with operating a nuclear power plant by assessing various metrics related to damage levels, such as core damage frequency, and fuel damage frequency. Unlike traditional deterministic methods, PSA provides a broader perspective by considering a wider range of faults and system inter-dependencies, trying to use as much as possible realistic criteria for plant and system performance. The PSA logical and systematic approach, based on more realistic assessments, enhances the understanding of inherent risks across diverse conditions. This will complement the deterministic methods in an integrated approach for informed decision-making in safety management.

However, while PSA is a powerful tool, it has its weaknesses and limitations. The extent to which PSA results contribute to informed decision-making depends on the model's detail, quality, and completeness. EUR Chapter 2.17 requirement 1.3A is asking for a PSA model sufficiently detailed to develop a Living PSA. From IAEA-TECDOC-1106 "*A "living PSA" (LPSA) can be defined as a PSA of the plant, which is updated as necessary to reflect the current design and operational features, and is documented in such a way that each aspect of the model can be directly related to existing plant information, plant documentation or the analysts' assumptions in the absence of such information. The LPSA would be used by designers, utility and regulatory personnel for a variety of purposes according to their needs…"*.

Since nuclear power plant undergo physical, operational, organizational, and knowledge-related changes over time, to ensure the continued relevance of PSA, the concept of a Living PSA is essential, requiring continuous updates to reflect plant changes accurately. This cannot be performed easily if the model does not include explicit relations with the existing plant information. A PSA model with explicit and deep relations with the existing plant information is a valuable and powerful tool in Nuclear Power Plant (NPP) safety management and informed decision-making allowing the users to improve and extend the insights from the importance analysis, make easier the PSA Event Analysis, make quick and easier some simplified hazards screening analyses (fire, flooding, etc.), set up applications like the safety monitor (an on-line tool reflecting the instantaneous risk based on the actual plant situation) to help plant staff in operational decisions by providing real-time analyses, implement applications outside the standard use of a PSA, for example for security evaluations, e.g., PSA-based vital area identification, etc.

The PSA team of Tractebel has launched a project dedicated to the wide enhancement and improvement of the capability of PSA models. This internship fits in this context.

Description of the work

This internship proposal aims at developing a test case to assess the potentiality of the application enhanced PSA model with explicit and deep relations with the existing plant information. This test will help to evaluate the potentiality of applications and the feasibility of a complete implementation on a real scale PSA model. Moreover, the limits of the approach, to be

addressed for future improvements, will be listed. The duration of this internship can be tailored to the needs of the student: its scope/content/level of detail can be adapted to fit in the academic calendar.

Scope

- Get familiarized with RiskSpectrum® and the way it produces and quantifies the Minimal Cut Sets (minimal combinations of events leading to fuel/core melt).
- Get familiarized with the RiskSpectrum® importance analysis function with attributes, components, systems, etc.
- Add, for a chosen test case, the necessary structures and information to the PSA model.
- Propose a practical guidance to approach the issue.
- Run simulations to demonstrate the beneficial effect of the developed guidance comparing the outcome with base results.
- Identify the limits of the guidance for further improvements.
- Write a summary report.

Who are we looking for?

- You have a particular interest in PSA and reliability/availability analyses.
- You have a good knowledge of reliability and availability estimation.
- You have programming skills (e.g., Python).
- You have an analytical mind.
- You are autonomous, rigorous, systematic, willing to listen and learn.
- You are not afraid to ask questions and to look for support.
- You are creative, seek solutions and propose ideas.
- You have a good team spirit.

What do we offer?

- An interesting internship in a multilingual environment, with a good work-life balance.
- The opportunity to meet industry experts and work in a team of experienced professionals.
- Familiarity with an environment that allows you to strengthen your professional and technical skills.
- An opportunity to experience the ways of working in a design office.

How to apply?

Do you think Tractebel is the ideal solution for your internship?

Contact your professor and send an e-mail to FEDERICO.AGOSTI@TRACTEBEL.ENGIE.COM with your CV and a concise motivation message.

We hope to see you soon!