Travelogue

Avveckling, Young Generation 2025

Welcome to the travelogue of our visits at nuclear facilities in Denmark, Lund and Italy, which is a bit the diary of our trips, the journal of our adventures, the saga of us conquering Europe.

Our twist and turns started in Denmark and Skåne at the end of June. A trained eye would guess why: it was to get the best weather during our escapades (we loved the deluge in Copenhagen). That is where we visited mainly Risø DTU (research site), Barsebäck (BWR) and ESS (accelerator) but also “bonus” visits such as the North Tokamak and Copenhagen Atomics (SMR).

We decided to go to Italy after the summer to avoid the heat wave, unfortunately the organisation took more time than expected so we traveled there mid-November. The truffle season was delightful except for the detail that it was difficult to discern the vine landscapes (see picture on the left to support the claim). We however managed to visit ISPRA (research site) and the Trino NPP (PWR), as well as a bonus visit at Politecnico di Turino (university).

Written by Natacha Benoit, Michela Casarella, Per von Wowern and Sune Levin.

Norden & Italy: poles apart

Participants

Name	Enterprise
Michela Casarella	Blykalla AB
Sune Levin	SKB
Per von Wowern	Westinghouse (Westdyne)
Martin Starke	OKG
Natacha Benoit	Cyclife Sweden AB

Purpose of the trip

If we must write about expectations, we might start with the most surprising. It might happen that one member of our group misunderstood the grid scoring during the registration to YG, he thought that the more points he was giving to a theme the more weight he would give to it. He finished by realising that it was not the case where he joined the group that he had the least interest in.

During the first seminar, all the different opportunities of destination were already listed. We were really excited to brainstorm on all the possibilities that we had to restrain ourselves. Like most of the groups, we probably used the most practical path: let's contact the sites/companies where we already had contact due to our work experience. It also happens that two of our members originated from outside Sweden and had contact in the nuclear field due to their studies. Like the other thematic, all the sites are more or less involved with decommissioning, even at the design phase. It was more a compromise between feasibility and what we were really motivated to visit; especially for the countries outside the Nordics.

For the "outside Nordics" destination, we had: Spain, USA, Italy, France and Japan.
We had to restrain ourselves even more for the motivation letter, so a choice had to be done. Spain and the USA were not the fastest to get an answer from. If we had a tiny chance to go outside Europe, we preferred Japan over the USA, especially since the contact was already more than done. Furthermore, Japan is a really interesting place to

go thinking of decommissioning, especially with their recent actuality. There is Fukushima of course, but also some sites which started decommissioning before the accident. Also, something like half of their reactors are stopped for dismantling. Of course, there was a huge interest in the destination for private interest. Also, on feasibility we heard a rumor that a direct line was opening between Sweden and Japan.
At this stage, we had the contact and enthusiasm from all the French sites mentioned in the letter. For Italy, we had two members that had a contact and who were digging both on their side.

In the Nordics, there were so many destinations that we wondered on the way to organise ourselves so that we can visit as much as possible with a minimum of time. It was also useful to have a red thread to justify our choice. We decided to organise them so we could compare them: between industry (oil/nuclear), type of sites (production, research, particle accelerator) and within the same country.

We created some ponderation table to stress the progress of the destinations we prioritised while waiting for the answer from the YG committee. Then, we received their verdict: site type comparison and Italy.

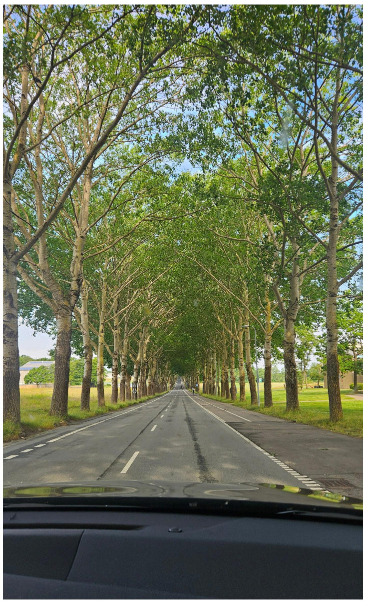
Nevertheless, we were still cultivating the hope to go to Japan as it was wise to keep doors open in case the Italian door got closed. Unfortunately, the organisation was not forbidding the idea but still quite reluctant to let us go outside Europe. Some of our companies were also quite vigilant about their finances and needed good justification to allow the travel expenses. On the other hand, our Japanese contact required such a level of detail that we could not provide. On one side we were being asked the budget we had to organise the visits, when on the other side our companies were asking us to estimate the cost of all the visits to accept or not the trip. The snake was biting its own tail. For all those reasons we stop digging this opportunity, not without a broken heart.
Both our Italian contacts did not work, so our Italian member finally managed to get an answer through the website of SOGIN (company currently responsible for decommissioning in Italy). The process was really long and we managed to get a confirmation really around the deadline we agreed with our YG mentor.

For the Nordics, we had two contacts at ES, several for Barsebäck and a group last year (which one of our group were befriended with) gave us the contact for Risø.

Individual sites

DTU Risø

Introduction to DTU Risø



DTU Risø Campus is located on the Risø peninsula in Roskilde Fjord, 40km away from Copenhagen. It was inaugurated in 1958 as the Research Establishment Risö, driven by Niels Bohr's vision for the peaceful use of nuclear energy. Initially, the site hosted Denmark's only nuclear research reactors and became one of the largest research investments in Danish history.

For three decades, Risø focused on nuclear research and energy security. After the oil crisis (will of energy independence) and subsequent political decisions, nuclear power was removed from Denmark's energy plan in 1985. Since then, Risø evolved into a hub for sustainable energy research, notably wind energy, solar technologies, and advanced energy systems.

What We Did

As our former guide was unfortunately sick (communication/visit coordinator), Bjarne took over at the last minute. Not only did they manage to maintain the visit, but also our guide was a really experienced member of Danish Decomissionning, who knew a lot about the history of the site.

We started the visit by a conversation, sitting on outside tables, with beautiful weather while drinking coffee. It was an opportunity to present each other and ask the comparison questions that we asked for the visits of the sites that involved decommissioning (see table at the end of the report). Then we started the visit with the reactors. Two reactors are already entirely decommissioned. The third one was under a major dismantling activity (cut of the concrete core), so unfortunately it was not part of the visit.

Then, we went to the hot cells facility (see picture above) that was used for fuel research and material testing during the operational period. Bjarne described the cleaning process (blasting, remote controlled equipment) and the challenge of contamination control. We learned about the historical accident involving alpha contamination and the safety measures implemented today. In the same building, we visited the area where the water was treated. The treatment consisted in distillation and concentration of the radionuclide so as to trap them in bitumen.

After that, we finished by walking among the waste storage areas. We toured the intermediate storage facilities containing around 6 000 of low-level waste. Our guide talked about the repacking project that they have on old waste packages. Also, we exchanged on their plan for a new 12 000 m^2 storage building to accommodate future waste.

DTU Physics (Tokamak)

Introduction to DTU Physics

As part of our Nordic trip we visited the Department of Physics at the Technical University of Denmark (DTU). The institute is deeply involved in nuclear research, with projects spanning plasma physics, materials for future reactors, and advanced facilities for nuclear systems development.

Particularly regarding Plasma Physics and Fusion Energy research, the DTU Physics department hosts the NORTH (NOrdic Research Tokamak Hub) facility, which is a small spherical tokamak and the only tokamak in Scandinavia. The NORTH research strategy consists of three paths:

- to study plasma-wave interactions with a focus on non-linear wave dynamics
- to study plasma turbulence
- to develop and mature plasma diagnostics.

The NORTH tokamak is a small scale tokamak with a radius of 25 cm and a central magnetic field up to 0.3 T. The plasma is heated using two 3 kW magnetrons operating at 2.45 GHz. The goal is to equip the device with plasma diagnostics in order to measure density, temperature and general wave propagation and perform dedicated research.

What We Did

The visit began with an introduction to ongoing research at DTU. We were shown how superconducting technology, in collaboration with industry, is being developed to power the magnets required for future fusion reactors. We also attended lectures on the DEMO fusion reactor concept, where scientists explained the extreme conditions that materials must withstand, for example, tungsten components exposed to megawatts of heat flux and high neutron damage. Another presentation outlined the upcoming Nuclear Salt Loop Facility (NSLF), designed to investigate molten salt fuels and their effects on structural materials.

The highlight was our tour of the laboratory hosting Tokamak NORTH. Surrounded by diagnostics, cables, and magnets, this tokamak is used to study plasma dynamics. We witnessed a plasma pulse live!

A plasma pulse in a tokamak is a very short discharge (milliseconds to seconds) where a neutral gas (often deuterium) is injected into the vacuum chamber and then ionized by strong electric fields. The resulting plasma is confined in a ring shape by magnetic fields. These pulses allow researchers to explore how plasmas behave and how to keep them stable, which is key for future fusion power plants.

Seeing this flicker of light, which represents the same physical process that powers the Sun, made the idea of fusion energy much more concrete.

Copenhagen Atomics

What We Did

Third day of the nordic trip, Tuesday the 24th of June, was a full day at the company Copenhagen Atomics office and manufacturing site on the outskirts of Copenhagen. This visit was also arranged by Germany as part of the Copenhagen Excursion.
The day started off at their conference center. It started off with presentations from selected members of the German group. They presented their work and the current state of the German nuclear industry. Our YG group finished off the presentations before lunch by doing a small introduction to YG Sweden and then short individual presentations from each group member.

The afternoon started with a presentation from Copenhagen Atomics CEO Thomas Jam Jensen. He told us about the company and the main product, their Thorium breeder reactor. It is a small modular reactor with molten salt as moderator and
Fuel binding matrix. The power output is 100 MWth and the reactor is supposed to fit in a shipping container. One of the larger investors for the company was also there and explained why he believed in the company and their strategy.

Before the visit was over we got a tour of the testing and manufacturing facility. Their factory was huge and was divided into different areas. The main area was where they tested their prototypes of the reactor. They had prototype reactors running without nuclear fuel. Their plan is to build their first fission reactor at the Swiss national nuclear Lab.

Another essential part of the factory was the molten salt loop testing room. The Room was filled with Refrigerator sized testing machines. The systems run continuously for long periods of time (months) to see how the molten salt affected the process and materials. These molten salts loop systems were also sold as separate product to
Research institute and other developers of molten salt based systems. Their next big plan for the factory is to start up their molten salt fuel production and assembly line.

Barsebäck

Introduction to Barsebäck & What We Did

We arrived at Barsebäck at 8 am Wednesday the 25th of June. There we met with Jens Rönnow who had been working at the plant since 1981, now working as "director of waste management" and was extremely knowledgeable about the plant. He showed us a presentation of the decommissioning happening there including answers to our main questions. The two plants B1 and B2 were planned for a runtime of 40 years but had to shut down prematurely due to political reasons. During the two reactors runtime of 24 and 28 years respectively they produced 201,8 TWh. The cost of building the reactors in the 1970s was 2 billions while the decommissioning currently is at a cost of 6 billion and is expected to end up around 10-13 billion. The decommissioning started in 2020 and is expected to be completed in 2028. The decommissioning is done in a joint venture with OKG, where experience from decommissioning at one site is used at the other site as well and with the same personnel. The greatest take home experience Jens had from decommissioning was to make good use of the service time between shutdown and decommissioning.

We also got to see comparisons of before and after decommissioning for a lot of different rooms in the reactor building. Seeing the before and after both in images and to some extent in reality was eye-opening and gave a feeling of the amount of work going into the decommissioning of a nuclear reactor. We then went on a tour inside and saw the reactor hall, turbine hall, wetwell and the control room. In the turbine hall we heard a loud suction noise which turned out to be the sound of sucking sand from sand filters into big bags. The sound echoed in the empty turbine hall and in many regards echoed the contrast between the amount of work ongoing in the quite empty shells that are the site of BKABs nuclear facility.

ESS

Introduction to ESS

ESS is a research facility with the aim to use neutron scattering for probing materials and processes in a wide variety of fields from physics to geology. The facility consists of a linear accelerator that accelerates protons to 96% of light speed and has them collide with a spinning tungsten wheel. This promotes neutron scattering and the neutrons are then gathered in a variety of channels that direct them to samples to be exposed/probed. The facility is currently under construction but is planned to be completed by 2027.

What We Did

ESS might seem a strange place to visit when our focus was decommissioning and the facility is not built yet. However, nowadays a nuclear facility needs a decommissioning plan in order to be licentiated and hence there is actually quite some work already put in to describe how the site will be decommissioned. For our visit, we got both a general presentation of the site as well as an overview of the decommissioning plan of ESS. We then had a walk around the site and saw the tungsten target (or the machinery above it where they were installing components), as well as the waste management halls. Both in the presentations and when walking around the site it was evident that a lot of thought has already been put into how to handle waste, and in particular the very exposed tungsten target. Hopefully the amount of effort ESS has put into this early on pays off in the long run, making waste management and decommissioning a lot smoother than at sites where it was not in the original plan for the facility.

Ispra

Introduction to Ispra

Ispra is the first research reactor of Italy, built in the years 1957-59 it is a heavy water reactor of the type Chicago pile 5 developed by Enrico Fermi. The reactor was designed for 5MW and had a graphite block to slow down neutrons for experiments on low energy neutrons. The main research activities had been testing neutron exposure of different materials. Ispra was sold to the European Commission in 1960 and since then the European joint research center (JRC) of Ispra has been established surrounding the facility.

What We Did

We visited Ispra on the 13th of November together with Guido Costantini who is the head of international relations of Sogin (a state owned company responsible for decommissioning of nuclear plants and management of nuclear waste in Italy). The manager of the site Paolo Capoferro and Guido showed us presentations about Sogin, the history of the Ispra research reactor and their work in decommissioning it before showing us around the site. We had a walk into the reactor room as well as a walk around to see the new facilities for in-term storage and free release measurements that they were currently establishing.

Since shutting down the reactor in 1973 and disposing of the used fuel by reprocessing, the doors to the reactor had basically been closed and nothing done in terms of decommissioning until Sogin started in 2020. Since Ispra was a joint European research reactor there has been a lot of different research activities during the years and there is a lot of different research equipment left with sparse or no documentation, which poses a challenge for characterizing the waste. When the waste was characterized Sogin would hand it to the JRC for in-term storage until a final repository is established in Italy.

Trino

Introduction to the site

Trino NPP, a pressurized water reactor (PWR) was designed by Westinghouse and modeled after the Yankee Rowe plant in the United States. The construction began in January 1961 and entered production on 1 January 1964, delivering 870 MW of thermal power and 272 MW of electric power, with a total lifetime generation of 26 TWh. The plant operated until 21 March 1987, after which it entered a long-term decommissioning phase managed by SOGIN. Over the years, extensive dismantling and remediation activities have been completed, including:

- Decontamination of steam generators
- Demolition of cooling towers and auxiliary buildings
- Removal of uncontaminated systems
- Treatment and shipment of spent fuel abroad for reprocessing
- Progressive dismantling of the primary and auxiliary circuits

Today, Trino NPP is an advanced decommissioning site, with major future activities focusing on dismantling the reactor vessel and internals, steam generators, pressurizer, and the construction of new waste management facilities to support final site restoration.

What we did

The visit occurred on 14th of November, as to start the second day of our YG visits in Italy. To optimize their resources, SOGIN has organised our visit conjointly with a group of nuclear engineering students coming from the University of Pise. Not only the visits in Italy have enabled us to meet great professionals from SOGIN, but have also allowed us to meet various profiles of the academic nuclear field (see also the section detailing the visit at Politecnico di Turino).

After getting a clear presentation of the site and different aspects concerning their positioning toward decommissioning, we went for a visit to the field. We did not meet a lot of workers, probably because it was a Friday. We went first into the control room, then visited some storage areas in hangars containing waste.

Later, we walked in the reactor and the fuel buildings. In the first one, the vessel head was removed from the reactor and laying nearby. The big components of the primary circuit remained but except that the space inside the industrial building were remarkably tidy. Not much machine or waste hanging around.

On the Trino site, SOGIN maximizes the segmentation before sending the waste to Sweden. The site is collaborating with Cyclife Sweden to optimize the volume of its metallic waste. This visit was an interesting professional opportunity, we even discussed the possibility of treatment of waste not agreed to be treated yet.

Politecnico di Torino - Department of Energy and Nuclear thermohydraulics laboratory

Introduction to the site

Our visit took place at the Department of Energy “Galileo Ferraris” (DENERG) of Politecnico di Torino, one of Italy’s leading technical universities, known for its strong focus on engineering, technology and applied research. Specifically we visited the Nuclear Thermohydraulics Laboratory of DENERG. The department brings together research and teaching activities across many areas of energy engineering, from traditional power systems to nuclear technologies and digital tools for the energy transition.

In recent years, DENERG has received significant national recognition by being awarded the “Dipartimento di Eccellenza 2023–2027” title by the Italian Ministry of University and Research. The department has been awarded the “Dipartimento di eccellenza 2023–2027” designation by the Italian Ministry of University and Research. This prestigious recognition supports an ambitious project focused on the energy and digital transition, aiming to integrate research, education and innovation to generate societal impact.

A key idea behind the project is Energy System Integration: instead of looking at technologies in isolation, the department is working to connect physical experiments, numerical models and digital platforms into a single research ecosystem. To make this possible, DENERG is developing a new infrastructure called I-Sinergys, which will link different laboratories and simulation environments, allowing researchers to combine experimental data with advanced modelling and digital tools.

This broader vision is directly reflected in the laboratories themselves. As part of the excellence project, several experimental facilities are being upgraded or newly developed, including the Nuclear Thermohydraulics Laboratory we visited. The lab will host a new testing infrastructure dedicated to passive heat removal systems, which play an important role in improving safety in advanced nuclear concepts and energy systems more generally.

What we did

Our visit in the department started with a presentation from the Phd student Davide. Davide’s research focuses on simulation of ionising radiation, in particular regarding fusion reactors. Part of his Phd studies had been at Plasma Science and Fusion center at MIT. In their laboratory they have an experimental tritium breeder device called BABY. Tritium is one of the most promising candidates for fusion fuel, however the availability of tritium is very scarce. Therefore a tritium breeder is needed inside a fusion reactor in order for it to be self-sufficient.

Davide simulated the tritium production and ionising radiation through the softwares OpenMC and LIBRA. He also explained and showed us briefly step by step on how to set up and use OpenMC. The group had discussion regarding how this software could be used in radiation protection work, for example when planning the dismantling of radioactive components. Although very powerful software it lacks the user interface and application handiness for practical use for radiation protection.

The visit continued at the Nuclear Thermohydraulics Laboratory, which is currently undergoing a transformation as part of the Dipartimento di Eccellenza project. At the time of our visit, the laboratory mainly consisted of a steel structural framework, representing the foundational stage of a new experimental facility. This structure will be progressively equipped in the coming years with additional systems, instrumentation and test sections designed specifically for experimental testing of passive heat removal systems.

During the visit, we were accompanied by two professors from Politecnico di Torino, who introduced the scientific objectives of the laboratory and its role within the broader DENERG excellence project. In addition, a representative from SOGIN, an important industrial partner of Politecnico, joined the tour.

Although no active experiments were running yet, the visit allowed us to understand how large experimental projects take shape over time and how strategic funding enables long-term research planning. The tour offered a clear picture of where the laboratory is heading and how it will contribute to research on passive safety systems within the wider context of the energy transition.

Comparison of the sites

NORTH Tokamak in the DTU Physics Department and the ESS facility were not included in the comparison since the decommissioning aspects are not fully developed yet. Generally the answers we got on the different topics were either quite similar (techniques, experience, radioactivity) or hard to compare (cost, lifetime).

TOPICS	DTU Riso	Copenaghen Atomics	Barsebäck	Ispra	Trino
What is the cost of decommissioning?	Initial budget of 1 billion Danish kronor, now around 2 billion	Due to the considerably smaller footprint and modular design it is probably significantly less than decommissioning of a conventional NPP	10-13 billion SEK	Not disclosed (we got a number but were told not to pass it on)	Not disclosed (we got a number but were told not to pass it on)
What techniques/tools do you use or plan to use in the decommissioning?	Plasma cutting and remote arms, wire cutting (concrete). Remote blasting Robots for inspection and cleaning 3D printing (cutting plan and visual support)	Used fuel is redistributed to the manufacturer. The dismantling of the site is up to the site owner. To solve but tools and techniques used to dismantle regular NPPs can be used	Reciprocating saw, Circular saw, Angle grinder, Wire saw, Plasma cutting, Gas cutting, Robot for cutting Reactor tank	A waste treatment facility in the JRC did diamond sawing and high-pressure water jetting	Special pipe cutting tool, bandsaw, disc saw, shearing tools for the vessel head Underwater mechanical cutting (vessel and internals) Remote

					segmentations
What experience is used in making a decommissioning plan?	Participation in an international forum on decommissioning twice a year Decommissioning course in the USA	Decommissioning of a molten salt research reactor at Oak ridge in the USA	Germany, Spain, USA, International cooperation groups, EPRI (Electric Power Research Institute), OECD-NEA (Nuclear Energy Agency)	Sogin gets experience from its other sites, but since they are all different reactor types they need to find specific solutions as well. Cooperation with JRC	Sogin gets experience from its other sites, but since they are all different reactor types they need to find specific solutions as well.
How do you keep track of the radioactivity?	Daily field measurement by the RP team Sample analyses at on site lab	N/A	Swab tests, Gamma measurements, material samples to internal or external labs, sort waste by source	Swab tests, gamma measurements, material samples to labs in the JRC	Swab tests, gamma measurements
What is/was the expected lifetime of the site?	No expected lifetime at the conception Actual lifetime of between 17 and 44 years depending on the reactor	50 years	24 and 28 years, expected 40 years	Didn't have a planned lifetime	23 years (actual)

Lessons and insights

To start with the more fact-based part, the Young Generation experience is meant to help us network between workers of the nuclear industry, but has also enabled us to network with students and professors at several opportunities (YG Germany, Trino, Politecnico di Turino). This gave us the opportunity to talk with nuclear engineering students, PHD, professors with a different view on the field and in a very open, idea sharing, atmosphere. It was also interesting to compare the differences between the generally more generic and hands-on techniques needed in decommissioning as compared to the very specific science topics within nuclear research.

We felt a difference during the visits in Nordic countries compared to Italy. For the former, the approach was characterised by high transparency and openness in communication, even on sensitive topics such as budgets. For Italy, it tended to be based on structured coordination and controlled engagement. Visits were meticulously organised, with a strong emphasis on protocol and hospitality. The level of attention to detail was evident, including personalised souvenirs for visitors. From an operational perspective, facilities demonstrated an exceptionally high standard of tidiness, even for the research site which we know are always more challenging in this aspect.

We get a bit further away from decommissioning but with Denmark and Italy we got down a rabbit hole about the early history of nuclear power in Europe, the dynamics resulting from WWII and the influence of the USA. Back in those days there were not thousands of scientists working in the nuclear fields so there were big names which were the founders: Fermi in Italy (see picture below), Joliot-Curie in France, Bohr in Denmark (see picture on the left). Talking about the latter, most used to know him for his model of the atom, but he also participated in the Manhattan project. This topic first came by chatting with our guide in Italy, Guido Constantini: head of international relations in SOGIN, and particularly cultivated. The starting point was: why was France a pioneer in developing civil nuclear and not Italy? His point was that Italy was leading before the war and then the country was chaperonned by the USA, and with Mussolini during WWII... Of course it is more complicated than that but nevertheless it's really a privilege to talk with Guido.

Interestingly, Bohr also played a crucial role in the Danish nuclear development, though it got delayed because the USA were not keen on letting Bohr do it after his role in the

Manhattan project. Both Fermi and Bohr had to leave their country to go to the USA during the second world war, because they had Jewish families. So in some way you can say that both Denmark and Italy were paternalised by the USA and both had a short civil nuclear history. It is interesting to see how the second world war and a few prominent scientists in similar ways shaped the field of nuclear power in both countries we visited.

One anecdote that keeps me awake is the conversation we had with our guide at Barsebäck. His name is Jens Rönnow, he has the looks of hardness and leadership typical of a veteran of the nuclear production while wearing a pearl bracelet I think his granddaughter did for him. We were in the control room and Barsebäck has the particularity to have windows showing some landscape. Our guide was working at the NPP before and after it stopped production. He was in fact in the control room when they pushed the button to stop the reactor (if he was not the one to do it). He talked about the anger and the emotions related to the closing of a working NPP due to political reasons and it echoed within my heart as an EDF worker, as we have a comparable situation with the Fessenheim NPP.

To conclude, we learned that there is no good or bad way to handle decommissioning, just a reflection of the culture and history of the country, plus the political situation and public opinion at the moment.