

TRAVEL REPORT

The ENSI Board met with the
Finnish and Swedish regulators
and visited the Olkiluoto site

Autumn 2024



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Eidgenössisches Nuklearsicherheitsinspektorat ENSI
Inspection fédérale de la sécurité nucléaire IFSN
Ispettorato federale della sicurezza nucleare IFSN
Swiss Federal Nuclear Safety Inspectorate ENSI

The ENSI Board met with the Finnish and Swedish regulators and visited the Olkiluoto site

In autumn 2024, the Board of the Swiss Federal Nuclear Safety Inspectorate (ENSI) visited the Finnish Radiation and Nuclear Safety Authority (STUK) and the Olkiluoto site in Finland. The ENSI Board then met with the Swedish Radiation Safety Authority (SSM) in Stockholm. The main objective of the meetings with the regulators was to discuss in general the long-term operation of nuclear power plants in view of security of energy supply and to exchange views on the current challenges in the regulatory supervision of the use of nuclear power.

Topics discussed at both meetings included the roles and responsibilities of the ENSI Board and the regulatory authorities, long-term operation of the existing nuclear power plants, competence and workforce management, state of discussion for new-build plans and the related impact on the nuclear legislation and regulation, as well as the final disposal of spent nuclear fuel.

STUK

Responsibilities, nuclear power plants and regulation

The Director General, Petteri Tiippana, welcomed the ENSI Board and opened the meeting addressing the current major undertakings in Finland: "The government reaffirmed its strong interest in and support for nuclear energy production. Accordingly, a fundamental renewal of the legislation and regulation on all levels is performed aiming for instance at a streamlined licensing process". The Director General then presented the nuclear energy and regulatory landscape. The popularity of nuclear power remains strong in Finland, the acceptance even increased in the past years given the geopolitical and climate issues. There are five nuclear power plants in operation: the newest one, Olkiluoto 3 (EPR, European Pressurised Reactor), Loviisa 1 and 2 (VVER, Pressurised Light Water Reactor of Soviet design, operating license renewed till 2050), and Olkiluoto 1 and 2 (Boiling Water Reactors (BWR), operating license valid until 2038). Other facilities include waste repositories for low and intermediate waste, the final disposal facility for spent fuel, which is currently in the operating license phase, and the uranium extraction facility which is part of the multi-metal production mine. The uranium extraction facility started operations in June 2024.

STUK is building up their expertise on new reactors to be prepared for new-build projects and is actively engaging with different stakeholders in the nuclear domain. Further, cooperation is intensified with other regulators and international organizations. The renewal of the Nuclear Energy Act and the Decree is led by the Ministry of Economic Affairs and Employment to make the hierarchy and structure clearer and to account for changes in the operating environment. The renewal of STUK's regulations and guides is targeting at risk-informed oversight and goal setting, technology neutral requirements. "The status of the Regulatory Guides will change, they will be purely for guidance and not binding", noted Petteri Tiippana, Director General of STUK. "STUK is dedicating a significant effort of about 40 person-years in four years and intends to complete the rework in essence in 2026", he concluded.

Long-term operation

STUK then presented the status of long-term operation (LTO) in Finland. All Nuclear Power Plants (NPPs) in Finland have reached their original design lifetime except for Olkiluoto 3. The operating licences are granted for a limited period. In connection with the renewal of the operating license, a Periodic Safety Review (PSR) must always be carried out. For the operating licence application, the

Ministry of Economic Affairs and Employment requests STUK's statement on safety. If the operating licence has been granted for more than 10 years, a PSR must be carried out at least at 10-year intervals according to the Nuclear Energy Act. LTO is not a commonly used word in Finland: from the regulator's point of view, an NPP can be in service if safe operation is demonstrated – regardless of whether the number of service years is less or more than the original design lifetime. The licensee must demonstrate that the NPP is safe to operate until the next PSR or until the end of the operating license. PSR requirements in more detail can be found in a YVL Guide referring to the related IAEA Safety Guide on PSR. STUK issued a dedicated Ageing Management Guide in 2013. Each NPP has an ageing management programme (AMP) approved by STUK. The aim of the AMP is to keep the systems, structures and components (SSC) continuously up-to-date and in good condition in terms of safety. During the operation, the licensee must annually submit a follow-up report on the AMP of SSC to STUK for information each year.

Then, STUK presented insights of the AMP at Olkiluoto 1 and 2: the licensee revised all fatigue analyses for 60 years of operation and demonstrated that the reactor pressure vessel (RPV) and the core internals, piping and supports will meet the design basis requirements. The time limiting ageing analysis (TLAA) are valid until 2038. RPV nozzle welds were found susceptible to stress corrosion cracking, two of total 20 nozzles were repaired by removing defects and re-welding with a material more resistant. Comprehensive condition monitoring programs have been introduced for the containments and the seawater structures. In 2024, several mechanical, electrical and automation modernization projects are in progress, such as the renewal of the emergency diesel generators, the containment penetrations for electric cables and the instrumentation and control (I&C) lifetime management with the renewal of automation systems.

From STUK's perspective, an AMP should be proactive and consider also technological obsolescence. Knowledge and resources allocated for ensuring appropriate AMP must be maintained. Postponed decisions to renew for instance an I&C system or an electrical system may result in challenges to acquire spare parts for the remaining systems.



Participants of the meeting with the Finnish Radiation and Nuclear Safety Authority (STUK)

Workforce, new-build NPP, encapsulation plant and disposal facility

Based on the popularity of nuclear power in Finland, there is no lack of interest in education, training and research. Still, the Olkiluoto 3 project required a rapid increase of staff – STUK also recruited staff without previous nuclear experience and trained them in-house. A systematic competence

management in a continuous and holistic approach was established with emphasis on safety culture, leadership and management for safety. The activities carried out are within the key areas of IAEA's approach to capacity building, i.e., training, human resources management, knowledge management, and knowledge networks. STUK explained how it builds capacity over the lifespan of employment, from workforce planning focused on competencies to retaining the competence of retiring staff. Operational and workforce planning pays close attention to competencies. STUK concluded with an overview of its topical activities and development work in 2024 – 2025.

Coming to new-build NPPs, STUK noted the strong interest in nuclear power within the industry. The government aims to support the deployment of small modular reactors (SMR). Yet, no license application has been submitted so far. STUK continued with selected examples on current activities: the operating company Fortum is carrying out a feasibility study, covering both SMR and large NPPs and targeting the Finnish and Swedish markets. Fortum has requested a pre-licensing evaluation of certain design features of specific designs. This work is ongoing, more cases will follow. A cooperation in the assessment with SSM is under discussion. Other projects under discussion are related to SMR for district heating, and as energy source for steelworks. In this context STUK mentioned the change in regulation in February 2024 concerning emergency planning zones: the zones will now be defined individually for each case facilitating land use planning. STUK is continuing its efforts in competence building in SMRs and intensifying the international cooperation related to new-builds.

Finally, STUK briefly presented its supervision of the ongoing activities at the encapsulation plant and the disposal facility. The operating license application is under review and assessment. The statement of STUK is expected to be ready in the first half of 2025 if all requested documentation is acceptable.

Olkiluoto site visit

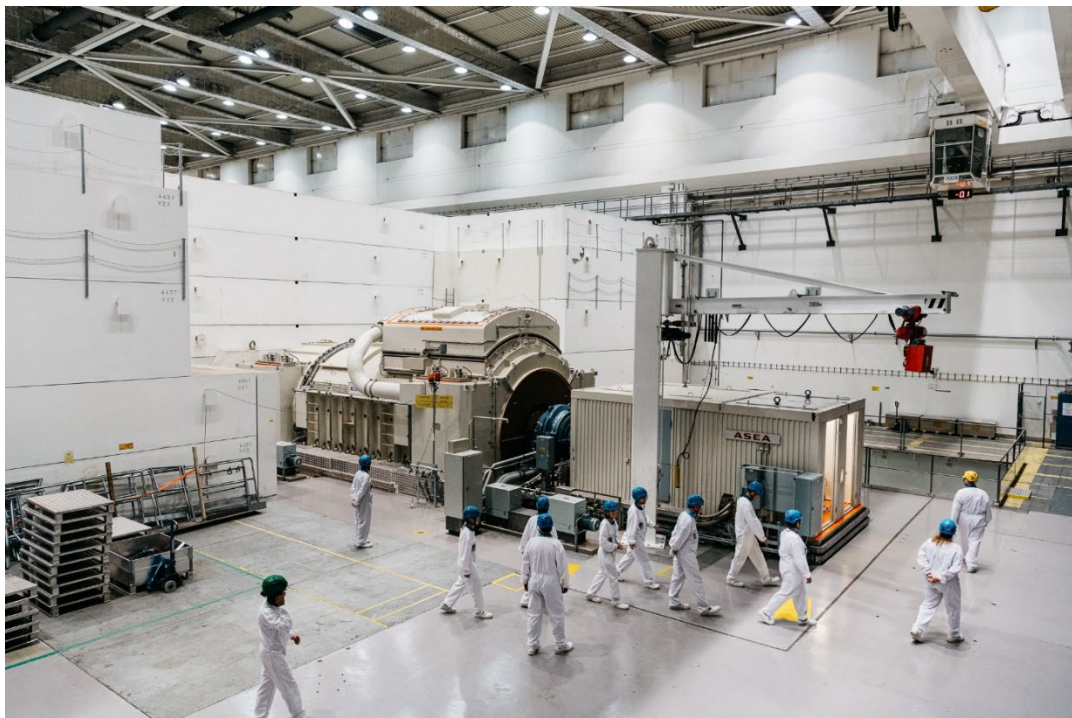


Visit of the ENSI Board at the Olkiluoto site

After the meeting with STUK, the ENSI Board visited the Olkiluoto site. STUK and Teollisuuden Voima Oyj (TVO) staff accompanied them to and around the site. At first, an introduction was given by TVO at the visitor centre addressing the history of the three NPPs at the site and providing an overview of the current situation. More insights were then presented on the Olkiluoto 3 NPP, such as specific design features of the generation III+ pressurised water reactor. The safety features are based on existing solutions and technologies which have been further developed. The focus of the development has

been on safety systems and the management of abnormal situations. Demanding safety features are required for managing severe accidents. In the highly unlikely event of a core meltdown, the core melt is transferred to the core melt spreading area where it is cooled and solidified. The Olkiluoto 3 NPP project suffered significant delays before commissioning. Major lessons learned from this project include the importance of a design being fully developed before application, the relevance of a supply chain being skilled to produce according to the high nuclear standards, and the need to go into a sufficient level of technical detail at an early stage of the project.

The technical visits started with a walk to the NPP buildings, and then first into the reactor and the turbine building of Olkiluoto 1. The fuel handling machine happened to be in the process of reloading fuel assemblies into a shipping container. Thereafter, the large turbine building of Olkiluoto 3 was visited inside. All visits were accompanied by technical explanations of the TVO and STUK staff.



Visit of the reactor and the turbine building of Olkiluoto 1 (photo credit: TVO / T. Karjanlahti)



Visit of the large turbine building of Olkiluoto 3 (photo credit: TVO / T. Karjanlahti)

SSM

Responsibilities, regulation and new-build NPPs

The Director General, Michael Knochenhauer, welcomed the ENSI Board and opened the meeting describing SSM's mandate which covers nuclear safety, radiation protection, security, and nuclear non-proliferation. The Director General reports to the Ministry of Climate and Enterprise and SSM has currently offices in Solna (Stockholm), Katrineholm and Göteborg. "We are in the process of a significant building up of personnel to tackle the increasing demand of our services," said the Director General. "The new government expressed a strong interest in nuclear energy production and particularly asked for increased efficiency in the licensing processes." Accordingly, the ongoing government's nuclear licensing inquiry is supported by SSM experts, and the Nuclear Activities Act is modernised. The restriction of a maximum of ten NPPs at the three existing sites only has been removed. The Swedish Environmental Protection Agency is requested to facilitate the municipalities' planning with licensing processes for a more efficient establishment of new nuclear power. The government also assigned SSM to support the development of a national strategy for strengthening the provision of nuclear safety and radiation protection competence. Organisational changes have been made at SSM in order to efficiently handle increased staff and to clarify tasks and simplify cooperation. This has included an improved licensing organisation, an increased capacity for review and assessment, and the appointment of a senior advisor to the Director General for the coordination of SSM activities regarding new-builds.

"Existing regulations are already largely applicable to new reactor technologies," noted Michael Knochenhauer, Director General of SSM. "They have been developed specifically for light water reactors but are technology-neutral and represent an integrated "3S" approach. The basic provisions do not need to be adapted, but for regulations at the facility level some adjustment is needed, and the third detailed level of regulations needs modifications," he summarised. SSM has recently published a handbook on the license application for new-build NPPs, providing a basis for further discussion between potential applicants and SSM. So far, no license application has been submitted in Sweden. SSM noted as related challenges the uncertainty of the time, the number and the type of applications,

possibly new reactor technologies and new organisational models or new sites, and particularly the capacity needed to deal with the applications.

In SSM's view, an early dialogue with the industry is key to be able to address these challenges adequately and on time. The state power company Vattenfall conducts a pre-study for a new-build project at Värö (Ringhals) and discussions on technical as well as licensing issues are currently taking place. The operating company Fortum conducts a pre-study on new-build NPPs in Finland and/or Sweden and meetings on licensing and now on technical issues are ongoing since 2022. Further, SSM has invited different suppliers of SMR technologies to present their projects.



Meeting with the Swedish Radiation Safety Authority (SSM) in Stockholm

Nuclear power plants and long-term operation

In Sweden, six nuclear reactors are in operation on three sites, commissioned between 1980 – 1985: the BWR Forsmark 1, 2 and 3, and Oskarshamn 3, and the Pressurized Water Reactors (PWR) Ringhals 3 and 4. The licensees are currently pursuing 60 years of operations, but have recently started pre-studies to assess the feasibility of 80 years of operation. The operating licence for NPPs is granted without a limitation, i.e. operation is permitted as long as the licensee meets the requirements set by the applicable laws and government ordinances, SSM's regulations and the conditions provided by the initial licence. The continued operation of an NPP beyond its original design lifetime is assessed in connection with the decennial PSR. SSM reviews the PSR and has the legal mandate to take the necessary decisions related to safety for the continued operation. A key aspect for justifying continued operation is the demonstration that the identified TLAA meets the criteria established. The TLAA should consider the entire remaining period for which continued operation is planned.

SSM continued with details of the revision of the regulatory framework related to LTO: in particular, the EU directive articles on PSR and the timely implementation of safety improvements were implemented. The new SSM regulations for the "Design", "Analysis" and "Operation of NPP" clarify the requirements for long term operation regarding the programmes to be implemented, such as ageing,

surveillance, maintenance, chemistry, and in-service inspection. Further, the process for the licensee to perform a PSR was specified, as well as the aspects required to be analysed and verified, potentially including necessary safety improvements to justify continued operation.

The oversight of the implementation of effective ageing management programmes comprises the licensee's demonstration of the operability of the SSC under the original design assumptions. The demonstration includes the revalidation of the design analyses, other verifying analyses (TLAA) and environmental qualifications and the proof that there is neither degradation nor deterioration of any kind. If need be, the necessary replacement must take place. The status of the continued operation in Sweden is as follows: the PSR of the NPP Forsmark 1 and 2 as well as of Ringhals 3 and 4 are accepted and the TLAA are verified until the end of 2030. The PSR for Oskarshamn 3 was conditionally accepted in 2019, the review of the TLAA is ongoing and will be finalised before the reactor goes into long term operation. The review of the PSR and the TLAA for Forsmark 3 is ongoing.

SSM then outlined the challenges faced over the course of time related to the aging management programmes (AMP) of the licensees. At the beginning of reviewing the AMPs around 2010, ageing management was largely separated from other licensee activities. Often there was only a small group working on the subject matter while the rest of the organisation was not fully aware of the issues arising. The situation has greatly improved over time, but more work is required for full integration of ageing management into the licensee's organisation. All licensees have ageing management programmes and ongoing projects to manage technological obsolescence as well.

"All licensees made use of the IAEA SALTO or pre-SALTO Missions," stated Michael Knochenhauer, Director General of SSM. "These were important steps from a technical and aging management point of view and created awareness of the requirements related to an operation beyond the original design lifetime. The significant feedback from the SALTO Missions during 2016 – 2023 resulted in licensees' actions addressing the review findings and gradually better results in the course of time", concluded the Director General.

Workforce, decommissioning, dismantling and waste management

Given the strong increase in the demand for competent personnel, a national strategy for competence management is under development with increased funding and focus from the government as well as interest and investments from the industry. A broad collaboration within an already existing national radiation safety competence platform has been established and SSM is contributing based on the IRRS recommendations (from 2012 and 2022) and previous government assignments.

The national strategy is divided into five strategic areas: national coordination, research policy for viable research environments, international research cooperation, education and training for competence needs in society, and attractiveness of the radiation safety area. SSM is dedicating increased funding to research, likewise the Swedish energy agency, a relatively new funder in nuclear technology. SSM then provided an overview of its main international research activities, such as the co-funded partnership in nuclear materials project. An important competence related topic consists of the evaluation and strengthening of the national technical support organisation (TSO) system. At present, SSM's internal experts rely on different external research and expert organisations, i. e. from universities, private and commercial organisations, and from a strong international collaboration. The State Office (Statskontoret) was assigned by the government to assess the prerequisites of a national TSO system, including funding principles. An external versus an internal TSO and the scope of a TSO mission is weighted up, and a comparison with other countries is carried out.

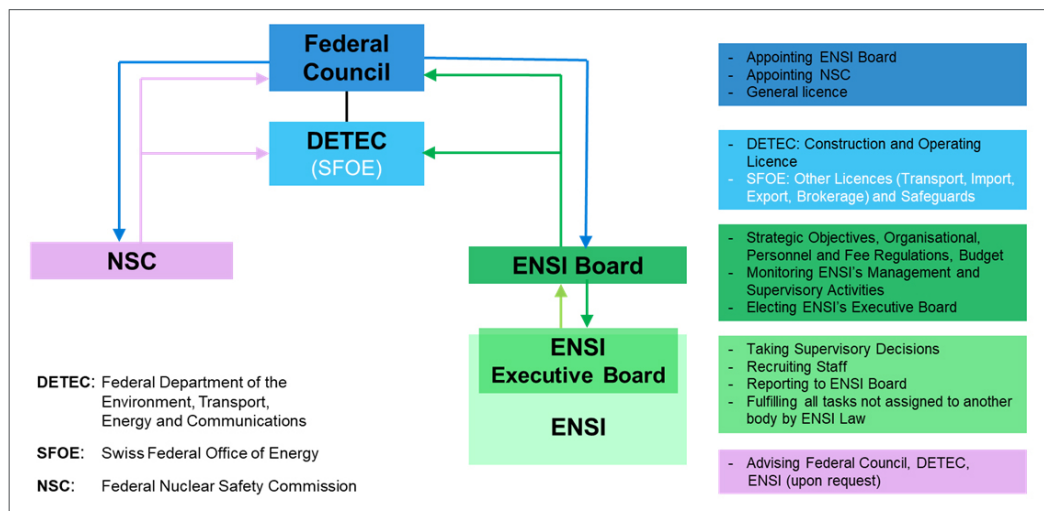
Finally, SSM provided an overview of the status of decommissioning and large-scale dismantling activities currently ongoing for seven NPPs in Sweden, i.e., Ågesta, Oskarshamn 1 and 2, Barsebäck 1

and 2 and Ringhals 1 and 2. Waste management considerations comprise the extension to a final repository for short lived low and middle level radioactive operational waste intended to accept wastes from dismantling and demolition activities. More highly active and long-lived wastes will be stored on site pending on the availability of a new repository for long-lived waste.

ENSI Board

Responsibilities, nuclear power plants and regulatory framework

In both meetings with the regulators, the ENSI Board outlined the allocation of responsibilities and the mandates of the different bodies in Switzerland and addressed the four NPPs in operation: the PWR Beznau I and II, Gösgen and the BWR Leibstadt. The Swiss legal and regulatory framework was presented together with the process of creating and updating the ENSI guidelines. The continuous improvement of safety in accordance with internationally recognised principles determined in the Nuclear Energy Act (NEA) was addressed as well. "If need be, ENSI will expand the existing regulatory framework to accommodate possible new applications in close interaction with international organisations and regulatory authorities like STUK and SSM", said Cornelia Spitzer, Vice President of the ENSI Board.



Allocation of responsibilities in the nuclear domain in Switzerland

Long-term operation

The ENSI Board then presented the status of LTO in Switzerland. All NPPs are now in LTO based on the Nuclear Energy Ordinance (NEO) because they passed the fourth decade of operation. Safety evidence for LTO must be submitted by a licensee as part of the decennial PSR as required in the NEO. The NEA generally requires retrofits of NPPs following the experience and the state of the art in retrofitting technology, including a further reduction of risk to humans and the environment as appropriate. The safety evidence for LTO comprises four pillars: the specification of the operating period taken as basis, the evidence that the design limits of the safety relevant system components are not reached, the specification of the planned retrofits and technical or organisational improvement measures, and the measures to ensure sufficient staffing levels and the necessary expertise. Particularly, the condition of large components, such as the RPV and the core internals, the nuclear steam generation system including the primary system and main coolant pumps, and the steel and concrete shell of the containment must be evaluated. The operating time management must be presented, covering civil, electrical, and mechanical engineering, instrumentation and control (I&C), radiation protection, core monitoring as well as fuel and waste management.

Detailed requirements on aging monitoring are determined in the guideline ENSI-B01 "Aging Monitoring" and in the guideline ENSI-A03 "Periodic Safety Review for Nuclear Power Plants". Basic

requirements include general topics, such as the identification of aging mechanisms and the suitability of maintenance programs, the documents to be provided, and the frequency and topics of the updates. Specific requirements address the structural, mechanical, and electrical engineering, I&C, the brittle fracture resistance of the RPV and the material fatigue monitoring. The scope and type of results of the ageing monitoring program for SSC is specified together with requirements on the test technology as well as the replacement and rework strategies. Technology related topics are addressed as well, such as the state of the art in science and technology of SSC in general, discontinued SSC and the replacement parts storage.

The licensee must demonstrate compliance of his retrofit concept with the NEO: that the requirements for nuclear safety and the protection against accidents are met and that the design principles for nuclear power plants are adhered to. Particularly, the following aspects must be presented: the degree of redundancy and diversity of safety functions, the functional independence and spatial separation of safety systems, the degree of automation of the safety systems, the protection against external events, and the precautions against severe accidents. Further, it must be systematically demonstrated how possible deviations identified are countered in accordance with the state of the art in retrofitting technology and that all appropriate precautions are taken to further reduce the hazard. The state of the art in retrofitting technology is assessed in accordance with the guideline ENSI-G02 "Design Principles for Nuclear Power Plants in Operation", together with an evaluation of international experiences and practices in similar systems and designs also considering the year of construction. Deviating solutions are reviewed to assess whether they are equivalent in terms of nuclear safety and security. Further, deterministic and probabilistic analyses and assessments are taken into consideration as well to evaluate the safety benefits of the retrofit concept, and the overall plant design including the retrofits must be compared against the design of new NPPs.

NPPs in Switzerland have an unlimited operating license if they are safe. This implies full compliance with the legal and regulatory framework, in particular the adequate and timely implementation of the regulator's necessary and proportionate requirements. "Given the dynamic legal request for a continuous improvement of safety, the licensees will weigh costs and return on investment. On the other side, ENSI is obliged to give nuclear safety priority over financial aspects in the fulfilment of its tasks. That is the status of LTO in Switzerland", summarised Cornelia Spitzer, Vice-President of the ENSI Board.

New-build discussion, workforce and deep geological repository

The ENSI Board described the nuclear power situation in the course of time: following the Fukushima accident in 2011, Switzerland decided to gradually phase out nuclear power and to stop the three general licence applications going on at that time. This decision was confirmed by a 2017 referendum, which led to a ban on constructing new nuclear power plants. The present energy strategy emphasizes a shift towards renewable sources, with hydropower already providing more than half of the national electricity needs. In response to changing energy demands and geopolitical factors, the Swiss government is considering lifting the ban on new nuclear power plants. This is part of a broader strategy shift to ensure energy security and meet climate targets. The Federal Council will submit a proposal to amend the nuclear legislation by the end of 2024, a debate in parliament will follow in 2025. "Building new nuclear plants faces significant challenges, including public opposition, financial constraints and regulatory hurdles. Following the current procedures, the process could possibly take decades", said Andreas Abegg, President of the ENSI Board.

The phase-out decision in Switzerland led to a decreasing interest in education and research in nuclear power. The retention and building-up of the necessary competence and workforce remain a challenge, both, for the industry and the regulatory body. In view of large retrofit projects related to LTO, even more human resources are needed. The needs for building and maintaining competence of the

parties that have responsibilities in relation to safety of facilities and activities in form of a national strategy or roadmap was recommended internationally as well. The ENSI Board outlined the related ongoing activities, such as strengthening education and continuous training at all levels (e.g., technicians at the Nuclear Technology School), and a joint Master of Science program in nuclear engineering (ETH Zurich – EPF Lausanne) in cooperation with the Paul Scherrer Institute. ENSI itself strives for an increase in its contribution to research in reactor safety and radiation protection and has numerous measures in place to strengthen both employer attractiveness and employee loyalty.

Finally, the ENSI Board provided an overview of the status of the decommissioning of the NPP Mühleberg in Switzerland and the deep geological repository, focusing on the schedules and timelines as well as the roles and responsibilities of the different parties involved.

“The ENSI Board thanks very cordially STUK and SSM for coordinating the meetings and welcoming us. The international cooperation between regulators that oversee similar technologies is of great importance to share experiences and insights”, concluded Andreas Abegg, President of the ENSI Board.

Issuer:
ENSI Board
Swiss Federal Nuclear
Safety Inspectorate
CH-5201 Brugg

+41 56 460 86 78
fachsekretariat@ensi-rat.ch
www.ensi-rat.ch

© ENSI Board, Autumn 2024
