

Advisory Committee on Nuclear and Radiation Safety Minutes of Meeting

17 – 19 June 2024, Oslo

Visit to IFE Halden on Tuesday 18 June 2024

1. Welcome & Introductions

Per Strand, DSA Director General, and the Committee Chairperson, Carl-Magnus Larsson, welcomed the members to the third (second in-person) meeting of the Advisory Committee on Nuclear and Radiation Safety since its reconstitution under new Terms of Reference in 2023. Among other things, the meeting was structured to allow a site visit to Institute for Energy Technology's (IFE) facilities at Halden, and to provide an opportunity for the current (IFE) and prospective licensee and operator of the facilities at the Halden site (Norwegian Nuclear Decommissioning, NND) to provide their perspectives.

Members of the Committee and DSA staff in attendance introduced themselves. Anna Clark was welcomed as a new member of the Committee.

2. NND's applications for licences under the Atomic Energy Act to own and operate the facilities at Halden and Himdalen

2.1 Status of DSA's review and assessment, and initial observations

DSA presented the status of its project for the review and assessment of NND's license application under the Nuclear Energy Act for a stepwise transfer of IFE's nuclear facilities to NND, starting with the facilities located at Halden and, in parallel or shortly thereafter, the waste facilities at Himdalen (KLDRA; Combined Disposal and Storage Facility for Low- and Intermediate-level Waste).

The review and assessment of NND's licence application is being performed as a DSA matrix project, engaging approximately 30 members of staff across DSA (close to 10 person-years of work) as well as external contractors. The project involves many of DSA's core processes such as review and assessment and inspections, and topical meetings and hearings. The review will form the basis for DSA's advice to the Norwegian Government regarding licence transfer and, in case DSA recommends the Government to award NND a licence, the licence conditions DSA considers justified and reasonable.

The project aims to answer five central questions,

1. Has information been submitted by the applicant in sufficient detail and depth to enable DSA to conclude its assessment and provide well-founded advice to Government?

2. Do the arrangements and agreements (including for transfer of responsibilities, assets and staff) allow for a seamless transition where potential safety risks have been identified and properly managed?
3. Does the applicant have the capability and capacity to comply with the Nuclear Energy Act and any other relevant legislation?
4. Can the applicant manage hazards and risks to health and safety of people, the environment, and assets, including during incidents and accidents?
5. What are the implications of the hearing process for the assessment of safety, and for DSA's advice in connection with a transfer of the licence from IFE to NND?

The general structure of the DSA's review project was revisited (it had been presented to the Committee in its preliminary form at the meeting in October 2023). Checklists for twelve different review and assessment areas have been developed. External consultants have been contracted for review and assessment of some areas of the applications and their assessments will be considered by DSA when finalising DSA's advice to the Norwegian Government.

Since the start of the project in January 2024, NND and DSA have had numerous meetings to discuss or clarify different topics – in some cases these meetings have been attended by IFE staff. In addition, an inspection of the Halden facilities regarding aging management and industrial safety was undertaken in the context of this project (not considering the broader issue of 'asset management' which includes issues related to, *inter alia*, financial management). There have also been two public hearing meetings, one for the licence application for the Halden facilities (held in Halden) and subsequently one for the Himdalen facilities (held in Lillestrøm), which were well attended including virtually through web streaming.

A main challenge for DSA in processing NND's licence application has been the on-going updates of the submitted documents since the start of the review and assessment process, and supplementation of the application with new documentation. Other challenges include the need for DSA to redirect resources from the project to manage urgent issues, and heightened security regime regarding restricted documents.

DSA is cognisant of the potential safety implications of a protracted licensing process, related to possible loss of staff at IFE – or of staff motivation – during the transfer process. At the same time, DSA must be convinced that NND has demonstrated readiness to assume the responsibilities associated with being a licence holder (see the five central questions above), to provide positive advice to the Government. DSA has proposed a 'soft deadline' for submission of supplementary or updated information from NND, for the end of July. This would enable NND to submit outstanding key documents and make it possible for DSA to carry out its review and assessment with the view of finalising the corresponding report by the end of September 2024. Submission of DSA's advice to the Government is planned for the end of October 2024. Following this submission, DSA will be in dialogue with

the Ministry of Health and Care Services (HOD) about the advice and potential specific licence conditions, and possible additional advice to Government.

DSA is also responsible for transferring permits under the Pollution Control Act, and for issuing a permit for operation pursuant to § 11 of the Nuclear Energy Act, and this work will need to be carried out in parallel to the work with HOD on finalising the licence decision.

2.2 NND – update of work related to the licence application

NND gave a presentation on main challenges, and on developments since the Committee meeting in October 2023 regarding the licence applications for the Halden and Himdalen facilities. NND seek to demonstrate how they will comply with the requirements of the General Licence Conditions (GLCs), and how they intend to ensure safety in the operational and decommissioning phases, retain and recruit the necessary competence, and develop the organisational safety and security culture. Since October 2023, NND has submitted updates of their application to DSA and will continue to send additional documentation in the early summer of 2024. NND presented an overview of its organisation after licence transfer, the work on building competence, and its management system 'Kjernen'. Following licence transfer, NND will manage Himdalen from the Halden site. The current proposed date for the transfer is 1 January 2025.

It was noted by NND that IFE will remain the licensee under the Nuclear Energy Act for the Kjeller site until such time (within the next few years) the licence can be transferred to NND. However, there will be significant collaboration and joint activities carried out by NND and IFE during this transitional phase.

2.3 Discussion and advice

During and following the DSA and NND presentations, the Committee made several comments and observations and, following the visit to Halden, prepared suggestions that were presented on the final day of the meeting as summarised below.

- The Committee was generally supportive of DSA's approach to review and assessment of NND's application and to DSA's pragmatic approach to progressing the work in a situation characterised by some fluidity and ongoing supplementation of the application, including in key areas.
- Transferring licences and permits under the current transitional conditions is a challenge and it is essential to develop a shared understanding of what 'readiness' to assume responsibilities as the licensee means, in practice and without delay. The Committee recommends that DSA communicates a list of 'necessary traits' to NND, which will focus the remaining work of both NND and DSA on factors that are essential indicators of readiness to assume the responsibilities of holding a licence under the Nuclear Energy Act. DSA and NND could benefit from a systematic categorisation of necessary elements of 'readiness' (for example a 'traffic-light' categorisation) based on the General Licence Conditions and international safety standards (among others).
- Close attention should be paid to the balance between readiness and actions to be carried out by the applicant (and reviewed by DSA) before the licence can take effect while being mindful that an extensive list of conditions could potentially indicate lack of readiness on the part of the applicant.
- It will be necessary to develop a formal mechanism for licensing that recognises the current situation and identifies immediate and future conditions for compliance. Addressing deficiencies in the safety assessment will be part of this process and it is important to distinguish between issues of critical importance and

those that can be dealt with less urgently. It was noted that, since fuel remains in the reactor at Halden, NND will need to demonstrate capability to manage the site safely and securely before, during and after fuel removal and transfer to temporary fuel storage locations.

- The difficulties associated with managing transfer of people were acknowledged. It will be necessary to ensure that the necessary, sufficient and appropriate competences are transferred from IFE to NND. It will also be essential to consider plant experience and knowledge management aspects.
- The means of implementing NND's safety culture within existing management structures was discussed, in relation to the existing safety cultures(s) across both organisations. The value of clear messaging and constantly maintaining the focus on safety, and the role of the regulator in influencing operator culture, were noted.

3. Update on the current debate on nuclear power and specifically SMR technology in Norway

4.1 Introduction

DSA provided an overview of the relevant legislation for building and operating nuclear facilities and the history of nuclear activities in Norway, as well as an update on the recent debate on the topic of nuclear power and on the possible future deployment of small modular reactors (SMR) in Norway. There has been significant interest, and in cases a tendency to over-simplify the situation both for and against the introduction of nuclear power. The Norwegian Government has established an independent commission to look further into this and related matters, which will commence its work in the coming months.

DSA also gave an overview of international developments, based on information from the Nuclear Energy Agency (NEA) SMR Dashboard Report. This provides an assessment of the status of progress of SMR developments worldwide, using six dimensions for assessing readiness: licensing, siting, financing, supply chain, engagement, and fuel.

4.2 Feasibility study - Norwegian context

The Committee considered some of the findings from a recent study regarding nuclear power reactors in general, and small modular reactors (SMR) in particular, in the Norwegian context, published by Rystad Energy in November 2023. The study considered the development of nuclear power globally, from the 60s to 80s, when Western Europe and North America led new construction, with a shift after 1986 following the Chernobyl accident. More recently, China has been leading new constructions and the Russian Federation dominates elements of the supply chains. Recent new constructions in Europe and North America (for example Vogtle 3 & 4, Olkiluoto 3 and Flamanville 3), have grossly exceeded budgeted time and costs.

The study indicated that the development of standardised modular SMR designs might reduce some of the risks of cost and time overruns by enabling the supply chain to learn and develop incrementally, reduce variation in design, and therefore avoid costly mistakes,

particularly if there were moves to more streamlined regulation. The study concluded that SMRs are not likely to be a sufficiently profitable form of power production in Norway, compared to other forms available (notably wind) within the next few years. Once SMRs are in operation elsewhere, and Norway can benefit from economies of scale, and the regulatory experience of other countries, it may be feasible to deploy SMRs in Norway. This was, however, considered in the study as unlikely to be before 2045. It was noted that the costs of accidents were not included in this analysis. The cost of waste management and decommissioning were also effectively written off by discounting.

The potential for Nordic cooperation to provide a broad mixture of energy sources to the region, and the dependence of large-scale investment on a steady and affordable supply of energy, was identified during discussion. These issues are of strategic importance to all countries and the balance will be dependent on technical developments in energy storage and supply and their costs.

4.3 SMR regulatory challenges – international context

The Committee discussed regulatory challenges associated with the introduction of SMRs in an international context. There is limited international experience in regulating and licensing SMRs. IAEA TECDOC – 2003, published in 2022, identifies key regulatory challenges and lessons learned. The SMR Regulators' Forum was established in 2015 (hosted by the International Atomic Energy Agency, IAEA). IAEA has launched a nuclear harmonisation and standardisation initiative, aimed at promoting international collaboration in regulatory and industry sectors. IAEA also conducted a review of its Safety Standards, which confirmed that they were generally applicable to innovative technologies, although some detailed design features warrant additional consideration. The results were presented in Safety Reports Series No. 123.

OECD-NEA (the Nuclear Energy Agency of the Organisation for Economic Cooperation and Development) launched its SMR Dashboard in 2023 and a workshop on innovative regulation was held in 2020. OECD-NEA also published a report on harmonising the nuclear licensing process for emerging technologies.

In the UK, the Office for Nuclear Regulation (ONR) has reviewed its framework in respect of regulating advanced new technologies including SMRs in 2019/2020. There are currently three SMR designs going through the generic design assessment (GDA) process; the GE Hitachi BWRX300; Holtec International SMR-300 and the Rolls Royce SMR-470MW.

4.4 Back-end regulatory challenges of SMRs

The Committee discussed the regulatory challenges associated with the 'back-end' of SMRs, focusing on the challenges related to economics, waste, proliferation and security, and public acceptance.

The costs of new nuclear SMRs currently exceed those of other forms of power generation, per unit energy produced, and the contribution of renewable energy sources is estimated to expand in the coming years. Members discussed the development of the Westinghouse

AP1000, which suggests that modularity may not deliver the cost savings anticipated and demonstrated the overrun of construction time and costs of new nuclear builds.

Neutron leakage was considered by the Committee as a feature of SMRs, which can have an impact on achievable burnup for given enrichment and fuel batch loading. This also impacts the generation of activation products, which in turn affects the quantities of radioactive waste produced. Some SMR designs are also based on novel fuel and coolants that may impose new waste challenges. Furthermore, some fuel types may require additional processing and generate additional secondary wastes, in addition to security and safeguards issues. There are no demonstration reactors in the West, which presents significant uncertainties and risks to the management and regulation of the back-end processes for advanced reactors.

However, the Committee also observed that modern facilities are designed with waste and decommissioning in mind. Some of the SMRs considered internationally are of a highly novel conceptual design and might not be representative of all types of SMRs. It was acknowledged that the implications of all forms of design needed to be considered and that the development of some designs appeared to be research-driven rather than pursued with deployment in the short term in mind.

4.5 Over-arching issues and advice

In the closing discussion under this agenda item and in the final session of the Committee meeting, several topics were covered. It was observed that some SMRs are being designed that are neither small nor modular. The importance of international cooperation regarding regulations of SMRs was also highlighted, especially among the regulators in the Nordic countries. There is existing cooperation between Finland and Sweden in view of the similar vendors and designs involved. It was noted that harmonisation does not necessarily mean that the regulatory approaches must be the same, but that the underlying requirements should be consistent. In establishing regulatory processes, it is necessary to consider the nature and experience of the vendor/operator and their understanding of nuclear safety and security.

Regarding new nuclear technologies, the Committee is aware that DSA is expected to monitor the development of new nuclear technology such as SMRs (and Advanced Modular Reactors, AMRs) while currently unable to prioritise this work. However, it was recognised that the new independent commission established by the Norwegian Government would consider the options further and DSA would need to provide relevant information; it will be necessary to follow the discussion and international developments.

Points to pay attention to - while not discounting the potential for enhanced passive safety features, reduced footprint, and flexibility – include but are not limited to:

- SMR (AMR) include a variety of designs where the features *small* and *modular* apply to a variable extent.

- Many designs are conceptual and their technical and economic feasibility are currently unproven.
- Customer focus is currently on small(-er) light water reactors.
- Normalised waste generation is unlikely to be lower than in 'conventional' Gen II/III/III+ reactors and it is necessary to pay attention to waste management issues.
- Additional security and safeguards considerations apply to non-light water designs based on fuel enrichment of up to 20% U-235 (high-assay low-enriched uranium; HALEU).

5 Site visit to the Halden reactor

The visit to IFE's Halden facilities was attended by the Committee, the Secretariat, DSA staff and NND staff, in addition to the IFE hosts.

5.1 Information about the Halden reactor – history, the facility and the organisational structure of IFE

IFE presented the facility and its history, and continued to outline the current organisation and challenges associated with the current status and with the anticipated licence transfer from IFE to NND. With regard to the licence transfer, IFE staff - who are proud of the accomplishments at the Halden site over the years – expressed a desire for a seamless transition free from significant and immediate changes, whereas subsequent gradual changes associated with the priorities of the new licence holder (NND) are welcomed.

The visitors were taken on a tour through the access hall ('Olafshallen') to the reactor hall excavated in the hill adjacent to the papermill (Saugbruks) owned by Norske Skog (which in the early days of reactor operation was a user of steam generated in the circulation system). The tour included the control room, the fuel bunker building and the reactor hall, and was led by IFE staff. Committee members were able to interact with managing and operational staff on matters relevant to operational history, maintenance, fuel management, waste management, decommissioning, and other matters. Committee members commented positively on the condition of facility assets, as far as it could be judged from a facility walk-down, and on the high standard of housekeeping. The reactor is currently in an extended shutdown state with fuel remaining in the reactor tank with the heavy water coolant/moderator being maintained at a temperature of about 75°C (in line with the safety case), maintained by heaters in the circulation system as the decay heat generation of the fuel is very low. The reactor control room is staffed 24/7 and the reactor parameters are continually monitored.

Representatives of NND reiterated their commitment to be ready for the responsibilities associated with holding a licence under the Nuclear Energy Act, including readiness for being regulated by DSA, with a target date for the transition of 1 January 2025. Initial focus is to adequately maintain the reactor and its associated systems in the current extended shutdown state, pending defuelling and subsequently an application (not expected before 2028) for a licence to start decommissioning works..

Committee members inquired about the status of the IFE Himdalen facility. IFE informed that there is no ongoing emplacement of waste at the facility. There are issues regarding the drainage system but there is no cause for concern over releases of radioactive material from the facility in the short- and medium terms, whereas for the long-term and post closure, the safety case has to be underpinned by a periodic safety review (PSR) and a new safety analysis report (SAR) that include consideration of long-term safety.

5.2 Discussion and advice

The Committee reflected on the discussions with IFE staff and the observations during the site visit at the end of the visit to Halden and at the last session of the Committee meeting. The following issues were highlighted:

- IFE acknowledged an improvement in the interactions between IFE and DSA and a more constructive and positive relationship. This has been particularly evident after the Committee meeting in October 2023, which included a visit to IFE's Kjeller site. However, there are still perceptions at IFE of disjointed regulatory approaches between the two departments at DSA that deal with nuclear issues. It was not clear to IFE that a consistent graded, or risk-informed, regulatory approach was practiced across DSA and there were some perceptions of disproportionate attention to low risks that diverted resources from more urgent activities or activities to improve safety over the long term. While this to some extent may reflect the differences between the Nuclear Energy Act and the Pollution Control Act, and while the Committee is unable to verify any substance behind the perceptions, the Committee considers that DSA should examine the contributing factors to IFE's experiences and perceptions and, where and if necessary, take relevant actions including breaking up 'logjams' where necessary decisions are at risk of being unduly delayed.
- The regulator's trust in the operator, and *vice versa*, and the trust of third parties in both the regulator and the operator, must be earned through records of actions. The Committee encouraged both DSA and IFE (and NND) to explore ways by which trust can be earned while being mindful of the necessary demarcation between the operator and the regulator, and of the relationships to third parties such as local stakeholders and municipalities.

6 Committee feedback on the meeting and preliminary discussion about next meeting.

The Committee agreed that it had been a positive meeting with fruitful discussions that provided the Committee an opportunity to offer considered advice to DSA – this is the main purpose of the Committee. The site visit to Halden gave members a good understanding of the challenges with decommissioning the site, and complemented and extended the information and observations from the site visit to Kjeller at the Committee's previous meeting. Multiple members commented the good dynamic within the Committee, which is promoted by a broad range of background, experience and skills. There were comments that the meeting was rather compressed (2.5 days including a full-day site visit) and that there would be benefit in having more time for comments and discussions between the different topics on the agenda.

Partly based on the discussions, it has preliminarily been agreed to make a site visit to the Himdalen facility, if possible, at the Committee's next meeting. It is also anticipated that there is additional clarity around DSA's advice to Government regarding the licence application submitted by NND, at the time of the next meeting. The possibility of some Committee members making presentations to a broader audience at DSA about the role and regulatory approach of a 'good regulator' is being considered.

DSA will contact members to decide on the date for the next meeting. Based on information to date, it will take place in mid-November for a duration of 3 – 3.5 days.

7 Adjournment

The Chair thanked the Committee members for their efforts and engagement in the discussions and thanked participating DSA staff for their contributions. The Secretariat was thanked for their tireless efforts before and during the meeting – and in anticipation for the work remaining to be done after the meeting. The meeting was adjourned.

Present:

Committee Members:

Name	Organisation
Carl-Magnus Larsson	Consultant, Sweden (Chairperson)
Jussi Heinonen	STUK, Finland
Karin Liljequist	SSM, Sweden
Øystein Nordgulen	Norwegian Geological Survey, Norway
David Senior	Consultant, UK
David Winfield	Consultant, Canada
Simon Wisbey	Consultant, UK
Allison Macfarlane	University of British Columbia, Canada
Anna Clark	IAEA

DSA Staff:

Name	Office/Department
Per Strand (day 1, 3)	Director General
Kristin Elise Frogg (day 1, 3)	Director of the Department of Radiation and Environmental Safety
Tone Bergan (day 1, 2, 3)	Director of the Department of Nuclear Safety and Control of Sources
Ingeborg Mork-Knutsen (day 1, 2, 3)	Head of Section for Nuclear Waste and Decommissioning
Heidar Hüttmann (day 1, 3)	Section of Nuclear Waste and Decommissioning
Fredrik Espegren (day 1)	Section for Nuclear Safety

Secretariat

Carol Robinson	Office of the Director General
Hege Sofie Haugan	Department of Radiation and Environmental Safety
Yngvild Sauge	Department of Radiation and Environmental Safety

Representatives of other organisations:

Name	Organisation
Nina Ramberg	Director for Safety, Quality Assurance and Environment, NND
Eivind Hannestad	Assistant Director for Safety, Quality Assurance and Environment, NND
Jarand Rystad	Chief Executive Officer, Rystad Energy
Tim Bjerkelund	Associate, Rystad Energy

Hosts and participants in site visit to IFE Halden (Committee and Secretariat members excluded):

Name	Organisation
Atle Valseth	Head of Nuclear Division / Deputy President (IFE)
Geir Mjønes	Sector Director for Nuclear Division, Halden (IFE)
Elisabeth Strålberg	Sector Director for Nuclear Division, Kjeller (IFE)
Sindre Øvergaard	Security Staff (IFE)
Pål Thowsen	Operations Manager HBWR (IFE)
Thomas Elisenberg	Deputy Sector Director (IFE)
Torbjørn Thomassen	Sector Director for Maintenance and Technical Support (IFE)
Runar Ulseth	Radiation Protection Engineer (IFE)
Pål Mikkelsen	Director General NND
Ann-Cathrin Becken	Sector Director (NND)
Nina Ramberg	Sector Director (NND)