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Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

National Report of the Kingdom of Norway to the seventh Review Meeting

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Abstract
National Report of the Kingdom of Norway to the seventh Review Meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, prepared in accordance with Guidelines regarding the form and structure of National Reports

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Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

National Report of the Kingdom of Norway to the seventh Review Meeting 24 May–4 June 2021

Contents

A. Introduction

This is the Norwegian report to the seventh Review Meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention) to be held at IAEA in Vienna, 24 May–4 June 2021. The Kingdom of Norway signed the Joint Convention on 29 September 1997, the day it was opened for signature. The Joint Convention was ratified and Norway's instrument of ratification was deposited on 12 January 1998. Since Norway was among the first 25 States to ratify, the Joint Convention entered into force for Norway when it entered into force generally, on 18 June 2001.

This report is prepared by the Norwegian Radiation and Nuclear Safety Authority (DSA)[1]. DSA is an independent regulatory body under the administrative authority of the Ministry of Health and Care Services. DSA is also a directorate under the Ministry of Climate and Environment in relation to radioactive pollution[2] and radioactive waste management.

The report has been written in accordance with the Guidelines regarding the Form and Structure of National Reports, established by the Contracting Parties under Article 29 of the Convention at the Preparatory Meeting held from 10–12 December 2001, and last amended by the second Extraordinary Meeting of the Contracting Parties held from 12–13 May 2014:

- → Section B describes national policies and practices related to spent fuel management and radioactive waste management;
- → Section C summarizes the position of Norway as regards the matters of scope referred to in Article 3;
- → Section D summarizes the inventories of spent fuel and radioactive waste and describes the facilities for spent fuel management and radioactive waste management in Norway;
- → Section E provides an overview of Norway's legislative and regulatory system related to spent fuel management and radioactive waste management;
- → Section F describes the general safety provisions covered in Articles 21–26 of the Convention;
- → Sections G and H describe the more specific safety provisions related to spent fuel management and radioactive waste management, respectively;
- → Section I reports on Norwegian experience in relation to transboundary movements of spent fuel and radioactive waste;
- → Section J describes the legislative and regulatory system, and practice, relating to disused sealed radioactive sources;
- → Section K provides a summary of safety of issues of concern and planned future actions to address those issues, and of international peer review services hosted by Norway;
- → Section L contains Annexes providing a list of relevant documentation, an overview matrix summarizing Norway's policy and practice in relation to spent fuel management and radioactive waste

[1] DSA was known as the Norwegian Radiation Protection Authority (NRPA) before 1 January 2019. For simplicity in this report, actions of NRPA before 1 January 2019 are attributed to DSA.

[2] The Pollution Control Act defines "pollution" as: (1) the introduction of solids, liquids or gases to air, water or ground; (2) noise and vibrations; (3) light and other radiation to the extent decided by the pollution control authority; and (4) effects on temperature; which causes or may cause damage or nuisance to the environment. The term pollution also means anything that may aggravate the damage or nuisance caused by earlier pollution, or that together with environmental impacts such as are mentioned in items 1 to 4 causes or may causes damage or nuisance to the environment. The Regulation on the application of the Act for radioactive waste imply more specific quantitative definitions for radioactive pollution.

management, a copy of the recently introduced General Licence Conditions for nuclear facilities, and a list of abbreviations used in this report.

This seventh report takes account of the comments, questions and remarks addressed to Norway's national reports submitted for, and presentations given during, the previous Review Meetings, as appropriate.

There have been a number of significant relevant developments since the sixth Review Meeting, which are reported under the relevant headings in this report, notably:

- → Permanent shut down of the two operational research reactors, preparatory to decommissioning, earlier than expected;
- → Establishment of Norwegian Nuclear Decommissioning (NND) as an agency under the Ministry of Trade, Industry and Fisheries, responsible for decommissioning the research reactors and other nuclear infrastructure and for management, storage and disposal of radioactive waste containing artificial radionuclides;
- → An IAEA Integrated Regulatory Review Service (IRRS) mission in 2019 and follow-up activities;
- → The establishment of General Licence Conditions (GLCs), clarifying regulatory requirements related to nuclear safety, and their application, among other things, to storage facilities for spent nuclear fuel, radioactive waste treatment facilities and, in due course, to facilities for the storage and disposal of radioactive waste;
- → Further development of the national policy and strategy for the management of spent nuclear fuel and radioactive waste.

In this context, the main current safety issues include:

- → Clarifying and updating the national framework and policy for spent fuel management and radioactive waste management in preparation for decommissioning, and finalizing strategies and plans for decommissioning and for management of spent fuel and radioactive waste.
- → Establishing the resources and competence of the new decommissioning and waste management organization NND, and clarifying its responsibilities, so that it is capable to take over the decommissioning of existing sites and to establish and operate the facilities needed to manage spent fuel and radioactive waste, and updating the resources and competence of other organizations, notably DSA, to support safe decommissioning and spent fuel and radioactive waste management.
- → Ensuring that all spent fuel is in a stable and passively safe condition, including safely removing the remaining fuel from the Halden research reactor, and providing for its safe and secure long term storage until a disposal solution is available, including upgrading the safety and safety assessment for existing stores and establishing additional storage where necessary.
- → Updating regulations and guides, for the increasing focus on decommissioning and on the management of spent fuel and radioactive waste.
- → Improving the inventory of spent fuel and radioactive waste and the characterization of facilities to be decommissioned to provide a more certain basis for planning decommissioning and the management of spent fuel and radioactive waste.

This report concludes that Norway meets the obligations of the Joint Convention. Furthermore, it demonstrates that the relevant Norwegian authorities are working to clarify and update the national policy and strategies for the management of spent nuclear fuel and radioactive waste to facilitate its implementation during nuclear decommissioning and to further enhance safety, in line with the aims of the Joint Convention.

B. Policies and Practices

Article 32(1). Reporting

B.1 Historical Background

Norway has no nuclear power programme, but has had four research reactors at Kjeller and Halden, all of which are now permanently shut down. Nuclear activities in Norway started in 1948 with the establishment of the Institute for Atomic Energy, now the Institute for Energy Technology (IFE) [3].

- → The first research reactor at Kjeller, JEEP I (Joint Establishment Experimental Pile), reached criticality in June 1951. It was permanently shut down in 1967 and partially decommissioned.
- → Halden boiling water reactor (HBWR), a 25 MW boiling heavy water reactor which was part of the OECD Halden Project, started operation in 1959. Among other things, it was used for material science research and investigations of high burn-up fuel performance. It was permanently shut down in 2018.
- → The N0RA (Norwegian zero effect Reactor Assembly) reactor at Kjeller was started in 1961 as a joint Norwegian–IAEA project. It was permanently shut down in 1968 and partially decommissioned.
- → JEEP II, a 2 MW heavy water pool reactor, reached criticality in December 1966. Its applications included production of isotopes, neutron transmutation doping of silicon and neutron physics research. It was permanently shut down in 2019.

Several operational facilities are associated with the research reactors, mostly at Kjeller, including storage facilities for spent fuel and a radioactive waste treatment facility. In addition, some facilities used in past activities, including a pilot reprocessing plant at Kjeller, were not fully decommissioned after operation.

The Combined Storage and Disposal Facility for Low and Intermediate Level Radioactive Waste (KLDRA), a cavern-type facility for the disposal and storage of short lived low and intermediate level radioactive waste also operated by IFE at Himdalen, was opened in 1999. Some waste previously disposed of at the Kjeller site was retrieved and transferred to the KLDRA facility.

Major resources of oil and gas were discovered in Norwegian waters in the North Sea between 1969 and 1979. Production in the main fields peaked in the 1990s and 2000s, but Norway is still the eighth largest producer of oil and the third largest producer of natural gas in the world. The oil and gas industry generates significant amounts of NORM waste.

Norway also has substantial deposits of alum shale, rocks containing naturally occurring radionuclides and with the potential to produce acidic chemical conditions in groundwater.

[3] IFE is an independent research foundation. Activities related to nuclear technology account for about 50% of IFE activity, petroleum technology about 30% and R&D in alternative energy about 20%. Parts of the funding for general research and radioactive waste handling come from various ministries. The HBWR is part of the OECD Halden Reactor Project, which is a co-sponsored research programme involving 19 countries, with the OECD Nuclear Energy Agency as the umbrella organization. Main research activities at the OECD Halden Reactor Project are fuel and material safety research; and man, technology and organizational (MTO) research. The JEEP II reactor is used for basic research in neutron physics, material science, irradiation of silicon, and production of radioisotopes.

B.2 National Policies and Strategies for the Management of Spent Fuel and Radioactive Waste[4]

In 2018 and 2019, IFE decided to permanently shut down its two remaining operational research reactors, HBWR at Halden and JEEP II at Kjeller. No further nuclear energy related activities are planned in Norway, and therefore policies and strategies are being developed to address the increasing focus on decommissioning existing nuclear facilities and managing the spent fuel and radioactive waste from these facilities. Some non-nuclear activities will continue to produce radioactive waste, but (with the exception of NORM wastes) the amounts will be much smaller than those from nuclear decommissioning.

In 2018, the Government decided to establish the Norwegian Nuclear Decommissioning (NND) as a state agency under the Ministry of Trade, Industry and Fisheries, to take over responsibility for decommissioning the research reactors and other nuclear infrastructure and for management, storage and disposal of radioactive waste containing artificial radionuclides. It is expected that NND will be responsible for:

- → Operating KLDRA Himdalen, the waste treatment facility at Kjeller, the spent fuel stores at Kjeller and Halden, and any other facilities needed for decommissioning;
- → Decommissioning the research reactors and other nuclear facilities currently operated by IFE at Kjeller and Halden;
- → Managing the Søve mine in Telemark and other sites contaminated with radioactive material as a result of past activities; and
- → Developing additional storage and disposal facilities needed for spent fuel and other radioactive waste, including waste from non-nuclear waste producers.

The schedule and other details for the transfer of responsibilities to NND are not yet finalized. NND is currently working with the Government and IFE to obtain a full understanding of the facilities and associated responsibilities and to develop the resources and competence to take them over, and in preparation for applying for a licence.

Following an instruction from DSA, a risk and vulnerability study (ROS analyse) was developed by IFE to identify risks associated with the transition from operation to decommissioning of the nuclear facilities and the transfer of responsibilities from IFE to NND, and means to mitigate such risks. DSA developed an independent analysis from a regulatory perspective and provided it to the relevant ministries. The analysis is providing input to the safe management of the sites and planning for the transition to decommissioning and transfer to NND.

In 2019, the Ministry of Climate and Environment requested DSA to develop supporting documents for a strategy for the management of radioactive waste, to take account of commitments under the Joint Convention and priority issues related to future waste streams, notably from nuclear decommissioning, and to follow up a previous investigation of the need for radioactive waste management capacity up to the year 2035. DSA established a programme of work which has continued into 2020.

Work to date indicates that the national strategy will need, among other things, to:

- → Include an holistic analysis of all options, taking account of interdependencies between different elements and stages;

[4] Reprocessing of Norwegian spent nuclear fuel outside Norway is considered as a possible management option, but only as a possible treatment option to facilitate disposal. Spent fuel is therefore effectively considered as waste, and policies and strategies for the management of spent fuel and radioactive waste are therefore reported together.

→ Clarify the application of the existing policy on waste to the management of radioactive waste and spent fuel, and requirements for safe and secure decommissioning of nuclear facilities;

→ Prioritize improved characterization to facilitate management of spent fuel and radioactive waste and decommissioning;

→ Initiate development of additional national facilities for management and disposal of spent fuel and radioactive waste, including improved longer term storage for spent fuel and high activity waste and a final disposal route for these, and additional disposal capacity (expansion of the existing facility or a new facility) for low and intermediate level waste, with particular reference to wastes arising from decommissioning.

The national strategy is intended to include the management of NORM waste, but it appears likely that it will not change the existing approach whereby NORM waste is normally managed separately from waste containing radionuclides of artificial origin.

NND will be responsible for radioactive waste management (other than for NORM waste), and issued a draft waste strategy for operational aspects of dealing with waste from the nuclear sector in 2019[5]. The intention is for the draft strategy to be updated after the national radioactive waste management strategy has been finalized.

Options for the management and disposal of spent nuclear fuel have been under consideration since a first official report, issued in December 2001. Subsequent concept evaluation studies (KVU) and corresponding quality assurance reports (KS1)[6] have provided a basis for proposed strategies with respect to spent nuclear fuel which are under consideration.

In 2017, the Ministry for Trade, Industry and Fisheries gave the Directorate for Public Construction and Property (Statsbygg) an assignment to begin conceptual design, siting analysis and cost estimates for a new central storage facility for spent fuel, co-located with a new repository for low and intermediate waste. This assignment was halted after the establishment of NND and pending further development of the national strategy for radioactive waste.

Technical assessments commissioned by DSA in 2018[7] indicated that it is likely that packaging and other disposal system features could be designed, and a disposal site found in Norway, suitable to allow safe direct disposal for the relatively small amounts of spent fuel concerned. Some previous evaluations have indicated or assumed that some of the spent fuel in Norway has characteristics that would make it unsuitable for direct disposal and therefore would require treatment to facilitate disposal.

A further concept evaluation report was issued in 2020[8], including proposals for shorter-term management of spent nuclear fuel and possible options for treatment. The published report has been the subject of detailed review, by DSA as well as the independent quality assurance review, and options are currently under further consideration by the Government.

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[5] https://www.norskdekommisjonering.no/wp-content/uploads/2019/12/Avfallsstrategi.pdf (in Norwegian).

[6] Major infrastructure projects in Norway require a concept evaluation study (KVU), produced by the developer, describing and justifying the proposed project, and an independent quality assurance review of the concept evaluation (KS1). For simplicity, this report refers explicitly primarily to the concept evaluations, and such references may be assumed to include the quality review of the evaluation.

[7] Walke R et al, Disposability Assessment for Norwegian Research Reactor Fuel: Post-ciosure Safety Assessment Report, Quintessa Ltd report QRS- 1924A for DSA (2018); and Avila R et al, Generic Post-Closure Safety Assessment of Alternative Disposal Concepts for the Spent Nuclear Fuel from Research Reactors in Norway, ÅF Industry AN and Intera report PCSA-NSF for DSA (2019).

[8] https://www.norskdekommisjonering.no/wp-content/uploads/2020/06/Begrenset-konseptvalgutredning-om-behandling-av-norsk-brukt-reaktorbrensel.pdf (in Norwegian).

Concept evaluation studies of this type (KVU) and the associated quality assurance reports are made publicly available and the public and relevant stakeholders are invited to put their comments, questions and concerns on the record. Formal processes for public involvement in decision making relating to specific proposed projects are described in section G.

B.3 National Practices for the Management of Spent Fuel and Radioactive Waste

Norwegian nuclear activities started in 1948 with the establishment of Institute for Atomic Energy, later renamed IFE. At the time of the previous national report, IFE owned and operated two research reactors. Both reactors have since been permanently shut down.

The JEEP II research reactor at Kjeller had a thermal capacity of 2 MW and was in operation from 1967 until December 2018, when it was shut for scheduled maintenance. During this maintenance, corrosion was found on safety-relevant components. On 25 April 2019, IFE's board of directors announced that the reactor would be permanently closed[9]. The reactor remains shut down and all of the fuel and heavy water has been removed.

The HBWR at Halden had a thermal capacity of 25 MW. It was in operation between 1959 and February 2018. In June 2018, IFE announced that the reactor would be permanently shut down and that preparations for the decommissioning phase would start. The reactor remains shut down but some fuel and heavy water remain in the reactor. In September 2018, IFE identified concerns about the adequacy of the safety margins in their criticality safety assessment, and concluded that further analysis was needed before they could remove the fuel and heavy water from the reactor. IFE submitted a revised criticality safety assessment in August 2019. Pending resolution of some remaining concerns about the adequacy of the revised assessment, DSA in December 2019 instructed IFE not to move any fuel or other materials covered by this assessment on the IFE sites, including the fuel and heavy water in the HBWR.

During operation, the amount of spent fuel generated from the nuclear reactors was approximately 145 kg annually. After 60 years of reactor operation, about 18 tonnes of spent fuel will require management:

- → The standard JEEP II fuel was 3.5 % enriched uranium dioxide with anodized aluminium cladding. In general, spent fuel was wet stored in fuel wells inside the reactor building for cooling, and later transferred to the dry spent fuel storage building on the Kjeller site.
- → At the HBWR, the standard fuel was around 6 % enriched uranium dioxide with Zircaloy-4 cladding. HBWR also utilized higher enriched fuel for the experimental purposes. In general, spent fuel was initially wet stored in fuel pits in the reactor hall for cooling, before being moved to the storage building outside the reactor hall, for further storage (wet and dry storage, as appropriate).

There are planned activities to improve the storage conditions for spent nuclear fuel. DSA has instructed IFE to construct a new storage facility for spent fuel and to increase storage capacity.

Spent fuel and long-lived waste unsuitable for disposal at KLDRA will be stored until final disposal is possible.

The Radioactive Waste Facility at Kjeller started operation in 1959 and continues to be used for handling, treatment, conditioning and storage of radioactive waste. Radioactive waste suitable for disposal at KLDRA is conditioned in the facility at Kjeller and transported in conditioned form to Himdalen for

[9] https://ife.no/en/permanent-closure-of-the-jeep-ii-research-reactor-at-kjeller/

disposal. Low and intermediate level waste from the HBWR is routinely transported to the facility at Kjeller for conditioning for disposal at KLDRA.

An incinerator at Senja in Troms County is permitted to receive small amounts of combustible radioactive waste (e.g. from medical facilities) for incineration.

The KLDRA at Himdalen, 26 km south-east of the Kjeller site, has been in operation since 1999. It consists of four rock caverns with two concrete sarcophaguses in each cavern. At present, one cavern is used for storage and three caverns for disposal. The current practice is to dispose of all low and intermediate level waste (LILW), except NORM waste, high activity disused sealed sources and long-lived intermediate level waste, at KLDRA. Earlier estimates indicated that this facility had sufficient capacity to accommodate disposal needs until 2030. However, the shut down and decommissioning of the research reactors earlier than originally anticipated have implications for the continued capacity of this facility. This is being addressed in the new national waste management strategy.

The storage cavern at KLDRA contains, among other things, 166 drums containing small amounts of plutonium contaminated waste. A final decision on the disposal of these drums has not yet been taken.

Waste with naturally occurring radioactive materials (NORM) is regulated as radioactive waste in Norway. There are four repositories in Norway for radioactive waste containing NORM:

- → Two facilities — Borge waste repository and Heggvin Alun — have permits to receive wastes containing acid forming rocks with NORM (alum shale);
- → The main repository in Norway for hazardous waste, NOAH Langøya, also has a permit to receive NORM waste, and mainly receives acid forming rocks;
- → A cavern-type repository for NORM from the petroleum industry, at Gulen on the West coast of Norway, has been in operation since 2008.

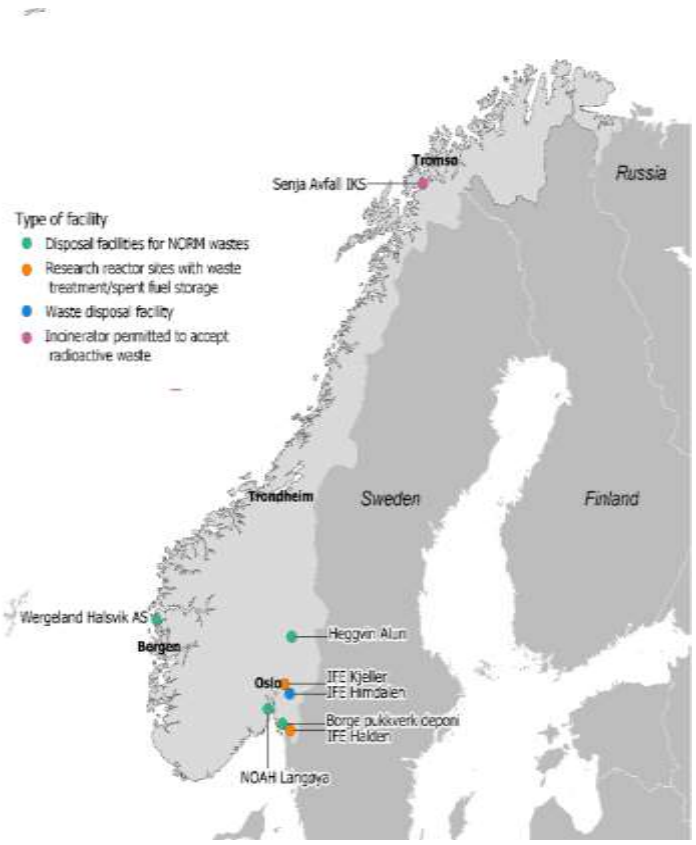

Figure 1 Location of relevant facilities in Norway

B.4 Categorization of Radioactive Waste in Norway

The categorization of radioactive waste is based on definitions in the Regulation on application of the Pollution Control Act to radioactive pollution and radioactive waste. Annexes Ia and Ib of this Regulation provide radionuclide-specific limiting values defining, respectively, radioactive waste and "radioactive waste subject to a disposal requirement" (i.e. for which disposal in a radioactive waste repository is required). The limiting values for radioactive waste are specified as specific activity (Bq/g) and for radioactive waste subject to a disposal requirement as specific activity (Bq/g) and total activity (Bq) for

each radionuclide. A 'sum of fractions' formula is specified for waste containing combinations of radionuclides. These levels are generally in line with the criteria in the International Basic Safety Standards for, respectively, clearance of bulk amounts of material and exemption of moderate amounts.

In comparison with the IAEA classification of radioactive waste (GSG-1), exempt waste (EW) is considered to be non-radioactive waste under the Norwegian regulations (i.e. below the criteria in Annex Ia).

Very short lived waste is not currently explicitly described in the Norwegian regulations. However, in practice such waste is typically stored until decayed and then managed as non-radioactive.

Very low level waste, according to the Norwegian categorization, may be considered to be radioactive waste with activity levels in the range between what is considered as being radioactive waste (Annex Ia) and radioactive waste intended for disposal in a radioactive waste repository (Annex Ib).

The IAEA classification for low level waste, intermediate level waste and high level waste all fall under the categorization of radioactive waste intended for disposal in a radioactive waste repository, under the Norwegian regulations. The waste acceptance requirements for KLDRA prohibit the disposal of waste with concentrations of long lived alpha emitting radionuclides exceeding 400 Bq/g on average or 4000 Bq/g in any individual package, and therefore effectively limit disposal at KLDRA to low level waste and short lived intermediate level waste.

NORM waste produced by the oil industry has been reported earlier by Norway under the Joint Convention, and is included again in this report. The repository at Gulen was designed to receive such waste and has been in operation since 2008. The repository was financed by the main waste generators from the oil industry, primarily the company Statoil ASA (from 2018 Equinor). Further details are given in section D.3.2.

C. Scope of Application

Article 3. Scope of application

As a Contracting Party to the Joint Convention, Norway has:

a) No reprocessing activity, and no spent fuel held at a reprocessing activity abroad.

b) Declared waste that contains only naturally occurring radioactive materials as waste for the purpose of this Convention.

c) Not declared spent fuel or radioactive waste generated within military or defence programmes as spent fuel or radioactive waste for the purpose of this Convention.

D. Inventories and Lists

Article 32(2) Reporting

D.1 Spent Fuel Management Facilities

There are two sites with spent fuel management facilities in Norway, as seen in the map in Figure 1 above; at Kjeller, about 20 km East of Oslo, and at Halden, about 110 km South of Kjeller near the Swedish border. Both sites are currently operated by IFE. NND is expected to take over the operation of the spent fuel management facilities at Halden and Kjeller and the decommissioning of facilities at Halden and Kjeller (including spent fuel management facilities when they are no longer needed).

The fuel used in the HBWR at Halden was typically low enriched uranium dioxide, although metallic natural uranium fuel was used earlier in the programme. The enrichment was mostly 6 %, but for experimental purposes fuel enriched to up to (but no more than) 20 % has sometimes been used. MOX fuel with enrichment up to 10 % fissile plutonium has also been used to a limited extent as part of the experimental programme.

During and after operation, the spent fuel at the Halden site has been stored in the bunker building outside the reactor hall. The fuel unloaded from the HBWR reactor was first cooled in the wet spent fuel pits in the reactor hall for about 90 days, then transferred to a fuel storage pond in the bunker building. Later, the spent fuel was usually moved to the dry storage in the bunker building. The bunker building also contains the fuel handling pond, used for fuel handling and inspection.

Aluminium-clad metallic natural uranium fuel from the first core loading of the HBWR is also stored in the dry storage compartment in the bunker building.

The fuel used in JEEP II at Kjeller was 3.5 % enriched uranium dioxide.

The fuel unloaded from the reactor was first cooled in the pond in the reactor hall, and later transferred to another building (MetLab II) where it was placed in Brønnhuset dry fuel storage at Kjeller. Brønnhuset consists of a concrete block with several storage steel pipes covered with shielding plugs. The concrete block is located beneath a building specifically designated for loading and unloading of transports of radioactive material. Some spent fuel is also stored in fuel wells in the same building.

Spent fuel from the former JEEP I and N0RA reactors is also stored at Kjeller in a separate storage facility, JEEP I Stavbrønn. The storage pipes in this storage location are surrounded mainly by sand; concrete is used at the bottom and top of the storage compartment.

Both Kjeller and Halden have hot cells for handling and inspection of spent fuel.

When the existing spent fuel management facilities were originally designed their continued use for the same purpose until the present was not envisaged. DSA has identified deficiencies in the designs and instructed IFE to upgrade their safety assessments, assess short term measures to enhance the safety of the facilities, increase storage capacity at Halden and establish new spent fuel management facilities to replace JEEP I Stavbrønn.

Table D1. Spent fuel management facilities

Facility	Location	Essential features	Main purpose
MetLab II (Brønnhuset)	Kjeller	Dry storage in vertical vaults	Spent fuel storage and storage of residual material from post irradiation examination (PIE) and testing of fuels and materials
MetLab II hot cells	Kjeller	Concrete shielded and lead shielded hot cells	Handling, refabrication (preparation for testing) and inspection of fuel and materials for PIE and testing
MetLab II fuel wells	Kjeller	Dry storage in vertical vaults	Spent fuel storage
JEEP I Stavbrønn	Kjeller	Dry storage in vertical vaults	Spent fuel storage of aluminium-clad metallic fuel from JEEP I
JEEP II pond (in reactor hall)	Kjeller	Pond for cooling and wet storage	Spent fuel cooling and storage
HBWR	Halden	Fuel in core of permanently shut down reactor	Purpose was research reactor operation. Reactor now permanently shut down, awaiting defuelling
HBWR fuel pits 1, 2 and 3	Halden	Wet storage in vertical vaults	Spent fuel cooling, currently used for spent fuel storage
Bunker building fuel storage pond	Halden	Wet storage in vertical vaults	Spent fuel storage
Bunker building fuel handling pond	Halden	Wet handling pond	Spent fuel handling and inspection
Bunker building dry storage	Halden	Dry storage in horizontal vaults	Spent fuel storage, mainly aluminium-clad metallic fuel from first HBWR core loading
MetLab compartments	Halden	Hot cells	Spent fuel handling and inspection

D.2 Inventory of Spent Fuel

The total inventory of spent nuclear fuel in Norway will be almost 18 tonnes, of which about 6.6 tonnes are stored at Kjeller, about 10.8 tonnes are stored at Halden, and almost 350 kg is still in the HBWR at Halden. The fuel in the HBWR core is not spent fuel as defined in the Convention, but will be spent fuel when permanently removed from the reactor. Approximately 10 tonnes is metallic uranium fuel in aluminium cladding, and the remainder is uranium dioxide, about 2 tonnes of which has aluminium cladding and the rest zircaloy. The fissile content of the spent fuel (and the fuel in HBWR) is given in Table D2. IFE is reviewing and making a complete source term inventory of all the irradiated fuel in Norway.

Table D2: Fissile content of spent fuel (and other irradiated nuclear material) in Norway as of May 2020.[10]

Type of material	IFE-Kjeller (kg)	IFE-Halden (kg)	Grand Total (kg)
Enriched uranium	2 229	3 838.3 (+ 343.7 in HBWR)	6 411
Natural uranium *(incl. metallic uranium)*	4 377 *(3 125)*	7 013 (+ 8 in HBWR) *(6 918)*	11 398 *(10 043)*
Depleted uranium	13.4	11.6	25
Other actinides	108.4	28.2 (+ 0.5 in HBWR)	137.1

D.3 Radioactive Waste Management Facilities

D.3.1. Radioactive waste management facilities for radioactive waste originating from nuclear facilities, research, medicine, disused sealed sources etc.

At the IFE Kjeller site the following facilities are in operation:

- → The Radioactive Waste Facility (built 1959) is a facility for receiving, sorting, handling, treatment and conditioning of radioactive waste before storage or disposal. It is currently the only facility of this type in Norway. It receives all LILW generated by Norwegian industry, hospitals, universities, research and defence organizations.
- → Storage Building 1 (built 1965–66) is part of the Radioactive Waste Facility and is a single-storey building with an area of 434 m^2. It is used for storage of unconditioned waste awaiting treatment and conditioned waste awaiting transfer to storage building 2.
- → Storage Building 2 (built 1977–78) is a single-storey building with an area of 430 m^2 and is used partly for storage of conditioned waste ready for transport to the Himdalen facility, and partly for storage of waste containing liquids from radiopharmaceutical production, which is awaiting solidification in a new treatment facility.

The KLDRA facility comprises a set of four rock caverns, connected by an access tunnel, built into a hillside at Himdalen in Aurskog–Høland municipality, about 25 km from Kjeller. It has been in operation since March 1999. The builder and owner of the facility is the Directorate for Public Construction and Property, Statsbygg, and the current operator is IFE. NND is expected to take over ownership and operation of the facility when it has built up its capabilities sufficiently to take on those responsibilities, and obtained the necessary licences from DSA. KLDRA has a designed disposal capacity of 2000 m^3 of conditioned waste, if all four caverns are used for disposal.

[10] The fuel still in the HBWR reactor is not spent fuel as defined in the Convention. However, it is intended to remove this fuel and manage it as spent fuel, and therefore it is included (separately) in this table.

Table D3. Radioactive waste management facilities.

Facility	Location	Main purpose and essential features
The Radioactive Waste Facility	Kjeller	Receiving, sorting, handling, treatment and conditioning of radioactive waste before storage or disposal. It receives all LILW generated by Norwegian industry, hospitals, universities, defence and research organizations, incl. operational waste from nuclear facilities. Storage of solidified uranium (yellow cake) until a suitable disposal facility is available.
Storage Building 1 (in Radioactive Waste Facility)	Kjeller	Storage of conditioned and unconditioned waste packages.
Storage Building 2	Kjeller	Storage of conditioned waste ready for transport to KLDRA Himdalen and un-irradiated material.
Combined Disposal and Storage Facility (KLDRA)	Himdalen	National facility for disposal, and currently also storage, of LILW. Rock cavern type facility, with caverns close to ground level and with minimum of 50 m of rock cover.

D.3.2. Management facilities for radioactive waste containing only naturally occurring radioactive material

Norway regulates waste containing naturally occurring radioactive material (NORM waste) as radioactive waste, but NORM wastes are managed and disposed of separately from radioactive waste from nuclear facilities, research, medicine, disused sealed sources, etc. Management and disposal facilities for NORM waste are operated by private companies.

Four disposal facilities for such waste are in operation: one for NORM waste from the oil and gas industry and land based NORM industries; and three for alum shale and other similar acid forming rocks.

In 2008, the repository for radioactive waste from the oil and gas industry and land based NORM industries started operation at Gulen, on the West coast of Norway. The repository is operated by Wergeland Halsvik AS and is situated in an underground rock formation. It consists of an entry tunnel, a tunnel for NORM waste treatment as well as two tunnels for waste disposal, with a total capacity for disposal of 7000 tonnes of NORM waste. Treatment at the facility consists of dewatering waste, filling void space in the barrels with sand or oil absorbent material and sealing between the barrels with a cement matrix. The intention is that the repository tunnels will be filled with waste drums, cemented in concrete mould castings.

In addition to the Gulen facility, there are currently three repositories that have a permit to accept alum shale and other similar acid forming rocks:

→ NOAH Langøya, a former open pit quarry for limestone and gravel on an island in a lake near Råde;

→ Borge pukkverk deponi, a former open pit quarry for limestone and gravel near Fredrikstad;

→ Heggvin alun is a surface landfill near Hamar.

The activity concentration of natural uranium in the acid forming rocks are usually about the same as the exemption levels for radioactive waste in Norwegian legislation, but they have a high potential for radioactive pollution if not handled correctly.

NOAH Langøya and Borge pukkverk deponi are very near maximum capacity within their present permits from DSA and the County Governor (Fylkesmann).

Table D4. NORM waste management facilities

Facility	Location	Main purpose and essential features
Wergeland Halsvik AS	Gulen	Repository for disposal of NORM waste from oil and gas and land-based industries. Underground rock caverns.
NOAH	Langøya	Former quarry mostly used for hazardous (non-radioactive) waste. Permitted for disposal of alum shale and other similar acid forming rocks.
Borge pukkverk deponi	Borge	Former quarry permitted for disposal of alum shale and other similar acid forming rocks.
Heggvin alun	Heggvin	Landfill-type repository for alum shale and other similar acid forming rocks

D.4 Inventory of Radioactive Waste

The inventory of radioactive waste disposed of (middle column) and in storage (right hand column) at KLDRA Himdalen is shown in Table D5. Approximately 160–170 drum equivalents of waste were generated each year[11], about half of which was typically from the activities at IFE's sites. The total amount of waste has fallen to less than 120 drums per year since the research reactors have shut down, and may be expected to be more variable when decommissioning starts.

In addition, 21 drums (1210 kg uranium) of yellow cake from the pilot reprocessing plant and 8 drums (41 GBq) containing radium needles previously used in hospitals are stored at the Kjeller site.

Table D5 Inventory of Norwegian radioactive waste at KLDRA Himdalen as of December 31st 2019

Radionuclide	Disposed waste (Bq)	Stored waste (Bq)
H-3	8,66E+13	
C-14	4,24E+11	
Cl-36	4,63E+07	
K-40	1,89E+09	
Co-60	9,27E+12	3,02E+08
Ni-63	1,66E+13	
Kr-85	2,29E+11	
Sr-90	2,04E+12	1,16E+11
Tc-99	8,93E+08	
I-129	3,91E+07	
Ba-133	4,84E+10	
Cs-137	4,76E+13	1,22E+11
Eu-152	1,73E+09	
Eu-154	2,88E+09	
Hg-203	1,57E+07	

[11] Volumes of radioactive waste managed at KLDRA Himdalen are typically expressed in terms of the number of standard 210 litre 'drums' or their equivalent. This does not necessarily mean that all waste is in such drums.

Radionuclide	Disposed waste (Bq)	Stored waste (Bq)
Pb-210	9,84E+06	
Ra-226	6,79E+09	
Ra-228	1,69E+08	
Ac-227	3,96E+09	
Th-228	2,00E+06	
Th-232	9,77E+08	
Pu-238	5,98E+11	4,78E+11
Pu-239	2,51E+10	3,12E+10
Pu-240	8,82E+10	1,20E+11
Pu-241	7,43E+12	1,22E+13
Pu-242	2,44E+08	3,32E+08
Am-241	6,34E+12	
Cm-244	3,64E+09	
U-233	1,27E+02	
U-234	2,30E+07	
U-235	4,79E+06	
U-236	3,90E+06	
U-238	1,50E+09	1,66E+08
Total no. of 210-litre drums	6381	166

No facilities are currently being decommissioned, but decommissioning of all of the nuclear facilities at Halden and Kjeller is being planned. Estimates of the future inventory of radioactive waste for disposal, largely from decommissioning of the nuclear facilities, have been made but are preliminary. In response to an instruction from DSA, IFE has developed a characterization strategy for the facilities and sites to be decommissioned. DSA has requested some further improvements to the strategy, and these are in progress. Implementation of the finalized strategy should provide a more accurate estimate of the activity inventory of waste that will need to be managed at KLDRA Himdalen and new facilities.

The volume inventory of LILW to be managed is estimated to be several times the capacity of 10 000 drums (about 2000 m^3) remaining of the existing KLDRA Himdalen, but will depend strongly on the extent to which exempt waste (below the activity criteria defining radioactive waste) and very low level waste (below the activity criteria defining radioactive waste subject to a disposal requirement) is segregated and diverted away from KLDRA Himdalen or a replacement. DSA is developing guidance on the process and regulatory expectations for the clearance of materials.

The inventory of the Gulen repository for NORM waste as of January 2019 is 2811 tonnes of waste, with a total activity of 58.21 GBq. The operator is required to keep records generally of the total activity and specifically of the activity of ^{226}Ra, ^{228}Ra and ^{210}Pb.

E. Legislative and Regulatory Systems

Article 18. Implementing measures

Article 19. Legislative and regulatory framework

Norway is a constitutional monarchy formally headed by the King as head of State and the Prime Minister as appointed head of Government. The Prime Minister is supported by a council (cabinet), appointed by him/her with the approval of the Storting (the Norwegian Parliament). Laws are passed by the Storting and sanctioned by the King in Council. Regulations, directives and orders and certain licences are adopted by the King in Council or the Ministries upon the advice of Ministries and directorates of the Ministries, such as DSA.

Spent fuel management and radioactive waste management, including transboundary movements, are regulated by three legal instruments and their corresponding regulations:

- → The Nuclear Energy Act;
- → The Pollution Control Act;
- → The Radiation Protection Act.

Developments have been made to the regulatory framework since the previous national report. General Licence Conditions (GLCs) have been introduced in IFE's operating licence for the Kjeller site effective from 1 January 2019, with the intention to apply these to the Halden site from 1 January 2021 and to KLDRA Himdalen in the future. Enforcement capabilities in the form of fines have been introduced in the Nuclear Energy Act. In addition, DSA has developed and strengthened procedures relating to core regulatory functions, such as authorization and review and assessment.

DSA has enhanced its inspection programme, for example by including measures to follow international recommendations and best practice more closely, improved the competence and capacity of DSA staff, enhanced the quality of regulatory functions and improved mechanisms to promote the operators' understanding of the regulatory requirements.

The IAEA organized an IRRS Mission to Norway in June 2019, and the recommendations and suggestions from the IRRS team are being addressed by the relevant authorities. Some of these recommendations and suggestions in particular provided an important input to plans for the further development of the regulatory framework in the next few years, to address the changing situation in Norway.

E.1. The Nuclear Energy Activities Act of 12 May 1972

The Nuclear Energy Activities Act of 12 May 1972 (Nuclear Energy Act) regulates the licensing regime for nuclear facilities, general requirements for licences, inspection regime and the legal basis for the regulatory body. Chapter III of the Act establishes the liability regime according to the Paris Convention of 29 July 1960 with later amendments, and related international legal instruments. The final part of the Act regulates confidentiality and penalties in case of non-compliance. The Act does not explicitly address specific stages in the lifetime of a facility, e.g. the need for a licence for decommissioning, but the general responsibilities apply for the whole lifetime of a facility. This was noted in the 2019 IRRS review, and possible means of addressing different lifetime stages more explicitly in regulations, licence conditions and/or guidance are being considered.

The GLCs introduced recently in IFE's operating licence for the Kjeller site, and planned to be applied to the other IFE sites, address the main requirements of the Nuclear Energy Act, The GLCs are reproduced in an Annex to this report.

Pursuant to the Act, the following four regulations have been issued:

- Regulation of 2 November 1984 on the Physical Protection of Nuclear Material. This establishes requirements for the physical protection of nuclear material and nuclear facilities. The Regulation implements the obligations of the Convention of the Physical Protection of Nuclear Material. The last revision, taking account of the Amendment to the Convention (which entered into force in May 2016), entered into force on 1 January 2019.
- Regulation of 15 November 1985 on Exemption from the Act on Atomic Energy Activity for Small Amounts of Nuclear Material. This exempts small amounts of nuclear material from Chapter III of the Act and thus from the liability regime.
- Regulation of 12 May 2000 on Possession, Transfer and Transportation of Nuclear Material and Dual-use Equipment. This deals with the control of nuclear material to make sure it is not used for undeclared activities. The Regulation implements the Additional Protocol to the Safeguards Agreement between Norway and the IAEA in the Norwegian legal framework.
- Regulation of 14 December 2001 on Financial Compensation after Nuclear Accidents. This stipulates how Contracting Parties to the Vienna Convention of 21 May 1963, Contracting Parties to the Joint Protocol of 21 September 1988 and Hong Kong shall be considered in connection to Norwegian legislation on nuclear liability. It also regulates how nuclear accidents in a non-party state shall be considered in connection with the Norwegian legislation.

Additionally, there are three Royal Decrees granting licences to IFE for its operations:

- 5 December 2014 on "Renewed Licence to Institute for Energy Technology (IFE) for Operation of Nuclear Installations in Halden pursuant to the Act on Nuclear Energy Activities". The licence expires on 31 December 2020, DSA has sent its recommendations on renewing the licence after review and assessment of the application to the Ministry of Health and Care Services.
- 20 December 2018 on "Renewed Licence to Institute for Energy Technology (IFE) for Operation of Nuclear Installations in Kjeller and for the Fuel Instrumentation Workshop in Halden pursuant to the Act on Nuclear Energy Activities". The licence expires on 31 December 2028.
- 27 April 2012 on "Renewed Licence to Institute for Energy Technology (IFE) for Operation of the Combined Storage and Repository for low and intermediate level radioactive waste (KLDRA)". The license expires on 30 April 2028.

The main basis for the licences are the safety analysis reports (SARs) submitted by IFE for the two reactors and the associated spent fuel management and radioactive waste management facilities at Halden and Kjeller, and KLDRA at Himdalen.

E.2. The Pollution Protection and Waste Act of 13 March 1981

The Pollution Protection and Waste Act of 13 March 1981 (Pollution Control Act) was established for the purpose of preventing and reducing harm and nuisance from pollution. This is reflected in the main rule of the act, which says that pollution is forbidden, unless it is specifically permitted by law, regulations or individual permits. The act shall secure a satisfactory environmental quality based on a balance of interests, which includes costs associated with any measures and other economic considerations. Pursuant to the Act, three regulations concerning radioactive pollution and radioactive waste have been issued:

- → Regulation on the Application of the Pollution Control Act to Radioactive Pollution and Radioactive Waste of 1 November 2010, which defines radioactive pollution and radioactive waste.
- → Regulation on the Recycling and Management of Waste of 1 June 2004 (Waste Regulation), which establishes requirements for waste in general. Section 16 deals specifically with radioactive waste.
- → Regulation on Pollution Control of 1 June 2004, which defines procedures for applications for permits and establishes administrative provision for radioactive pollution and waste.

E.3. The Radiation Protection and Use of Radiation Act of 12 May 2000

The Radiation Protection and Use of Radiation Act of 12 May 2000 (Radiation Protection Act) constitutes the legal basis for regulating the use of ionizing and non-ionizing radiation, radiation protection requirements, medical use of radiation and contingency planning. The Act itself establishes the framework, which is described in further detail by the regulations. Pursuant to the Act, one Regulation has been adopted:

- → Regulation on Radiation Protection and Use of Radiation of 16 December 2016. This defines radioactive material that is exempted from the Act, and specifies more detailed requirements, including specific requirements for different types of use of radiation.

E.4. Other Acts, Regulations, and Decrees

The Royal Decree of 23 August 2013 establishes the organization of the emergency preparedness system in Norway.

The Nuclear Energy Act covers transport of nuclear material and the Radiation Protection Act is applicable to the transport of radioactive material, but transport of spent fuel and radioactive waste is also subject to:

- → Regulation on Transportation of Dangerous Goods by Land, of 1 April 2009;
- → Regulation on Dangerous Goods on Norwegian Ships, of 1 July 2014; and
- → Regulation on the Transport of Goods in Aircraft of 11 January 2003.

These regulations generally follow the IAEA Transport Regulations (SSR-6) and the modal regulations and codes of relevant UN organizations.

The Regulation relating to Systematic Health, Environmental and Safety Activities in Enterprises of 6 December 1996 (the Internal Control Regulation) applies generally to Acts concerning health and safety issues, including the Radiation Protection Act and the Pollution Control Act. Applying the Regulation to the Nuclear Energy Act is currently out on public hearing and the change is expected to come in to force on 30 June 2021.

According to Act of 27 June 2008 on Planning and Building Activities with specific regulations concerning impact assessments of 21 June 2017, nuclear power plants and other nuclear reactors, plants for the handling of irradiated nuclear fuel, plants for production or enrichment of nuclear fuel, and installations for disposal of radioactive waste and storage facilities where radioactive waste is stored for a period of more than 10 years shall always be subjected to an impact assessment. Closure or dismantling of such facilities is also subject to such an assessment. When planning an installation for handling/processing and storing of radioactive waste for a period of less than 10 years, the decision on whether an impact assessment should be carried out is to be taken by the competent authority, in this case DSA.

E.5. Regulatory Body

Article 20. Regulatory body

As defined in the Nuclear Energy Act and Radiation Protection Act, the regulatory body is DSA. DSA is also the regulatory body for the Pollution Control Act in matters concerning radioactive pollution and radioactive waste as delegated by the Ministry of the Environment on 30 December 2010. DSA regulates matters concerning nuclear safety, security, safeguards, nuclear emergency preparedness and radiation protection including radioactive waste and spent fuel management.

DSA is organized as a directorate under the Ministry of Health and Care Services, from which it primarily receives its funding. DSA is also a directorate under the Ministry of Climate and Environment, with respect to radioactive releases to the environment and radioactive waste from nuclear and non-nuclear industries, and under the Ministry of Foreign Affairs, with respect to the State System for Accountancy and Control (SSAC) for safeguards, implementing safety measures under the Action Plan for Nuclear Safety and Security in Russia, Ukraine and Other Countries in Eurasia. DSA also has areas of responsibility for the Ministry of Defence concerning the regulation of nuclear-powered military vessels entering Norwegian waters and ports. DSA also provides assistance and advice to other ministries on matters related to radiation protection, radioactive waste management, and nuclear safety, security and safeguards.

DSA receives funding from the ministries that assign it tasks, through the State budget. For the purpose of the budget, DSA maintains staff and resources dedicated to work for each of the ministries. The Ministry of Health and Care Services coordinates the yearly letter of assignment to DSA from the different ministries, outlining specific tasks for the year, supplementing the ongoing tasks. DSA reports to the relevant ministries on the different tasks.

DSA:

- → Is the autonomous decision-making authority responsible for the area of nuclear safety, security and safeguards following the Nuclear Energy Act, for which it is responsible to the Ministry of Health and Care Services;
- → Is the competent decision-making authority for the Act and Regulation on Radiation Protection and use of Radiation, for which it is responsible to the Ministry of Health and Care Services;
- → Is the competent decision-making authority following the Pollution Control Act, for which it responsible to the Ministry of Climate and Environment regarding radioactive waste, radioactive releases, discharges and remediation of contaminated areas.

DSA has a total staff of about 125 persons. DSA is currently organized in three departments, which are further divided into specialized sections:

- → Department for Radiation Protection and Measurement Services
- → Department for Nuclear Safety and Environmental Protection
- → Department for Planning and Administration

Following a change of Director General on 1 September 2020, and in the light of the changing needs of the regulatory body, an internal reorganization of DSA is under consideration, with the aim of introducing a modified organizational structure early in 2021.

The Department for Nuclear Safety and Environmental Protection deals with the safety, security and safeguards of Norway's nuclear facilities, licensing of radioactive waste management and discharges. It

also handles licensing of shipments of nuclear material and waste and issues approval certificates for transport packages.

Applications for licences and renewals of licences for the operation of nuclear facilities are submitted to the Ministry of Health and Care Services. On behalf of the ministry, DSA assesses the applications. The assessment with recommendations is then sent to the ministry for further hearing and decision. Licences under the Nuclear Energy Act are finally granted by the Government. DSA carries out regular inspections and audits to ensure that the requirements of a licence are fulfilled.

DSA is also responsible for issuing permits for radioactive waste management and discharges under the Pollution Control Act for all three nuclear sites in Norway.

DSA is responsible for the State System of Accountancy and Control under the Safeguards Agreement between Norway and the IAEA.

DSA is also the competent body with responsibilities for authorization and inspection of transport of nuclear material according to the Nuclear Energy Act, and for transport of radioactive material regulated under the regulations on transport of hazardous material on land. Given the locations of the Halden, Kjeller and Himdalen sites, transport of spent fuel and radioactive waste between the sites is primarily by land Transport of hazardous material at sea and by air is the responsibility of other authorities.

DSA is fully authorized through legislation to enter a nuclear installation and surrounding area, at any time, and to request the information necessary for the purpose of the inspection. To enable the requisite inspections to be carried out after operational interruptions or accidents, licensees are required to provide reports to DSA. Inspections are provided by DSA also in response to the operator's request in cases of any intended changes in construction, operation or management which constitute a departure from approved conditions. DSA inspections often focus on a specific activity or practice.

DSA may at any time independently arrange for public hearings and by other means communicate regulatory requirements, decisions and opinions to the public. It will, as appropriate, liaise with the regulatory bodies of other countries and with international organizations for cooperation and exchange of regulatory information.

In 2019, DSA established GLCs applicable to installations licensed under the Nuclear Energy Act, which were used in preparing the licences for IFE-Kjeller and IFE-Halden, in 2018 and 2020, respectively. The GLCs are site-based and are based on international safety standards and are intended to clarify regulatory requirements for nuclear facilities and activities. The GLCs are reproduced in an Annex to this report.

F. Other General Safety Provisions

Article 21. Responsibility of the licence holder

IFE is the licence holder for ownership and operation of Norway's two research reactors and associated spent fuel management and radioactive waste management facilities as well as for the operation of the KLDRA facility at Himdalen. It is the responsibility of IFE to ensure safety for all its facilities during operation, decommissioning and closure of facilities, in accordance with licence requirements and appropriate IAEA safety standards. A licence for operation is normally granted for a specific time period. At the end of a licence period the operator can apply for a new licence. The licensee is also responsible for providing the necessary financial and human resources for maintaining safety and radiation protection at an appropriate level.

The current licences for the IFE's nuclear facilities expire:

- → For JEEP II reactor Kjeller and associated facilities, on 31 December 2028, as specified in the licence effective from 1 January 2019;
- → For HBWR at Halden and associated facilities, on 31 December 2020. IFE has applied for renewal: at the time of writing, DSA had completed its review and assessment of IFE's application and recommendations had been presented to the Government.
- → For KLDRA Himdalen, on 28 April 2028.

DSA also issues separate permits for radioactive waste management and discharges to IFE, requiring IFE to employ the best available technology to reduce discharges to levels such that resulting doses are as low as reasonably achievable to avoid harmful effects on health and the environment.

Article 22. Human and financial resources

Human and financial resources of DSA are not explicitly covered by legislation. However, the Norwegian regulatory body was established in 1993, and precedent serves as the basis for its annual budget. Most non-administrative staff members at DSA hold higher university degrees. All new employees are required to complete an internal training course that provides an overview of the legislation DSA is responsible for, strategies, plans and internal administration. They are also assigned a mentor who is responsible for on the job training for duties the new employee assumes as well as more general work guidelines. Inspectors are required to complete the national general inspection course and attend relevant courses organized by the IAEA. If the new employee will be expected to have duties as a part of the secretariat for the Crisis Committee or officer on duty, they receive additional training as well as being expected to participate in internal exercises and training. Training is given by senior staff, and DSA employees attend courses and/or seminars as needed. For certain specific tasks, external advisers or consultants are also contracted.

IFE has a total staff of approximately 600 persons, of which approximately 100 are employed for operation of the reactors and associated facilities and the radioactive waste management facilities. IFE provides the financial resources and staff to operate Norway's nuclear facilities (reactors, storage facilities, radioactive waste treatment plant) and the KLDRA facility. It also organizes the necessary training and refresher training of its own personnel and pays an annual inspection fee to the DSA.

IFE has proposed a reorganization of its staff in the nuclear sector to address the changed priorities and challenges arising from permanent shutdown of the reactors and preparation for decommissioning and in preparation for the planned future transfer of responsibilities to NND. DSA is currently assessing IFE's proposal.

The Government established NND by Royal decree on 12 February 2018 as the organization that will be responsible for decommissioning of nuclear facilities and management of radioactive waste from the nuclear sector in Norway. NND is financed and instructed by the Ministry of Trade, Industry and Fisheries. Following an instruction from the Ministry of Trade, Industry and Fisheries, IFE has developed a decommissioning fund of 3 MNOK/year, but the Government, through NND, will effectively underwrite the financing of decommissioning and radioactive waste management. NND's most recent estimate suggests that decommissioning the Kjeller and Halden sites and managing the associated wastes will cost at least 20 000 MNOK.

NND is currently building its organization to achieve the levels and areas of competence needed to assume the responsibility of operating the facilities currently operated by IFE. It is expected that a significant number of the existing IFE staff will move to NND in due course. In order to obtain the licences to operate these facilities, NND will need DSA's approval, which will require demonstration that they have the necessary competences to meet the general responsibilities and specific requirements of such licences.

The Nuclear Energy Act and the Pollution Control Act authorizes DSA to impose sanctions on IFE in the event that safety standards are not maintained at an acceptable level. All DSA requirements can be appealed to the Ministry of Health and Care Services, or the Ministry of Climate and Environment in case of releases to the environment and waste management; this is a general right in the Norwegian civil service system. DSA may at any time withdraw the permit to operate (for all or some facilities) as necessary if sanctions are not followed or safety standards are not adequate. DSA has the authority to impose fines, either as a one-time sum or on a per diem basis until the requirements has been fulfilled. In case of criminal activities, DSA reports to the police. A new legal provision has been passed by the Parliament that empowers the DSA to impose administrative fines. This provision will come in to force at the same time as a corresponding regulation.

For the NORM waste disposal facility at Gulen, the cost of closure and future surveillance has been estimated, and funds are held in a dedicated holding account. The owner of the repository is committed to continually assess the need to set aside more money for this purpose according to needs identified in the facility's plans for closure and post-closure control, which must be updated every 5 years. In addition to the company's own fund for the closure and post closure remediation, a guarantee is provided by the Ministry of Petroleum and Energy as a fund in case the operator is not able to operate the repository.

Article 23. Quality assurance (QA)

As required by its licences and the Internal Control Regulation, IFE has established a system for quality assurance to cover its research reactors and waste facilities, and provides for all aspects of operating a nuclear facility. This QA system is supervised by the regulatory body (DSA). The licensee must also fulfil Norwegian quality assurance requirements as to health, working environment and safety, as specified in other regulations.

IFE's QA programme is based on the ISO 9001 standards and IAEA guidelines and is described in its QA handbook. The QA handbook also describes the policy guidelines of IFE, and guidelines for setting the goals of different departments at different levels.

IFE is responsible for implementing and maintaining a quality system according to the licence granted by the Norwegian Government. IFE performs self-assessment and internal audits of the system, and DSA performs audits to verify that IFE procedures and its quality management system comply with the requirements specified in the licence and in laws and regulations. DSA's evaluation system follows the principles set out in the IAEA Safety Standards GSR Part 1 (Rev. 1).

DSA has developed a quality assurance system with written procedures for licensing and inspection activities. A full integrated management system for DSA is under ongoing development.

Article 24. Operational radiation protection

The national system for radiation dose control for workers is based on the regulatory requirements that all workers who may receive a dose exceeding 1 mSv per year are required to wear personal dosimeters. Radiation dose control for the public is based on the regulatory requirement that operators must limit exposure such that the dose constraint of 0.25 mSv per year is not exceeded.

Optimization of radiation protection is a general regulatory requirement in Norwegian legislation. In addition, provision is made for operational optimization through the regulations and several guidelines detailing specific technical solutions concerning shielding, work practices, protection devices, etc.

The Regulation on Radiation Protection and Use of Radiation of 16 December 2016, effective from 1 January 2017, is based on international standards including GSR Part 3., dose limits from ICRP 103, and the general requirements that radiation sources and equipment shall be made according to the latest version of applicable ISO and IEC standards. The Regulation contains a general requirement that organizations using such sources and equipment must possess adequate competence in radiation protection. This general requirement is further elaborated in several guidelines, where more specific training requirements in the various fields of work are given.

According to the Radiation Protection Regulation, the operator shall report radiation doses received by each worker annually to DSA. These doses must be kept below 20 mSv/y. A dose limit of 1 mSv to the foetus for the remainder of the pregnancy is applied to pregnant workers, i.e. after the pregnancy has been declared.

IFE has developed a system of work planning to keep staff radiation doses as low as is reasonably achievable, especially during maintenance work. This has led to improvements in general radiation protection at the facilities as well as lower doses received by staff.

DSA has defined radionuclide specific discharge limits for IFE's nuclear facilities in permits granted under the Pollution Control Act. These limits are established taking account of historical discharge data and optimization considerations, including planned research activities, and ensuring compliance with site-specific dose constraints of 1 µSv/year to the representative person from liquid discharges and 100 µSv/year from discharges to the air (of which the dose contribution from iodine isotopes must be below 10 µSv/year). These constraints are applied separately to Kjeller and Halden.

A separate set of criteria has been established for the facility in Himdalen. No continuous radioactive discharges are permitted from the facility during operation, and the resultant dose to the critical population group from any activity releases from the facility after closure, shall not exceed 1 µSv/year.

IFE submits annual reports of environmental and discharge information to the regulatory body (DSA). Information concerning discharges is available to the public on the IFE website (http://www.ife.no).

Article 25. Emergency preparedness

Emergency planning in Norway is based upon the principles of responsibility, proximity, similarity and co-operation. This implies that:

→ The organization which holds responsibility in a normal situation maintains the responsibility when extraordinary situations occur.

- → Any crises shall be dealt with at the lowest possible level.
- → The organization which is in daily operation shall to the greatest possible degree be similar to the organization which is planned for in a crisis situation.
- → In a crisis situation, the involved organizations on all administrative levels shall co-operate.

The main element in the response organization is the Crisis Committee, headed by the Director General of DSA.

In general, the licensee is responsible for organizing plans for on-site emergency preparedness and response. IFE has adapted plans for each site; these are not specific to spent fuel management or radioactive waste management facilities. The plans are exercised regularly and DSA witnesses and inspects exercises regularly and at least once a year. The performance is evaluated according to licence conditions, as well as the goals set for each exercise. The off-site response is planned by the local police authorities and coordinated with the Crisis Committee (see below).

Based on the Royal Decree of 23 August 2013, the Government has established a national response organization made up of representatives from the following entities:

- → The Crisis Committee for Nuclear Preparedness;
- → The Advisors to the Crisis Committee;
- → The Secretariat for the Crisis Committee (DSA);
- → The County Governors.

The ministries are responsible for emergency preparedness within their areas of competence. In order to deal effectively with the early phase of a nuclear event, the ministries have transferred responsibility for remedial actions to the Crisis Committee.

The Crisis Committee consists of the representatives of the following institutions:

- → DSA;
- → The Directorate for Civil Protection;
- → The Norwegian Armed Forces;
- → The Directorate for Health;
- → The Norwegian Costal Administration;
- → The Norwegian Food Safety Authority;
- → The National Police Directorate; and
- → The Royal Ministry of Foreign Affairs.

The Crisis Committee is responsible for implementing protective actions in case of a nuclear event representing a potential threat to Norway, or Norwegian citizens and interests. The Committee decides whether to:

- → Order the acute evacuation of local communities in cases where the emission source, for example a local reactor, a wrecked vessel with a reactor, or satellite fragments, represents a direct threat to lives and health locally,
- → Order short-term measures or restrictions in the production of foodstuffs, for example by keeping domestic animals inside or postponing harvesting,
- → Order or advise the decontamination of affected people,

- → Advise the general public to keep indoors,
- → Advise the use of iodine tablets,
- → Provide nutritional advice, for example by advising people to refrain from consuming certain contaminated foodstuffs, and
- → Offer advice on other measures, including measures to prevent or reduce environmental contamination.

DSA heads the Crisis Committee. The DSA is also mandated to make decisions on behalf of the Crisis Committee until the Committee is assembled. If time permits, the Crisis Committee must consult with the ministries before deciding on actions. DSA is also the Secretariat for the Crisis Committee and is responsible, inter alia, for alerting the Nuclear Emergency Organization, and relevant international bodies. The Secretariat organizes a 24/7 Officer on Duty Service.

Further information on emergency preparedness and response arrangements are provided in the report to the Convention on Nuclear Safety Review Meeting, with reference to Article 16 of the Convention on Nuclear Safety.

Article 26. Decommissioning

No nuclear facilities are in the process of being decommissioned in Norway. Following the decision to permanently shut down the last two operating research reactors in Norway, planning and preparation for decommissioning has intensified.

The research reactors HBWR and JEEP II were permanently shut down in 2018 and 2019, respectively. At JEEP II, the fuel and heavy water have been removed from the reactor, while at HBWR, part of the fuel has been removed and the heavy water is still in place. HBWR and JEEP II, and all related support facilities, will become subject to decommissioning once final decommissioning plans have been developed by the licensee and authorized by the regulator. Decommissioning will also include completing the decommissioning of the remaining parts of the historical research reactors JEEP I and N0RA, which were shut down and put into a safe condition in the 1960s, but not completely decommissioned according to today's standards and requirements.[12]

The facilities are still under operating licensing conditions. IFE Kjeller site received a new licence valid from 2019 until 2028. An application to extend the licence for the IFE Halden site is under consideration: the current licence is valid to 31 December 2020.

The Government established NND by Royal decree on 12 February 2018 as the organization that will be responsible for decommissioning of nuclear facilities and management of radioactive waste from the nuclear sector in Norway. NND is financed and instructed by the Ministry of Trade, Industry and Fisheries. In due course, NND is expected to apply for licences and permits to operate at the Kjeller and Halden sites (and for the operation of KLDRA Himdalen). NND issued a draft decommissioning strategy for the nuclear sector[13] in 2019. It is intended to update the draft strategy after the national radioactive waste management strategy has been finalized.

[12] JEEP I and N0RA were described as "decommissioned" in previous national reports. In reviewing the need for decommissioning at the Kjeller site following the decision to permanently shut down JEEP II, it became clear that they were decommissioned according to the standards and requirements of the time of shutdown, but that parts of the reactors remain.

[13] https://www.norskdekommisjonering.no/wp-content/uploads/2019/12/Dekommisjoneringsstrategi.pdf (in Norwegian).

The GLCs require that the licensee maintains a comprehensive decommissioning plan for the site, and reviews and revises the plan at such times as the regulator may require and, in any event, no later than 5 years from the previous revision.

As part of the licensing requirements in December 2006, IFE provided a plan for the decommissioning of its facilities. The plan was revised on several occasions, most recently in 2018, and specifies decommissioning of the facilities to "green field". These decommissioning plans follow the IAEA's recommendations at the level of "ongoing planning" and are continuously updated. The operator is expected to deliver an overarching final decommissioning plan covering both the Halden and the Kjeller sites and more detailed final decommissioning plans for each licensed facility. Decommissioning cannot commence before DSA has accepted the plans.

Facilities entering the decommissioning phase are still subject to the licensing regime under the Nuclear Energy Act. The GLCs include provisions for the licensee to ensure qualified staff and adequate financial resources, radiation protection and emergency planning. Provisions regarding discharges are addressed in the Pollution Control Act and its regulations and in the permits issued under this Act. Provisions for record keeping are outlined in the GLCs and would be further detailed in specific licensing conditions as considered necessary.

DSA's basic regime of issuing and enforcing permits and licences, and performing inspections and other control measures, are essentially the same in the transition and decommissioning period as during operation. However, the detailed application of these measures may change as decommissioning proceeds, taking account of the general reduction in hazards and temporary changes to activities (and the associated risks) during decommissioning.

G. Safety of Spent Fuel Management

Norway's inventory of spent fuel has arisen through the operation of research reactors at Halden and Kjeller. The first research reactor JEEP I at Kjeller, reached criticality in July 1951. It was followed by the HBWR at Halden in 1959 (part of the OECD Halden Reactor Project), a boiling heavy water reactor with maximum thermal capacity of 25 MW. The N0RA (Norwegian zero effect Reactor Assembly) reactor at Kjeller came into operation in 1961 and was a joint project between Norway and IAEA. JEEP II, also at Kjeller, was a 2 MW heavy water pool reactor, and reached criticality in December 1966. The JEEP I and N0RA reactors were permanently shut down in 1967 and 1968, respectively. HBWR and JEEP II were permanently shut down in 2018 and 2019, respectively. No future spent fuel arisings are expected in Norway (except that the fuel currently in the HBWR core will become spent fuel when removed).

These four reactors are the source of Norwegian spent fuel. Some fuel has been returned to its State of origin, some fuel underwent reprocessing at the pilot plant at Kjeller, and some was reprocessed (and the products and waste retained) in Belgium. Approximately 18 tonnes remain in Norway, including the fuel currently in the HBWR core (Table D2), which will become spent fuel when it is removed, according to the Joint Convention definition.

Spent fuel management, as well as other nuclear activities are mainly governed by three acts: the Nuclear Energy Act (12 May 1972), the Radiation Protection Act (12 May 2000) and the Pollution Control Act (13 March 1981) and their subordinate regulations. The operating site licences for Kjeller and Halden issued by the Government in accordance with the Nuclear Energy Act also include general conditions (GLCs)[14] and site specific conditions. Furthermore, detailed instructions, issued by DSA under any of the mentioned acts provide legally binding orders for the licence holder.

Norwegian safety requirements for the safety of spent fuel management follow the relevant IAEA Safety Requirements and, as far as possible, Safety Guides. The licence holder of a nuclear installation, currently IFE, is responsible for the management of spent fuel and the radioactive waste generated.

The principles and requirements for safety are addressed in IFE's SARs. These SARs constitute an integral part of IFE's licence as granted by the Norwegian Government. Any modifications which could have a safety implication or result in changes to the SAR need to be substantiated in a safety assessment by IFE and submitted for approval to DSA as the regulatory body. DSA performs review and assessment to inform decisions on the approval of modifications, which is needed for IFE to implement a modification.

Specific conditions are set out in the site licences as necessary to improve the safety of the facilities, to address any shortfalls identified as part of the review and assessment and authorization processes of DSA as the regulatory body.

The GLCs further clarify regulatory expectations with regard to safety relevant to facilities licensed under the Nuclear Energy Act. The GLCs were established in the context of the relicensing of the JEEP II reactor, in 2019, and were subsequently applied to the relicensing of HBWR in 2020. It is anticipated that these conditions will be applied in future licensing activities, notably for KDLRA Himdalen. General Licence Condition 13 regarding radioactive waste and spent fuel management states that:

"The licensee shall implement and maintain an adequate waste management programme documenting handling, processing, transportation, storage and safeguarding of radioactive wastes, including spent fuel and nuclear material that is declared as waste, mixed with any other hazardous substance."

[14] Assuming that DSA's recommendation is followed when a new licence is issued for Halden.

Other GLCs address general safety issues for nuclear facilities that are also relevant to spent fuel management (the GLCs are reproduced in an Annex to this report). The GLCs may be supplemented by additional conditions in specific licences.

Regulatory guidance is being developed to assist licensees in interpreting and implementing the GLCs. This is intended to include general guidance on the application of the GLCs to all types of facility, and specific guidance on the application of particular conditions to particular types of facility, such as spent fuel management facilities and radioactive waste management facilities.

Article 4. General safety requirements

Criticality and removal of residual heat generated during spent fuel management are addressed in the GLCs under the Nuclear Energy Act. IFE's SAR includes OLCs for criticality zones and for areas where spent fuel is being managed. In December 2019, DSA instructed IFE to temporarily stop all fuel movements until concerns identified by IFE regarding the criticality safety assessments in the relevant SARs were satisfactorily addressed. Revised criticality safety assessments have been reviewed and assessed by DSA, and further instructions were sent to IFE in July 2020 that must be addressed prior to the resumption of fuel movements. IFE is in the process of addressing the shortfalls identified. However, specific assessments were authorized to allow the limited movement of fuel necessary for IAEA safeguards inspections in May 2020 and October 2020.

A requirement for minimization of radioactive waste associated with spent fuel management is imposed by the Pollution Control Act, where the purpose of the act is stated as *to reduce the amount of waste and to promote better waste treatment.*

The regulations under the Pollution Control Act also establish provisions to consider interdependencies among the different steps in radioactive waste management.

Recent steps to address interdependencies among the different stages in spent fuel management include progress towards the development of a national strategy. This is supported by several concept selection studies which evaluate the needs and identify different alternatives for treatment, conditioning, storage and disposal for the Norwegian spent fuel and radioactive waste. Specific efforts are being made to strengthen the consideration of alternative options, taking account of all aspects of each option and the interdependencies between them, to provide a sound basis for strategic decisions.

DSA has instructed IFE to enhance the spent fuel inventory information to support the safe management of spent fuel until a disposal solution is available. IFE has also been instructed to improve the condition of the existing spent fuel storage as well as establishing new stores that can maintain safe and secure storage for an extended period of time.

Provisions for effective protection of the environment are outlined in the Pollution Control Act and, with the Radiation Protection Act, it provides the legal basis for regulating radioactive waste management and discharges to the environment, including those arising from spent fuel management. The Radiation Protection Act, the Regulation on Radiation Protection and Use of Radiation and the GLCs, effectively require the operator to ensure that the requirements in GSR Part 3 are met.

Provisions for management of both radioactive and hazardous waste are addressed in the Pollution Control Act. This promotes a holistic approach to waste management and ensures that biological, chemical and other hazards are accounted for in managing radioactive waste. In general, these aspects are addressed by the Environment Agency (Miljødirektoratet), but for sites licensed under the Nuclear Energy Act they are regulated by DSA in consultation with the Environment Agency.

A general requirement and overarching premise for both currently operating and new facilities is that future generations should not be exposed to risks from present-day nuclear activities greater than those permitted for the current generation.

Other burdens on future generations from present-day spent fuel management are required to be minimized by putting spent fuel into a passively safe form as soon as possible, providing storage for spent fuel that will be passively safe and secure until the spent fuel can be disposed of, and to dispose of spent fuel and decommission spent fuel management facilities as soon as can reasonably achieved.

Article 5. Existing facilities

All of the facilities currently involved in spent fuel management existed before the Joint Convention entered into force for Norway in 2001. In general, the spent fuel management facilities are beyond their intended design lifetimes, and when they were originally designed their continued use for the same purpose until the present was not envisaged. DSA has identified deficiencies in the designs and instructed IFE to upgrade their safety assessments, assess short term measures to enhance the safety of the facilities, and to establish new spent fuel management facilities where the current facilities cannot be upgraded sufficiently to maintain safety for as long as they are now expected to operate.

The management of spent nuclear fuel in Norway has gone through various phases linked to the development of the research reactor programme. The first core loading in HBWR was stored after its discharge in 1961. In the 1960s, reprocessing was an emerging technology, and spent fuel from JEEP I was used as loading material in a pilot reprocessing plant at the Kjeller site. This plant was in operation from 1961 to 1968, and was later partly dismantled. However, reprocessing was still considered a viable option for the Norwegian fuel cycle, the second core loading from HBWR was reprocessed in Belgium in 1969. The uranium and plutonium gained from the reprocessing were sold for civilian use, and the waste was disposed of in Belgium. When the third core loading was discharged, reprocessing was no longer considered to be a viable option; consequently, this and later spent fuel from the HBWR are stored on the Halden site, together with the discharged first core loading. The remainder of the spent fuel from the JEEP I reactor, along with spent fuel from the N0RA and JEEP II reactors, are being stored at Kjeller. Low-level liquid uranium solution from the pilot reprocessing plant has been solidified into yellowcake and is stored at the Kjeller site.

Spent fuel management facilities in Norway include fuel stores and supporting hot-cell facilities. Research activities, including those related to spent fuel management in the hot-cell facilities, were significantly reduced after the announcement to permanently shut down the HBWR reactor.

At the Halden site, spent fuel is stored for cooling in wet pits inside the reactor hall and in wet ponds and dry stores inside a bunker building next to the reactor hall. Furthermore, the heavy water and some fuel are still in the HBWR reactor. The spent metallic natural uranium fuel from the first core loading of the HBWR is stored in a dry storage compartment in the bunker building.

At Kjeller, spent fuel is stored in a pond inside the reactor hall and in dry storage facilities, known as the Brønnhus and the JEEP I Stavbrønn store. The unloaded spent fuel from the JEEP II reactor was first cooled in a pond inside the reactor hall, for at least 90 days. After this the fuel was placed in the Brønnhus, consisting of a concrete block with several steel storage pipes covered by shielding plugs. The concrete block is placed under a building specially designated for loading and unloading transports of radioactive material. After the decision to permanently shut down the JEEP II reactor, the JEEP II core has been emptied of fuel (and heavy water) and the final core loading is stored in the pond inside the reactor hall. Spent fuel from the former JEEP I (1951–1967) reactor and remaining fuel from the N0RA (1961–1968) reactor is stored in the JEEP I Stavbrønn, a separate spent fuel storage building at the Kjeller site. The storage pipes in this facility are surrounded mainly by sand; concrete is used only at the bottom and on

top of the storage compartment. This facility was expected to be used for short term storage, and DSA has identified the deficiencies in the design and instructed IFE to establish new storage facilities and to consider short term measures to improve the existing storage conditions.

As detailed in Norway's previous report, IFE identified corrosion products including traces of uranium hydride when examining (in 2012) one of the metallic uranium fuel elements stored in the JEEP I Stavbrønn at Kjeller. Later inspections revealed water ingress into several storage positions in the JEEP I Stavbrønn. The fuel assemblies that were stored in positions where water ingress was detected have been moved to other dry storage positions. Inspections also revealed that water had seeped into the Brønnhus fuel store. DSA instructed IFE to make a full investigation of all the stored spent fuel from JEEP I at Kjeller and the first charge of HBWR at Halden. The inspection programme for the JEEP I Stavbrønn has, however, been suspended while the SAR is being revised, among other things to include updated OLCs for fuel handling.

IFE has conducted non-destructive examination of the spent metallic uranium fuel from the first charge of the HBWR at Halden. The preliminary results from video inspections of all elements and x-ray imaging of about 10 % of the elements show that most of the fuel elements in the HBWR storage building are in an adequate condition. However, traces of corrosion are found on some storage pipes. The condition of the spent fuel stores at Halden is under investigation.

DSA has instructed IFE to improve the conditions of its spent fuel management facilities in general as well as establishing new storage capacity. IFE is assessing different options for additional storage to replace the JEEP I Stavbrønn by constructing a new storage facility or converting an existing facility to a storage facility. In addition, transport to a treatment facility abroad is also being considered.

DSA will ensure that IAEA's guidelines for safeguards by design will be taken into account in the process of planning and constructing new stores for spent fuel. An early consideration of safeguards in the design process will allow informed design choices that are optimized concerning economy, operation, safety, security and safeguards. DSA has identified the need for extra spent fuel storage capacity at the Halden site and instructed IFE to extend the capacity of the spent fuel storage.

Article 6. Siting of proposed facilities

It is expected that new spent fuel management facilities will be needed in the near future, but no definitive proposals have been made for such facilities in Norway at present.

Siting of nuclear facilities is regulated primarily according to the Planning and Building Activities Act and the Impact Assessments Regulation (see also section E.4). According to the Impact Assessments Regulation, DSA determines the plan for the environmental impact assessment and undertakes assessment, review and approval of the assessment performed by the operator. Regulatory review of the suitability of the site for a proposed facility is explicitly considered later, in relation to an application for a construction licence, but the environmental impact assessment would be considered in the context of the likelihood (or otherwise) that the site will be suitable.

Involvement and consultation with interested parties is a key part of the decision-making process in accordance with the Act of 10 February 1967 relating to procedure in cases concerning the public administration (Public Administration Act). Chapter IV of the Act contains provisions for preparation of regulatory decisions:

→ Section 16 establishes that interested parties shall be given advance notification before decisions are made and be given the opportunity to express their concerns within a stipulated time limit. Advance notification can be omitted under certain circumstances (section 16 a–c);

→ Section 17 establishes that the administrative agency shall ensure that the case is clarified as thoroughly as possibly before decisions are made;

→ Sections 18 establishes the right of interested parties to obtain access to relevant documents, with certain restrictions.

In addition, the Impact Assessments Regulation, section 34, includes provisions for consultation with affected third-party countries.

Article 7. Design and construction of facilities

Design and construction of new nuclear facilities would be the result of a licensing process according to the Nuclear Energy Act following an impact assessment. In the licensing process, the IAEA Safety Requirements and guidance would be an important and integral part, and the obligations prescribed in Article 7 of the Joint Convention would be followed.

Article 8. Assessment of safety of facilities

A licence for construction is granted on the basis of a systematic safety assessment. The builder/owner of the facility is responsible for carrying out the assessments. The authorities then review the safety reports in connection with the licence application. Plans for later decommissioning of the facility are required as a part of the assessments.

Before the facility can be commissioned, the proposed operator must apply for an operating licence. The application must describe the systems necessary for safe operation and how the authorities' requirements will be fulfilled.

Before the start of operation, updated and detailed versions of the safety assessments must be prepared, reviewed and approved by the authorities. Permission to start the operation of the facility can be granted by DSA only after all documentation is in place and approved.

Article 9. Operation of facilities

Some facilities, including some of the spent fuel management and radioactive waste management facilities, were constructed before the Nuclear Energy Act entered into force in 1972, so the original design and construction of the facilities were not regulated under the Act. Nevertheless, the design and construction of the Norwegian facilities was consistent with international practices at the time they were built. Later modifications have been subject to approval by DSA in accordance with the requirements stipulated in the licences.

The safety assessment of facilities is guided by the relevant IAEA recommendations. SARs are required to be updated on a regular basis and reported to the regulatory body. In line with the terms of the current licence, an environmental impact assessment for IFE's nuclear facilities has been conducted according to the Planning and Building Act.

At present, the OLCs and the operation and maintenance of the spent fuel facilities are considered as part of the operation of the research reactor facilities, regulated through the operating licence of the IFE nuclear facilities. The licence has been granted on the basis of the submitted SARs. DSA performs inspections to ensure that OLCs and operation, monitoring and maintenance are in accordance with the licence requirements.

The radiation dose limit to the public for the operation of such facilities is a part of the total limit for any discharge from reactor sites. Constraints are set for permissible doses from the operation of each facility,

and the fulfilment of these constraints is documented in the SARs. If and when another facility is put into operation, the operating procedures will become a part of the licence for that facility. Decommissioning plans are developed and updated during the licence period. In the case of a new facility, plans for decommissioning would be required at the planning stage.

Any incidents at nuclear facilities, including spent fuel management or radioactive waste management facilities, with potential consequences for safety must be reported directly to DSA, without delay.

Article 10. Disposal of spent fuel

The current disposal plans for the spent fuel inventory are recommendations from Government commissioned concept evaluation studies. No definitive decision on disposal of spent fuel has been taken and any decision will be in accordance will the strategy for radioactive waste management under development.

Some previous studies assumed that some of Norway's spent fuel would not be suitable for direct disposal, and that some form of treatment (e.g. reprocessing) therefore would be needed. However, technical assessments commissioned by DSA in 2018[7] indicated that it is likely that packaging and other disposal system features could be designed, and a disposal site found in Norway, suitable to allow safe direct disposal for the relatively small amounts of spent fuel concerned. Direct disposal may therefore be considered as one of the options for spent fuel management, subject to further assessment.

H. Safety of Radioactive Waste Management

Spent fuel in Norway is regarded as radioactive waste. The legal background for the management of radioactive waste management in Norway is therefore similar to that for spent fuel management, although some additional safety, security and safeguards requirements apply to spent fuel. To avoid excessive repetition of information, this chapter refers where appropriate to the corresponding information on spent fuel management in section G. Where the information for radioactive waste management is different from or additional to that for spent fuel management, the relevant information for radioactive waste management is in this chapter.

Article 11. General safety requirements

General safety requirement for radioactive waste management facilities are described in section G in this report.

Specific criteria for the safety of radioactive waste management are established by DSA on a site-specific basis in connection with periodic reviews of the operating licence, annual status reports and the permits for radioactive waste management and discharges. Specific requirements are included in the SARs for both the Radioactive Waste Facility at Kjeller and KLDRA Himdalen. IAEA safety standards are an important component of the preparation of the SARs and for their review and assessment as part of authorization activities.

Article 12. Existing facilities and past practices

With the exception of facilities for disposal of NORM waste, all of the facilities currently involved in radioactive waste management existed before the Joint Convention entered into force for Norway in 2001.

The Norwegian facilities for radioactive waste management were built 40–60 years ago, except KLDRA Himdalen, which was built during the 1990s and started operation in 1999. The Norwegian authorities have carried out regular inspections and reviewed and enforced safety procedures in connection with licence applications.

Predisposal radioactive waste management, including conditioning of waste for disposal, is primarily carried out by IFE at the Radioactive Waste Facility on its Kjeller site. KLDRA Himdalen receives conditioned waste and disposes of it. NORM wastes are typically managed primarily at their disposal facilities.

Operators of radioactive waste management facilities must provide a yearly report which gives an overview over the amount of waste received, conditioned and disposed of (or sent to KLDRA Himdalen for disposal), and of waste stored on site, in addition to reports on discharges from the facilities and results from environmental monitoring. Operators must also provide other details of significance to safety and the integrity of the facilities. Many of the requirements for basic waste management (e.g. minimization of waste, application of the waste hierarchy) are similar to those for the operator of any facility with a permit under the Pollution Control Act. General criteria for what must be reported are published (in Norwegian) on the DSA homepage, and facility specific criteria are included in the permits.

Nuclear facilities have licence conditions requiring periodic safety reviews.

For radioactive waste facilities for NORM and alum shale wastes, there are currently no requirements to perform a periodic safety review. However, authorized parties are not permitted to deviate significantly from the conditions specified in their authorization application and there is generally a condition in permits to notify DSA in advance of any such changes or modifications. Furthermore, the permit may be withdrawn

or altered if it is more than 10 years since it was issued. These situations may result in the need to re-apply for an authorization, which would be supported by a revised assessment. This process would involve DSA assessment, review and approval.

H.1. Radioactive Waste Management Facilities at Kjeller

The Radioactive Waste Facility at the Kjeller site was built in 1959, and is currently operated by IFE. This is a facility for receiving, sorting, handling, treatment and conditioning of radioactive waste. It receives all LILW generated by Norwegian industry, hospitals, universities, research organizations and military forces, in addition to waste from IFE. Waste containing naturally radioactive nuclides (NORM) is not received at this facility.

Most of the remaining solutions of uranium containing plutonium and fission products from the historical pilot reprocessing facility at Kjeller have been solidified. The solidified uranium (yellow cake) is stored in the Radioactive Waste Facility at Kjeller until a suitable disposal facility is available. There is still some solution left from the reprocessing test facility. The remaining solution is expected to have a low content of nuclear material, but the radiation level of the solution is high, which makes it a challenge to manage, especially since the content is not known in detail.

The Radioactive Waste Facility also contains a storage facility (storage building 1), built in 1965–66, for unconditioned waste awaiting treatment and conditioned waste awaiting transfer to storage building 2.

Storage building 2, built in 1977–78, is devoted to the storage of conditioned waste packages before transport to the disposal facility at Himdalen. It also serves as a store for wastes from the production of radiopharmaceuticals which are not suitable for disposal at KLDRA Himdalen (liquids awaiting solidification in a new facility).

H.2. Combined Disposal and Storage Facility at Himdalen (KLDRA)

The facility is built into a hillside in crystalline bedrock. It has four caverns for waste packages and one slightly inclined 150-metre long access tunnel for vehicles and personnel. All the caverns and the access tunnel have a monitored water drainage system. A service and control room with service functions for personnel and a visitor's room are located along the tunnel. The rock caverns are excavated in such a way that about 50 m of rock covering remains above the sarcophaguses containing waste. This natural geological covering provides protection against intruders, aeroplane crashes and other external events, although it is not intended to act as a main barrier in long-term safety calculations. Long-term safety will rely on the engineered barriers.

In each cavern, two solid sarcophagi have been constructed with a concrete floor and walls. Three caverns are used for waste disposal, with drums and containers stacked in four layers. When one layer in a sarcophagus section has been filled with waste packages, it is encased in concrete. When a section of the sarcophagus has been filled, a temporary waterproof membrane is affixed over that section, shaped to shed infiltrating groundwater. It is planned to construct a concrete roof over the sarcophagi.

One of the caverns is used for storage for special waste packages, which currently includes 166 drums of waste containing some plutonium (about 35 g in total), which was among the waste retrieved from a former disposal trench on the Kjeller site. The decision whether to retrieve the waste from the storage cavern or dispose of it by encasing it in concrete will be made on the basis of experience during the operational period and the safety reports to be prepared for closure of the facility.

Closure of KLDRA Himdalen is expected around 2030: a closure plan is required to be presented to DSA five years before planned closure. The total capacity of the facility is 2000 m^3 (approximately 10,000 210-litre drums). This was originally foreseen to provide capacity for operational LILW up to 2030, but concept evaluation studies indicate that the LILW generated due to decommissioning of the nuclear facilities at Kjeller and Halden will mean that new disposal capacity is likely to be needed earlier. Additional capacity could be provided either by extending the existing KLDRA facility in Himdalen by constructing a new facility at a new location. It has been recommended to the Government, that the process for developing additional capacity should be started as soon as possible.

For the long-term safety of the facility, DSA has stipulated two basic principles to be followed:

- → Future generations have the right to the same level of radiation protection as the present generation.
- → Except for a certain period of institutional control of 300 years, the safety of the facility should not rely on future surveillance and maintenance.

More specific long term safety criteria were set by DSA during the design of KLDRA Himdalen. These are specific to KLDRA Himdalen, and are as follows:

- → For the most likely scenarios, based on realistic calculations, doses to the most exposed individuals should not exceed 1 µSv per year.
- → For other scenarios, a dose of 100 µSv per year to the potentially most exposed individuals should not be exceeded. These scenarios are assumed to include establishment of a well very close to the repository after the repository has filled with water, or drilling through the repository.

The dose criteria are recognized to be lower than those used and recommended internationally and also lower than those allowed generally in Norwegian radiation protection legislation. The criteria were considered to be reasonably achievable in the specific context of KLDRA Himdalen, due to the relatively small amount and low level of activity of the inventory.

The waste acceptance criteria for disposal at KLDRA Himdalen are based on these dose criteria, and include a limit on activity of long lived alpha emitting radionuclides of 400 Bq/g on average and 4000 Bq/g in any drum. This is consistent with the IAEA's recommended classification of waste suitable for near surface disposal. The main contributors to the disposal inventory are fission and activation products with half-lives of 30 years or less and therefore radiological impacts after a 300-year period of institutional control are likely to be (and are shown to be in the SAR) very low.

H.3. NORM Waste

The Gulen repository for radioactive waste from the oil and gas industry and land based NORM industries is operated by Wergeland Halsvik AS and is situated in an underground rock formation. It consists of an entry tunnel, a tunnel for NORM waste treatment as well as two tunnels for waste disposal, with a total capacity for disposal of 7000 tonnes of NORM waste. Treatment at the facility consists of dewatering waste, filling void space in the barrels with sand or oil absorbent material and sealing between the barrels with a cement matrix. The intention is that the repository tunnels will be filled with waste-drums, cemented in concrete mould castings.

There are four physical barriers to stop the spread of radioactivity from the disposed waste. The first barrier consists of the plastic drum in which the waste is disposed. The concrete walls of the permanent mould casting constitute the second barrier, whilst the third barrier is the cement around the castings. The final barrier is the surrounding rock formation itself.

For long term safety analyses the repository has been assessed in relation to possible impacts from e.g. flooding, mud slides, earthquakes, breakdown of barrier, and human intrusion.

H.4. Legacy Wastes

In 1970 IFE, with the regulatory permission required at the time, buried barrels of LILW in a trench on the Kjeller site. A total of 997 drums of waste and 19 pieces of equipment was disposed of in the trench. In 1993–94, some drums were excavated and found to be degraded, and it was subsequently decided to retrieve the waste from the trench. The drums were retrieved in August 2001. Of the 997 drums, 166 were designated as "plutonium drums", containing a total of 35 grams of plutonium-239/240 originating from the former pilot reprocessing plant's treatment of spent fuel from the JEEP I reactor. In accordance with a parliamentary decision, these plutonium drums have been placed in the storage hall of the KLDRA facility at Himdalen. No decision has yet been taken on whether to dispose of them at Himdalen or remove them from storage and manage them elsewhere.

In 2000, IFE Kjeller removed from the riverbed of the nearby Nitelva River approximately 180 m^3 (45 drums) of sediment contaminated by plutonium from liquid discharges from the pilot reprocessing plant in the late 1960s. In 2001, IFE retrieved a 900-metre long section of a disused liquid discharge pipeline buried in the bed of the Nitelva River. Waste retrieved in these clean-up operations that was not suitable for disposal at KLDRA Himdalen is stored at Kjeller.

Article 13. Siting of proposed facilities

The framework for siting radioactive waste management facilities, and provision for involvement of the public in such decisions, is essentially the same as for spent fuel management facilities, as reported in section G.

It is recognized that the waste from nuclear decommissioning will greatly exceed the currently available disposal capacity for LILW at KLDRA Himdalen, and will substantially increase the volumes of higher activity and/or longer lived radioactive waste requiring disposal in a deeper facility. As noted above, it is recognized that new capacity for the disposal of LILW is needed, either in the form of a new facility or extension of the existing KLDRA facility in Himdalen. The national radioactive waste management strategy may be expected to indicate that a disposal facility for higher activity wastes will be needed and that, given the expected long duration of such a project, that work towards siting should start soon. Additional facilities may also be needed for predisposal management of wastes arising from decommissioning, and for the disposal of large volumes of very low level waste from decommissioning.

NND is expected to be responsible for developing and operating such new facilities. The Government and/or NND will be responsible for site selection, including for any new disposal facilities. No specific site selection process has been defined to date.

DSA will be expected to provide some input to the site selection process as the potential regulator of the proposed facility. DSA therefore recognizes that guidance is likely to be needed for the siting stages of developing radioactive waste management facilities.

Article 14. Design and construction of facilities

Most of the framework for designing and constructing radioactive waste management facilities is essentially the same as for spent fuel management facilities, as reported in section G.

Before any new facilities for nuclear activities can be built in Norway, all obligations in these articles must be met, and decommissioning (or closure) plans prepared. Among these obligations is the requirement to consult the relevant Convention Contracting Parties. For the design and construction of a major facility for radioactive waste management, the same procedures as described in section G are to be followed.

Assumptions were made about the future closure of KLDRA Himdalen when it was designed and constructed, and these are reflected in the SAR for the facility. This foresees sealing the caverns and access tunnel but not backfilling the whole void space in the facility. A closure plan is required to be submitted to DSA for approval five years before proposed closure of the facility, and this may confirm the original plan for closure or present a modified plan. The closure plan will need to be supported by a safety assessment that is based on the proposed closure arrangements.

Article 15. Assessment of safety of facilities

Most of the considerations for safety assessment of radioactive waste management facilities are essentially the same as for spent fuel management facilities, as reported in section G.

The radioactive waste management facilities on the Kjeller site are included in the licence and permit for that site, but they have a separate SAR. The KLDRA Himdalen facility has a separate licence and permit, and a separate SAR. The main SAR for the operation of KLDRA Himdalen has a similar form to those for other facilities, but is supplemented by a more extensive assessment of post-closure safety.

IFE's current licence for KLDRA Himdalen is valid until 28 April 2028, with the condition that the facility's SAR will be reviewed and updated periodically every five years. The next review and update is to be submitted to DSA by the end of 2020. A further update of the SAR may be required in the future to support an application for NND to take over ownership and operation of the facility.

Article 16. Operation of facilities

Most of the considerations for operation of radioactive waste management facilities are essentially the same as for spent fuel management facilities, as reported in section G.

Radioactive waste must be adequately characterized both with regard to the radionuclide inventory and other aspects such as physical and chemical states. The producer of the waste is responsible for this characterization. All relevant information about the waste must be recorded by the producer of the waste and the form containing this information must follow the waste, and ultimately be submitted to the relevant authority (DSA or Environment Agency) when the waste has been disposed of.

Section 16 of the Regulation of 1 June 2004 on the Recycling and Management of Waste under the Pollution Control Act (Waste Regulation) states that radioactive waste cannot be mixed with other wastes in order to produce waste below the criteria defining radioactive waste or radioactive waste subject to a disposal requirement, and waste containing one radionuclide should not be mixed with wastes with other radionuclides if this makes it unsafe to store or difficult to handle. In addition, the permit for KLDRA Himdalen states that the operator must keep a journal of the radionuclide inventory of each waste drum and its location in the facility.

Permits under the Pollution Control Act state that a closure plan has to be developed and submitted at a certain time (usually five years) prior to planned closure. The closure plan must be provided to the relevant authority (DSA or Environment Agency), which has to approve it.

Regulation of radioactive waste with NORM is generally equal to the regulation of radioactive waste with anthropogenic nuclides, but it is adjusted according to the risk of effects on humans and the environment.

Hence similar assessments are performed for facilities for waste with NORM as reported for other facilities, although they are adapted to address the specific risks of waste with NORM.

Article 17. Institutional measures after closure

The KLDRA Himdalen disposal facility is currently owned by the state (Statsbygg). The ownership will be transferred to NND at some point in the future. NND is owned by the state and the responsibility for post-closure measures will still rest with the state, independent of whether the owner is Statsbygg or NND.

Permits under the Pollution Control Act require that the operator keeps updated records of the inventory of the facility. These records shall be kept by the operator's enterprise as long as it exists. If the enterprise ceases to exist, the records must be transferred to DSA. Documentation received by the regulator as a part of case handling is regulated by the Archives Act, which states that the relevant party (i.e. DSA) must have an archive that keeps documents for the present and the future. The Archives Act also states that archived documents cannot be deleted without permit from the National Archives unless certain criteria are fulfilled.

The operator of the facility will make a post-closure plan in due time (as specified in the permit) before closure, taking account of operational experience and current requirements at that time. An institutional control period of 300 years is currently assumed for the KLDRA Himdalen disposal facility, but the exact length of the period will need to be determined and justified in the closure plan and confirmed at the time of closure. During the institutional control period, there will be monitoring of the disposal system and local area, and restrictions on land-use in the area. The responsibility for post-closure management currently rests with the owner of the facility.

The operator of the facility is responsible for safety throughout the lifetime of the facility. The permit under the Pollution Control Act states that if during the post-closure institutional control, measurements indicate discharges of radionuclides to the environment from the facility, necessary intervention must be performed.

The duration of any post-closure institutional control period for the Gulen disposal facility for NORM waste is not specifically defined in the permit for the operating phase from DSA. Plans for closure and post-closure control of the facility are required to be updated every 5 years.

I. Transboundary Movement

Article 27. Transboundary movement.

Transboundary movements of radioactive material in general are regulated under the Nuclear Energy Act and the Radiation Protection Act (and associated regulations). Transboundary movement of radioactive waste and spent nuclear fuel is also subject to the Pollution Control Act, and particularly the Regulation for application of the Act to radioactive pollution and radioactive waste.

Norway does not currently export spent nuclear fuel or radioactive waste apart from small amounts from experimental work in connection with the OECD Halden Project. Some options under consideration for the management of Norway's spent fuel (or some of it) would involve treatment of the spent fuel in other countries. If it were demonstrated that it was necessary in order to ensure a safe and environmentally sound solution for the treatment of spent fuel abroad, and that it was demonstrated to be the best option, then it would in principle be possible to export such spent fuel and to import the products of the treatment.

Radioactive waste with NORM has in some cases been imported to Norway during the decommissioning of disused offshore installations for extraction of oil and gas by other countries in the North Sea-area. These imports require a permit for import of radioactive waste. The permits specify whether the waste may enter the Norwegian waste stream and be disposed of in Norway or whether the radioactive waste extracted from a disused installations must be returned to country of origin.

All transfers of radioactive waste and spent fuel to and from other countries must be authorized by DSA, subject to import and export permits. Such transfers must be consistent with the requirements set out in the Joint Convention and also comply with the provisions of the Convention on the Physical Protection of Nuclear Material, and its Amendment, the safeguards agreements between Norway and the IAEA, international requirements for safe transport and other relevant standards and agreements.

Transit through Norway of nuclear material in general is not permitted without a licence. To date, such transits have never been performed.

J. Disused Sealed Sources

Article 28 Disused sealed sources

The Radiation Protection Regulation specifies the regulatory aspects of handling radioactive sources (except for waste handling, which is covered by the Pollution Control Act and the regulations on waste). This regulation distinguishes between very low, medium and high activity sealed sources:

- → Authorization from DSA is needed before using a high activity sealed source, which is defined as a source of activity exceeding 2 million times the exemption value given in the Regulation (which values are those specified in GSR Part 3 for exemption of moderate amounts of material).
- → Notification must be sent to DSA in case of use of a medium activity source (more than the exemption value but less than 2 million times that value): these are typically industrial gauges.
- → For very low activity sources, no authorization or notification is needed; such sources are below the regulatory exemption levels.

DSA maintains electronic records of sealed sources above exemption levels, including sources used in industrial radiography, oil and gas well logging, medical therapy, and industrial gauges. The information on sealed sources is stored in a web-based register which enables the owners and users of radiation sources to make notifications to DSA directly electronically. Owners and users are also able to register, check and verify the information associated with their enterprise.

Starting with the entry into force of the Radiation Protection Regulation in 2011, all import and export of IAEA category 1 and 2 sources requires an authorization from the DSA.

Distributors of medium and high activity sources are required to have authorization from DSA. When DSA issues authorizations for companies to buy, sell, lease or use sealed sources, it is with the requirement that disused sources are to be returned to the manufacturer. However, if no viable options for a licence holder in Norway are available, the source is to be sent to IFE for treatment and for storage or disposal at KLDRA Himdalen.

It is the responsibility of the licence holder to ensure that disused sealed sources are handled in a safe manner and that they are ultimately returned to the manufacturer, or if that is not possible to dispose of them at KLDRA Himdalen. If the licence holder is in financial difficulty or out of business, safety and proper disposal of the disused sealed sources will be handled by a case-by-case basis. DSA may take the responsibility for the source(s). Licence holders are generally not required to provide financial assurance for the decommissioning of their facility and disposal of disused sources when applying for a licence.

Practical implementation of the return requirement means that the sources are re-exported to a manufacturer abroad, or if not possible sent to IFE Kjeller for treatment and for storage, or disposal at KLDRA Himdalen if the source complies with the waste acceptance requirements. The same regulatory requirements as for other radioactive wastes are in force for long-term storage facilities for disused sealed sources. The same safety precautions, including monitoring activities, are required during handling of disused sealed sources.

IFE has been the only producer of radioactive sources in Norway, producing sources at the JEEP II reactor. IFE's licence for this production was part of the general licence to own and operate nuclear installations and a permit for the production is given by the DSA with statutory basis in the Radiation Protection Act and associated regulations. The licence contains comprehensive requirements for radiation protection, safety and security. As a distributor of radioactive sources, IFE was also required to provide annual reports

to DSA specifying sources, activities, names of buyers etc. In view of the permanent shutdown of JEEP II, this production has stopped.

Norwegian authorities allow re-entry of disused sealed sources on a case-by-case basis. Norwegian-produced instruments containing sealed sources produced in a third country, are permitted re-entry to Norway if this is preferable to removing the source and returning it to the third country.

Orphan sources have been identified in Norway. For example, there have been several instances where sources have been removed or sent to other companies without proper notification. If an orphan source is found, the normal procedure is that DSA attempts to find the owner, and, if relevant, also reports the case to the police. If the owner is not found, DSA makes sure the source is handled properly as radioactive waste. If the source is found to be orphaned, deliberately or by an act of negligence, the police will consider prosecution and further actions. Fines up to NOK 2 million (€ 250 000) have been given.

At the Storskog border point between Norway and the Russian Federation, a monitoring portal has been in operation since 2004. The Norwegian customs service also has portable measuring equipment across the country. Some other governmental organizations have similar handheld equipment, for example the coastguard and civil defence organizations. DSA assists them (as a second-line service) in case of alarms. Most private companies dealing with scrap metal, or other businesses that might inadvertently receive contaminated waste, have monitors to detect such sources before they are sent to a foundry or melted down. Several orphan sources have been detected this way.

K. General Efforts to Improve Safety

K.1. Overarching Issues Identified at the Sixth Review Meeting

At the sixth Review Meeting, Contracting Parties agreed that National Reports for the seventh Review Meeting should address four overarching issues. These issues are primarily addressed under the relevant headings above. However, a summary is provided below under each heading, for ease of reference.

Implementation of national strategies for spent fuel and radioactive waste management

As described in Section B.2, DSA is currently supporting the Ministry of Climate and Environment in the development of the national strategy for the management of spent fuel and radioactive waste. The Ministry of Trade Industry and Fisheries has also requested NND develop proposals for strategies for more operational aspects of decommissioning and for the management of radioactive waste arising from nuclear facilities. Relevant documents have been prepared and were under discussion, at the time of writing. Detailed plans for implementation will be developed in due course.

DSA has identified the following priority actions that affect implementation:

- → Include an holistic analysis of all options, taking account of interdependencies between different elements and stages;
- → Clarify policy on a number of aspects of the management of radioactive waste and spent fuel, and requirements for safe and secure decommissioning of nuclear facilities;
- → Prioritize improved characterization to facilitate management of spent fuel and radioactive waste and decommissioning;
- → Initiate development of additional national facilities for management and disposal of spent fuel and radioactive waste, including improved longer term storage for spent fuel and high activity waste and a final disposal route for these, and additional disposal capacity (expansion of the existing facility or a new facility) for low and intermediate level waste.

Safety implications of long-term management of spent fuel

As indicated in Section D, and in the section above, there are on-going activities to assess and ensure the safety of the long-term management of spent fuel. Actions have been initiated to improve the SARs for the current fuel storage facilities and to assess and plan for longer-term storage arrangements. The design lifetime of existing and new or upgraded facilities will be important considerations in this process. The options for treatment and disposal of the various types of spent fuel have been the subject of recent analyses and these issues are being considered by the Government.

Linking long term management and disposal of disused sealed radioactive sources

As indicated in Section J, it is the responsibility of the licence holder to ensure that disused sealed sources are handled in a safe manner and that they are ultimately returned to the manufacturer, or if that is not possible to dispose of them at KLDRA Himdalen (or store for future disposal if they do not meet acceptance requirements for KLDRA).

Regulatory mechanisms to encourage the return of disused sealed sources have been in place for some time and are being further developed. In addition, options for the disposal of high activity sealed sources,

which are not suitable for disposal at KLDRA Himdalen, are being considered as part of the national strategy for the management of spent fuel and radioactive waste.

Remediation of legacy sites and facilities

There are legacy sites in Norway, for example the Søve disused niobium mine in Telemark County and sites where alum shale has been illegally disposed of. There is ongoing work to remediate some of the sites, prioritized on a risk basis.

Remediation is regulated under permits that require that remedial and protective actions are justified, and that protection is optimized. The Pollution Control Act provides the basis for the regulation of remediation of sites due to radionuclides as well as other pollutants, which allows the approaches to regulate and remediate sites that are contaminated with both radionuclides and other pollutants to be harmonized. Remediation of non-radioactive contaminated sites is regulated by Norwegian Environment Agency and DSA works in cooperation with this agency, where appropriate.

K.2.Challenges for Norway Identified at the Sixth Review Meeting

During the sixth review meeting of the Joint Convention, 2018, four challenges were identified for Norway: Information on these is given below and in the previous sections of the report. No suggestions were identified.

Resolution of current safety and technical issues at spent nuclear fuel storage facilities, including ensuring adequate spent fuel storage capacities;

To ensure short-term safety of spent fuel management, IFE has been instructed by DSA to further investigate the storage conditions of all the metallic spent fuel. It is observed that the storage condition of the metallic spent fuel has deteriorated. Consequently, IFE has been instructed by the DSA to build a new storage facility for spent fuel at Kjeller.

At the Halden site, IFE is making progress in monitoring the condition of the spent metallic fuel. DSA has instructed IFE to extend the storage capacity for spent fuel at the Halden site.

In December 2019, DSA instructed IFE to temporarily stop all fuel movements until the relevant criticality safety assessments were satisfactorily updated. Updated assessments have been provided and reviewed, and IFE are currently addressing further instructions given by DSA in July 2020.At both the Kjeller and Halden sites, DSA will make sure that IAEA's guidelines for safeguards by design will be taken into account in the process of planning and construction of new stores for spent fuel. An early consideration of safeguards in the design process will allow informed design choices that are optimized concerning economy, operation, safety, security and safeguards.

Further development of the national spent fuel and radioactive waste management strategy and development of an action plan defining next implementation steps, milestones and responsibilities;

The Norwegian Government has continued development work on the national strategy and plans for spent fuel and radioactive waste management, building on the results of the concept evaluation studies described in previous reports.

Development of technical solutions to extend the current storage and disposal capacities, in line with planning for decommissioning of the research reactors;

Potential technical solutions are being considered and evaluated through KVUs and other processes. It is expected that the national radioactive waste strategy will identify preferred solutions for further development and evaluation in the implementation of the strategy.

Management of national competences taking into account as facilities are moving to new lifetime phase (decommissioning, disposal facility construction).

A national organization (NND) has been established to be responsible for decommissioning and the management of radioactive waste, primarily from the nuclear sector. This organization is currently building its competence, drawing upon the existing competence of the current operator IFE, and, in due course, will be responsible for the practical implementation of the national radioactive waste strategy.

The Ministry of Climate and Environment significantly increased funding to DSA from 2019, in areas related to decommissioning and radioactive waste. DSA has initiated a process to map the competence needs of the organization, as a whole and in each department and section, and the competences of the existing employees. DSA is working towards establishing the necessary regulatory guidance and procedures, and developing its own competence and capacity to address the increasing focus on decommissioning and spent fuel and radioactive waste management.

K.3.International Peer Reviews

In October 2017 an IAEA Integrated Safety of Research Reactors (INSARR) mission was conducted for the JEEP II reactor, including the JEEP I Stavbrønn storage. The report was made publicly available. Some recommendations related to general issues of safety (e.g. need for improvements in safety management and organizational aspects), but did not specifically relate to spent fuel management or radioactive waste management. DSA took account of the mission findings in preparing recommendations with respect to the licence application in 2018 and IFE has established a follow-up plan. Since this mission took place before the decision to permanently shut down JEEP II, some of the findings may no longer be relevant, but recommendations that remain relevant continue to be followed up.

In March 2018 an IAEA Independent Safety Culture Assessment (ISCA) mission was conducted to review safety culture in IFE's organization. The ISCA team concluded that the safety culture at IFE was under development and was improving, but several areas for improvement were identified, some of which are also relevant to spent fuel management and radioactive waste management. DSA took account of the mission findings in preparing recommendations with respect to the licence application for Kjeller in 2018 and IFE has established a follow-up plan. Since this mission took place before the decision to permanently shut down HBWR and JEEP II, some of the findings may no longer be relevant, but recommendations that remain relevant continue to be followed up.

A full-scope Integrated Regulatory Review Service (IRRS) mission to Norway took place in June 2019. The mission report has been made publicly available[15]. In this report, the IRRS Team stated that it "was positively impressed by the extensive preparation, expertise and dedication of DSA. The IRRS Team was extended full cooperation in the regulatory, technical, and policy discussions with the management and staff of DSA, in a very open and transparent manner."

[15] https://www.iaea.org/sites/default/files/documents/review-missions/irrs_norway_2019.pdf

The IRRS Team identified two good practices related to the global safety regime and inspection, respectively:

- → "The Government of Norway through establishing the Nuclear Action Plan and continuing it for more than 20 years shows a long-term commitment for international cooperation in safety and security. By strategically providing funding for projects to ensure risk reduction regarding serious accidents and radioactive contamination as well as to prevent nuclear and other radioactive material from falling into the wrong hands, Norway's NAP has substantially contributed to increasing safety and security in Russia and Ukraine."
- → "The formalized cooperation group of regulatory authorities, proactively devising joint guidelines and training for harmonizing inspections and the performance of joint inspections, integrating radiation protection with overall health and safety aspects is identified as a good practice."

Further areas of good performance were identified, including "strengthened justification in the substitution of blood irradiators based on caesium chloride and … the Crisis Committee for Nuclear and Radiological Emergency Preparedness and Response."

The IRRS Team report also included a number of recommendations and suggestions to improve the Norwegian regulatory system and the effectiveness of the regulatory functions in line with IAEA safety standards, many of which confirmed the actions for further improvement that were identified in DSA´s self-assessment. In summary, the IRRS Team concluded that "the following issues are representative of those which, if addressed by the Government of Norway and DSA, should further enhance the overall performance of the regulatory system.

The Government should:

- → Establish a comprehensive national policy and strategy for safety;
- → Update and further develop the national framework for safety and security;
- → Establish a national policy and a strategy for spent fuel and radioactive waste management including decommissioning;
- → Make provisions to provide DSA with the necessary resources to fulfil its obligations;
- → Establish provisions regarding national competence in nuclear and radiation safety.

The regulatory body, DSA, should:

- → Develop an integrated management system to ensure safety, addressing the whole organization;
- → Implement a human resource plan and training programme based on an analysis of the necessary competence and skills;
- → Take action for the further development of regulation and guides in order to ensure a comprehensive regulatory framework;
- → Establish and implement an enforcement policy;
- → Introduce and implement the concept of clearance;
- → Implement an inspection programme based on a systematic graded approach."

K.4.Current Practices and Improvement Measures

The focus of current activities and measures for improvement are heavily influenced by the early shut down of the research reactors and the need to prioritize issues related to preparations for decommissioning and the associated management of spent fuel and radioactive waste.

The recommendations from the IRRS mission are being taken into account in the preparation of a national Action Plan. Work to clarify the national policy and strategy for the management of spent fuel and radioactive waste has been a particular focus, as indicated in Section B.1.

The IRRS mission recommendations related to DSA are reflected in the current overall programme of work. For example, work to establish an integrated management system has been ongoing for some time and human resource and competence planning has been identified as high priority. DSA is working towards developing a policy and strategy for competence management, including a human resource plan. These issues are also being taken into account in the internal reorganization of DSA, currently in progress. One of the aims of this reorganization is to further enhance DSA's organizational structure to respond to present and future regulatory challenges, notably those associated with decommissioning and the management of spent fuel and radioactive waste management.

In addition to these internal arrangements, DSA has established the following mechanisms to enhance its competence and capacity by working with external support organizations:

- → Enhancing its framework contract arrangements with external support organizations to cover a broader range of expertise. These external support organizations essentially cover the functions of a technical support organization;
- → Establishing an Advisory Committee on Nuclear Safety and Radioactive Waste Management, comprising international experts and representatives from regulatory bodies from other countries to, among other things, to review relevant work undertaken by DSA or for DSA, under framework agreements made with external support organizations.

Key features of the IRRS recommendations particularly relevant present and future DSA activities related to the management of spent nuclear fuel and radioactive waste management include:

- → Development and implementation of a national policy and strategy for spent fuel and radioactive waste management, to reflect national priorities and to form the basis for long-term decision making with respect to the decommissioning of facilities, management of spent fuel, predisposal waste management and disposal of radioactive waste, including the necessary financial provisions;
- → Ensuring that the regulatory framework fully addresses the early stages of development of nuclear installations and decommissioning, as stages requiring authorization, are suitably addressed;
- → Development of specific regulations and guidance related to preparation and maintenance of safety cases during construction and operation of spent fuel and radioactive waste management facilities;
- → Further development of processes for the release (clearance) of materials from regulatory control.

Significant work has been undertaken in the intervening period on the first of these recommendations, in particular, which is described in more detail in section B.1, and work is also in progress to address the others. For example, a review of international guidance on clearance and its application to the situation in Norway has been undertaken and relevant guidance is in the process of being developed.

As indicated above, in the period since the previous National Report, DSA has established General Licence Conditions (GLCs) that are closely linked to both the Nuclear Energy Act and to international standards. The objective is to clarify the regulatory requirements related to nuclear facilities and activities in order to,

among other things, facilitate the operators' understanding of regulatory expectations. Additional guidance on the application of the GLCs is under development. General guidance will specify the principles, requirements and associated criteria for safety upon which DSA's regulatory decisions and actions are based. Additional specific guidance will provide additional guidance for particular types of facility that are, or could be, licensed under the Nuclear Energy Act (e.g. spent fuel treatment and storage facilities and radioactive waste management facilities).

K.5.Activities to Enhance Openness and Transparency

Provisions for the involvement of interested parties and for their input to decision making follows and is ensured by the general requirements laid down in the Public Administration Act and, in the case of new facilities, the Planning and Building Act. Hearings are performed for licensing and are mandatory under the Pollution Control Act for permits. Such hearings are advertised on the DSA website and in the local media of new activities requiring a permit or licence.

The Environmental Information Act of 9 May 2003 Relating to the Right to Environmental Information and Public Participation in Decision-making Processes Relating to the Environment also ensures public access to environmental information.

According to a Directive from the Ministry of Health and Care Services, DSA has a responsibility to disseminate updated knowledge to relevant authorities and the public. DSA has established a communication strategy, which relates to communications with relevant ministries and governmental agencies/authorities, as well as counties and municipalities. This strategy also commits DSA to taking an active role in communicating its regulatory practices with licensees, registrants and other stakeholders.

DSA aims to be a transparent and credible authority, by actively communicating knowledge within its field of expertise to target groups in an understandable and consistent manner. DSA communicates new knowledge to all affected audiences through the strategic use of communication channels, including maintaining a proactive dialogue with the media. As part of its communication strategy, reports and information of interest to the pubic are published on DSA's webpages, including documents relevant to decision-making processes. In addition, DSA publishes press briefings and news, including information concerning incidents, accidents and abnormal events. Inspection reports are also published on the webpage.

Mechanisms and legal provisions are therefore in place for DSA to inform and consult interested parties and the public about the possible radiation risks associated with facilities and activities, and about the processes and decisions of the regulatory body. The Freedom of Information Act provides an additional mechanism for ensuring the public access to information held by public authorities.

L. Annexes

L.1. References to National Laws, Regulations, Requirements, Guides etc.

Nuclear Energy Activities Act of 12 May 1972 No. 28 (Nuclear Energy Act):

- → Regulation of 2 November 1984 on the Physical Protection of Nuclear Material (as amended 20 December 2018).
- → Regulation of 15 November 1985 on Exemption from the Act on Atomic Energy Activity for Small Amounts of Nuclear Material.
- → Regulation of 12 May 2000 on Possession, Transfer and Transportation of Nuclear Material and Dual-use Equipment.
- → Regulation of 14 December 2001 on Economical Compensation after Nuclear Accidents

Radiation Protection and Use of Radiation Act of 12 May 2000 No. 36 (Radiation Protection Act):

- → Regulation on Radiation Protection and Use of Radiation of 16 December 2016 .

Pollution Protection and Waste Act of 13 March 1981 (Pollution Control Act);

- → Regulation of 1 November 2010 on the Application of the Pollution Control Act to Radioactive Pollution and Radioactive Waste
- → Regulation of 1 June 2004 on the Recycling and Management of Waste (Waste Regulation)
- → Regulation of 1 June 2004 on Pollution Control

Norwegian Radiation Protection Authority, Implementation of the Obligations of the Convention on Nuclear Safety in Norway (Report 2018).

Norwegian Radiation Protection Authority, Norwegian work on establishing a combined storage and disposal facility for low and intermediate level waste (Report 1995:10), IAEA-WATRP review team, (1995).

Report of the Integrated Regulatory Review Service (IRRS) Mission to Kingdom of Norway (2019) (https://www.iaea.org/sites/default/files/documents/review-missions/irrs_norway_2019.pdf)

Norwegian Nuclear Decommissioning, Draft Decommissioning Strategy: Integrated Strategy for Decommissioning the Nuclear Facilities at Halden and Kjeller (2019) (in Norwegian) https://www.norskdekommisjonering.no/wp-content/uploads/2019/12/Dekommisjoneringsstrategi.pdf

Norwegian Nuclear Decommissioning, Draft Waste Strategy (2019) (in Norwegian) https://www.norskdekommisjonering.no/wp-content/uploads/2019/12/Avfallsstrategi.pdf

NOU 2001:30 (Official Norwegian Report), Evaluation of strategies for final disposal of high level reactor fuel (2001) (in Norwegian).

Technical Committee on Storage and Disposal of Metallic Uranium Fuel and Al-clad Fuels, Recommendations for the Conditioning of Spent Metallic Uranium Fuel and Aluminium Clad fuel for Interim Storage and Disposal (2010) (in English) (http://www.regjeringen.no/upload/NHD/Vedlegg/rapporter_2010/tekniskutvalgsrapport2010.pdf).

NOU 2011:2 (Official Norwegian Report) Interim storage solution for spent nuclear fuel and long-lived intermediate level waste (2011) (in Norwegian)
http://www.regjeringen.no/pages/15663778/PDFS/NOU201120110002000DDDPDFS.pdf

KVU1: The future decommissioning of the nuclear reactors in Norway (2015) (in Norwegian) (https://www.regjeringen.no/contentassets/9ed6b7a312ea48c6a2b6705d1fcd82c3/kvu-dekommisjonering-rapport-og-vedlegg-5-11.pdf).

KVU2: The handling of Norwegian Spent Fuel and other Radioactive Waste (2015) (in Norwegian) (https://www.regjeringen.no/no/dokumenter/oppbevaring-av-norsk-radioaktivt-avfall/id2365157/).

KS1 Quality assurance of the future decommissioning of the nuclear reactors in Norway (2016) (in Norwegian) (https://www.regjeringen.no/contentassets/73601c56109e4bcf9a2dab33df2c0a90/rapport-ks1-fremtidig-dekommisjonering-av-de-nukleare-anleggene-i-norge.pdf)

KS1 Quality assurance of the handling of Norwegian spent nuclear fuel and other radioactive waste (2016) (in Norwegian) (https://www.regjeringen.no/contentassets/3184f416f1ec443083d69e7a8e711706/rapport-ks1-oppbevaring-av-norsk-radioaktivt-avfall.pdf).

KVU Step 2: Future decommissioning of IFE's nuclear facilities (2019) (in Norwegian) (https://www.norskdekommisjonering.no/wp-content/uploads/2020/05/KVU-trinn-2-Fremtidig-dekommisjonering-av-IFEs-nukleære-anlegg.pdf)

KS1 Quality assurance of KVU Step 2: Future decommissioning of IFE's nuclear facilities (2020) (in Norwegian) (https://www.norskdekommisjonering.no/wp-content/uploads/2020/05/KS1-Fremtidig-dekommisjonering-av-IFEs-nukleære-anlegg-offentlig.pdf)

Limited concept investigation on the handling of Norwegian spent reactor fuel (2020) (in Norwegian) (https://www.norskdekommisjonering.no/wp-content/uploads/2020/06/Begrenset-konseptvalgutredning-om-behandling-av-norsk-brukt-reaktorbrensel.pdf)

L.2. Overview Matrix

Type of Liability	Long-Term Management Policy	Funding of Liabilities	Current Practice / Facilities	Planned Facilities
Spent Fuel	Regarded as radioactive waste. Ongoing assessment of alternative options, including treatment options. New facility needed for disposal.	Government / operator. New governmental organization (NND) will take over responsibility.	Storage at reactor sites (Kjeller and Halden).	New and improved storage capacity needed at both sites. Options (including centralized storage at Kjeller) being considered.
Nuclear Fuel Cycle Wastes	Disposal of LILW at KLDRA Himdalen, subsequently at extended KLDRA or new facility. New facility needed for disposal of higher activity waste.	Government / operator. New governmental organization (NND) will take over responsibility.	Disposal at KLDRA Himdelan or storage at Kjeller or KLDRA.	Needed but not yet planned: • New or extended KLDRA (plans on hold). • New disposal facility for spent fuel and/or higher activity waste.
Application Wastes	Disposal of LILW at KLDRA Himdalen, subsequently at extended KLDRA or new facility.	Government, and fees from users.	Disposal at KLDRA Himdalen.	New or extended KLDRA needed (plans on hold).
Decommissioning	Strategy under development. Current plans based on achieving unrestricted use of sites.	Government / operator. New governmental organization (NND) will take over responsibility.	Reactors permanently shut down. Final plans for decommissioning being developed.	New or extended KLDRA needed (plans on hold).
Disused Sealed Sources	Return to manufacturer, or Disposal in KLDRA Himdalen or new facility for higher activities.	Fees from users / governmental	Return to manufacturer, disposal at KLDRA Himdalen or storage at Kjeller.	Needed but not yet planned: • New or extended KLDRA (plans on hold). • New disposal facility for spent fuel and/or higher activity waste.
NORM Wastes	Disposal at licensed repositories.	Operator	Disposal at Gulen and three other facilities accepting alum shale.	None.

L.3. General Licence Conditions (GLCs) Included in Licence for IFE Kjeller, and Intended for Inclusion in other Licences under Nuclear Energy Act

Interpretation: This document sets out the conditions used by the Norwegian Radiation and Nuclear Safety Authority (DSA) in forming its recommendations to the Norwegian Government regarding the issue of licences to own and operate nuclear facilities in accordance with the Nuclear Energy Activities Act.

There are 25 conditions, listed below. Each condition is set out thereafter.

1 Control of the Site

1.1 The licensee shall make and implement adequate arrangements to control all property transactions affecting the licensed site to ensure that the licensee remains in overall control of the site.

1.2 The licensee shall mark the boundaries of the licensed site by fences, or other appropriate means, and shall ensure that all such boundaries are properly maintained.

1.3 The licensee shall make and implement adequate arrangements to prevent unauthorized persons from entering the licensed site.

2 Documents and Records

2.1 The licensee shall make adequate arrangements to demonstrate compliance with any of the conditions attached to this licence. All documentation relevant to the issuing of a licence shall be recorded and preserved by the licensee for the lifetime of the installation or activity, and for any specified period beyond such lifetime, that DSA may specify.

2.2 If so directed by DSA, the licensee shall submit any written arrangements made in support of any licence condition to DSA as DSA may specify.

3 Insurance / Guarantee

3.1 The licensee shall maintain the necessary insurance arrangements or other securities, cf. Nuclear Energy Activities Act, § 11 No. 2, letter © and §§ 35 and 37.

4 Restrictions on Nuclear Material, Radioactive Material and Radioactive Waste

4.1 The licensee shall ensure that no nuclear material or radioactive material (including such material which has been declared as waste) is brought onto the licenced facility except in accordance with adequate arrangements made by the licensee for this purpose.

4.2 The licensee shall not consign nuclear material or radioactive material (other than radioactive waste) to any place in Norway other than an approved site except with the written agreement of DSA.

4.3 The licensee shall keep a record of all nuclear material, radioactive material and radioactive waste consigned from the licenced facility detailing the amount, type and form of such nuclear material, the manner in which it was packed, the name and address of the person to whom it was consigned and the date when it left the licenced facility.

4.4 The licensee shall ensure that the previously mentioned record is preserved in accordance with condition 2.1.

5 Resources

5.1 The licensee shall provide and maintain adequate financial and human resources to ensure the safe operation of the licensed facility.

5.2 The licensee shall make and implement adequate arrangements to control any change to its organizational structure or resources that may affect safety.

5.3 These arrangements shall provide for the classification of changes to the organizational structure or resources according to their safety significance.

5.4 The licensee shall at all times have sufficient personnel in possession of adequate expertise at all levels of the organization.

5.5 The management of the licensee shall encourage and work to foster and maintain a healthy safety culture.

6 Safety Analysis Report (SAR)

6.1 The licensee shall conduct and maintain safety analyses that use a graded approach of appropriate detail for the complexity of the facility or process analysed.

6.2 The safety analyses, and changes to the safety analyses, shall be reviewed and subject to approval by DSA.

7 Incidents on the Site

7.1 The licensee shall make and implement adequate arrangements for the notification, recording, investigation and reporting of unplanned situations or events occurring on the site.

8 Occupational Health and Safety Programme

8.1 The licensee shall implement and maintain an occupational health and safety program for the site.

9 Decommissioning

9.1 The licensee shall maintain a comprehensive decommissioning plan for the site, and shall review and revise the plan at such times as the DSA may require and in any event, no later than 5 years from the previous revision.

10 Safety Committee

10.1 The licensee shall maintain a safety committee with an established mandate and procedures approved by the DSA.

11 Training

11.1 The licensee shall establish and maintain an overall training policy and initial and continuing training programs on the basis of long-term qualifications and competencies required for performing all jobs, and training goals that acknowledge the critical role of safety.

12 Radiological Protection (RP) Programme

12.1 The licensee shall implement and maintain an adequate radiological protection programme at the site.

13 Radioactive Waste and Spent Fuel Management

13.1 The licensee shall implement and maintain an adequate waste management program documenting handling, processing, transportation, storage and safeguarding of radioactive wastes, including spent fuel and nuclear material that is declared as waste, mixed with any other hazardous substance.

14 Emergency Planning

14.1 The licensee shall implement and maintain adequate Emergency Planning to prepare for and respond to emergency events, including fires, initiating at or affecting the licensed site, and for dealing with both the on-site and off-site effects of such emergencies.

15 Management System

15.1 The licensee shall implement and maintain an adequate management system, including a written safety policy that places safety paramount within the management system, overriding all other demands, for activities carried out under this licence.

16 New Nuclear Facilities

16.1 The licensee shall only carry out construction and/or operation activities of any new nuclear facility at site with the prior approval of the DSA.

17 Safety of Operations

17.1 The licensee shall, in respect of any operation that may affect safety, ensure that safety analyses identify the conditions and limits necessary in the interests of safety.

17.2 The licensee shall ensure that all operations, which may affect safety, including those, which ensure that any conditions, and limits necessary in the interests of safety are met, are implemented.

17.3 Operating procedures should be periodically reviewed and updated in accordance with predetermined process and known to operating personnel. The appropriate operating procedures should be prepared, reviewed and approved prior to the start of any new activities.

17.4 The licensee shall ensure that adequate records are made of the operation, inspection and maintenance of any facility, which may affect safety. These shall include records of the amount and location of all radioactive material, including nuclear fuel and radioactive waste, used, processed, stored or accumulated at the licensed facility at any time.

17.5 The licensee shall ensure that no operations are carried out which may affect safety except under the control and supervision of suitably qualified and experienced persons appointed for that purpose by the licensee.

18 Design and Safety Classification

18.1 The licensee shall identify all items important to safety and classify them based on their safety function and their safety significance.

18.2 The licensee shall ensure that a plant equipment is not operated, inspected, maintained or tested unless suitable and sufficient safety mechanisms, devices and circuits are safely connected and in good working order.

18.3 The licensee shall ensure that all structures, systems and components important to safety shall be designed to be calibrated, tested, maintained, repaired or replaced, inspected and monitored as required to ensure their capability of performing their functions and to maintain their integrity in all conditions specified in their design basis.

18.4 The licensee shall adopt the single failure criteria approach. No single failure of a component can result in loss of capability of a system to perform its safety function.

18.5 The licensee shall ensure that design features include automatic initiation of the protection system to ensure safe operations for the full range of postulated initiating events.

18.6 The licensee shall ensure that all structures, systems and components operate within with specified safety limits and safety margins during all operational states.

19 Maintenance

19.1 The licensee shall make and implement adequate arrangements for the regular and systematic examination, inspection, maintenance and testing of all plant equipment which may affect safety. These arrangements shall provide for the preparation of a maintenance schedule for each relevant component. The licensee shall submit all or part of this maintenance schedule to DSA for approval as DSA as may specify.

19.2 The licensee shall ensure, in the interests of safety, that every examination, inspection, maintenance and test of any plant equipment or any part thereof is carried out:

(a) by suitably qualified and experienced persons;

(b) in accordance with schemes laid down in written procedures;

© within the intervals specified in the maintenance schedule; and

(d) under the control and supervision of a suitably qualified and experienced person appointed by the licensee for that purpose.

19.3 DSA may agree to an extension of any interval specified in the maintenance schedule.

19.4 The preventive maintenance programme shall cover all structures, systems and components important to licensed facility safety.

19.5 The licensee shall provide written procedures for examination, inspection, maintenance and testing based on the safety analysis and manufacturer's recommendations.

19.6 The licensee shall ensure that all measuring and test equipment used has been properly calibrated, subject to controlled use and tagged/removed from service when out of tolerance.

19.7 The licensee shall ensure that a full and accurate report of every examination, inspection, maintenance or test of any part of plant equipment, dated and signed by the appointed suitably qualified and experienced person, is made to DSA immediately on completion.

19.8 The licensee shall carry out such tests, inspections and examinations in connection with any plant equipment (in addition to any carried out under the maintenance schedule) as DSA may specify after consultation with the licensee.

20 Configuration Management Programme

20.1 The licensee shall make and implement adequate arrangements to control any modification, temporary modification or experiment carried out on any part of the existing facility or processes that may affect safety.

20.2 These arrangements shall provide for the classification of modifications, temporary modifications or experiments according to their safety significance. The arrangements shall, where appropriate, divide the modification, temporary modification or experiment into stages. Where DSA so specifies, the licensee shall not commence or proceed from one stage to the next without the documented agreement of DSA.

21 Shutdown or Cessation of Operations

21.1 When necessary, for the purpose of enabling any examination, inspection, maintenance or testing of any plant equipment or process to take place, the licensee shall ensure that any such plant equipment or process shall be shut down or cease operation in accordance with the requirements of its maintenance schedule unless DSA has agreed in advance to an extension of its operating period.

21.2 The licensee shall, if so specified by DSA, ensure that when any plant equipment or process is shutdown in accordance with the above condition it shall not be started up again without the agreement of DSA.

21.3 The licensee shall, if so directed by DSA, shut down or cease operation of any plant equipment or process on the licensed facility within such period as DSA may specify and then shall not start it again without the agreement of DSA.

22 Periodic Safety Review

22.1 The licensee shall, as necessary or at intervals to be specified by the DSA, carry out a safety review of compliance monitoring and operational performance to confirm that the nuclear installation remains fit to continue operation.

22.2 The licensee shall submit reports of these safety reviews to DSA.

23 Nuclear Material Accountancy and Safeguards

23.1 The licensee shall implement adequate arrangements for nuclear material accountancy and safeguards.

23.2 The licensee shall submit such parts of the arrangements to DSA as DSA may specify.

24 Nuclear Security

24.1 The licensee shall implement adequate arrangements for ensuring the security of nuclear material, radioactive material and radioactive waste on the licensed site.

24.2 The licensee shall submit such parts of the arrangements to DSA as DSA may specify.

25 Commissioning

25.1 The licensee shall make and implement adequate arrangements for the commissioning of any plant or process which may affect safety.

L.4. Abbreviations

DSA	Direktoratet for strålevern og atomsikkerhet (Norwegian Radiation and Nuclear Safety Authority)
GLC	General Licence Condition
HBWR	Halden boiling water reactor
IFE	Institutt for energiteknikk (Institute for Energy Technology)
INSARR	Integrated Safety Assessment of Research Rectors
IRRS	Integrated Regulatory Review Service
ISCA	Independent Safety Culture Assessment
JEEP	Joint Establishment Experimental Pile
KLDRA	Kombinert lager og deponi for lav- og middels radioaktivt avfall (Combined Storage and Disposal Facility for Low and Intermediate Level Radioactive Waste)
KS1	Kvalitetssikring av konseptvalg (Quality assurance of concept selection)
KVU	Konseptvalgutredning (Concept evaluation study)
LILW	Low and intermediate level radioactive waste
NND	Norsk nukleær dekommisjonering (Norwegian Nuclear Decommissioning)
NOK	Norwegian krone
NORA	Norwegian Zero-effect Reactor Assembly
NORM	Naturally occurring radioactive material
NRPA	Norwegian Radiation Protection Authority (now DSA)
OLCs	Operational limits and conditions
PIE	Post-irradiation examination
ROS analyse	Risiko- og sårbarshetsanalyse (risk and vulnerability analysis)
SAR	Safety analysis report
Statsbygg	Directorate for Public Construction and Property

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DSA
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