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Radiation and Nuclear Safety Authority
STUK

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Executive summary

This is the Finnish National Report, in accordance with the provisions of Article 14 of the European Council Directive (2011/70/EURATOM). The fulfilment of the obligations of the Directive and the developments within waste management are assessed in this report. It describes the waste management facilities and practices in Finland and presents the recent developments.

The Finnish regulatory framework for radioactive waste and spent fuel management fulfils the requirements of the European Council directive (2011/70/EURATOM) as well as the oblig-ations of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

Radioactive waste management is regulated in Finland with two Acts, based on the origin of the radioactive waste. The waste produced in connection with the use of nuclear energy is covered by the Nuclear Energy Act and Decree and subsequent STUK regulations, whereas the radioactive waste produced in connection with the use of radiation in industry, medicine, science and with practices involving naturally occurring radioactive material (NORM) are covered by the Radiation Act and subsequent Decree and regulations.

In Finland, the producer of nuclear waste is responsible for the implementation and expenses of the pertinent waste management and decommissioning activities, including the related planning, research and development work. Respectively, the user of radioactive substances shall render harmless the radioactive waste arising from the operations in question, including those involved with natural radioactive substances.

The Nuclear Energy Act states that nuclear waste generated in Finland with minor exceptions shall be treated, stored and permanently disposed of in Finland. Nuclear waste generated elsewhere shall not be handled, stored or permanently disposed of in Finland. The preferable management option for disused sealed sources is to return them to the supplier/manufacturer. Disused radiation sources that were not manufactured in Finland may not be imported to Finland as radioactive waste.

Apart from some old mill tailings containing NORM, it is to be noted that Finland has no legacy radioactive waste, and has not had any such activities where such waste would have been generated.

As spent nuclear fuel is defined in the Finnish legislation as nuclear waste, the nuclear power plants (NPPs) at Loviisa and Olkiluoto are the main generators of nuclear waste. Fortum Power and Heat Oy (FPH) operates two VVER units at the Loviisa site and Teollisuuden Voima Oyj (TVO) two BWR units at Olkiluoto. The Loviisa units 1 and 2 were commissioned in 1977 and 1981, and the Olkiluoto units 1 and 2 (OL1-OL2) in 1978 and 1980, respectively. In addition, a new nuclear power plant unit is under commissioning phase at the Olkiluoto site (Olkiluoto 3). At the Olkiluoto and Loviisa sites there are interim storages for spent fuel as well as disposal facilities for low and intermediate level nuclear wastes. Furthermore, a Triga Mark II research reactor has been operated in Espoo by VTT Technical Research Centre of Finland Ltd (VTT). However, in 2012 VTT decided to start planning of the decommissioning and eventual shut-down of the research reactor, due to economical reasons. The permanent shut-

down took place on June 30th, 2015. Furthermore VTT has submitted a licence application for decommissioning in June 2017. According to the VTT time schedule, the decommissioning will start in 2019 and lasts for two years. The time schedule may change due to open issues in waste management and the safety assessment review process.

In addition to the existing facilities there is a prospecting nuclear utility company, Fennovoima Oy, which is planning to build a 1200 MW NPP to Pyhäjoki municipality. In addition to the NPP there will be LILW disposal facility and spent fuel interim storage at the NPP-site.

The four Finnish NPP units have operated safely with high capacity factors and generated spent fuel accordingly. The generation of low and intermediate level nuclear waste (LILW) has been kept low. Activities and programmes related to waste management have continued in accordance with the national strategy, milestones and timetable. The NPP operating licencees including Posiva Oy, in charge of executing in Olkiluoto the final disposal of spent nuclear fuel generated at Olkiluoto and Loviisa NPPs have shown good safety performance and safety management practices in carrying out their responsibilities in spent fuel and radioactive waste management.

The main focus of activities during the last two years has been the spent nuclear fuel disposal project. The construction licence application including the safety documentation for the spent nuclear fuel encapsulation and disposal facilities was submitted to the authorities at the end of 2012. The Government granted the construction licence for Posiva in November 2015. The Finnish Radiation and Nuclear safety Authority (STUK) has reviewed Posiva's application and given its statement to the Ministry of Economic Affairs and Employment (MEAE) in February 2015. Posiva Oy is aiming to start disposal operations in 2024.

Non nuclear radioactive waste is generated in industry, healtcare and research facilities mainly from disused sealed sources. The pretreatment management is mainly done by Suomen nukliditekniikka oy, which is a specialized private company. The first batch of radioactive waste has been disposed during 2016 in TVO's disposal facility in Olkiluoto.

The recent highlights in Finland have been as follows:

Spent nuclear fuel disposal project has progressed as planned

- At the end of 2012 Posiva submitted the construction licence application for a geological disposal facility and encapsulation plant and its supporting safety documentation to the authorities. MEAE started the licensing process and STUK started the safety review and assessment in the beginning of 2013. Government granted the construction licence for the spent fuel disposal facility in November 2015. After the granting of the construction licence Posiva has started the excavations of the underground disposal facility. Simultaneously Posiva has started the construction works above ground for the encapsulation plant, by performing foundation excavations.

- Regulatory oversight procedures were established for ONKALO (underground rock characterisation facility, which will be part of the disposal facility) and continues to

be developed to encounter the new phases of the disposal project. The latest development in spent fuel disposal oversight has been the introduction of Guide YVL D.7, the regulatory guide for the release barriers in the spent fuel disposal in March 2018.

- The planned Posiva disposal facility currently covers spent fuel from the four reactors in operation and from the one under commissioning (Olkiluoto 3). As Fennovoima Oy is not an owner of Posiva, the plans of Posiva do not cover disposal of spent fuel from Fennovoima's future NPP unit. Fennovoima submitted an EIA-program for its own spent fuel disposal facility in June 2016 along with technical co-operation agreement with Posiva Solutions Oy, a wholly owned subsidiary of Posiva. The aim of the EIA-program of Fennovoima is to select the disposal site in the 2040's.

Management of radioactive waste has been improved

- A revised licence to operate the Olkiluoto LILW disposal facility, granted in 2012, allows the disposal of low and intermediate level operational waste from Olkiluoto 3 in addition to the wastes from existing Olkiluoto 1 and 2 NPP units as well as max 100 m^3 of the radioactive waste that the Government is responsible to take care of. The application contained an updated safety assessment of the facility and safety assessment regarding the radioactive waste that the Government is responsible for.

- The First batch of radioactive waste for which Government is responsible to take core of (later referred as institutional radioactive waste) was disposed in Olkiluoto LILW disposal facility in 2016.

- In the Loviisa NPP the solidification plant was authorized for full operation in 2016.

- MEAE has established a working group to discuss the current challenges in the waste management field. The identified challenges are the decommissioning of the FiR 1 research reactor and the disposal of the nuclear wastes arising from FiR 1 as well as the disposal of radioactive materials (LILW waste) from the adjacent research laboratory of VTT. Furthermore, the challenges of the Finnish radioactive waste management include the disposal of the non-nuclear high activity sealed sources, the disposal of radioactive wastes from non-nuclear facility decommissioning and other radioactive waste. The working group will give development action recommendations for ministries as well as for the nuclear utility companies and Posiva to execute.

- No spent fuel nor radioactive waste accidents in the Finnish NPPs have been reported during the last four years. However, one incident regarding spent fuel handling was reported from Loviisa NPP. During a scheduled maintenance outage a hermetically sealed fuel bottle was dropped over the reactor during fuel loading,

after the fuel bundle got entangled to the bottle. The incident did not cause damages to the fuel bundle.

The regulatory system has been strengthened

STUK has continued to increase its resources and activities in response to the expanding operations for Posiva's construction phase and in preparation for Posiva's operating licence application.

- The Finnish nuclear and radiation safety legislation and regulatory guidance were developed further. EU directives were adopted and international guidance, such as IAEA safety standards and WENRA recommendations were taken into account in the revision of nuclear safety and radiation protection legislation:
  - The Nuclear Energy Act was revised and amended in 2011 (Council Directive 2009/71/Euratom), in 2012 (inspection organizations included), and in 2013 (Council Directive 2011/70/Euratom), in 2017 (Council directive 2014/87/Euratom) and the decommissioning licence was added.
  - The Radiation Act and Decree were revised in 2013 (Council Directive 2011/70/Euratom and for conformance with the European Community Radiation Protection Legislation).
  - The Council Directive 2013/59/Euratom of 5 December 2013 will be implemented in the new Radiation Act and in amended Nuclear Energy Act. The new Radiation Act is likely into come in force during 2018.
  - Detailed safety requirements on the management of spent nuclear fuel and other nuclear waste resulting from the production of nuclear energy are provided in STUK's regulatory guides, the YVL Guides. To take into account the recent developments in the Nuclear energy legislation and introduction of STUK requirements, the YVL-guides are under revision, and new versions are scheduled to be released during 2018.
  - Detailed safety requirements on the management of radioactive waste, subject to the Radiation Act, are provided in STUK's ST Guides. They have been updated in accordance with the changes in the respective legislation.
- In 2012, the Finnish regulatory framework for nuclear and radiation safety was reviewed in the IRRS (Integrated Regulatory Review Service) peer review process. According to the IRRS recommendations, some amendments need to be considered for the legislation mainly concerning the independence of STUK. The amendments to the Nuclear Energy Act and the Radiation Act came into force in January 1st 2016. The follow up IRRS took place in June 2015. The next IRRS combined with ARTEMIS review is planned for 2022.

Technical support and competence have been developed

- Competence management, especially taking into account the retirement of large post-war age groups, has been a concern also in Finland. During 2010–2012, MEAE set up a committee to report on the availability of competence and resources in the nuclear energy sector. One of the recommendations was that the future needs and focus areas of the Finnish nuclear energy sector must be accurately defined and a long-term strategy drawn up for research activities. One of the conclusions was also that there is a challenge in maintaining continuity of knowledge and also in attracting new competent personnel. Investments in research and the availability of high-standard education and training are crucial. At the end of January 2013 MEAE set up a working group to prepare a research and development strategy. During 2017 the report was updated to respond to the changed circumstances.

- International cooperation and transparency are the cornerstones of the development of the national solutions for spent fuel and radioactive waste safety in Finland. In addition to active participation in international and bilateral forums (IAEA, EU, WENRA, OECD/NEA), also foreign consultants continued to participate both in regulatory reviews and Posiva's development work.

Challenges for future work

- The planning and preparation for the construction and for the commissioning phase pose new situations both for Posiva and for STUK. Posiva and STUK invest in their processes and resources to ensure that all safety related regulatory and implementation tasks can ensure high level of safety and can be performed without undue delay

- Spent fuel of the research reactor FiR 1 is stored on site. VTT has decided to enter into permanent shut-down and decommission FiR 1 due to insufficient funding for continued operation. VTT has prepared the EIA report during 2014 and has applied operating licence for the research reactor decommissioning in June 2017. The primary solution for spent fuel management is to return the fuel to the United States. VTT and US DOE are currently negotiating the contract under the present fuel return programme.

- LILW generated from the operation of the research reactor FiR 1 is stored at the reactor facility until decommissioning. VTT is negotiating with the Finnish NPP licencees (TVO and FPH) for possible interim storage and for the future disposal of VTT's decommissioning waste. In the licence application (submitted in June 2017) VTT has presented several options for the nuclear waste management.

- Communication has been and will continue to be an increasingly important success factor for STUK, Posiva, and the nuclear utility operators. The interest in radiation and nuclear safety topics will continue to increase. The media, including the social media, plays an important role in communication.

- While most radioactive waste streams have a disposal solution, a small quantity of the institutional radioactive waste – consisting of some nuclear material and a few high activity sources – cannot be disposed of in the Olkiluoto LILW disposal facility

due to limitations in the operating licence. The issue is being discussed in the MEAE working group.

- New mining projects, especially Terrafame's uranium extraction plans, will create new challenges to NORM waste management regulations and practices. Further development is needed to fulfil current and possible future demands.

Conclusion

In conclusion, based on the information presented in the report, Finland complies with the obligations and objectives of the European Council Directive (2011/70/EURATOM). Challenges for the future are recognized, regularly reviewed and addressed. The required efforts for continuous improvement are made.

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1 Introduction

National Nuclear and Other Radioactive Waste Management Policy in Finland

Responsibilities

The producer of nuclear waste is responsible for the implementation and expenses of the pertinent waste management and decommissioning activities, including the related planning, research and development work.

The user of radioactive substances shall render harmless the radioactive waste arising from operations in question, including those involved with natural radioactive substances.

The State has the secondary responsibility in case the producer of nuclear or radioactive waste is not capable of fulfilling its management obligation.

Waste management and decommissioning principles

The Nuclear Energy Act states that nuclear waste generated in Finland with some exceptions shall be treated, stored and permanently disposed of in Finland. Nuclear waste generated elsewhere shall not be handled, stored or permanently disposed of in Finland.

The amount of generated nuclear waste shall be minimized whenever practical. The waste generation can be reduced i.e. by proper planning of repair and maintenance and by means of decontamination, clearance and volume reduction practices.

Spent fuel management is based on once trough principle with direct disposal.

Means to reduce the amounts of nuclear waste arising from the decommissioning shall be considered already in the design of a nuclear facility. Decommissioning plans shall be regularly updated during the operation of the facility. Implementation of decommissioning shall not be unjustifiably postponed.

The amount of radioactive waste arising from the uses of radioactive sources or from other radiation practices shall be as low as practicable, however, without jeopardizing the general principles of radiation protection including optimization. The preferable management option for disused sealed sources is to return them to the supplier/manufacturer. It is prohibited to import disused sources to Finland for the purpose of disposal.

Safety principles and control

Safety of nuclear and other radioactive waste management facilities shall be kept as high as reasonably achievable (the SAHARA principle) and all actions justified by safety research and the progress in science and technology shall be taken into account to enhance safety. Nuclear and other radioactive waste shall be managed and disposed of so that the radiation impact is as low as reasonably achievable (the ALARA principle) and so that no radiation impact exceeding the currently acceptable level will occur in the future and ensuring that the long-term safety is based on passive safety functions.

The Ministry of Economic Affairs and Employment (MEAE) determines the principles on the basis of which the nuclear waste management obligation is to be implemented. Licencees are responsible to demonstrate the safety of the nuclear facilities. STUK is responsible for regulatory oversight of facilities and activities. The Decision in Principle and the construction, operating and decommissioning licences for nuclear waste management facilities are prepared by MEAE and granted by the Government.

Nuclear and Other Radioactive Waste Management Policy and Strategy in Finland

The history of waste management strategy is described in the national programme, giving the basis on which the political and policy decisions were made, leading to the current legislation where all the requirements of Article 4 have been adopted.

Legislation
The main regulations in the field of radioactive waste management are the Nuclear Energy Act (990/1987) and Decree (161/1988), the Radiation Act (592/1991) and Decree (1512/1991), the Government Decrees, the Decisions of the Government and STUK Regulations as well as the Regulatory Guides (YVL Guides and ST Guides) issued by the Radiation and Nuclear Safety Authority (STUK). The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management has been signed by Finland in 1997 and it entered into force in 2001. The Finnish regulatory framework fulfils both the obligations of the Joint Convention and the requirements of the European Council directive (2011/70/Euratom).

Responsibilities of licencees
The producer of nuclear waste is responsible for the implementation and expenses of the pertinent waste management and decommissioning activities, including the related planning, research and development work.

Current and future producers of nuclear waste (the NPP utility operators Teollisuuden Voima Oyj (TVO), Fortum Power and Heat Oy (FPH) and Fennovoima (FV) as well as research reactor operator VTT Technical Research Centre of Finland Ltd (VTT)) take care or will take care of interim storage of spent fuel, of conditioning, storage, and disposal of low and intermediate level waste and of planning for and implementation of the decommissioning of the NPPs.

Regarding the spent fuel management, a joint company Posiva, owned by FPH and TVO, taking care of the preparations for, and later the implementation of its owners' spent fuel disposal. FV will be responsible for its own spent fuel disposal.

VTT Technical Research Center of Finland Ltd, as an operator of the research reactor FiR 1, is responsible for the planning and implementation of the spent fuel and LILW management and decommissioning of the facility, including the agreements for the disposal of the arising waste.

Producers of other radioactive waste are required to manage their waste within the limits of their technical capability while ensuring safety and security. Radioactive waste from small users (institutional waste) that cannot be exempted, including spent sealed sources that cannot be returned to the manufacturer, must be handed over to a

recognized installation licenced to receive, condition, and transfer radioactive waste to the national central storage operated by STUK.

Waste management and decommissioning objectives
Such low and intermediate level nuclear waste that meets the acceptance criteria for the LILW disposal facilities at the NPP sites has to be disposed of without unnecessary delays. Waste that cannot yet be disposed of is stored safely, e.g. liquid waste that is not yet conditioned. Also other low and intermediate level waste, such as decommissioning waste and small user waste, is envisaged to be disposed of in the rock cavern repositories at the NPP sites.

The geological disposal of TVO's and FPH's spent fuel is under preparation in accordance with a strategic plan, which is in line with the 1983 Government Policy Decision and the 2003 Decision of the Ministry of Trade and Industry (the predecessor of the MEAE). The goal for starting the disposal operations is approximately the year 2024. Posiva was granted a construction licence for the spent fuel disposal facility in the end of 2015. During the construction period, regulatory oversight will be executed in similar manners as with other nuclear facilities. Posiva's objective is to submit the operating licence application in 2021.

The prospective nuclear utility Fennovoima Oy started Environmental Impact Assessment (EIA) process for the spent fuel disposal in June 2016 by submitting EIA Programme for a spent nuclear fuel disposal facility of its own as required in the Decision in Principle for the NPP of Fennovoima. In the EIA programme Fennovoima presented two possible locations for the disposal facility, Eurajoki and Sydänneva-area in the municipality of Pyhäjoki. The location of the Eurajoki research area will be specified earliest after the NPP construction licence is granted and at the latest at the time of NPP operational licence.

The implementation of decommissioning of the NPPs will be optimized taking into account the technical aspects, radiological impact, future use of the site, availability of competent workforce and the costs. The strategy takes advantage of options for clearance of very low level waste and structures of the plant and of the on-site disposal of decommissioning waste.

In the cases of other uses of radiation, the accumulation of waste needing to be transferred to the national central storage is minimized by e.g. preferring the returning of disused sealed sources to their manufacturer abroad and allowing the storage of short lived radioactive waste at the licencees' premises for the purpose of aging them below the limits set for releasing them from the regulatory control. The disposal of the radioactive wastes transferred to the national central storage is taking place as part of the operations of the Olkiluoto LILW disposal facility (within the limitations of the operating licence).

Waste minimization and recycling shall be the preferred waste management methods when ever reasonably practical. For the clearance procedure the nuclide specific limits are set in the YVL- and ST-guides, and in the future STUK regulation which will be based on BSS-directive. However, the dilution of waste with the intention to free release is generally forbidden

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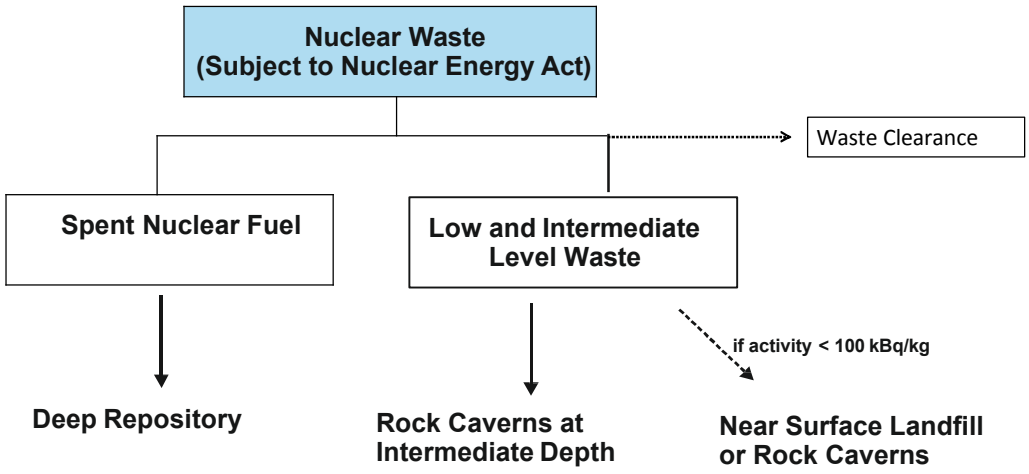
Financial liability system
The producer of nuclear waste is liable for the implementation and expenses of the pertinent nuclear waste management and decommissioning activities, including the related planning, research and development work.

Also under the Radiation Act the costs incurred when rendering radioactive waste harmless shall be borne by the waste generator.

Radioactive waste: legislation and management implementation

In the Finnish legislation, radioactive waste is divided into two categories based on the way it is generated, and respectively, it is addressed either by the Nuclear Energy Act and related Decrees, or by the Radiation Act or related Decrees. See Fig. 1.



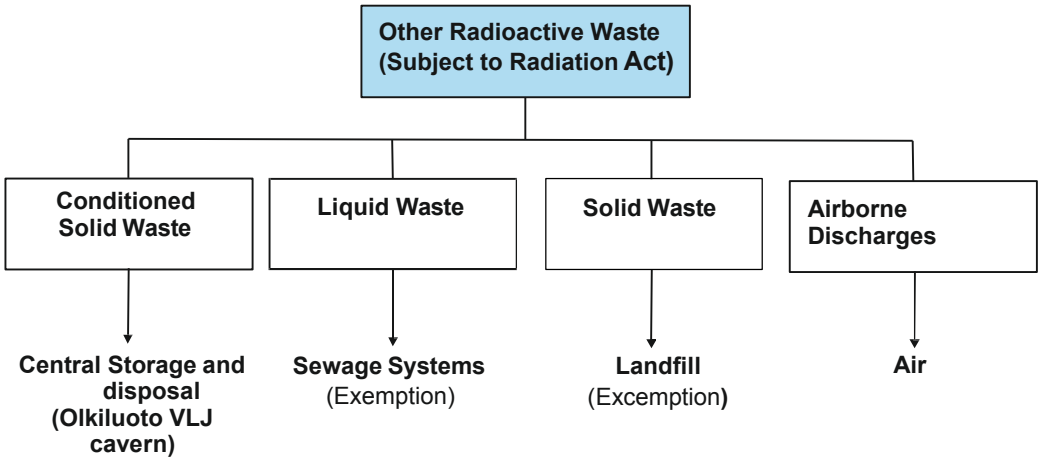


Fig. 1. Radioactive waste and the pertinent practices for its management and disposal that conform to the stipulation in the Finnish legislation

Nuclear waste, regulated by the nuclear energy legislation framework, is defined as radioactive waste in the form of spent fuel or in some other form, generated in connection with/or as a result from the use of nuclear energy. According to the Nuclear Energy Act a licencee whose operation generates or has generated nuclear waste, is responsible for all nuclear waste management measures including related planning, research and development work, and is also responsible for the financing the costs of the future management of the waste and of the decommissioning of the facility.

In Finland, the current producers of nuclear waste are the nuclear power plant utilities Teollisuuden Voima Oyj (TVO) and Fortum Power and Heat Oy (FPH) as well as VTT Technical Research Centre of Finland Ltd, which operated and will decommission the research reactor FiR 1. Both nuclear power plants have storage facilities for spent nuclear fuel and facilities for treatment, storage and disposal of low and intermediate level waste (LILW). VTT is responsible for the management of nuclear waste from the research reactor. (Fig. 2)

Posiva joint-company of TVO and FPH , is in charge of the preparations for and later implementation of spent fuel disposal for its owners FPH and TVO.

Fennovoima has presented plans for its own nuclear waste disposal in connection with the nuclear power plant construction licence application at the end of June 2015. For the spent nuclear fuel disposal Fennovoima has started EIA-program for the site selection of Fennovoima's own spent fuel disposal facility.

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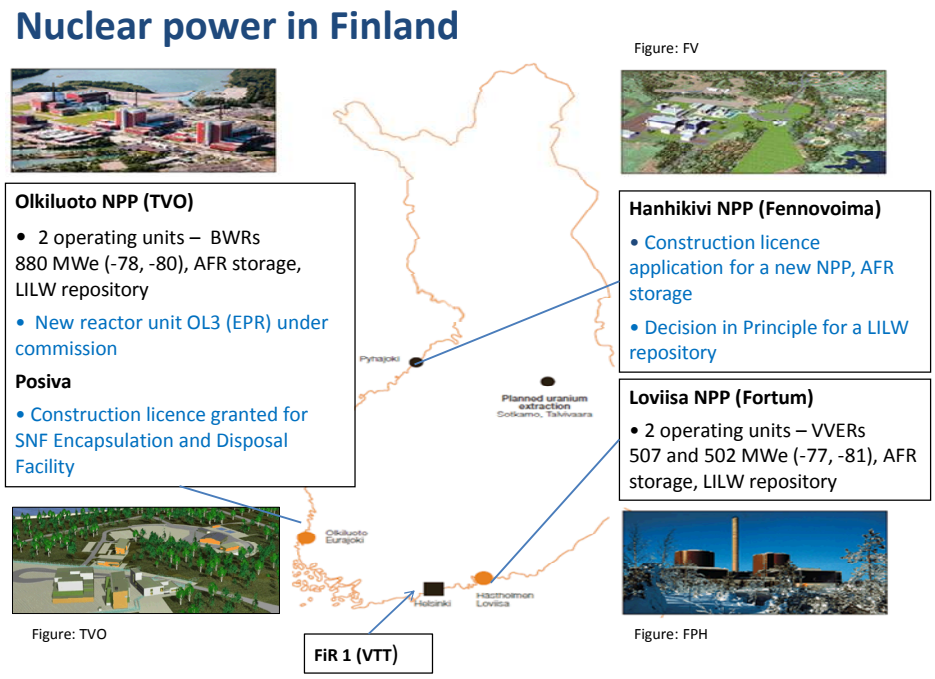

Fig. 2. Producers of nuclear waste in Finland, the situation at the end of 2017

Radioactive waste, regulated by the Radiation Act, refers to radioactive substances, and items contaminated with radioactive materials, which have no use any more and have to be rendered harmless due to their radioactivity. Such waste is generated mainly from the uses of radioactive sources in health care, industry or research.

The licencees under the Radiation Act perform some waste management operations, such as initial storage, clearance and disposal into landfill type sites. Small user waste that cannot be cleared, including spent sealed sources that cannot be returned to the manufacturer, must be handed over to Suomen Nukliditekniikka, a private entrepreneur licenced to receive, condition and transfer radioactive waste to a central storage operated by STUK.

The Government grants licences for nuclear facilities (Fig. 3). The Ministry of Economic Affairs and Employment (MEAE) is responsible for the supreme command and control of nuclear matters in Finland and oversees also that nuclear waste management and related R&D complies with the national policy and, together with the State Nuclear Waste Management Fund- , also controls that provisions for future waste management are adequate. The Ministry of Social Affairs and Health (MSAH) is the supreme authority on the supervision of practices involving exposure to radiation.

STUK is independent regulatory authority responsible for the regulatory oversight of radiation and nuclear safety, for issuing detailed safety regulations and for the technical and safety related review of licence applications and other related documentation. Licences for uses of radiation are granted by STUK.

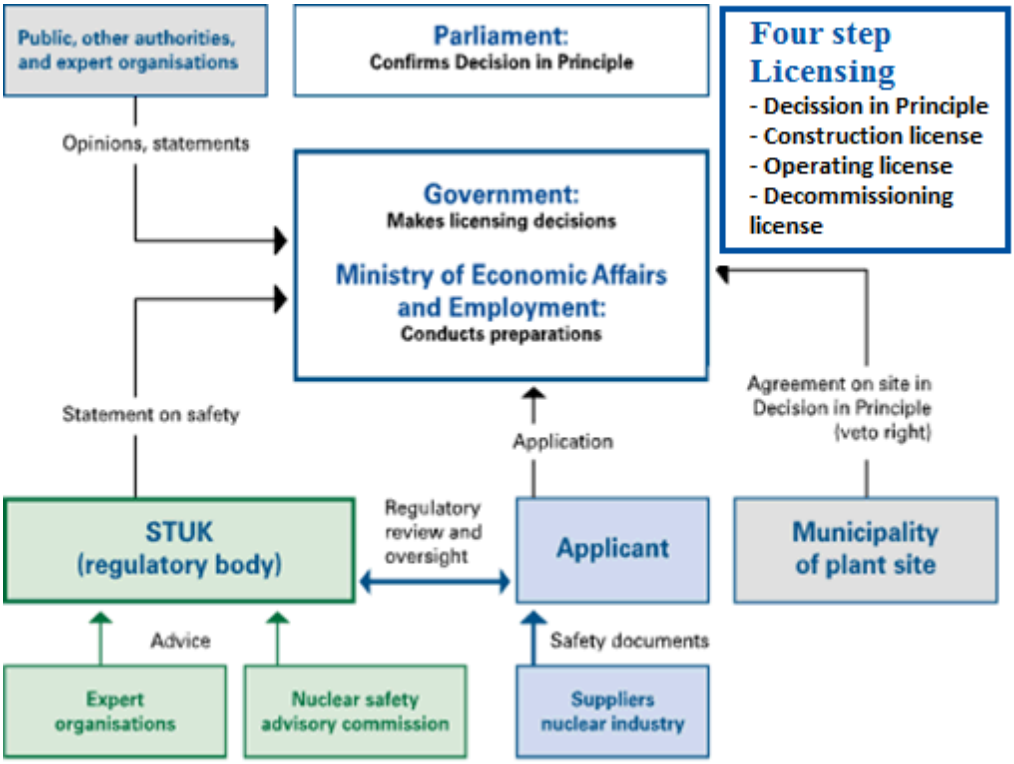

Fig. 3 Licensing process of nuclear facilities in Finland

Report preparation

The national report has been prepared by STUK in collaboration with MEAE. Contributions to the contents were given by TVO, FPH, FV, Posiva, VTT, and the Ministry of the Environment. Materials provided by the licencees in connection with the national report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, and STUK's annual reports to the MEAE and the MSAH, and the Member State Report under Council Directive 2009/71/Euratom were utilized.

MEAE has prepared the national programme according to 2011/70/Euratom article 12 in July 2015. The program has not been updated since.

2 Recent developments

The legislative and regulatory system has been enhanced

The current Finnish nuclear energy legislation is based on the Nuclear Energy Act from 1987, together with the supporting Nuclear Energy Decree from 1988. A significant amendment to the Nuclear Energy Act was passed in 1994 to reflect a new policy, which emphasizes the national responsibility to manage nuclear waste generated in Finland. In general, the import and export of nuclear waste, including spent fuel, is prohibited in the revised Act. Since 1994, the Nuclear Energy Act has been revised several times, e.g. to implement the Nuclear Safety Directive (Council Directive 2009/71/EURATOM) , and its

amendment (Council Directive 2014/87/EURATOM), and the European Council Directive on the management of spent fuel and radioactive waste (Council Directive 2011/70/EURATOM). In 2015, a revision to the Nuclear Energy Act enabled STUK to issue legally binding regulations. Based on the 2015 revision of Nuclear Energy Act, STUK issued four regulations in 2016 to replace the earlier Government Decrees and one new regulation on the safety of uranium and thorium production:

- Radiation and Nuclear Safety Authority Regulation on the Safety of Nuclear Power Plants (Y/1/2016)
- Radiation and Nuclear Safety Authority Regulation on the Security in the Use of Nuclear Energy (Y/2/2016)
- Radiation and Nuclear Safety Authority Regulation on Emergency Response Arrangements at Nuclear Power Plants (Y/3/2016)
- Radiation and Nuclear Safety Authority Regulation on the Safety of Disposal of Nuclear Waste (Y/4/2016).
- Radiation and Nuclear Safety Authority Regulation on the Safety of Mining and Milling Operations Aimed at Producing Uranium or Thorium (Y/5/2016)

In 2017 the Nuclear Energy act and the subsequent decree were revised due to the Basic Safety Standards directive 2013/59/Euratom (comes into force with the Radiation Act) and because of the amended Nuclear Safety Directive. The revision of the Nuclear Energy Act includes also amendments related to changes in the Pressure Equipment Act and licensing of nuclear facilities. The amended Nuclear Energy Act and Decree will introduce a new decommissioning licence step. The decommissioning licence will be granted by the Government similarly as construction and operating licences. This change will clarify the terms related to the decommissioning of the nuclear facilities in the future.

The revision of the Radiation Act is under parliamentary approval, and will come into force during 2018. The references given in this report are to the current legislation. Based on the draft radiation act, there will be a Governmental decree, decree of the Ministry of Social Affairs and Health and reference to STUK regulations. The most significant new regulation for the nuclear and radioactive waste management will be STUK regulation on exemption and clearance (The clearance levels to be set in that regulation will be applied also for the nuclear waste). The nuclide specific clearance levels for the unlimited free release will be based on the BSS-directive.

Related to the amended Nuclear Energy Act and Radiation Act, STUK regulations, the YVL-guides are under revision process. During this update cycle only some major changes are expected and the objective is to revise nearly all YVL-guides during 2018. YVL D.5 on Disposal of nuclear waste was already updated and additionally there is one new YVL-guide (released 2/2018) related to the nuclear waste management, Guide YVL D.7 *on* release barriers of spent fuel disposal facility has been published.

STUK's role and responsibilities were assessed in a peer review, as part of the IRRS mission (IAEA's Integrated Regulatory Review Service), in October 2012. In the follow-up mission in June 2015 regulatory activities in Finland were reviewed on the basis of IAEA Safety Standards and international best practices. The resulting recommendations and suggestions from the 2012 IRRS missions have been taken into account by STUK systematically in a comprehensive action plan. Significant progress has been made in

most areas and many improvements have been implemented in accordance with the action plan. The IRRS team determined that 7 out of 8 recommendations and 19 of 21 suggestions made in 2012 has been implemented. The recommendation still to be addressed deals with STUK's position under the Ministry of Social Affairs and Health, which will be discussed further in Finland. Two new recommendations were raised to amend legislation so that decommissioning of a nuclear installation and the closure of a disposal facility would require a licence amendment; and to address arrangements for research in radiation safety. STUK has updated its action plan to take these recommendations into account in future development actions. One of the open suggestions is related to STUK's management system. Although STUK had initiated many improvements to its management system, the IRRS team felt that there is still work that needs to be undertaken for further enhancing STUK's management system.

Development of national competences for future needs

Ensuring adequate and competent resources is a continuous challenge in a small country like Finland, where the nuclear energy sector is very active: four nuclear power reactors (OL1, OL2, Lo1 and Lo2) are in operation, one nuclear power reactor (OL3) scheduled to be commissioned in 2019, one is in the construction licence phase (Hanhikivi 1, FH1), two low and intermediate waste disposal facilities in Loviisa and Olkiluoto are in operation, a spent nuclear fuel disposal project is ongoing in its construction stage and the decommissioning of the research reactor FiR 1 and radioactive materials research laboratory is going to start in the near future at VTT.

Basic training in nuclear science is provided by the Lappeenranta University of Technology as well as Aalto and Helsinki universities. MEAE, STUK, all of the licencees, VTT and the universities share the challenge of ensuring adequate and competent resources and have jointly arranged yearly nuclear safety (YK course) and nuclear waste management (YJH course) courses for new staff in several organizations. During 2017 these courses were combined to one course named YJK course and plan is to organize this joint course yearly. In addition, the availability of competent human resources has been ensured by training young experts in the nuclear safety field in different ways, e.g. on a doctoral programme (YTERA- Doctoral Programme for Nuclear Engineering and radiochemistry) and the national research programme (KYT-program) which plays a very important role by providing education to guarantee competent new human resources in the nuclear and radioactive waste management areas.

During 2010–2012 a committee set up by the Ministry of Economic Affairs and Employment (MEAE) worked on a report to provide recommendations and steps to be taken until the 2020s for ensuring the competence and resources needed for the nuclear sector. One of the recommendations of the committee was that the future needs and focus areas of the Finnish nuclear energy sector research must be accurately defined and a long-term strategy should be drawn up for further development of research activities. This calls for a joint project between research organisations and other stakeholders in the field. The competence review was updated in 2017 to reflect the current changes in the operating environment.

At the end of January 2013, the MEAE set up a working group to prepare a research and development strategy. The report "Nuclear Energy Research Strategy", published at the

end of April 2014, emphasizes the importance of research in competence building with seven recommendations. The implementation of the recommendations is on-going by the MEAE. As an example of the on-going implementation, the Nuclear Energy Act was updated in 2015 to ensure the financing for the enhancement of the nuclear safety research infrastructure.

In addition to the research and development programs of the utilities and Posiva, the main ongoing research and development (R&D) program in Finland concerning nuclear waste and spent nuclear fuel management and disposal is the KYT research programme, the programme plan of which is updated every four years. :

- The national research programme (KYT2018) for 2015-2018 and (KYT2022) for 2019-2022, administered by MEAE; aims at supporting the creation and maintenance of overall competence and the basic skills needed regarding the management and disposal of nuclear wastes.

The Government reduced STUK's budget over the past years mostly due to reorganisation of funding and research in the governmental organisations. Oversight activities are charged in full from the licencees, and nuclear and waste safety research programmes are funded via the waste management fund, so budget cuts have not impacted nuclear safety research or resources needed for regulated activities. However, due to budget cuts, STUK has partly terminated and significantly reduced its radiation safety research (e.g. research into the biological effects of radiation, or biodosimetry). Since radiation safety research activities contributed to the maintenance and development of expertise in Finland, STUK has established a national radiation safety research programme (CORES) in co-operation with interested universities in Finland to ensure that radiation safety research will be continued in Finland.

Spent nuclear fuel disposal project progressed to the construction phase

The Finnish nuclear fuel cycle policy is based on the once-through principle. After removal from reactors, spent fuel is stored in pool type interim storage facilities at the power plant sites. Two interim storages have been in operation in Loviisa and Olkiluoto already for over 30 years. Fennovoima is also planning to construct a pool type interim storage facility at the forthcoming NPP site in Pyhäjoki. After a storage period of some tens of years, the spent fuel will be disposed of into the Finnish bedrock.

In 1999, in a Decision-in-Principle (DiP) application, Posiva proposed, to site the disposal facility for spent nuclear fuel at Olkiluoto in Eurajoki. The application was reviewed from a safety viewpoint by STUK and was accepted by the municipality of Eurajoki in January 2000. The Finnish Government made the DiP in December 2000 and Parliament ratified it in May 2001. The DiP authorized Posiva to continue the planned disposal project and also to construct an underground rock characterization facility "ONKALO" at the actual disposal depth. Underground rooms constructed for rock characterization purposes are a part of the disposal facility and were constructed under pertinent regulatory control.

Posiva submitted the construction licence application and its supporting safety documentation to the authorities at the end of 2012. STUK's safety review and

assessment of the application was submitted to the MEAE in February 2015. The construction licence was granted by the Government to Posiva in November 2015 and the construction of the disposal facility started in December 2016. Posiva is responsible for the preparations and later implementation of spent fuel disposal for its owners TVO and FPH. The disposal project and granted licence covers spent fuel from five reactors: Loviisa 1 and 2, and Olkiluoto 1, 2 and 3.

In the Decision-in-Principle for a new NPP, Fennovoima was required to define its plans for future spent nuclear fuel disposal. As required, Fennovoima submitted an environmental impact assessment programme for spent fuel disposal in June 2016 to MEAE. Fennovoima and Posiva Solutions Oy, Posiva's subsidiary that focuses on supplying services, have signed a co-operation agreement to ensure that Posiva's expertise will be available for Fennovoima's spent nuclear fuel management. The co-operation started in 2016. In January 2018 Fennovoima reported to MEAE that the Eurajoki research area will be selected more specifically after the granting of the Construction licence but before the Operating licence for Hanhikivi 1 NPP is granted. The other research area for Fennovoima spent fuel disposal facility is Sydänneva in Pyhäjoki municipality.

Spent fuel interim storage safety was enhanced

The spent fuel interim storage facility of TVO in Olkiluoto has undergone many improvements during its extension, which commenced its operations in summer 2015. Protection against a large airplane crash has been included in the design of the extension and the protection has also been improved for the original part of the facility. Additionally, the cooling water systems for the spent fuel storage pools have been improved to enable feeding water from outside to the facility. The monitoring of the storage pool water level and temperature has been improved regarding earthquake resistance and the potential loss of the facility power supply has been taken into account to address lessons learned from the Fukushima Dai-ichi accident.

Furthermore, the spent fuel storage in Loviisa has been improved by FPH since the Fukushima Dai-ichi accident. The main changes are aimed at reducing the dependency on the plant's normal electricity supply and distribution system, as well as on seawater cooled systems for residual heat removal from the reactor, as well as from the containment and spent fuel pools. Two air-cooled cooling units were constructed and commissioned in 2014-2015 to ensure long-term decay heat removal in case of the loss of seawater for cooling. The design plans for the installation of a diverse water supply to the spent fuel pools have also been approved by STUK in 2015 and the installation is planned to be carried out during 2019. Finally, the flood protection of the NPP and interim spent fuel storages has been improved.

Operation in low and intermediate level waste management has proceeded as previously

The predisposal management of LILW takes place at the NPPs under their operating licences and other provisions. There have not been any major changes in the procedures during the reporting period. In the Loviisa NPP the solidification plant was authorized for full operation in 2016 being the main development in the predisposal management of LILW. The Loviisa NPP is now able to start the solidification of historical liquid radioactive

waste, which has been stored in tanks from the start of NPP's operation from since late 1970s. The aim is to solidify and dispose of all existing liquid waste during the forthcoming years.

At both operating NPPs, solid LLW is transferred after conditioning to the disposal facilities located at the power plant sites. At Olkiluoto the operation of the LILW disposal facility started in 1992 and in Loviisa in 1998. Fennovoima is planning to construct a similar LILW disposal facility at the Pyhäjoki site.

The disposal of non-nuclear radioactive waste was started

TVO has leased a cavern in the LILW disposal facility at Olkiluoto to the State for the interim storage of non-nuclear radioactive waste. The revised (in 2012) licence conditions of the Olkiluoto LILW disposal facility have enabled the disposal of non-nuclear radioactive waste, including sealed sources at the Olkiluoto LILW disposal facility. The disposal was started at the end of 2016. Sealed sources containing nuclides causing the highest long term doses (C-14, Ra-226 and Am-241) are packed separately and are still stored in the interim storage.

Planning for decommissioning of Finland's first nuclear reactor commenced

The research reactor FiR1 (TRIGA Mark II, 250 kW) has been in operation since 1962. The FiR1 reactor has been operated by VTT Technical Research Centre of Finland Ltd. since 1971. In 2012, VTT decided to shut the reactor down due to insufficient funding for its continued operation. The FiR1 reactor will be the first nuclear reactor to be decommissioned in Finland. The EIA for decommissioning of FiR1 was concluded with the statement of the MEAE in February 2015. VTT submitted an application to the Government for a licence for decommissioning in June 2017 (formally a new operating licence, as the Finnish legislation did not recognize separate decommissioning licence at the time). The dismantling is scheduled to start in 2020, subject to the ongoing negotiations on waste management solutions. The dismantling will be regulated by STUK concerning radiation and nuclear safety aspects.

Simultaneously to the FiR 1 decommissioning there is a decommissioning process for the radioactive materials research laboratory in the adjacent building. Unlike the FiR 1 decommissioning the radioactive laboratory decommissioning is subject to Radiation Act, which makes the licence process somewhat lighter (no need for ministry or governmental licences). STUK will review and approve the decommissioning plans for the laboratory. VTT is planning to submit the laboratory decommissioning application to STUK in the fall of 2018.

Challenges for future work in spent nuclear fuel and radioactive waste management

Finland has identified three main challenges for the future work and these challenges are summarized below.

- **Improvement of the national plan for radioactive waste management**

Finland has a well-functioning system and technical solutions for the management of nuclear waste arising from NPPs and also for the major part of non-nuclear radioactive waste. However, as a consequence of the sealed source incident in 2016 at Suomen Nukliditekniikka and its related clean-up work of the contaminated areas, as well as the planning of the research reactor decommissioning waste storage and disposal, and the continuing challenge of disposal of a few HASS sources, that need to be evaluated. Improvements to the national radioactive waste management plan and licensing system need to be evaluated and thereafter improved to address all possible identified waste streams. The MEAE has invited an ad-hoc expert group to address these issues. The group will also address recommendations made by the Finnish Safety Investigation Authority regarding the sealed source incident in autumn 2016. The working group started its work in autumn 2017.

- **Developing competences and the regulatory framework for decommissioning**

  The research reactor, FiR 1, will be the first nuclear reactor to be decommissioned in Finland. As this is the country's first decommissioning project, Finland has limited experience in this area. VTT and STUK are both co-operating internationally with their peers, gathering knowledge and experience regarding decommissioning. The decommissioning project of the research reactor is an important learning process for STUK as the experiences gained will be used in updating regulations and YVL guides, and later on also for planning the regulatory oversight for decommissioning NPPs.

- **Communication to improve the general public's understanding of disposal safety**

  The Finnish public has a high degree of trust in the radiation and nuclear safety regulator, STUK, and good level of trust towards the safety of nuclear waste disposal in the country. However, the interest of the general public towards disposal related information seems to be decreasing. Additionally, the latest results of polls (conducted by e.g. organization *Finnish Energy* in 2016) evaluating public opinion show an indication of a slight decrease in trust towards safety of geological disposal. The development of this trend needs to be followed in the up-coming polls. The regulatory work and decisions made by the regulator need to be clear and understandable to the public. The general public should also have the correct understanding of disposal safety and the related risks. STUK's strategy for years 2018–2022 indicates that the goal of STUK's public communication is to help people to understand correctly the risks of radiation.

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3 Scope and inventory

Spent fuel storages and inventory of spent fuel

The spent fuel from the NPPs will be disposed of in Posiva's spent fuel disposal facility starting in 2024. Since the operation plan of the disposal facility is still developing, the disposal rate is not taken into account here.

Loviisa NPP

Storage	*Inventory (end of 2016)/ storage capacity*	
	Mass[1] (tHM)	*Fuel assemblies*
Pool storage in Loviisa 1 reactor building	17.8/57	148/481
Pool storage in Loviisa 2 reactor building	23.0/58	191/485
Basket type pool storage at the NPP	57.7/57	480/480
Rack type pool storage at the NPP	523.1/635	4348/5286
Total inventory/storage capacity (gross)	621/809	5167/6732
Total effective[1] storage capacity	673	5601

The amount of fuel is likely to increase by 10.1 tHM/a/reactor unit until the end of the NPP operation (2027 and 2030). The current storage capacity is adequate until the planned end of operation.

Olkiluoto NPP

Storage	*Inventory (end of 2016)/ storage capacity*	
	Mass[1] (tHM)	*Fuel assemblies*
Pool storage in Olkiluoto 1 reactor building	86.2/260	540/1520
Pool storage in Olkiluoto 2 reactor building	89.7/266	546/1560
Separate storage facility at the NPP site	1302.0/1666	7663/9756
Total inventory/storage capacity (gross)	1477.9/2192	8749/12836
Total effective[1] storage capacity	2021	11836

The amount is likely to increase by 18.3 tHM/a/reactor unit for Olkiluoto 1 and 2 until the end on NPP operation (2038)
The amount of spent fuel originating from Olkiluoto 3 reactor unit is 32.1 tHM/a starting 2019 until the end of the NPP operations (2079)
Capacity extension for the spent fuel interim storages are needed in 2030's, if the disposal of the spent fuel is not in operation at that time.

FiR 1 research reactor

Storage	*Inventory (end of 2016)*	
	Mass (kgU)	*Fuel elements*
Total inventory	21.4	103

[1] In the effective capacity the required reserve capacity for exceptional unloading of the entire reactor core to storage pool, for storage pool repairs and space for dummy elements is not included

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Radioactive waste management facilities and inventory of radioactive waste

Loviisa NPP

Storage	*Inventory (end of 2016)*	
	Volume (m^3)	*Activity (TBq)*
Buffer storage rooms inside the NPP	218.8	<1
On-site storages for operational waste	108.8	low for LLW 0.9 TBq for solidified resins
Tank storage for wet LILW	1293	15
Dry silos for ILW	43.5	high (not measured)
Disposed LILW	2067	1.18

Estimation of the future solid LILW generation is 64 m^3/a. In addition solidified liquid waste will be disposed around 340 m^3/a so that all stored liquid waste is solidified at the time of decommissioning. The amount of decommissioning waste is around 29 000 m^3, generated mainly during 2027-2035. Additionally there is 1200 m^3 of waste generated in 2066-2068 from the decommissioning of the spent fuel storage facility.

Olkiluoto NPP

Storage	*Inventory (end of 2016)*	
	Volume (m^3)	*Activity (TBq)*
Buffer storage rooms inside the NPP	190	16.6
On-site storages for operational waste	49.3	0.09
Pool storage for activated metal waste	53	high
Spent oil candidate for clearance	16	low
Interim storage for state owned waste	35.2 (in onsite storage)	not measured
Disposed LILW	6178	58.6

Estimation of the future annual waste generation and disposal (for Olkiluoto 1 and 2) is 140 m^3/a. For Olkiluoto 3 the estimated waste generation is 50 m^3/a.
The amount of decommissioning waste is around 32 000 m^3, generated from Olkiluoto 1 and 2 mainly during 2068-2076. The amount of Olkiluoto 3 decommissioning waste is estimated to be around 11000 m^3 before packing and generated during 2079-2085. Additionally there will be approximately 2000 m^3 of waste from the spent fuel interim storage decommissioning to be generated around 2100.

FiR 1 research reactor

Storage	*Inventory (end of 2016)*	
	Volume (m^3)	*Activity (TBq)*
Waste storage in the laboratory building	6	0.001

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Estimated decommissioning waste amount before packing is 38 m^3 with 3.5 TBq activity, likely to be generated during 2020's

Storage of non-nuclear radioactive waste

Storage	*Inventory (end of 2016)*	
	Volume (m^3)	*Activity (TBq)*
Suomen Nukliditekniikka Oy	2	3.8

Storage of non-nuclear radioactive waste

Storage	*Inventory (end of 2016)*
	Mass
STUK, at Roihupelto	HEU 0.8 g LEU: 536 g U_{Nat}: 574 g DU: 369 kg Th: 199 g

Storage for state owned waste

Storage	*Inventory (end of 2016)*	
	Volume (m^3)	*Activity (TBq)*
In on-site storage (KAJ-storage Olkiluoto)	35.2 m^3	36
Disposed in the Olkiluoto disposal facility	20.8 m^3	~16

4 General principles and policies (Article 4)

Art. 4.1

Member States shall establish and maintain national policies on spent fuel and radioactive waste management. Without prejudice to Article 2(3), each Member State shall have ultimate responsibility for management of the spent fuel and radioactive waste generated in it.

Finland has established national policy for spent nuclear fuel and other radioactive waste management in 2015. The responsibility of maintaining the policy has been defined in Nuclear Energy Act (section 27 b) and in the draft Radiation Act (Section 87).

The Finnish policy on the ultimate responsibility for spent fuel and radioactive waste management is declared in the legislature, in the Nuclear Energy Act (990/1987) and in the Radiation Act (592/1991).

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The Nuclear Energy Act states that nuclear waste generated in connection with or as a result of use of nuclear energy in Finland shall be handled, stored and permanently disposed of in Finland.

In addition, the Nuclear Energy Act states that nuclear waste generated in connection with or as a result of the use of nuclear energy elsewhere than in Finland, shall not be handled, stored or permanently disposed of in Finland.

The cases to which these legal requirements do not apply are listed in the Nuclear Energy Decree (161/1988).

The Radiation Act declares the duties and responsibilities as follows:

- The responsible party shall take the measures necessary to render harmless any radioactive waste arising from its operations.
- If the responsible party fails to discharge the duty of care referred to in the Radiation Act (Section 50), then the State shall take the measures necessary to render any radioactive waste harmless and to decontaminate the environment.
- The State shall also take measures when the origin of the waste is unknown, or when no responsible party subject to a primary duty of care can be found.
- It is prohibited to import radioactive waste to Finland for the purpose of disposal.

Art. 4.2

Where radioactive waste or spent fuel is shipped for processing or reprocessing to a Member State or a third country, the ultimate responsibility for the safe and responsible disposal of those materials, including any waste as a by-product, shall remain with the Member State or third country from which the radioactive material was shipped.

As described in Art. 4.1, according to the Nuclear Energy Act (Section 6a) nuclear waste generated in Finland shall be handled, stored and permanently disposed of in Finland. Respectively, nuclear waste generated elsewhere than in Finland, shall not be handled, stored or permanently disposed of in Finland.

There are three minor exceptions to these principles, notably the nuclear waste arising from the use of a research reactor in Finland (the Nuclear Energy Act (Section 6a)). As stipulated in the Nuclear Energy Decree (Section 7b), the spent fuel from a research reactor in Finland can be handled, stored and disposed of outside Finland, if justified on grounds of safety or due to a significant economic or other weighty reason.

The other exception is nuclear waste containing minor quantities of radioactive material (e.g. contaminated metal components) and which is delivered to another country for treatment in the appropriate manner. After the treatment the radioactive waste shall be returned to Finland for disposal as defined in Nuclear Energy Act (Section 6a).

The third exception is minor quantities of nuclear waste which have been or will be delivered to another country for research.

Radioactive waste shall not be exported to a country whose technical, legislative or administrative facilities are inadequate for the care of radioactive waste (the Radiation Act (Section 52a)).

Disused radiation sources that were not manufactured in Finland may not be imported to Finland as radioactive waste (the Radiation Act (Section 52a)).

Shipments of radioactive waste and spent fuel shall be arranged in the manner prescribed in Council Directive 2006/117/Euratom on the supervision and control of shipments of radioactive waste and spent fuel, referred to as the Shipments Directive (the Radiation Act (Section 52a) and the Nuclear Energy Act (Section 55b)).

Art. 4.3(a)

National policies shall be based on all of the following principles:

(a) The generation of radioactive waste shall be kept to the minimum which is reasonably practicable, both in terms of activity and volume, by means of appropriate design measures and of operating and decommissioning practices, including the recycling and reuse of materials;

According to the Nuclear Energy Act (Section 27a) the amount of nuclear waste generated in the use of nuclear energy must be kept as small as is reasonably possible with practical measures, both regarding volume and activity, without compromising the general principles set forth in the Nuclear Energy Act (Sections 5 to 7). Subsequent STUK regulations STUK Y/1/2016 (Section 20) and STUK Y/4/2016 (Section 18) give more detailed requirements for safety.

STUK regulation (STUK Y/1/2016 section 13) and subsequent regulatory Guide YVL D.4 underlines that generation of waste shall be reduced i.e. by proper planning of repair and maintenance and by means of decontamination, clearance and volume reduction practices. The Guide also refers to sound working methods for waste minimization, e.g. by volume reduction of waste, by avoiding transfer of unnecessary objects and materials into the controlled areas and by adoption of working processes that either create only small amounts of waste or the created waste is easily manageable.

The release of very low level waste from regulatory control (clearance) is regulated by virtue of Guide YVL D.4. Both conditional and unconditional clearances are effectively used for waste minimization by the NPPs. Clearance criteria, levels and procedures are given in Guide YVL D.4. In the future the limits will be given in STUK regulation based on the new Radiation Act.

The average annual accumulation of LILW to be disposed of has been fairly low: about 100 m^3 per NPP (each having two operational reactor units). The accumulation of waste has in some years even turned to decline by effective waste minimization and volume reduction measures, such as radiochemical treatment of liquid waste, campaigns for removal of very low level waste from control, and compaction of maintenance waste. Some large metal components of NPP origin have been transported for treatment to Studsvik facility in Sweden. Activation products or external contamination containing parts or components that have been separated from the metal are transported back to Finland for disposal.

According to the Radiation Act (Section 49a) the amount of radioactive waste generated by the use of radiation and other radiation practices shall be kept as low as reasonably achievable without endangering the implementation of the general provisions of the Radiation Act (Section 2). The concept of clearance is used allowing for the reuse and recycling of material (based on the criteria and values given in IAEA publication GSR Part 3).

The laboratories using radioactive sources in medical and research applications usually store their short-lived radioactive waste at their premises until it has decayed below the limits set for discharges in Guide ST 6.2. Only small amounts of waste need to be conditioned for disposal.

Art. 4.3(b)

(b) The interdependencies between all steps in spent fuel and radioactive waste generation and management shall be taken into account;

According to the Nuclear Energy Act, a licencee, whose operation generates or has generated nuclear waste, is responsible for all nuclear waste management measures including related planning, research and development work, and is also responsible for the financing the costs of the future management of the waste and of the decommissioning of the facility. Therefore, the interdependencies and different requirements of the different phases of the process must also be taken care of by the licencee (STUK Y/4/2016, section 8).

Guide YVL B.4 sets requirements on the nuclear fuel. The disposal process and long-term safety shall be taken into account when designing the fuel. The integrity of nuclear fuel shall be ensured during its operation, handling, transport, long-term storage and disposal. Guide YVL D.3 concerns the handling and storage of the nuclear fuel. The integrity of nuclear fuel rods shall be secured in the handling, storage, and encapsulation of nuclear fuel.

Guide YVL D.4 on treatment and storage of LILW from NPPs requires that waste is treated, e.g. segregated, categorised and conditioned, in an appropriate way with regard to its further management.

The Radiation Act requires the radioactive waste, its handling, storage and disposal to be defined and planned for in advance, and the plans to be included in the licence application (Section 16). The amount of generated waste shall be kept as low as practicable, however without jeopardizing the general principles for radiation protection (justification, optimization and dose limitation) governing the practice as a whole (the Radiation Act (Section 49a)).

The interdependencies within the spent fuel and radioactive waste management are minimal, due to the legal requirement that the generator of such waste is responsible for all the management of that waste and the fact that the NPP licencees are operating the spent fuel interim storages and the repositories for LILW at the NPP sites.

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Art. 4.3(c)

(c) Spent fuel and radioactive waste shall be safely managed, including in the long term with passive safety features;

The Finnish legislation does not directly mention passively safe repositories but requires repositories with effective containment for relevant time spans that do not require post-closure monitoring (the Nuclear Energy Act (Section 7h)). Repositories shall be based on multiple safety functions achieved through mutually complementary barriers (multibarrier principle) so that a deficiency of an individual safety function provided by a barrier or a predictable geological change will not jeopardize long-term safety.

The Nuclear Energy Act (Section 7h) defines the safety responsibilities as follows:

"A nuclear facility shall have facilities, equipment and other arrangements to ensure the safe handling and storage of nuclear material required by the facility as well any nuclear waste generated during operation and decommissioning. "Nuclear waste shall be managed so that after disposal of the waste no radiation exposure is caused, which would exceed the level considered acceptable at the time the final disposal is implemented.

"The disposal of nuclear waste in a manner intended as permanent shall be planned giving priority to safety and so that ensuring long-term safety does not require the surveillance of the final disposal site.

"Nuclear waste management plans shall be kept up to date as provided in Section 28."

"The long-term safety of disposal shall be based on long-term safety functions achieved through mutually complementary barriers so that the degradation of one or more long-term safety function or a foreseeable change in the bedrock or climate will not jeopardize the long-term safety. (STUK Y/4/2016 section 30)

According to STUK Y/1/2016 (Section 12) the storage conditions of spent fuel shall be designed so that the condition of fuel assemblies, fuel racks, or storage pools will not significantly deteriorate during the storage period. When the handling, storage, and encapsulation processes for nuclear fuel are designed, priority shall be given to simple and inherently safe concepts.

STUK regulation STUK Y/1/2016 (Sections 13 and 17) and guide YVL D.4 handles the predisposal management of the LILW and decommissioning. The design of a processing and storage facility for operational waste or the decommissioning of a nuclear facility shall give priority to concepts where high temperatures, elevated pressures or other operational conditions that increase the accident potential are not necessary. Priority shall also be given to concepts that are based on inherently safe systems and components. The safety of a permanently closed nuclear facility that has been brought to a state of monitored storage shall, to the extent practicable, be independent of active systems and operational actions.

The first batch of institutional radioactive waste stored in the national central storage was disposed in the TVO's LILW disposal facility in 2016. In the future the institutional

radioactive waste will be disposed of whenever the waste package is full. Since the institutional radioactive waste is disposed of in Olkiluoto LILW, the post-closure safety features are the same as those for nuclear based LILW disposal facility in Olkiluoto.

Art. 4.3(d)

(d) Implementation of measures shall follow a graded approach;

Generally, all authorities shall observe the Administrative Procedure Act (434/2003). In the Administrative Procedure Act (Section 6) it is stated that an authority shall treat the customers of the administration on an equal basis and exercise its competence only for purposes that are acceptable under the law. The acts of the authority shall be impartial and proportionate to their objective. They shall protect legitimate expectations as based on the legal system.

In particular, the Nuclear Energy Act states (Section 7a) that safety requirements and measures to guarantee safety shall be designed and applied in proportion to the risks associated with the use of nuclear energy.

The general principles are set in the Nuclear Energy Act and in the Nuclear Energy Decree. More detailed requirements, related to the safety of disposal of nuclear waste, are presented in the STUK regulation (STUK Y/4/2016). Guides YVL D.3, YVL D.4, YVL D.5 and YVL D.7 refine details for safe operation of waste management and disposal facilities and long-term safety of disposed waste and the release barriers for spent fuel disposal facilities.

In the Radiation Act (Section 14) it is stated that the responsible party shall be required to take such measures to improve radiation safety as are justifiable with respect to their nature, costs and positive impact on radiation safety.

Art. 4.3(e)

(e) The costs for the management of spent fuel and radioactive waste shall be borne by those who generated those materials;

According to the Nuclear Energy Act (Section 9) a licencee whose operations generate or have generated nuclear waste (licencee under a waste management obligation) shall be responsible for all nuclear waste management measures and their appropriate preparation, as well as for their costs (waste management obligation).

According to the Radiation Act (Section 50) the responsible party shall take the measures necessary to render harmless any radioactive waste arising from its operations. A financial guarantee for ensuring appropriate management of disused sources shall be furnished for practices where possible waste management costs are considerable (Section 19) including the use of some High Activity Sealed Sources (Section 31f).

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Art. 4.3(f)

(f) An evidence-based and documented decision-making process shall be applied with regard to all stages of the management of spent fuel and radioactive waste.

According to the Nuclear Energy Act (Section 8) the use of nuclear energy without a licence is prohibited. The use of nuclear energy covers e.g. construction and operation of nuclear facilities, mining and milling operations aimed at producing uranium or thorium, possession, fabrication, production, transfer, handling, use, storage, transport and import of nuclear material and nuclear waste, export of nuclear waste as well as the export and import of ores containing uranium or thorium.

It is the licencee's obligation to ensure safe use of nuclear energy. Therefore the licence applicant shall submit a detailed demonstration of safety to STUK's review and assessment according to regulations such as the Nuclear Energy Act, the Nuclear Energy Decree, Government Decrees, STUK requirements and YVL Guides.

A safety licence issued by STUK is needed for the use of radiation sources. The application shall include a waste management plan (the Radiation Act (Section 16)). When the practice ends the licencee shall provide evidence on the appropriate management of radioactive waste under its responsibility (the Radiation Act (Section 20)). When transferring radioactive waste, the transferor must ensure that the transferee has a safety licence enabling it to hold the waste (the Radiation Act (Section 52)). Import, export or transport of radioactive waste via Finnish territory is subject to STUK's separate approval for each such transaction (the Radiation Act (Section 52a)).

Art. 4.4

Except for the provisions set out in Article 2(3):

(a) Repatriation of disused sealed sources to a supplier or manufacturer;
(b) Shipment of spent fuel of research reactors to a country where research reactor fuels are supplied or manufactured, taking into account applicable international agreements;
(c) The waste and spent fuel of the existing Krško nuclear power plant, when it concerns shipments between Slovenia and Croatia.
Radioactive waste shall be disposed of in the Member State in which it was generated, unless at the time of shipment an agreement, taking into account the criteria established by the Commission in accordance with Article 16(2) of Directive 2006/117/Euratom, has entered into force between the Member State concerned and another Member State or a third country to use a disposal facility in one of them.

Prior to a shipment to a third country, the exporting Member State shall inform the Commission of the content of any such agreement and take reasonable measures to be assured that:
(a) the country of destination has concluded an agreement with the Community covering spent fuel and radioactive waste management or is a party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management ('the Joint Convention');
(b) The country of destination has radioactive waste management and disposal programmes with objectives representing a high level of safety equivalent to those established by this Directive; and
(c) The disposal facility in the country of destination is authorised for the radioactive waste to be shipped, is operating prior to the shipment, and is managed in accordance with the requirements set down in the radioactive waste management and disposal programme of that country of destination.

According to the Nuclear Energy Act (Section 6a) nuclear waste generated in Finland shall be handled, stored and permanently disposed of in Finland. Respectively, nuclear waste generated elsewhere than in Finland, shall not be handled, stored or permanently disposed of in Finland.

The Nuclear Energy Decree (Chapter 7b) specifies the procedure for those cases where import and export of nuclear waste may still take place. Before a decision is made on a licence to export nuclear waste, STUK shall ensure that the export of nuclear waste meets the requirements of the Council Directive on the supervision and control of shipments of radioactive waste and spent nuclear fuel (2006/117/Euratom).

The Radiation Act states (Section 52a) that radioactive waste shall not be exported to a country whose technical, legislative or administrative facilities are inadequate for the care of radioactive waste. Each shipment of radioactive waste shall be approved by STUK and managed according to the directive 2006/117/Euratom. Detailed procedures are described in guide ST 5.7. Disused radiation sources that were not manufactured in Finland may not be imported to Finland as radioactive waste.

5 National Framework (Article 5)

Art. 5.1

Article 5.1 Member States shall establish and maintain a national legislative, regulatory and organisational framework ('national framework') for spent fuel and radioactive waste management that allocates responsibility and provides for coordination between relevant competent bodies. The national framework shall provide for all of the following:

In addition to the National Programme, written and delivered to the European council in 2015, there is a waste management plan for nuclear waste. The plans are prepared by licencees every third year or when there are significant changes according to the Nuclear Energy Act (Section 28) The plan shall describe the waste management actions and research for the coming three years in detail and in general for additional three years.

Under Radiation Act the licencees are required to present waste management plans when applying the safety licence. Presently there are no requirements is Radiation act for scheduled updating of the plans.

Art. 5.1(a)

(a) A national programme for the implementation of spent fuel and radioactive waste management policy;

In Finland, the policies and strategies for radiation and nuclear safety are mainly expressed through legislation.

Finland has delivered the National Programme to European Council in 2015. After 2015 there have been no changes to the policy. Self evaluation and international peer-review will be performed to the National Policy in 10 year intervals, or in a case of incident which have significant impact on nuclear or radiation safety.

The revisions and amendments to the Nuclear Energy Act (Sections 27b, 54 and 54a) and the Radiation Act (Section 87 in the draft), define the requirements on the national programme for spent fuel and radioactive waste management in Finland. The

amendments also define the responsibilities for the implementation of the national programme.

Art. 5.1(b)

(b) national arrangements for the safety of spent fuel and radioactive waste management. The determination of how those arrangements are to be adopted and through which instrument they are to be applied rests within the competence of the Member States;

As described in Introduction chapter, the actors in the radiation safety field are the Ministries as legislative bodies, the Government with the legislative authority, STUK as the regulatory body, and the licencees as operators in the field. Spent fuel and radioactive waste management always requires a licence.

The Finnish Constitution is the cornerstone of all legislation and exercise of public power. The Constitution stipulates how and by whom the acts and decrees as well as delegation of legislative powers can be issued. The decisions are taken by the Parliament or the Government as appropriate. It is a general principle that the ministries are responsible for the preparation of legislation. The Ministry of Economic Affairs and Employment (MEAE) is responsible for the legislation in the nuclear energy field and the Ministry of Social Affairs and Health (MSAH) for the use of radiation (acts and decrees). As prescribed in the Act on STUK (1069/1983) STUK participates in the preparatory legislative work, making proposals for the development of legislation in the field of nuclear and radiation safety. As of 2015 STUK has had a mandate to give binding regulations under Nuclear Energy Act on detailed safety requirements.

The arrangements for the safety of spent fuel and radioactive waste are governed by the Nuclear Energy Act (Sections 7a-r) and the Radiation Act and the subsequent Decrees.

According to Nuclear Energy Act (Section 7q) STUK can issue technical binding regulations concerning the safety principles described in sections 7a-p of the act. Similar mandate will be given to STUK in the new Radiation Act.

Detailed safety regulations (YVL Guides) concerning the nuclear safety are issued by STUK based on the Nuclear Energy Act (Section 7r). Concerning the safety in the use of radiation, more detailed regulations on achieving the standard of safety (ST Guides) are issued by STUK based on the Radiation Act (Section 70).

These guides are non-binding regulations for the licencees, as the licencee has right to propose an alternative procedure or solution to that provided in the regulations. If the licencee can convincingly demonstrate that the proposed procedure or solution will implement safety standards in accordance with the Nuclear Energy Act, STUK may approve the procedure or solution by which the safety level set forth is achieved.

Art. 5.1(c)

(c) a system of licensing of spent fuel and radioactive waste management activities, facilities or both, including the prohibition of spent fuel or radioactive waste management activities, of the operation of a spent

fuel or radioactive waste management facility without a licence or both and, if appropriate, prescribing conditions for further management of the activity, facility or both;

According to the Nuclear Energy Act (Section 8) the use of nuclear energy without a licence is prohibited.

The licensing process is defined in the legislation. The licences are prepared by the MEAE and granted by the Government. For a NPP, a spent nuclear fuel interim storage, a nuclear waste disposal facility or another significant nuclear facility the process consists of four stages:

- Decision-in-Principle – made by the Government and ratified by the Parliament
- Construction Licence – granted by the Government
- Operating Licence – granted by the Government
- Decommissioning licence – granted by the Government

The conditions for granting a licence are prescribed in the Nuclear Energy Act (Sections 18 to 20a).

Before a Construction Licence can be applied for a NPP, spent fuel interim storage, nuclear waste disposal facility or other significant nuclear facility, a Decision-in-Principle by the Government and a subsequent ratification of the DiP by the Parliament are required. An Environmental Impact Assessment (EIA) procedure has to be conducted prior to the application of the DiP and the EIA report and relevant plans to minimize environmental impact has to be annexed to the DiP application as defined in Nuclear Energy Act (Section 24). Unlike in normal EIA procedure, in the case of Nuclear facility the responsible authority for EIA-procedure is MEAE as defined in EIA act (252/2017) section 10. A condition for granting the Decision-in-Principle is that the construction of the facility in question is in line with the overall good of the society. Further conditions are as follows:

- The municipality of the intended site of the nuclear facility is in favour of constructing the facility (right of veto);
- No factors have appeared which indicate that the proposed facility could not be constructed and operated in a safe manner.

The entry into force of the Government's Decision-in-Principle further requires ratification by the Parliament. The Parliament cannot make any changes to the Decision; it can only approve or reject it as such. The authorization process of a nuclear facility is described in Fig. 3 in the Introduction section of this report. In the construction, operating and decommissioning licence phases the acceptance of the Parliament is no more inquired. A statement from the host municipality is requested and taken into account, however municipality has no veto power.

The operating licences of a nuclear facility are granted for a limited period of time, generally for 10–20 years (for LILW-disposal facilities several decades). In case the operating licence is granted for a longer period than 10 years and 15 years for disposal facilities, a periodic safety review is required in Nuclear Energy Act (Section 7e)).

According to Section 7h of the Nuclear Energy Act the disposal of nuclear waste in a manner intended as permanent shall be planned giving priority to safety and so that ensuring long-term safety does not require the surveillance of the final disposal site.

When applying for an amendment to the construction licence or operating licence or renewal of operating licence or decommissioning licence of a nuclear facility, the same procedures shall be observed as when applying for a new licence, to the extent applicable (the Nuclear Energy Decree (Section 40)).

The decommissioning licence is the only nuclear licence in Finland which is granted for indefinite time period. The requirements of the Decommissioning licence are described in Nuclear Energy Decree (Sections 33a and 34a). Although the licence is valid there is a requirement for periodical safety review in every 10 years as defined in Nuclear Energy Act (Section 7e)

On the basis of the Nuclear Energy Act (Section 16), minor licences for spent fuel and other nuclear waste management activities (export, import, transfer and transport licence and licences for operations e.g. small scale disposal (<1TBq)) are granted by STUK.

The licensing system for practices under the Radiation Act is described in Sections 16 and 17. The use of radiation requires a safety licence, which is granted by STUK upon application. A safety licence can be subject to additional conditions needed to ensure safety. In addition, the cases not requiring a licence are identified, e.g. when the use of radiation or a device is exempted.

As the regulatory body STUK has the right to prescribe licence conditions for further management of the activity.

Art. 5.1(d)

(d) a system of appropriate control, a management system, regulatory inspections, documentation and reporting obligations for radioactive waste and spent fuel management activities, facilities or both, including appropriate measures for the post-closure periods of disposal facilities;

According to the Nuclear Energy Act, STUK is responsible for the regulatory oversight of the safety of the use of nuclear energy. Based on the Nuclear Energy Act (Section 63) STUK has the right to inspect and control operations in nuclear facilities and for this purpose to have access to any place where such an operation is being carried out, as well as to carry out measurements required for supervision, to take and to receive samples and to install equipment necessary for such supervision. STUK oversees also the construction of a nuclear facility (the Nuclear Energy Decree (Section 109)).

STUK has established an inspection program for nuclear facilities that covers all relevant areas of nuclear safety and security. STUK's Periodic Inspection Program is focused on the licencee's main working processes and covers management and organizational aspects, broad overlapping processes (such as assessment and improvement of safety, safety functions, operational safety, radiation protection, waste management) as well as detailed technical issues.

All the inspections are carried out according to a detailed plan and inspection findings and the related regulatory requirements are presented in the inspection protocol (inspection report). All inspections are documented in a database that is used to monitor the inspection findings. STUK's inspection findings are also communicated directly to the licencee after an inspection. The developments of the observations from the inspection are followed in the regulatory process and communicated to the staff of the regulatory body.

Guides YVL A.5, A.9 and A.10 provide in detail the reporting requirements on construction, on operation as well as on incidents, operational disturbances, and events which have to be reported to STUK. The guides also define requirements for the contents of the reports and the administrative procedures for reporting, including time limits for submitting various reports.

STUK publishes descriptions of the operational events in its triannual reports on nuclear safety. The reports are also available to the general public in Finnish. Pursuant to the Nuclear Energy Decree (Section 121), STUK is obliged to report on its regulatory oversight in the field of nuclear energy once a year to MEAE. STUK's Annual Report summarizes the operation and events from the whole year and the report is available to the general public in Finnish and in English.

According to the STUK regulation (STUK Y/4/2016), records shall be kept of the disposed waste. These records include waste package specific information on waste type, radioactive substances, location in the waste emplacement rooms and other necessary data. STUK maintains a database where the nuclear waste data reported annually by the operators of the NPPs are stored. Guide YVL A.9 gives general requirements for reporting to STUK and includes provisions for waste management reporting. More detailed requirements for waste management records are given in Guides YVL D.4 and YVL D.5. During the operational period the records referred to above shall be annually complemented and submitted to STUK. STUK shall organize the storing of the information on the disposal facility and on the disposed waste in a permanent manner. At the time of the closure of the disposal facility, the records of the amounts of disposed waste and the relevant information contained in the FSAR will be converted into a format that is acceptable by the national archive for long term filing.

A licencee with a waste management obligation shall apply for an order on the expiry of his waste management obligation when all the measures necessary for closing the disposal facility have been completed (the Nuclear Energy Decree (Section 84)). A prerequisite for the expiry of the wastes management obligation is that STUK has confirmed that the nuclear waste of the licencee have been permanently disposed of in a manner that STUK has approved (the Nuclear Energy Act (Section 33)) and that the measures specified in the Nuclear Energy Act (Section 32) have been duly completed. According to Guide YVL D.5 a precondition for the permanent closure of a disposal facility is that STUK has approved the closure plan, which shall include:

- a description of the technical implementation of the closure of the disposal facility;
- an update of the safety case; and

- a plan for the potential post-closure monitoring measures and a proposal for the restriction zone with prohibition on measures referred to in the Nuclear Energy Decree (Section 85).

As producers of nuclear waste, TVO and FPH are under the Nuclear Energy Act responsible for implementing the management of nuclear waste produced in the Olkiluoto and Loviisa nuclear power plants as well as for the costs thus incurred. VTT is responsible for the nuclear waste management for FiR 1. According to the legislation, MEAE decides on the principles to be followed in nuclear waste management. The legislation provides that the parties with the nuclear waste management obligation must also provide MEAE with regular reports on how they have planned to implement the measures included in nuclear waste management and their preparations. The report is required to be submitted by each producer of nuclear waste at three-year intervals, and the report must describe in detail the measures for the next three-year period and also present an outline of the plans for the subsequent three-year period.

According to the Radiation Act (Section 53), STUK is authorized to inspect any radiation practices and it has access to places in which the practices are performed. STUK is authorized to conduct tests and measurements, to take or obtain necessary samples, and to install the devices needed for regulatory purposes at the said places or in the vicinity. In addition, STUK is authorized to obtain the notifications, data and documents needed for regulatory purposes.

All radioactive sources the activity of which is above the exemption level as well as their transfers have to be notified to STUK. This requirement applies to sources in use as well as radioactive waste. When an operator wishes to end a particular practice, it has to demonstrate that it has in an acceptable manner relinquished or rendered harmless the radioactive substances in its possession. In practice this is done by sending the source in question to the manufacturer or handing it over to the recognized installation for rendering the source harmless. There is one operating recognized installation in Finland, and it regularly reports to STUK of the wastes it has received.

Art. 5.1(e)

(e) enforcement actions, including the suspension of activities and the modification, expiration or revocation of a licence together with requirements, if appropriate, for alternative solutions that lead to improved safety;

The procedures used in the enforcement of regulatory requirements are based on the mandate of the regulatory authorities given in the legislation. The enforcement tools and measures of STUK are provided in the Nuclear Energy Act (Chapter 10). Enforcement measures defined in the Nuclear Energy Act (Sections 66 and 67) are a conditional fine, a threat that the activity is interrupted or limited, and a threat that the work is done at the cost of the neglecting organization.

In addition to administrative enforcement measures it is possible to get assistance from police authorities in a situation where STUK interrupts an activity or limits it, based on

acute safety reasons (the Nuclear Energy Act (Sections 67 and 68) and the Radiation Act (Sections 55 and 58)).

In the most severe case the authority that has granted a licence may revoke it wholly or partly, if implementation of the general principles for the use of nuclear energy as laid down in the Nuclear Energy Act is essentially endangered (the Nuclear Energy Act (Section 26)).

The choice of procedure applied in each situation is primarily based, following the principle of graded approach, on the safety significance of the situation. There are different levels of enforcement activities. The applied procedures in situations which have minor safety significance are an oral notice and a request for action by a protocol made by the inspector. A written notice and an order for action by STUK's decision are used if there are factors increasing the seriousness of the situation or matter. STUK's internal guides cover the different cases and the appropriate actions.

Coercive measures are used to reinforce STUK's order by a conditionally imposed fine, a threat to interrupt or limit the operation or to have the neglected obligation fulfilled at the expense of the neglecting party.

The most often used enforcement action is STUK's decision. In the decision the nature of the deficiency is stated and a time limit is set for the implementation of the required measures.

STUK ensures that the licencee effectively implements the remedial actions raised by the enforcement actions through document control, reporting, within the periodic inspection programme, inspections required by YVL Guides or other inspection activities. Reporting and the procedures relating to the operational experience feedback are described in Guides YVL A.9 and A.10, respectively.

The grounds for exercising the power of the decision-making authority are described in Guide STUK 2.1 (Rules of Administration, STUK's internal guide) and more detailed procedures for immediate enforcement authority of inspectors are given in Guide YTV 6.3 (STUK's internal guide). Effective legal tools are available to STUK, but they are seldom needed. It is not STUK's policy to threaten the licencees with fines or other penalties, but instead to motivate them to maintain high quality of work and good safety culture and to encourage open discussions with the regulators.

STUK's rights to control radiation practices and to enforce regulatory requirements are prescribed in the Radiation Act (Chapters 14 and 15). STUK is authorized to:

- conduct inspections and obtain information (Section 53)
- issue orders pertaining to ensuring radiation safety
- issue order that a practice be discontinued or restricted (Section 55)
- prohibit the sale or other transfer of radiation appliances, radioactive substances, equipment and other products pertaining to safety of radiation practice which do not meet relevant safety requirements (Section 56)
- to issue a threat of fine (Section 59)
- to issue a threat that the neglected measure be performed at the defaulter's expense (Section 59).

An order to discontinue or restrict a practice can be issued by an individual inspector onsite if a practice causes an obvious detriment to health or the danger thereof. In this case the Section Head and the Director of Radiation Practices Regulation Department have to be informed without delay. The order needs to be confirmed formally later by a written decision by the Director of the Radiation Practices Regulation Department.

The Radiation Act (Section 60) includes reference provisions concerning penalties prescribed in the Penal Code for:

- the use of radiation in a manner liable to endanger life or health
- environmental damage occasioned contrary to the Radiation Act and to provisions issued pursuant thereto
- careless handling of radioactive material or a radiation device.

Radiation offences are prescribed in the Radiation Act (Section 61). The public prosecutor may prefer not to charge for an offence referred to in the Radiation Act before obtaining a statement on the matter from STUK.

STUK's procedures for enforcement in the use of radiation are described in STUK's internal guides.

Art. 5.1(f)

(f) the allocation of responsibility to the bodies involved in the different steps of spent fuel and radioactive waste management; in particular, the national framework shall give primary responsibility for the spent fuel and radioactive waste to their generators or, under specific circumstances, to a licence holder to whom this responsibility has been entrusted by competent bodies;

According to the Nuclear Energy Act (Section 9), a licencee, whose operations generate or have generated nuclear waste, shall be responsible for all nuclear waste management measures and their appropriate preparation, and the licencees are also responsible for the arising expenses.

The NPP utilities FPH and TVO themselves take care of the interim storage of spent fuel, of the management of LILW including storage and disposal, and of the planning for and implementation of the decommissioning of the NPPs. Their joint company, Posiva, is taking care of the preparation for and later implementation of spent fuel encapsulation and disposal. Fennovoima Oy is planning to take care of its own spent fuel interim storage and management, management of LILW including storage and disposal (on site) and planning and implementation of decommissioning of the NPP. In June 2016 Fennovoima submitted to MEAE the EIA-program for the disposal of the spent fuel.

The Radiation Act (Section 50) provides for the management of radioactive waste from non-nuclear applications. The responsible party (i.e. the licencee or any company or organization which uses radiation sources in its practices) is required to take all the measures needed to render the radioactive waste arising from its operation harmless. In case where the practice produces or may produce radioactive waste that cannot be rendered harmless without considerable expenses, a financial security shall be furnished to ensure that these costs and those arising in performing any necessary environmental decontamination measures are met.

The state has the secondary responsibility in case a producer of nuclear waste (the Nuclear Energy Act (Sections 31 and 32)) or other radioactive waste (the Radiation Act (Section 51)) is incapable of fulfilling its management obligation.

Art. 5.1(g)

(g) national requirements for public information and participation;

The availability of information related to the siting process for a major nuclear facility is based on the Finnish legislation on the openness of information, notably on the Act on the Openness of Government Activities (621/1999). Further requirements are based on the Act (252/2017) and Decree (277/2017) on the Environmental Impact Assessment Procedure and the Nuclear Energy Act. The first step of consultation with the general public is the Environmental Impact Assessment (EIA) procedure. Public hearings are arranged both in the programme phase of the EIA and during the actual assessment. The responsible contact authority for that procedure in case of nuclear energy related projects is the Ministry of Economic Affairs and Employment. The EIA report and relevant plans to minimize environmental impacts have to be annexed to the DiP application as defined in Nuclear Energy Act (Section 24).

The Nuclear Energy Act (Section 13) states that, before the Decision-in-Principle is made, the applicant shall make available to the public an overall description of the facility, of the environmental effects it is expected to have and of its safety. MEAE shall provide residents and municipalities in the immediate vicinity of the nuclear facility as well as local authorities a chance to present their opinions in writing before the Decision-in-Principle is made. Furthermore, MEAE shall arrange a public hearing in the municipality where the planned site of the facility is located and during this hearing the public shall have the opportunity to give their opinions either orally or in writing. The presented opinions have to be made known to the Government. The Nuclear Energy Act (Section 14) further provides that a necessary prerequisite for the Decision-in-Principle is that the planned host municipality for the nuclear facility is in favour of siting the facility in that municipality.

Before granting the licence for construction, operation or decommissioning of a nuclear facility MEAE informs the public where the application is available for perusal, and requests the public to express their statements and opinions as defined in the Nuclear Energy Act (section 23a).

According to the Nuclear Energy Act (Section 10 a) the licencee shall keep general description of the facility and applied safety principles publicly available.

According to the Act and Decree on the Environmental Impact Assessment Procedure the decommissioning of a nuclear facility requires that an Environmental Impact Assessment (EIA) should be performed. In 2015 the required EIA was completed for the planned decommissioning of the Finnish research reactor (FiR 1).

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Art. 5.1(h)

(h) the financing scheme(s) for spent fuel and radioactive waste management in accordance with Article 9.

The producers of spent fuel and radioactive waste are responsible for all the costs generated in the waste management process. The framework for the financing system is described below.

The Nuclear Energy Act (Sections 35 to 53)and Nuclear Energy Decree (Sections 86 to 98) provides detailed regulations for the financial arrangements for nuclear waste management and the Decree on the State Nuclear Waste Management Fund (VYR) further specifies the financing system. The financial provisions are described in greater detail in the Government Decree on Financial Provisions for the Cost of Nuclear Waste Management (991/2017). The producers of nuclear waste are obliged to present every three years justified estimates of the future cost of managing their existing waste, including management and disposal of spent nuclear fuel and decommissioning of facilities. MEAE confirms annually the assessed liability and the proportion of liability the Nuclear Waste Management Fund has to reach (the fund target). The tasks of the Nuclear Waste Management Fund are described in detail in the Government Decree on the State Nuclear Waste Management Fund (161/2004). The waste generators pay annually the difference between the fund target and the amount already existing in the Fund, but can also be reimbursed if the funded amount exceeds the liabilities. The waste generators shall provide securities to MEAE for the portion of financial liability that is not yet covered by the Fund.

The Radiation Act (Section 19) provides for furnishing the financial security of radioactive waste management for non-nuclear practices as follows: to ensure that the licencee meets the costs incurred in rendering radioactive waste harmless and in carrying out any decontamination measures that may be needed in the environment, the licencee shall furnish securities if the operations produce or are liable to produce radioactive waste that cannot be rendered harmless without substantial cost. The Radiation Act (Section 31f) provides for furnishing security in case of using high activity sealed sources.

Art.5.2

Member States shall ensure that the national framework is improved where appropriate, taking into account operating experience, insights gained from the decision-making process referred to in Article 4(3)(f), and the development of relevant technology and research.

The Nuclear Energy Act (Sections 54 and 54a) states the time schedule for the national framework of self-evaluation as well as for the international evaluation. The evaluation is required to be performed every 6 years or every 10 years depending on the topic or if there is significant accident effecting radiation or nuclear safety.

The Nuclear Energy Act (Section 7a) states regarding continuous improvement: The safety of nuclear energy use shall be maintained at as high a level as practically possible. For the further development of safety, measures shall be implemented that can be considered justified considering operating experience and safety research and advances in science and technology.

Finland is a contracting party to the international treaties and conventions for ensuring safety in the utilization of nuclear energy and radiation. Finland also has several bilateral agreements for exchange of information on nuclear facilities and on notification of a nuclear and radiation emergencies. In addition, STUK has made bilateral arrangements with several foreign regulatory bodies, and these arrangements generally cover exchange of information on safety regulations, operational experiences, waste management etc.

Finland has implemented the Code of Conduct on the Safety and Security of Radioactive Sources and the Code of Conduct on Safety of Research Reactors.

STUK participates actively in European and international co-operation in the field of nuclear and radiation safety and security as well as safety of waste management.

The IAEA safety standards and WENRA harmonised safety reference levels are addressed when developing Finnish legislation, regulation and requirements. In practice, currently, the most important references considered in rulemaking are the IAEA safety standards and the WENRA reference levels. Considering the WENRA reference levels, the Finnish policy is to include all of them when updating the regulatory guides.

The Finnish Government has requested several international peer reviews concentrating on the safe use of nuclear energy. These peer reviews have been focused on regulatory activities (IRRS), waste management (EU Peer Review), nuclear power plants (OSART), research reactor (IAEA) and in physical protection (IPPAS) as well as on environmental surveillance program (EC). In addition STUK's research activities have been evaluated by international teams.

Two peer reviews should be especially mentioned: the peer review on activities related to the spent fuel disposal project in 2009 and the IRRS in 2012. As one of the results, the amendments to the Nuclear Energy Act and the Radiation Act were prepared in 2013 and entered into force by January 1st 2016. As a result of the follow-up mission in June 2015 the review team concluded that the recommendations and suggestions from the 2012 IRRS mission have been taken into account systematically in a comprehensive action plan. Significant progress has been made in most areas and many improvements have been implemented in accordance with the action plan. The IRRS team determined that 7 out of 8 recommendations and 19 of 21 suggestions made by the 2012 IRRS mission had been effectively addressed and therefore could be considered closed.

Finland has been active in making Finnish experts available in international peer reviews. STUK's experts have participated in several IRRS and ARTEMIS missions.

STUK analyses both domestic and foreign operational experience from various sources to identify lessons learned and to improve safety at nuclear facilities and activities. STUK uses the feedback from both operational and regulatory experience for improving review, assessment, and inspection activities and for developing the regulatory guides.

STUK has made arrangements for receiving and collating information from other countries and relevant authorized parties. STUK actively disseminates lessons learnt from operational experiences to the international community. The most important arrangements are the Incident Reporting Systems (IRS) on incidents and operational

events by IAEA and OECD/NEA. STUK has voluntarily provided experts to work in EU Clearinghouse on Nuclear Power Plant Operational Experience Feedback (Petten).

STUK also gathers information directly from its cooperation with other regulators, especially with the regulators and plant operators of Sweden and Russia having similar operating plants (BWRs, VVERs) as Finland. Other sources of operating experience are meetings of regulator groups: OECD/NEA/WG's, WENRA, NERS, VVER-forum, MDEP, EU-projects and early information channels like IAEA/NEWS and WGPCNEWS as well as OECD/NEA Topical Databases.

6 Competent regulatory authority (Article 6)

Art. 6.1

Each Member State shall establish and maintain a competent regulatory authority in the field of safety of spent fuel and radioactive waste management.

Supreme authorities

According to the Nuclear Energy Act (Section 54), the overall authority in the field of nuclear energy is the Ministry of Economic Affairs and Employment (MEAE) which has the responsibility of formulating the national energy policy. The MEAE prepares matters concerning nuclear energy, including nuclear waste management, for the Government for decision-making. The Nuclear Energy Act (Section 28) states that the Ministry shall decide, having consulted, when necessary, the Ministry of the Environment in the matter, the principles on the basis of which the waste management obligation is to be implemented.

As stipulated in the Radiation Act (Section 5), which covers radioactive, non-nuclear waste management, the Ministry of Social Affairs and Health (MSAH) is the supreme authority on the supervision of practices involving exposure to radiation.

Regulatory authority for radiation and nuclear safety

The Radiation and Nuclear Safety Authority of Finland (STUK) is an independent governmental organization for the regulatory control of radiation and nuclear safety. In accordance with the Nuclear Energy Act, the Radiation Act, the Act on the Radiation and Nuclear Safety Authority of Finland (1069/1983) as well as other regulations and international agreements, the Radiation and Nuclear Safety Authority shall be responsible for:

1) Regulatory control of the safety of the use of nuclear energy, and regulatory control of physical protection, emergency preparedness and nuclear materials;
2) Regulatory control of the use of radiation and of other radiation practices;
3) Monitoring of the radiation situation in Finland, and for maintaining preparedness for abnormal radiation situations;
4) Maintaining national metrological standards in its field of activity;
5) Pursuing research and promoting development to enhance radiation and nuclear safety;

6) Providing information on radiation and nuclear safety issues, and for participating in training activities in the field;
7) Producing expert services applicable in its field of activity;
8) Making proposals for developing legislation in its field of activity, and for issuing general guides concerning radiation and nuclear safety; as well as
9) Contributing to international co-operation in its field of activity, and for taking care of international control, contact and reporting activities, as enacted or prescribed.

In May 2015 the Nuclear Energy Act and the Radiation Act were amended in such a way that the mandate of STUK was increased. Based on the changes STUK has these authority to issue binding regulations, which have replaced some of the lower level government decrees related to nuclear and radiation safety. Further, based on the changes of the Nuclear Energy Act the Government has to take into account the proposals included in the STUK's statements when considering the conditions of the Decision-in-Principles and licences for nuclear facilities.

STUK does not grant construction or operating licences for nuclear facilities as it is the duty of the government. However, no such licence can de facto be issued without STUK's safety review and statement on the fulfilment of the safety regulations.

The regulatory oversight of the use of nuclear energy is described in detail in Regulatory Guide YVL A.1.

According to the Radiation Act (Section 6) STUK is responsible for controlling that the Radiation Act and other regulations based on the Act are followed. According to the Radiation Act (Section 16), STUK grants safety licences for the use of radiation. The regulatory rights of STUK are described in the Radiation Act (Sections 53 to 58).

STUK's reports on the regulatory oversight of nuclear and radiation safety, including radioactive waste management, are published annually.

Art. 6.2

Member States shall ensure that the competent regulatory authority is functionally separate from any other body or organization concerned with the promotion or utilisation of nuclear energy or radioactive material, including electricity production and radioisotope applications, or with the management of spent fuel and radioactive waste, in order to ensure effective independence from undue influence on its regulatory function.

STUK is administratively under the Ministry of Social Affairs and Health. Connections to various ministries and governmental organizations are described in Fig. 4.

It is emphasised that the regulatory oversight of the safe use of nuclear energy and radiation is independently carried out by STUK and other governmental bodies cannot take for their decision a matter that has been delegated by law to STUK. STUK has no responsibilities, duties or functions which would be in conflict with the regulatory oversight.

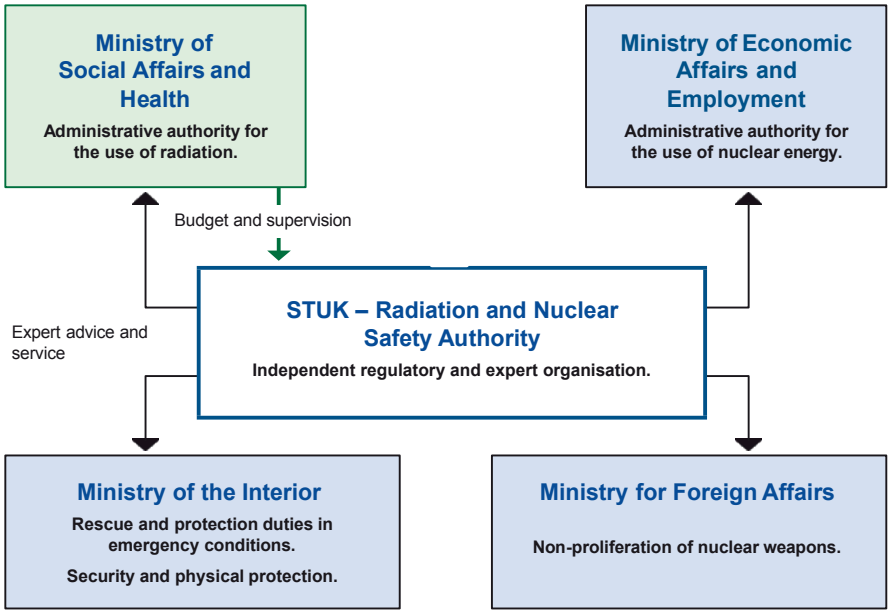

Fig. 4. Co-operation between STUK and Ministries and other governmental organizations.

The company managing the institutional radioactive waste, Suomen Nukliditekniikka, operated in the same building as STUK offices until 2016, but has moved to different location in 2017.
The conditioned waste from Suomen Nukliditekniikka is disposed of to STUK operated Disposal, which is located in TVO LILW-disposal facility. The regulatory role and the owner of the disposal facility have been administratively separated. This separation was reviewed in 2012 IRRS, and no concerns nor development suggestions were raised of it.

Art. 6.3

Member States shall ensure that the competent regulatory authority is given the legal powers and human and financial resources necessary to fulfil its obligations in connection with the national framework as described in Article 5(1) (b), (c), (d) and (e).

STUK's legal powers are described under Art. 6.2 and Art. 5.1(e).

STUK's human resources

STUK has adequate resources to fulfil its responsibilities. The total number of the personnel (at the end of 2017) was 326, most of which are directly involved with radiation and nuclear safety as well as nuclear safeguards and security related regulatory activities. In addition STUK has organized national and international expert support groups for the safety issues of the disposal site, disposal technology and safety assessment. In the most significant licensing phases (construction licence and operating licence) external experts have been used to assist the STUK's experts and distribute the workload.

To ensure that STUK has the appropriate number of persons with relevant competencies, the following general process is applied. STUK establishes its strategy normally for a five year period. The latest strategy was launched at the end of 2017 and it covers years 2018 to 2022. The focus of the strategy is to give more responsibility to licencees and focus the regulatory resources based on safety significance. Several projects have been established for the implementation of the strategy. Each project has a specific strategy objective which needs to be developed.

STUK's competence and human resource needs are evaluated in each step mentioned above (strategy, operating programmes and annual plans) from the organizational level to the individual level. Resource needs identified during the planning are documented in human resource plans and the needs also influence the training programme. STUK's Management System provides more guidance on the personnel administration, resource allocation and competence management.

STUK trains its personnel continuously. Training programmes are established on the organizational as well as on the individual level reflecting the tasks and responsibilities of each individual. Individual needs for training are identified in the course of work and during the annual planning. STUK has carried out self-assessments to explore the level of knowledge, skills and abilities available and necessary for the regulatory functions of STUK. IAEA's SARCoN tool has been piloted in the nuclear safety department. Inspectors working for the control of the use of radiation are required to have a formal qualification of radiation safety officer.

Regulatory support organizations and technical and scientific programmes

The main national technical support organization of STUK in the field of nuclear engineering is VTT, Technical Research Centre of Finland Ltd. In VTT and other Governmental or University institutes, tens of experts are working in the area of safety of nuclear power plants as well as in the area of spent nuclear fuel and radioactive waste management.

STUK has three advisory commissions. The members of the commission are individuals from various Finnish authorities and in the nuclear security also nuclear licencees. The members are nominated for three years at the time.

- An Advisory Commission on Nuclear Safety has been established by a separate Decree (164/1988). This Commission gives advice to STUK on important safety issues and regulations. The Commission also gives its statements on licence applications. It has two international Committees, one for nuclear waste safety (NWSC) and one for reactor safety (RSC).

- An Advisory Commission on Radiation Safety has been established by radiation safety decree section 30 (1512/1999).

- An Advisory Commission on Nuclear Security was established in 2009 based on Nuclear Energy Act section 56. New decree defining the nuclear security advisory committee is under preparation. The duties of the commission include the

assessment of the threats in the nuclear field as well as consultation to STUK in important security issues.

Financial resources of regulatory body

STUK receives about 34 % of its financial resources through the State budget. However, the costs of regulatory oversight are charged in full from the licencees. The model for financing the regulatory work is called a net-budgeting model and it has been applied since 2000. In this model, the licencees pay the regulatory oversight fees directly to STUK. In 2016, the cost of the regulatory oversight for nuclear safety was 19 million €. The regulatory oversight of the use of radiation and non-nuclear waste was about 3.4 million € in 2016.

STUK has adequate resources to fulfil its responsibilities in regulatory oversight. The net-budgeting model makes it possible, for example, to increase personnel resources flexibly based on needs.

7 Licence holders (Article 7)

Art. 7.1

Member States shall ensure that the prime responsibility for the safety of spent fuel and radioactive waste management facilities and/or activities rest with the licence holder. That responsibility cannot be delegated.

In Finland, the responsibility for safety rests with the licencee and this responsibility cannot be delegated as prescribed in the Nuclear Energy Act (Section 9). The licencee is also responsible on the suppliers and subcontractors products and services fulfil the safety requirements defined in the Nuclear Energy Act.

As a precondition for granting a safety licence for the use of radiation the Radiation Act requires (Section 16) that the applicant presents valid proof on the safe management of any radioactive waste which may be generated. Further, the Radiation Act (Section 50) provides that the responsible party shall organize the practice so that it meets all radiation safety requirements prescribed in the Act and shall take all the measures needed to render radioactive waste arising from its operation harmless. The Radiation Act also provides for the responsibility of decontamination of the environment, if the radioactive material is released in such an extent that the resulting health or environmental hazards require action. According to the Act (Section 50), in utilization of natural resources containing radioactive materials, the responsible party shall ensure that radioactive wastes do not pose any health or environmental hazards during the operations, including measures taken while stopping these activities.

The Radiation Act (Section 51) provides that if the responsible party does not meet the requirements set for radioactive waste management, the State has the secondary obligation in managing the radioactive waste or residues. The same applies if the origin of the waste is unknown, or no primary responsible party can be found.

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Art. 7.2

Member States shall ensure that the national framework in place require licence holders, under the regulatory control of the competent regulatory authority, to regularly assess, verify and continuously improve, as far as is reasonably achievable, the safety of the radioactive waste and spent fuel management facility or activity in a systematic and verifiable manner. This shall be achieved through an appropriate safety assessment, other arguments and evidence.

The continuous safety assessment and enhancement approach applied in Finland is based on the Nuclear Energy Act (Section 7a) stating that the safety of the use of nuclear energy shall be as high as reasonable achievable. To further enhance safety, all actions justified by operational experiences, safety research and the progress in science and technology shall be taken.

The safety impact of a spent fuel management facility is analysed either in the safety analysis reports presented as part of the construction, operating and decommissioning licence applications of NPPs regarding spent fuel interim storage or separately for the planned encapsulation plant and disposal facility for spent fuel. The safety impact of the radioactive waste management facility is analysed in the safety analysis reports presented as part of the construction and operating licence applications of the facility.

It is the responsibility of the regulatory body to verify that the licencees fulfil their responsibilities set in the regulations. This verification is carried out through safety reviews and assessments as well as inspection programmes established by STUK and conducted at set intervals.

The operating licences for nuclear facilities are granted for a limited period of time.

For the licence renewal and the Periodic Safety Review (also during decommissioning), a comprehensive re-assessment of safety, including the environmental safety of the nuclear facility and the effects of external events on the safety of the facility, shall be performed. STUK reviews the licence applications, including all site-specific safety reports.

The comprehensive safety assessments for applications for the renewal of licences are required to include the updates of e.g. the following safety relevant documents:

- Final safety analysis reports
- Quality assurance programmes for operation
- Technical specifications
- Programmes for periodic inspections
- Plans for nuclear waste management, including decommissioning and disposal
- Plans for physical security and emergency preparedness
- Administrative rules for the facilities
- Programmes for radiation monitoring in the environment of the facilities
- Licencee assessments of compliance with the regulations, including assessment of the fulfilment of YVL Guides' requirements
- Licencee assessments of how an adequate safety level has been maintained

The periodic safety review report shall include the same information, updated as appropriate.

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The latest comprehensive safety assessments of the Loviisa and the Olkiluoto NPPs, including the spent fuel interim storages and the LILW management at the NPP, were carried out for the Loviisa NPP in periodic safety review of the plant in 2014-2016 (STUK review) and for the Olkiluoto NPP in connection of operational licence renewal 2016-2018 (STUK review).

The latest comprehensive safety assessment of the radioactive waste disposal facility (VLJ disposal facility for TVO) was carried out in 2011-2012. To cover the needs of the disposal of operational waste from the OL3 unit and the disposal of other radioactive waste (managed by STUK) TVO applied for a change in the operating licence conditions. This change was accepted by Government in 2012. The comprehensive safety assessment of the Loviisa LILW disposal facility was carried out as a periodic safety review during 2013 and 2014.

The re-licensing safety reviews and statements by STUK given to MEAE concluded that, as regards radiation and nuclear safety, the conditions at the Loviisa and the Olkiluoto NPPs comply with the Finnish nuclear energy legislation and regulations. In addition to the review of the above mentioned documents, STUK has also performed independent safety assessments and has annually made a number of regular and topical inspections to the facilities.

Safety improvements have been annually implemented at the Loviisa and the Olkiluoto plants including the facilities for spent nuclear fuel handling and interim storage since the commissioning. At the Olkiluoto spent fuel interim storage recent safety improvements have been carried out in connection with the enlargement of the spent fuel interim storage. There exists no urgent need for additional improvements to upgrade the safety of these facilities.

The safety of the FiR 1 research reactor was reviewed in the context of the renewal of the operating licence in 2011. The present licence is valid until the end of 2023. However, in the summer of 2012 VTT made the decision to stop the operation. During the decommissioning phase the safety will be reviewed focusing on the safety of the decommissioning in particular. The first step in this phase has been the preparation of the programme for the environmental impact assessment (EIA) during 2013-2015. The EIA report was prepared by VTT in 2014. VTT submitted the operating licence application for decommissioning to the Government in June 2017.

Following the accident at the Fukushima Dai-ichi nuclear power plant, national safety assessments as well as EU level stress tests were initiated in Finland during 2011 and 2012. The safety of spent fuel interim storages was assessed as part of NPP safety assessments. STUK has reviewed the results and made licencee specific decisions in July 2012. Based on the results, it is concluded that no such hazards or deficiencies have been found that would require immediate actions at the Finnish NPPs. However, areas where safety can be further enhanced have been identified and there are plans on how to address these areas.

The power companies have collected the action lists after the Fukushima Dai-ichi related stress test evaluations and the actions are ongoing. The R&D activities needed to fulfil the actions are carried out in the national research programmes SAFIR2018/SAFIR2022,

KYT2018/KYT2022 and in Nordic nuclear energy related R&D co-operation, also proprietary R&D projects have been launched. As an Example the Loviisa spent fuel storage has been improved since the Fukushima Dai-ichi accident. The main changes are aimed at reducing the dependency on the plant's normal electricity supply and distribution system, an on seawater-cooled systems for residual heat removal from the reactor, as well as containment and spent fuel pools. Two air-cooled cooling units were constructed and commissioned in 2014-2015 to ensure long-term decay heat removal in case of the loss of seawater for cooling. The design plans for the installation of a diverse water supply to the spent fuel pools have also been approved by STUK in 2015 and the installation is planned to be carried out during 2019. Finally, the flood protection of the NPP and interim spent fuel storages has been improved.

For the non nuclear radioactive waste the safety review has been performed with inspections. However, according to the new Radiation Act there will be periodical reviews of the safety license.

Art. 7.3

As part of the licensing of a facility or activity the safety demonstration shall cover the development and operation of an activity and the development, operation and decommissioning of a facility or closure of a disposal facility as well as the post- closure phase of a disposal facility. The extent of the safety demonstration shall be commensurate with the complexity of the operation and the magnitude of the hazards associated with the radioactive waste and spent fuel, and the facility or activity.

The licence applications for a new licence or for the renewal of an existing licence include the documents required by the Nuclear Energy Decree (Sections 35, 36 and 36a): Preliminary or Final Safety Analysis Reports; Probabilistic Risk Analysis Reports; Quality Assurance Programmes for Construction and Operation; Safety Classification Document, Operational Limits and Conditions Document (Technical Specifications); Programmes for Periodic Inspections; Plans for Physical Protection and Emergency Preparedness; Manuals for Accounting and Control of Nuclear Materials; Administrative Rules for the Facilities; Programmes for the radiological baseline survey or the results of the radiological baseline survey; Programmes for Radiation Monitoring in the Environment of the Facilities; Decommissioning plans.

The design of the facility is described in the Preliminary Safety Analysis Report (PSAR) and in the Final Safety Analysis Report (FSAR). These reports are submitted to STUK for approval in connection with, respectively, the applications for Construction and Operating Licences. According to the Nuclear Energy Decree, the FSAR has to be continuously updated.

The STUK regulation (STUK Y/1/2016) requires that the nuclear power plant safety and the technical solutions of its safety systems, including systems for spent fuel interim storage, shall be assessed and substantiated analytically and, if necessary, experimentally. These include analyses of operational occurrences and accidents, strength analyses, failure mode and effect analyses, and probabilistic risk assessments. Analyses shall be maintained and revised if necessary, taking into account operating

experience, the results of experimental research, plant modifications and the advancement of computational methods.

The safety assesment shall be presented in connection with the construction licence application and the operating licence application of the nuclear waste facility. The safety assessment for disposal facilities shall be updated at minimum 15-year intervals unless otherwise provided in the licence conditions. Furthermore, the safety case shall be updated prior to the permanent closure of the facility.

According to Guide YVL D.5 a safety analysis, or a safety case as in the STUK regulation (STYK Y/4/2016), shall include:

- a description of the disposal system and the definition of barriers and safety functions;
- a specification of performance targets for the safety functions;
- a definition of the scenarios (scenario analysis);
- a functional description of the disposal system and a description of the conditions prevailing in the disposal site by means of conceptual and mathematical modelling, and the determination of necessary model parameters;
- an analysis of the quantities of radioactive substances that are released from the disposed waste, penetrate the barriers and enter the biosphere, and an analysis of the resulting radiation doses;
- whenever possible, an estimation of the probabilities for activity releases and radiation doses arising from unlikely events impairing long-term safety;
- uncertainty and sensitivity analyses and complementary qualitative considerations; and
- a comparison of the outcome of the analyses against the safety requirements

Regarding the disposal of spent fuel, compliance with long-term radiation protection objectives as well as the suitability of the disposal concept and site shall, according to the STUK regulation (STUK Y/4/2016), be justified by means of compliance with the long-term radiation protection objectives, equally the suitability of the disposal concept and site shall be justified through a safety case that addresses both the expected evolutions and unlikely disruptive events impairing long-term safety.

The periodic safety review shall include assessments of the disposal facility's safety status and the long-term safety of the disposal as well as potential development targets in order to maintain and enhance safety. The safety analysis report and the safety case shall be updated to reflect the results of the safety review. The periodic safety review shall be conducted in compliance with the requirements of Guide YVL A.1, where applicable.

The Nuclear Energy Act (Section 7g) states that provisions for decommissioning shall be included in the design of a nuclear facility. In the context of the licensing requirements, the STUK regulation (STUK Y/1/2016) states that the design of a NPP shall take into account decommissioning so as to limit waste volumes and radiation exposure both to the workers and to the environment. The Nuclear Energy Decree (Section 32) provides that the application for a construction licence has to include a description of the applicant's plans and available methods for arranging nuclear waste management, including the decommissioning of the nuclear facility and the disposal of nuclear waste,

and a description of the timetable of nuclear waste management and the estimated costs. More detailed requirements are given in the Regulatory Guides YVL A.1 and YVL D.4.

According to the Nuclear Energy Act (Section 7g) the licencees are obliged to prepare decommissioning plans for regulatory review when applying operation licence and to update them every six years during operation. These plans aim at ensuring that decommissioning can be appropriately performed when needed and the estimates for decommissioning costs are realistic.

The final decommissioning plan shall be prepared and submitted in the decommissioning licence application according to the Nuclear Energy Decree (section 20a).

Detailed requirements for the contents of the post-closure safety case are provided in Guide YVL D.5 (Annex A). The post-closure safety case shall include a description of the disposal system: quantities of radioactive substances; waste packages; buffer materials; backfill materials; structures for isolation and closure; excavated rooms; the geological, hydrogeological, hydrogeochemical, thermal and rock mechanical characteristics of the host rock; and the natural environment at the disposal site. The post-closure safety case shall define the safety concept, barriers and safety functions with their performance targets. The safety case shall include an assessment of the confidence level with regard to compliance with the safety requirements and of the uncertainties with the greatest impact on the confidence level.

The four reactor units in Finland have been operated for 36 to 40 years. These units are planned to be operated further up to the total operation period of 50 years (Lo 1 & 2) and 60 years (OL 1 & 2). No nuclear power plants are currently being decommissioned and the first project of this kind will be the decommissioning of the research reactor which will take place in the near future.

The latest update of the Loviisa NPP decommissioning plan was issued at the end of 2012 by Fortum Power and Heat. Teollisuuden Voima Oyj's decommissioning plan for operating NPPs has been updated and submitted to the authorities at the end of 2014. For the new reactor unit OL3 under commissioning the decommissioning plan was prepared for operation licence application in 2016.

The preliminary safety analysis report (PSAR) and the other safety related documents for the extension of the Olkiluoto spent fuel interim storage facility were reviewed in 2010. The FSAR for the storage extension was approved for the commissioning of the extension in 2015.

Fennovoima has submitted the preliminary decommissioning plan as a part of the construction licence application in 2015. Fennovoima has issued the PSAR for the spent fuel interim storage in spring 2018. The storage will be commissioned in early 2030s.

Posiva submitted the construction licence application for the spent fuel encapsulation and disposal facility at the end of 2012. In 2013 and 2014 STUK carried out an overall assessment of the post-closure Safety Case submitted to STUK in connection with the application for a construction licence, establishing the sufficiency and adequacy of the information provided, and issuing a decision on accepting the document for a more

detailed review process. STUK's regulatory review of the construction licence application was completed in February 2015, and to support the more detailed review STUK also used outside experts. STUK concluded, based on the licence application review and assessment, that the safety requirements have been met although several improvements for safety needs to be done before operation license can be granted. The construction licence for the spent fuel encapsulation and disposal facilities was granted by the Government in the end of 2015.

The predisposal management of radioactive waste subject to the Radiation Act involves generally operations which may not cause any extensive hazards: handling of sealed sources, segregation and packaging of small amounts of LLW. Thus no comprehensive safety or environmental impact assessments are needed but the safety of the required operations is evaluated in the context of the licensing processes.

Art. 7.4

Member States shall ensure that the national framework require licence holders to establish and implement integrated management systems, including quality assurance, which give due priority to safety and are regularly verified by the competent regulatory authority.

According to the Nuclear Energy Act (Section 7j) the management system of a nuclear facility shall pay particular attention to the impact of safety related opinions and the attitudes of the management and personnel towards the maintenance and development of safety, alongside systematic operating methods and their regular assessment and development.

The importance of a good safety culture is emphasized in section 38 of the STUK regulation on the Safety of disposal of nuclear waste (STUK Y/4/2016) and Regulation on the safety of nuclear power plant section 25 (STUK Y/1/2016).

STUK's Guide YVL A.3 sets general requirements for management systems. Guide YVL A.3 is based on IAEA GS-R-3. The management system must support the characteristics of the organizational culture that promote good safety culture, and the management must express its commitment to safety. Safety culture expertise must be available for developing the licencee's processes, procedures and measures to ensure and improve the safe operation of the facility. The development of the safety culture must be target oriented and systematic. The licencee also has to establish a process to measure, assess and improve its safety culture.

Guide YVL A.5 concerns nuclear facility construction and modification. Also in this guide there are requirements concerning safety culture and risk management. The management systems of the licencees and applicants are subject to approval by STUK. During construction and modifications the licencee must ensure that the contributing parties are able to perform according to safety requirements and there must be training on safety culture issues for the personnel taking part in the activities. The licencee must have procedures for evaluating and developing the safety culture of the contributing parties.

STUK regularly reviews the licencees' management systems.

Regarding the uses of radiation, the spectrum of practices is very wide starting from "one-man-company" to very large organizations. Therefore, a graded approach is applied regarding requirements on management systems. Guide ST 1.1 stipulates: "The statutory requirements of the responsible party can be best met through the use of a management system (a quality system) that is designed for use in the radiation practice. The management system shall be described in guidelines and other documents, and all respective documents shall be arranged to form a unified, continuously updated totality (the procedures manual or similar)." In addition, there are in place many practice specific requirements for quality assurance (i.e. measures that must be implemented but which are not necessarily a part of a formal management system). In the new Radiation Act there will be requirement for all radiation users to have management system.

Measures taken by licence holders

The licencees (FPH, TVO and VTT), the licence applicant Fennovoima and the nuclear waste management company Posiva have adopted certified quality management systems consistent with the ISO 9001 standard. The management systems of the aforementioned organizations fulfil also the requirement set in Guide YVL A.3. Moreover, FPH, TVO and Posiva have adopted an environmental management system according to ISO 14001 occupational health and safety according to OHSAS 18001.

Loviisa NPP

Fortum has in its management system established documented quality and safety policies for the Loviisa NPP. That includes also the conditioning, storage and disposal of LLW and ILW as well as the intermediate storage of spent fuel on the NPP site. The management system aims at filling all the requirements stated in the YVL guides and is continuously developed. The development of the Loviisa NPP's quality management system is based on the principle of continuous improvement in accordance with the observations and remarks made in quality audits and quality assessments. The Loviisa NPP has also made organizational changes that aim at promoting safety and safety culture development. There is a unit especially dedicated for operational experience and safety culture. In addition, the Loviisa NPP has an independent advisory body for safety issues, i.e., a nuclear safety committee with external expert members.

Fortum has continued having international evaluations of safety management and procedures at the Loviisa NPP in order to improve its own operations and management system.

Olkiluoto NPP

TVO has documented quality and safety policies for the Olkiluoto NPP that are binding for all persons working for the NPP, also for those working with the conditioning, storage and disposal of LLW and ILW as well as the intermediate storage of spent fuel on the NPP site. TVO is actively developing the management system towards a process based management system due to the growing organization and the need for systematic and efficient operations throughout the organization. TVO has also defined so called 'Management Expectations' flyers, where the managers communicate very clearly their expectations for safe working and safety attitudes. The Olkiluoto NPP has worked several years with safety culture evaluation and development. TVO has founded a special

safety culture team that is independent off operations and construction. This team meets regularly about 10 times a year and the objective is to form a comprehensive view of the safety culture situation in the whole TVO and report and give suggestions for improvement actions to the top management of the organization.

TVO has assessed the safety culture of the Olkiluoto NPP employing several methods. The safety culture issues have been regularly discussed in the internal safety committee. The self-assessment is repeated approximately every third year. Personnel surveys and the peer review method of the World Association of Nuclear Operators (WANO) have also been utilised actively. TVO has continued using and developing the safety culture promotion and assessment methods concerning the Olkiluoto unit 3 project and the contributing parties. Assessment method consists of a questionnaire, interviews and analysis of safety observations, authority inspections and non-conformance records.

Posiva

Posiva has established and implemented its integrated management system (IMS). STUK has reviewed and approved the management system as part of the construction licence application documentation. The management system needs to be supplemented and updated before the commissioning and operating phases of the project.

The construction licence was granted to Posiva in November 2015. During 2016 STUK re-evaluated the readiness of Posiva's organization for the construction activities. As a part of this evaluation also the integrated management system and Posiva's most important functions were assessed through several inspections at the site. STUK's approval for the launching of the construction activities of the disposal facility was given in late 2016 and Posiva started the construction of the facility in December 2016.

Posiva's contractors supplying products important to nuclear safety must also have a quality management system fulfilling the main requirements of Guide YVL A.3. These organisations also need to prepare a supply specific quality plan for the design, manufacturing and testing of the products. STUK verifies the implementation of the quality management systems and the quality plan with a graded approach through reviews and inspections. As a part of this oversight STUK participates in the safety related contractor audits performed by Posiva.

VTT

The quality management system of VTT Technical Research Centre of Finland Ltd, the operator of the research reactor FiR 1, is based on the quality standard ISO 9001. When the decommissioning and dismantling activities of FiR 1 start, VTT will prepare additional instructions to supersede and complete the present operating management system of the research reactor.

Suomen Nukliditekniikka

Being a very small company (the owner being the only worker), there is no formal management system in place. However, all important working procedures having safety relevance are prescribed in the company's internal documents.

Fennovoima

Fennovoima has established an integrated management system, which continues to be developed to cover the requirements of the advancing nuclear project. The system is certified according to ISO 9001 in 2015, OHAS 18001 in 2016. The ISO 14001 is under certification process.

Article 7.5

Member States shall ensure that the national framework require licence holders to provide for and maintain adequate financial and human resources to fulfil their obligations with respect to the safety of spent fuel and radioactive waste management as laid down in paragraphs 1 to 4.

Finances

The licencee's financial state is evaluated at predetermined intervals and especially during each licensing step. As a condition for granting a licence the applicant shall have adequate financial resources to realise the project and take care of the waste management obligations, as defined in Nuclear Energy Act (sections 19, 20 and 20a). The nuclear waste management fund is a backup fund if the licencee would be unable to fulfil its obligations. According to the normal practice the fund will return money to the licencee after the specified obligation has been fulfilled.

The Nuclear Energy Act (Section 35 to 53) provides detailed regulations for the funding arrangements and provisions for nuclear waste management and the Decree on the State Nuclear Waste Management Fund further specifies the system for financial provisions. The financial provisions are described in greater detail in the Decision by the Government on Financial Provisions for the Cost of Nuclear Waste Management (165/1988). The Decision by the Government on Financial Provisions for the Cost of Nuclear Waste Management has been replaced by a Government decree in 2017 (991/2017). The producers of nuclear waste are obliged to present justified estimates every three years of the future cost of managing their existing waste, including spent nuclear fuel disposal and decommissioning of facilities. The MEAE annually confirms the assessed liability and the proportion of liability the Nuclear Waste Management Fund has to reach (the fund target). The tasks of the Nuclear Waste Management Fund are described in detail in the Government Decree on the State Nuclear Waste Management Fund (161/2004). The waste generators annually pay the difference between the fund target and the amount already existing in the Fund, but can also be reimbursed if the funded amount exceeds the liabilities. The waste generators must provide collateral securities to MEAE for the portion of financial liability that is not yet covered by the Fund.

The licencee under a waste management obligation shall supply the State with collateral securities fulfilling the conditions laid down in the Nuclear Energy Act (Section 45), prior to the commencement of the waste generating operation.

Human resources

According to the Nuclear Energy Act (Sections 19, 20 and 20a), a necessary condition for granting a construction, operation and decommissioning licence of a nuclear facility is the availability of the necessary expertise. The licencee shall have adequate, suitable and competent personnel to operate a nuclear facility. Additionally the licencee shall ensure that safety significant suppliers and subcontractors have adequate suitable and competent personnel for the task (Nuclear Energy Act (section 7i). Furthermore, a nuclear facility must have a responsible manager and his/her deputy approved by STUK (the Nuclear Energy Act (Section 7k)).

The STUK regulation (STUK Y/4/2016) requires that the organisation shall have access to the professional expertise and technical knowledge required for the safe operation of the nuclear waste facility and long-term safety of nuclear waste disposal. Duties significant to safety shall be designated. Training programmes shall be prepared for the development and maintenance of the professional skills of the persons working in these positions, and adequate command of the knowledge required for the positions shall be verified.

According to the Nuclear Energy Act (Sections 55 and 7k), STUK is responsible for controlling the necessary qualifications of the persons engaged in activities important to safety. Guide YVL A.4 sets more specific requirements for safety critical positions, e.g. for the responsible manager and persons responsible for safeguards, emergency preparedness and security. The Guide has also specific requirements on management and leadership competence.

Accordingly, personnel and human resources related issues are included in STUK's inspection programmes for Posiva. During the years 2015–2017 the assessing of the organization and personnel planning of Posiva has been continued as part of the periodic inspections. Posiva's organization, human resources and competence have been one of the general oversight topics for the construction of the spent nuclear fuel encapsulation plant and disposal facility.

As required by the STUK regulation (STUK Y/4/2016), the NPP utilities and Posiva have special training programmes including waste management for their personnel. Staff training at Posiva is based on personal-level training and development plans and company-level plans, which are updated annually.

In activities related to the use of radiation other than in nuclear facilities the Radiation Act (Section 14) prescribes that the responsible party is required to ensure that in safety related matters of the operations the expertise is available, taking into account the nature and the risks posed by the operation. The responsible party shall appoint a radiation safety officer. In a licence application the applicant shall provide information on the competence of the persons working with radiation.

STUK shall lay down the qualifications of the radiation safety officer and other persons, as applicable, and investigate that these qualification requirements are met (the Radiation Act (Section 18)). The licencee shall provide appropriate training for the employees. Guide ST 1.4 sets the requirements for the organization for the use of radiation including the competences needed. Guide ST 1.8 further sets detailed requirements on radiation protection training for the radiation safety officers and qualified experts. The competence that has to be demonstrated by an exam includes a

general part covering the basics of radiation protection and the appropriate legislation. Special requirements are attributed to different fields of applications of radiation.

8 Expertise and skills (Article 8)

Member States shall ensure that the national framework require all parties to make arrangements for education and training for their staff, as well as research and development activities to cover the needs of the national programme for spent fuel and radioactive waste management in order to obtain, maintain and to further develop necessary expertise and skills.

Research

According to the Nuclear Energy Act the nuclear power companies are required to take care of the management of the nuclear waste resulting from their operation, including all activities, preparations and plans. These are to be presented in the complete nuclear waste management plan, which also needs to cover research and development activities (R&D). The R&D within nuclear waste management is aimed at storage and disposal of spent fuel, handling, storage and disposal of nuclear power plant operational waste, decommissioning of nuclear power plants and novel solutions for nuclear waste management.

The required contents of nuclear waste management plans are defined by the Nuclear Energy Decree. The plans have to be reported to the MEAE for appraisal every three years.

Since 1989 there have been research programmes in nuclear waste management coordinated by the public administration. Starting in 2003, after the change of the Nuclear Energy Act (Section 53b) the public research within nuclear waste management has been organized into national nuclear waste management research programmes (KYT), which maintains and develops such research activity and infrastructure as well as further training aiming at ensuring that the authorities have, at their disposal, such adequate and comprehensive nuclear engineering expertise and other facilities that are needed to assess the various ways and methods of nuclear waste management.. The research subject areas cover different types of waste, safety aspects in geological disposal, and alternative technologies.

The framework programme for KYT2018 can be found at KYT's website http://kyt2018.vtt.fi/en/docs/TEMjul_51_2014_web_12112014.pdf.

An international peer review of the KYT programme was organised by the MEAE in 2017. The results of the peer review are published at MEAE's website http://tem.fi/en/publication?pubid=URN:ISBN:978-952-327-279-8

STUK participates in the international cooperation within research related to nuclear waste. Finnish research organizations, nuclear utilities and Posiva participate in the research programmes by EU. Posiva has been one of the co-founders of the disposal technology community IGD-TP (Implementing Geological Disposal - Technology Platform).

Finland also participates in the work of the nuclear waste committee (Radioactive Waste Management Committee RWMC) of Nuclear Energy Agency NEA and its three working groups. Stakeholder Confidence (FSC) concentrates on societal acceptance of nuclear waste management. Integration Group for the Safety Case (IGSC) concentrates on the safety of disposal from different aspects and on developing the safety case of the disposal. Working Party on Decommissioning and Dismantling (WPDD) concentrates on strategies and dismantling technologies, regulation, waste, financial aspects and costs of decommissioning. Posiva also has bilateral agreements or understandings on international cooperation with several research and implementing organizations acting in the area of nuclear waste management. Posiva also participates in the Horizon programme of the European Commission and in various projects of the Nuclear Energy Agency of the OECD.

Since 2001 Posiva and the Swedish nuclear waste management company SKB (Svensk Kärnbränslehantering Ab) have had a bilateral agreement on extensive cooperation in spent fuel disposal research and development work. The forms of cooperation have varied from information exchange to common projects, depending on the subject matter.

During 2010–2012 a committee set up by the MEAE worked on a report to provide recommendations and steps to be taken until the 2020s for ensuring the competences and resources needed for the nuclear sector. One of the recommendations of the committee was that the future needs and focus areas for research in the Finnish nuclear energy sector must be accurately defined and a long-term strategy must be drawn up for further development of research activities. This calls for a separate joint project among research organisations and other stakeholders in the field. The competence review was updated in 2017 to reflect the current changes in the operating environment.

The recommendations of the working group are the following:

1. The areas of focus in nuclear energy research must be compiled into wide-ranging national programmes.
2. The scientific level of Finnish nuclear energy research needs to be raised.
3. Active participation is needed in international research that is important for Finland through broad-based national multidisciplinary collaboration.
4. To secure the quality and quantity of researcher education, a broad and comprehensive doctoral programme network needs to be established for the nuclear energy field.
5. Building, maintaining, and utilising infrastructure requires coordination at the national level. Financing needs to be considered strategically and the roles of national financiers need to be clarified.
6. In research activities input is needed into the development of innovations. The growth of business operations and internationalisation are supported by bringing the players together under Team Finland.
7. It is proposed that an advisory committee be set up in connection with MEAE linked with nuclear energy research and co-operation as a permanent expert body to support decision-making in national questions related to the nuclear energy.

Implementation of these recommendations will require concrete actions concerning funding of the national nuclear safety R&D programmes, including nuclear waste safety.

The current main R&D programmes on nuclear waste management in Finland are the following:

- The programme of Posiva Oy; the programme is mainly aimed at planning and implementing the disposal of spent nuclear fuel from TVO and FPH;
- The KYT programme (KYT 2018/KYT2022), administrated by the MEAE; is aimed at supporting the further development and maintenance of the overall national competence and the sufficient and comprehensive expertise needed for regulatory purposes, and at assessing alternative solutions for the long-term management of spent fuel.
- The programme of STUK; aimed at supporting the regulatory decision making of STUK when regulating Posiva and the power companies;
- The NPP utilities FPH and TVO have their own R&D programmes for low and intermediate level wastes (treatment, conditioning/solidification, storage, and disposal) and decommissioning of nuclear power plants.

Skills development

The long time-scales associated with the spent fuel disposal underline the importance of the availability of qualified domestic experts in the field also in the future. However, changes in energy markets and the fast development of technology will bring new challenges to the knowledge base, and this requires special effort by all the parties. Also a considerable share of Finnish nuclear experts, within the regulator, the operators as well as within research institutes and universities, is currently retiring and at the same time additional human resources are needed owing to the spent fuel disposal project and the new NPP projects. The challenges are tackled by training young experts in the nuclear safety field in two specific training related co-operation programmes of Finnish organizations active in the nuclear energy field.

In 2010 the first course covering comprehensively nuclear waste management ("National YJH course") was launched. The course has been lectured annually. The course was merged with the national nuclear safety course in 2017. Approximately 80 persons participate to the National nuclear safety course "YJK" annually. The National nuclear safety course was lectured for the 15th time in 2017-18.

The intention is to continue with the training courses on an annual basis as long as there are enough participants who need the training. Training materials have been developed so that they can be used by the organizations in their internal training programmes as appropriate.

In 2012, the three Universities Aalto University, Helsinki University and Lappeenranta University of Technology set up a Doctoral programme YTERA (YTERA – Doctoral Programme for Nuclear Engineering and Radiochemistry), which was funded by the Academy of Finland, the universities and the industry (the NPP utilities and Posiva). The Doctoral Programme covered all fields of nuclear engineering and radiochemistry including nuclear waste management. The doctoral programme ran until the end of 2015. At the end of the YTERA-program 21 doctoral theses were approved and further

23 were started. Some of the started doctoral studies have been concluded after the YTERA-program in KYT and SAFIR research programs.

Regarding the uses of radiation sources, the licencee shall ensure that it has at its disposal the expertise needed in the view of the nature and extent of the operation (the Radiation Act (Section 14)). The licencee shall nominate a Radiation Safety Officer (RSO) who has the competence defined by STUK (the Radiation Act (Section 18)). In some practices, also experts with particular competence shall be nominated. The competences needed are prescribed in Guide ST 1.4. The related training requirements, including the syllabus for such training, for RSOs are established in Guide ST 1.8. In addition, the licencee shall arrange appropriate training, including refresher training, to workers involved in the use of radiation (the Radiation Act (Section 14a)). More detailed requirements on the training are given in Guide ST 1.8.

9 Financial resources (Article 9)

Member States shall ensure that the national framework require that adequate financial resources be available when needed for the implementation of national programmes referred to in Article 11, especially for the management of spent fuel and radioactive waste, taking due account of the responsibility of spent fuel and radioactive waste generators.

Financial arrangements under the Nuclear Energy Act

The costs of the disposal of LILW and spent fuel, as well as of the decommissioning of the NPPs and the FiR 1 research reactor, are paid by the licencee. Additional backup funds are collected in the Nuclear Waste Management Fund. The obligation for financial provision starts when MEAE or STUK grants a licence for operations that produce nuclear waste. For new NPPs the obligation to set assets in the Fund starts when the NPP has an operating licence and fuel is loaded in the reactor. Collateral securities must be supplied for to the State before commencing waste generating operations.

Also the cases of eventual unplanned decommissioning and post-closure of facilities currently in operation are provided for annually.

The current estimates, including costs from the management of existing waste quantities and from the decommissioning of current NPPs and the research reactor, amounted to 2584 million Euros at the end of 2017.

According to the Nuclear Energy Act (Section 32), a condition for the expiry of waste management obligation of a nuclear waste generator is that the waste has been permanently disposed of in an approved manner and a lump sum to the State for the further control of the waste has been paid. Thereafter, the State is responsible for the necessary waste management measures and the incurred costs.

Financial arrangements under the Radiation Act

As specified in the Radiation Act, the licencee is responsible for the costs incurred in rendering radioactive waste harmless. Section 19 lists the requirements for furnishing security as follows:

"To ensure that the costs incurred in rendering radioactive waste harmless and in performing any necessary environmental decontamination measures are met, the holder of a safety licence shall furnish the security stipulated by the Radiation Decree, when:

1. The licence is granted for extensive manufacture of, use of, or trade in radioactive substances or radiation sources containing such substances, or
2. The operations produce, or may produce radioactive waste that cannot be rendered harmless without considerable expenses.

The provisions of paragraph 1 hereof shall not apply to the State, municipalities, intercommunal organizations or public corporations."

The Radiation Decree further specifies when a financial security needs to be furnished, e.g. for a sealed source or other radioactive waste with substantial liability. The State has the secondary responsibility in case the producer of radioactive waste is not capable to fulfil his management obligation.

In case where the practice produces or may produce radioactive waste that cannot be rendered harmless without considerable expenses, a financial security shall be furnished to ensure that these costs and those arising in performing any necessary environmental decontamination measures can be covered.

The licencee is responsible for decommissioning also in cases of uses of radioactive sources subject to the Radiation Act. The licencee shall provide evidence that all disused sources have been transferred from the site appropriately and, where appropriate, that there is no remaining contamination. The Radiation Act prescribes (Sections 19 and 31f) practices subject to a financial provision at the licensing phase to ensure the availability of sufficient funds to cover decommissioning costs.

10 Transparency (Article 10)

Art. 10.1

Member States shall ensure that necessary information on the management of spent fuel and radioactive waste be made available to workers and the general public. This obligation includes ensuring that the competent regulatory authority inform the public in the fields of its competence. Information shall be made available to the public in accordance with national legislation and international obligations, provided that this does not jeopardise other interests such as, inter alia, security, recognised in national legislation or international obligations.

The Act (1069/1983) on STUK states STUK's duties as follows: In order to prevent and restrict the harmful effects of radiation, to exercise regulatory control of the safety of the use of radiation and nuclear energy as well as the related research, training and communications the Radiation and Nuclear Safety Authority is established subordinate to the Ministry of Social Affairs and Health.

The Decree (902/1990) on STUK further defines STUK's responsibilities. Among others STUK shall be responsible for providing information on radiation and nuclear safety issues, and for participating in training activities in the field.

The Act (621/1999) on the Openness of Government Activities applies to the documents and information delivered to STUK and those prepared by STUK. Under the Act everyone

has the right to obtain information from official documents in the public domain. Official documents are in the public domain unless specifically otherwise provided for. The provisions on the secrecy of documents and information on the use of nuclear energy are set out in the Openness Act and in the Nuclear Energy Act (Section 78). A document or information shall be kept secret when it's necessary to protect e.g. security arrangements, preparations for emergency conditions or private economic interests.

In addition, the Openness Act also requires authorities to produce data material describing their activities, such as publications, brochures and statistics as well as information on their socially significant decisions. The authorities shall also ensure that documents pertinent to their activities are easily accessible for example in data networks and libraries. The Openness Act also imposes on the authorities the obligation to inform the public of their activities.

In 2013, Finland joined the Open Government Partnership in order to get a new boost to continuous work towards active citizen participation and open government (the global Open Government Partnership initiative aims at promoting more transparent, effective and accountable public administration). As off end of the 2017 STUK made the whole diary available in internet, with few exceptions. The diary information will be available 6 months after the submission of the documentation.

The NPP utilities and Posiva shall keep a general description of the facility and the safety principles complied with available to the public, in compliance with Nuclear energy Act (Section 10a) and the obligation to provide information. The companies engage in open, objective, and interactive cooperation with its stakeholder groups including own employees and the general public especially in the neighbourhood of the nuclear power plant. The objective is to increase knowledge of nuclear power and waste management as well as to support open and constructive interaction among the different stakeholder groups. NPP utilities and Posiva also listen and observe the concerns of stakeholder groups. The most important matter of concern is the safety of nuclear power production and the disposal of nuclear fuel. The communication activities are geared around these topics and provide in-depth information about how the companies ensure the safety of the operations.

Art. 10.2

Member States shall ensure that the public be given the necessary opportunities to participate effectively in the decision- making process regarding spent fuel and radioactive waste management in accordance with national legislation and international obligations.

Public and stakeholder participation in the licensing process of a nuclear facility

The availability of information related to the siting process for a major nuclear facility is based on the Finnish legislation on the openness of information, notably on the Act on the Openness of Government Activities. Further requirements are based on the Act and Decree on EIA-Procedure and the Nuclear Energy Act. The first step of consultation with the general public is the EIA-procedure. Public hearings are arranged both in the programme phase of the EIA and during the actual assessment. The responsible contact authority for that procedure in case of project related to nuclear energy is the MEAE.

According to Nuclear Energy Act (Section 24) the EIA report must be attached to the application for the Decision-in Principle.

The Nuclear Energy Act (Section 13) states that, before the Decision-in-Principle is made by the Goverment, the applicant shall make available to the public an overall description of the facility, of the environmental effects it is expected to have and of its safety. MEAE shall provide residents and municipalities in the immediate vicinity of the nuclear facility as well as local authorities a chance to present their opinions in writing before the Decision-in-Principle is made. Furthermore, MEAE shall arrange a public hearing in the municipality where the planned site of the facility is located and during this hearing the public shall have the opportunity to give their opinions either orally or in writing. The presented opinions have to be made known to the Government. The Nuclear Energy Act (Section 14) further provides that a necessary prerequisite for the Decision-in-Principle is that the planned host municipality for the nuclear facility is in favour of siting the facility in that municipality.

The Nuclear Energy Act (Section 23a) states that MEAE has to organize to public a chance to present their opinions for Construction, Operating and Decommissioning licence. Public hearing must also be organized in the case of amending the terms of operating licence.

The public has several possibilities of participating in the decision making. It must, however, be noted that the responsibility for decision-making on the safety issues always lies with the regulatory body.

The Radiation Act does not prescribe any formal public participation procedures. The EIA process is the only formal process in connection with major undertakings.

Availability of information

Active communication is an integrated part of all STUK's activities and an absolutely necessary task when taking care of radiation and nuclear safety in Finland. The same truth applies, of course, to Posiva and to nuclear power companies.

Under the Act on Openness of Government Activities everyone in Finland has the right to obtain information from official documents in the public domain.

STUK as a governmental authority has a information services and, public diary, available in STUK’s web pages. There citizens, STUK's customers and other stakeholders can monitor issues that STUK is currently handling and make requests of information. All major decisions STUK makes are also actively published as press releases, on STUK’s own web page, on social media platforms.

In addition, STUK actively strives to provide citizens with information on radiation safety and issues related to STUK’s own activities. As written in STUK’s strategy for 2018–2022 STUK wants to interact and listen, communicate with the needs of the target groups in mind and find way to the forums where people discuss. STUK’s goal is to help people to understand the risks of radiation correctly and support society in being resilient to disturbances.

A prerequisite for successful communication is that STUK is well known among traditional and new media as well as among general public. The information given by STUK must be regarded truthful. Communication is always based on the best available knowledge and even information regarding sensitive matters are openly communicated.

At STUK communication is considered to be a privilege and duty of all employees. This is important in the new communication climate that emphasized even more personal communication. Organizations should have many faces, a network of many communication contacts.

STUK's web pages (www.stuk.fi) are in Finnish, Swedish and in English. STUK is also active in using channels of social media and is able to adapt to the changes in the field.

Communication will become an increasingly important success factor for STUK, Posiva, and the power companies. The interest in radiation and nuclear safety topics will continue to increase. The media, including the social media, plays an important role in communication.

Consulting of Contracting Parties

Finland is a party to the Convention on Environmental Impact Assessment in a Transboundary Context, done in Espoo in 1991. The Finnish policy is (Act 252/2017 on the Environmental Impact Assessment) to provide full participation to all neighbouring countries which can be affected by the nuclear facilities in question.

11 National programs (Articles 11 AND 12)

Article 11.1 Each Member State shall ensure the implementation of its national programme for the management of spent fuel and radioactive waste ('national programme'), covering all types of spent fuel and radioactive waste under its jurisdiction and all stages of spent fuel and radioactive waste management from generation to disposal.

The National Programme is submitted as a separate document. It contains the policy and the strategy for spent fuel and radioactive waste management. Latest version was delivered to European Commission in 2015.

In Finland, the policies and strategies for radiation and nuclear safety are mainly expressed through legislation.

The latest revisions and amendments to the Nuclear Energy Act (Section 79) and the Radiation Act define the requirements on the national programme for spent fuel and radioactive waste management in Finland. The amendments also define the responsibilities for the implementation of the national programme.

Article 11.2 Each Member State shall regularly review and update its national programme, taking into account technical and scientific progress as appropriate as well as recommendations, lessons learned and good practices from peer reviews.

The peer reviews and the measures taken due to their recommendations, as well as how to include the advances in science and technology, are described under Art. 5.2. Nuclear Energy Act amendments done in 2015 and 2017 take into account the 2012 IRRS, and

detailed justification of the changes are described in the Government Proposal for the Parliament (HE 93/2017).

The review and update process of the national programme is described in Nuclear Energy Act (Section 54 and 54a) and in the draft Radiation Act (Section 87). That document also describes the measures taken to notify significant changes of the national programme to the Commission.

Article 12.1 The national programmes shall set out how the Member States intend to implement their national policies referred to in Article 4 for the responsible and safe management of spent fuel and radioactive waste to secure the aims of this Directive, and shall include all of the following:

...

The content of the National policy has been defined in the Nuclear Energy Decree (Section 79c)

Article 12.2 The national programme together with the national policy may be contained in a single document or in a number of documents.

The national programme and policy for the nuclear waste are contained in one single document, which was delivered to EC in 2015. In the future the national program will be maintained trilaterally by MEAE, MSAH and STUK, as defined in Nuclear Energy Act (section 27 b) and Radiation Act (section 87).