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Radiation and Nuclear Safety Authority

Reference: Request for a statement by STUK, reg. no. 20/H42212/2014, 11 December 2014

Posiva Oy's construction licence application for the construction of an encapsulation plant and disposal facility at Olkiluoto for the disposal of spent nuclear fuel.

With reference to the request for a statement by the Radiation and Nuclear Safety Authority (STUK) (20/H42212/2014, 11 December 2014), the draft statement by STUK and the safety assessment, the Advisory Commission on Nuclear Safety issues the following statement regarding the construction licence application for a spent nuclear fuel encapsulation plant and disposal facility. During its meeting on 11 December 2014, the Commission received a presentation on STUK's draft statement on the construction licence application and the related draft safety assessment. Furthermore, during earlier meetings in the autumn of 2014, the Commission has received presentations on STUK's opinions on matters related to the assessment of the construction licence application. The Commission is familiar with STUK's draft proposal (1/H42212/2013) and the related draft safety assessment (11 December 2014).

The Radiation and Nuclear Safety Authority (STUK) has requested the Commission to pay specific attention on:

- whether the regulations, requirements and objectives concerning safety are up to date with regard to issuing a construction licence
- whether safety, security arrangements, emergency arrangements and nuclear safeguards have been taken into consideration to a sufficient level of detail and by applying sufficient expertise
- whether the results of the assessment are acceptable.

Furthermore, STUK has requested the Commission to include in its statement any other aspects concerning the construction licence application and the safety assessment.

Overview of the plant project

The aspects concerning the disposal of spent nuclear fuel have already been discussed quite extensively within the scope of international co-operation on multiple forums and in national development projects. In Finland, the need for creating a long-term development programme with interim goals for nuclear waste management and disposal was already expressed at early stages of the operation of the current Finnish nuclear power plant units. In November 1983, the Government issued a decision in principle regarding research, investigation and planning objectives in terms of nuclear waste management. The decision presented specific target schedules for the different stages of preparing for the disposal of spent nuclear fuel. They included a requirement to carry out detailed disposal site surveys for the disposal of spent nuclear fuel and a requirement to select, by the end of 2000, a disposal site that meets the safety and environmental protection criteria.

Furthermore, the decision required the licensees to prepare the plans necessary for the construction licence application for an encapsulation plant and disposal facility, allowing a presentation to the regulatory authorities by the end of 2010. In 2003, the overall schedule for the construction of the encapsulation plant and disposal facility was specified by a decision of the Ministry of Trade and Industry, which stated that the construction licence application must be submitted by the end of 2012.

Additionally, concerning nuclear waste management, the 1983 decision required the licensees to annually present to the Ministry of Trade and Industry, together or individually, a plan of the research and investigation work scheduled for the next calendar year and an account of the work carried out in the previous year for regulatory purposes. The current regulations require a presentation to the Ministry of Employment and the Economy every three years. The Ministry of Trade and Industry (replaced by the Ministry of Employment and the Economy as of 2008) and STUK have assessed the power companies' and Posiva Oy's plans and the documentation concerning the status of research and development projects. On the basis on these assessments, STUK and the Ministry have presented requirements for the planned further research.

In December 2012, Posiva Oy submitted to the authorities for assessment a detailed documentation concerning the construction licence application. In international comparison, Finland is at the forefront in projects that aim at a practical implementation of the disposal of spent nuclear fuel. Posiva and other Finnish organisations have worked in extensive co-operation with their Swedish counterparts, which has improved the scope of the projects. However, in Sweden, the commissioning of a spent nuclear fuel disposal facility is scheduled for a later timeframe than the current implementation schedule of Posiva Oy.

Posiva as an operator, organisation and resources, management system, safety culture and management of safety and quality.

The Commission shares STUK's understanding that Posiva employs sufficient and extensive expertise concerning the construction of a nuclear waste facility. However, before the commissioning stage and at early stages of operation it must be ensured that, in spite of the organisational changes in early 2015 (between Posiva and TVO), Posiva has sufficient prerequisites to maintain and develop the competence of its personnel for further improving the security of the constructed facility. The Commission also shares STUK's opinion that Posiva's management system, its processes and instructions have been developed and implemented in accordance with the quality management requirements presented in the YVL Guides. With its management system, Posiva is considered to have the ability and readiness to ensure quality and safety during the planning, construction and commissioning of a nuclear waste facility.

The Commission shares STUK's opinion that Posiva and its suppliers have the prerequisites and readiness to maintain a good safety culture when implementing the nuclear waste facility construction project. STUK finds that Posiva's management and personnel have demonstrated on a practical level their commitment to a high level of safety. STUK also finds that, in terms of ensuring the safe operation of the nuclear waste facility, Posiva has sufficient arrangements in place for establishing

and training the organisation and the necessary personnel.

Status of regulations, requirements and objectives concerning safety with regard to issuing a construction licence

Already before Posiva Oy submitted an application for a Decision-in-Principle in May 1999, Government Decision 478/1999 had confirmed the essential safety requirements concerning the safety of disposal of spent nuclear fuel. The requirements specify that “In any assessment period, disposal shall not cause health or environmental effects that would exceed the maximum level considered acceptable during the implementation of disposal.” At an early stage, more detailed regulations were included in STUK's guides “Long-term safety of disposal of spent nuclear fuel” (YVL 8.4) and “Operational safety of a disposal facility for spent nuclear fuel” (YVL 8.5), which came officially into force on 1 December 2001. At the next stage, Government Decree 736/2008, which replaced Government Decision 478/1999, was prepared. This Decree still remains in force. The Decree specifies the general requirements, whereas the more detailed requirements are presented in guide YVL D.5 (Disposal of Nuclear Waste), whose final version entered into force as of 1 December 2013. However, when preparing its construction licence application, Posiva had access to a nearly finalized draft of YVL D.5.

In Finland, the development of regulations concerning the safety of the disposal of nuclear waste has advanced significantly faster and has reached a more detailed level than in most other countries. International organisations such as EU, IAEA and OECD/NEA have discussed the safety requirements for the disposal of nuclear waste on quite a general level. International assessments of the Finnish country reports that have been prepared within IAEA's Joint Convention have found that the Finnish implementation and plans for nuclear waste management meet the common international requirements. IAEA's Integrated Regulatory Review Service (IRRS) assessment has found that STUK's operations and national arrangements meet IAEA's requirements.

The Commission finds that the regulations, requirements and objectives concerning safety are up to date with regard to issuing a construction licence.

Safety principles of the disposal system

The Commission shares STUK's understanding that, when planning an encapsulation plant and disposal facility, Posiva has taken into account the decrease of the activity of spent nuclear fuel by means of interim storage and planned the lifetime stages of the disposal facility (construction, disposal operations and closure) in a way that contributes to long-term safety. The selection of the disposal depth takes into account long-term safety and provision of sufficient protection against above-ground phenomena and human activities.

The safety functions of the disposal system presented by Posiva (disposal canister, buffer material surrounding the canister, tunnel filling, closure of facilities and the host rock that acts as a natural barrier) follow the multi-barrier principle. The Commission shares STUK's opinion that, in the operating licence phase, the descriptions of the safety functions must indicate in more detail the factors that

affect the performance of each barrier.

During the operation of the disposal facility, the performance of the engineered barriers shall be monitored before the final closure of the facilities in accordance with Government Decree 736/2008, Section 9. Section 10 of this Decree includes an ambiguous reference to ensuring long-term safety with follow-up monitoring, which could be interpreted to refer to post-closure monitoring. This, however, would be in conflict with the principle presented in Section 7h of the Nuclear Energy Act, according to which the disposal of nuclear waste in a manner intended as permanent does not require surveillance of the disposal site for ensuring long-term safety. There is enough time for quite extensive follow-up monitoring during the operation stage before the final closure of the disposal facility as the first disposal tunnels will be closed up to a hundred years before the closure of the entire disposal facility. Monitoring during construction and before closure should consider the possible changes in the properties of the host rock and groundwater. Posiva has presented a plan for monitoring operations during construction.

The Commission shares STUK's opinion that the monitoring of engineered barriers before the closure of the disposal facility still requires further development in terms of monitoring technology and the object of monitoring as well as the applicable requirements by the authorities.

Planning of the encapsulation plant and disposal facility with regard to operational safety

The nuclear fuel encapsulation plant and disposal facility is a nuclear facility. When planning the safety of the facility, Posiva has applied the principle of defence-in-depth and defined three safety functions: management of radioactive materials, management of reactivity and removal of residual heat. The safety functions are the same as for nuclear power plants, but the fuel handling conditions are different. The amount of fuel present at a given time is considerably lower compared to a power plant and the fuel is not subjected to high pressures or temperatures. Fuel creates less residual heat than in power plants and, therefore, residual heat can be removed by passive means without a power source. As the facility does not intend to bring fuel into a critical state for achieving a chain reaction, subcriticality can be ensured by reliable structural means. Criticality of fuel would require the simultaneous occurrence of several diverse and highly unlikely accident conditions. However, unlike in a power plant, fuel assemblies are handled (e.g. when drying) and lifted in the air uncovered, which requires utmost care in order to prevent any damage. Due to the management of radioactive materials, all the stages of the process take place in closed, sealed facilities, whose ventilation systems enable filtering during normal and accident conditions. All processes are remote-controlled for the purposes of radiation protection of the personnel.

There is no international experience available on similar plants. There is, however, experience in handling spent nuclear fuel in reprocessing facilities, for example.

The sealed canisters are transported from the interim storage at the encapsulation plant to the disposal facility with a canister lift and transfer and installation vehicles. The canister is protected on vehicles with a combined mechanical and radiation shield. The design of the process enables returning canisters from any stage to the

encapsulation plant for additional processing in case they become damaged.

Disturbances and accidents

The essential operational functions of an encapsulation plant and disposal facility include different lifting and transfer functions. Nearly each piece of equipment designed for these functions is unique, but they all are based on proven technology. Functions whose failure could result in releases of radioactive substances or radiation exposure of personnel at the facility have been ensured against a single equipment failure.

Of the safety functions, maintaining the subcritical state of fuel (i.e. preventing a chain reaction) and residual heat removal are based on inherent safety features and do not require a power source. Similarly, the handling functions are designed such that the equipment stops in a controlled state in case the power source is lost.

The potential disturbances of operational functions as well as internal and external threats have been analysed in terms of nuclear and radiation safety. The designs make provisions for essential disturbances: drops of loads, fires, collapsing structures and flooding. The design basis analyses have used both experimental and computational methods. The analyses focus on conditions that could result in releases of radioactive substances.

The amount of radioactive materials that could be released at the different stages of encapsulation and disposal depends on the properties of the handled nuclear fuel. Power plant operators have archived individual data for each fuel assembly, which enables planning how each disposal canister is filled in a way that radiation dose rates, heat generation and criticality safety can be managed. This information will be archived into the Posiva database in full. However, safety calculations will use a conservative assumption that a disposal canister that becomes damaged contains the highest possible quantity of radioactive materials. It is also assumed that all of the fuel in the canister becomes damaged and the contained radioactive materials are released at a conservatively estimated rate that does not underestimate the source term of the radioactive materials in any case. However, STUK requires that Posiva provides a more specific value for the release rate at a later time before its operating licence application because this value also has an essential impact on demonstrating long-term safety.

The design of a nuclear waste facility takes into account the minimising of the radiation doses to the personnel and to the environment. The rooms of the facility will be classified into radiation protection zones with the related access prevention and control arrangements. The thickness of the handling chamber walls has been dimensioned in a manner to protect the personnel controlling the processes remotely. The canister transport vehicle is equipped with a separate radiation shield for the canister. Releases into the environment are tracked by continuously operating monitoring systems and sampling. The design of the encapsulating plant includes effective filtering and cleaning systems for releases of radioactive substances that are assumed to enter into the rooms of the plant as well as a processing system for any generated waste.

In addition to the safety analyses, a probabilistic risk assessment (PRA) has been prepared for the design phase of the nuclear waste facility. The PRA uses preliminary design information, general data on equipment reliability, conservative estimates and expert judgement. During the operation of the plant, significant releases can only occur if a fuel assembly becomes damaged and, simultaneously, ventilation filtering fails. The most significant initiating event would be dropping a canister during handling at the encapsulation plant. However, even in this case filtering would limit the release, and, basically, the failure of the ventilation filtering could only be caused by a human error during the maintenance of the filtering system. Posiva has also investigated the consequences of such simultaneous events even though their analysis is not required due to their low probability.

Posiva has presented risk management calculations also for the transport of nuclear fuel. STUK estimates that they can be implemented according to Posiva's plan. Separate licences for transports will be issued at a later time.

STUK has systematically assessed Posiva's operational plans for the nuclear waste facility and the analyses they are based on in terms of achieving the principle of defence-in-depth and the specified safety functions. STUK has found the plans and the radiation protection arrangements to be sufficient.

However, the high reliability of filtering systems and access prevention and control arrangements that prevent the personnel from accessing closed facilities during the operation of the encapsulation plant must be ensured as design work progresses.

STUK has also assessed the safety and seismic classification that Posiva has proposed for the nuclear waste facility and found it to be sufficient at this time. However, due to the novel type of the plant, STUK states that Posiva must continue assessing the safety significance of the system components and structures and modify the classifications as necessary.

The Commission agrees with the above conclusions.

Construction of the nuclear waste facility

According to Posiva's design, the above-ground nuclear waste facility comprises an encapsulation plant and other buildings that are necessary for supporting the operational activities of the facility, for example. The design and location of the encapsulation plant take into account the potential internal and external threats to the plant. Amongst these threats the structural design is most affected by postulated earthquakes, extreme weather phenomena, aircraft collisions, explosions and fires.

Radiation protection of the operating personnel is a significant individual factor that affects the dimensioning of the structures. According to the plans, it will be implemented by massive concrete structures that surround the facilities for handling fuel and canisters. The encapsulation plant building will be designed in accordance with the requirements of EN standards and their related national Finnish appendixes. The plant's facilities that are likely to be the subjects to the surface contamination will use stainless-steel coating to facilitate decontamination. Other rooms subject to sporadic contamination will similarly use a coating that facilitates decontamination.

The buildings for the encapsulation plant and other above-ground structures will use technology proven in the construction of nuclear facilities, which can be implemented in accordance with the requirements presented in the YVL Guides.

The disposal functions in underground facilities must be separated from the excavation and construction work of the disposal facility such that excavation and construction work cannot have any harmful impact on the operational safety of the facility or the long-term safety of disposed waste. Furthermore, the layout, excavation, construction and closure of underground facilities must be implemented such that the host rock retains, to the highest possible degree, its characteristics deemed important in terms of long-term safety.

When planning the locations of the facilities, Posiva avoids rock joints and geological and hydrogeological zones that may have adverse effects to long-term safety. This is in order to control the disturbance to the host rock from construction within the set targets. For this purpose, Posiva has developed a Rock Suitability Classification (RSC), which is used as a basis for determining the locations according to the criteria set for each phase, all the way to each individual disposal hole. Posiva must further develop the Rock Suitability Classification for the needs of long-term safety and optimal positioning and use of facilities.

As outlined in the Decision-in-Principle, Posiva has constructed Onkalo, an underground research facility, which will be a part of the planned underground disposal facility. Onkalo comprises some of the above-ground connections and technical facilities. Onkalo's design and construction are subject to the same requirements as the disposal facility, and STUK's regulatory control over the work at Onkalo is equivalent to the regulatory control of the construction of a nuclear facility. The excavation for Onkalo is nearly complete and Posiva is in the process of reviewing Onkalo's result documentation that indicates regulatory compliance of Onkalo's construction.

The Commission agrees with STUK's assessment that the underground disposal facility can be built in the manner that the disturbance to the bedrock and groundwater environment from the construction can be controlled. The Commission finds, however, that Posiva must further develop its Rock Suitability Classification as it applies the method when determining the locations of the disposal tunnels and individual disposal holes. STUK also finds that the rock construction methods and materials must be developed further so that Posiva can demonstrate the regulatory compliance of the underground facilities.

As required for quality management and intermediate assessment during construction, the facility must be constructed in compliance with the approved plans and procedures. Moreover, the licensee must ensure that also the plant supplier and subcontractors producing services and products important in terms of safety perform in an appropriate manner. Posiva requires high quality and a good safety culture from the suppliers that participate in the construction. As Posiva has overall responsibility for the project, it must prepare a separate plan for the management and organisation of all construction work.

Posiva's quality assurance in terms of construction follows Posiva's management system. Posiva's management system is subject to specific procedures for the construction of nuclear facilities, such as the planning, control and management, assurance and continuous improvement of quality and organisation of work. These issues are presented in the street plan of the facility project, which specifies the processes, procedures and instructions applicable to the project. According to Posiva, the quality group of the safety unit (QA) acts independently of the organisation responsible for the different stages of construction and ensures that the construction work follows Posiva's management system as well as the relevant plans, requirements and instructions. According to the Commission, it is very important to ensure that the facility is constructed according to the approved plans and procedures.

The Commission agrees with STUK's assessment that Posiva has developed and implemented sufficient procedures for control and supervision regarding the construction of the nuclear waste facility. By complying with the procedures, it is possible to ensure that the nuclear waste facility and its systems, components and structures are designed, manufactured, built, installed and commissioned in accordance with the approved plans and procedures.

Commissioning and operation of the nuclear waste facility

In connection with the commissioning of the nuclear waste facility, the licensee shall ensure that the systems, structures and components and the facility as a whole operate in the planned manner. Furthermore, it must be ensured that an expedient organisation is in place for the future operation of the facility, alongside a sufficient number of qualified personnel and instructions suitable for the purpose. Based on STUK's assessments and inspections, the Commission finds that Posiva has prepared sufficient plans for verifying, by means of test operation at the commissioning stage, the safe and compliant operation of the nuclear facility, its systems and components and that its operating instructions are comprehensive and validated. Posiva's plans also include providing timely training for the operating organisation, for which Posiva has planned a tentative structure and number of personnel.

The operating instructions, instructions for the identification and control of transients and accidents and Operating Limits and Conditions related to the operation of the nuclear waste facility must be prepared before submitting an operating licence application. Similarly, a condition monitoring and maintenance programme for the nuclear waste facility must be prepared before submitting an operating licence application. Posiva has in place a condition monitoring and maintenance programme for the facilities and systems implemented as part of the Onkalo project.

For ensuring radiation safety, the plans include radiation monitoring at the significant release routes during the operation of the facility. The surroundings of the facility will include Posiva's own monitoring equipment, but Posiva will also utilise TVO's existing radiation monitoring network already in place in the area.

Decommissioning and dismantling of the nuclear waste facility

For nuclear waste facilities, decommissioning refers to dismantling the above-ground elements so that, after decommissioning, no special measures due to radioactive materials originating from the dismantled facility are required on the site. For the purposes of the construction licence, Posiva has submitted a sufficient description of the decommissioning of the encapsulation plant and taken decommissioning into account in the design requirements of the plant. In the documentation for the construction licence application, Posiva has presented the principles of closure in a sufficient manner for the purposes of the construction licence and designed the closure of the disposal facility such that the host rock retains, to the highest possible degree, its characteristics deemed important in terms of long-term safety.

Ageing management

In connection with the construction licence application, Posiva has submitted a preliminary account on the plan of the principles of ageing management. The plan describes the principles of ageing management with regard to the encapsulation plant and disposal facility. Furthermore, the plan includes preparing an ageing management programme and enclosing it with the operating licence application. STUK has approved the preliminary plan of the principles of ageing management for the encapsulation plant and disposal facility and finds it to be in accordance with the requirements presented in Guide YVL A.8. According to STUK, the ageing management programme that Posiva encloses with the operating licence application must describe how the ageing management principles presented in the preliminary plan are implemented in practice.

Long-term safety

In connection with the construction licence application, Posiva has submitted to STUK the safety case for the nuclear waste facility, which especially discusses the long-term safety of the disposal facility. The safety case describes the disposal concept, disposal system and barriers. The safety of the disposal concept is justified with the safety functions, but the safety case does not indicate how the actual safety functions were selected.

Government Decree 736/2008 requires the safety case to be presented in connection with the construction licence application and the operating licence application of the nuclear waste facility. Detailed requirements pertaining to the content of the safety case are specified in Guide YVL D.5. The Commission share's STUK's overall conclusion that the requirement of the Government Decree is met but Posiva must update its safety case in connection with the operating licence application.

Section 12 of Government Decree 736/2008 presents general requirements for the geological characteristics of the disposal site. Among other things, STUK states that Olkiluoto's bedrock has been researched in diverse ways. The characterisation is sufficient for starting the construction of the disposal site. However, characterisation must be continued as the construction project progresses to less researched parts of the disposal site. Posiva's description of the disposal site is based on the results of

several different fields and methods of research, and combining the data to form an overall understanding requires further development efforts. STUK also finds that Posiva's current operability analysis for the disposal site does not include the disposal facility for low and intermediate waste, which will be constructed along the Onkalo vehicle access tunnel. STUK requires that the disposal facilities for spent fuel and low and intermediate waste are discussed as a whole in the performance assessment. The construction licence application presents disposal site research reports, performance assessments and conclusions that the Olkiluoto bedrock is suitable for a disposal site. The Commission shares the understanding presented in STUK's conclusions that these are sufficient for the construction licence stage. The requirements that Posiva has set for the host rock are achieved with high probability and by a large margin.

Sections 6 and 9 of the Government Decree present requirements for engineered barriers. As regards the disposal canister and other engineered barriers, STUK states that the design bases and principles concerning long-term safety are presented comprehensively on the level of principles in the preliminary safety analysis and safety case, which were presented as part of the documentation for the construction licence application. There are still shortcomings in demonstrating the performance of engineered barriers and describing the potential developments concerning the release barriers. These shortcomings require research and development before submitting an operating licence application. Furthermore, STUK requires that the relation between the safety functions and the performance targets of and the design requirements for the engineered barriers must be clarified before submitting an operating licence application; the justifications of safety must be documented in a traceable and transparent manner.

One design requirement for disposal canisters is that the fuel must remain subcritical. In this regard, STUK finds that Posiva's criticality safety analyses cannot entirely rule out the possibility for criticality of a disposal canister on a very long time span. However, as these analyses use highly conservative assumptions on the development of the geometry of the disposal canister in the long term, it is STUK's understanding that recriticality of disposed fuel would be very unlikely.

As regards the development of manufacturing methods for engineered barriers, Posiva's work on disposal canisters has advanced the furthest: Posiva has manufactured components of disposal canisters that meet the applicable requirements. However, there are still development needs concerning the manufacture of the disposal canisters and especially the other engineered barriers as well as the demonstration and verification of their regulatory compliance.

With regard to the long-term safety of final disposal, Section 4 of Government Decree 736/2008 presents requirements of expected evolution scenarios concerning the probable long-term radiation impacts. The Commission concurs with STUK's conclusion that, based on the analyses of expected evolution scenarios and the analyses describing the reduction of the safety functions, the annual doses and releases of radioactive materials are below the set limits.

Similarly, Section 5 of Government Decree 736/2008 presents requirements for consideration of unlikely events that impair long-term safety. Posiva has considered

rock displacements that damage disposal canisters, bore penetrations of disposed canisters and the disposal facility, boring a medium-depth water well at the disposal site and rapid corrosion of the internal components of the canister as unlikely events that impair long-term safety. Posiva has reviewed the unlikely events, their probabilities and expectation values of the resulting radiation exposures and releases of radioactive substances. Compared to the dose and release limits, the calculation results meet the requirements of Section 5 of the Decree.

One aspect of the safety case is to systematically create scenarios that assess the uncertainty of how the disposal system behaves over time. As part of the process describing the potential future developments of the disposal system, Posiva has defined possible scenarios that may lead to the failure of disposal canisters and release of radionuclides due to a single factor. STUK requires that, with regard to developments that deviate from the expected behaviour, Posiva also considers in the operating licence application the possibility that one or more performance targets are not met.

Section 14 of Government Decree 736/2008 presents additional requirements for items concerning long-term safety in the safety case and requires that, in addition to radiation exposure impacts on people, possible impacts on flora and fauna are analysed. According to STUK's assessment, Posiva's biosphere model is overall in accordance with the requirements. With reference to the Decree's requirement, detailed requirements concerning the protection of other living nature and the possible impacts of disposal on flora and fauna are presented in Guide YVL D.5. According to the requirements, disposal of spent fuel shall not affect detrimentally to species of fauna and flora. This shall be demonstrated by assessing the typical radiation exposures of terrestrial and aquatic populations in the disposal site environment, assuming the present kind of living populations. The method that Posiva uses for evaluating the impact on other living nature is up to date and in line with the best practices. Posiva has presented the accumulation rates of the absorbed dose for flora and fauna. The estimated dose rates are, by a large margin, below the currently estimated harmful dose rates for healthy animal populations.

The Commission agrees with STUK's overall assessment of the safety case that Posiva has presented the safety case in a sufficient scope for the construction licence stage. The results of the safety analysis and the other aspects presented in the safety case are sufficient to demonstrate that the requirements are met. STUK finds that Posiva's method of forming scenarios is sufficient for the construction licence stage but based on the current reviews it cannot be said with certainty that the scenario analysis makes systematic provisions for the developments of the disposal system that are significant in terms of assessing safety.

Section 15 of Government Decree 736/2008 states that the input data and models utilised in the safety case shall be based on high-quality research data and expert judgement. Data and models shall be validated as far as possible, and correspond to the conditions likely to prevail at the disposal site during the assessment period. The Commission shares STUK's understanding that, based on the review, the scope of the safety case is sufficient for the construction licence stage. However, the operability and safety analysis require further development and changes that extend the scope of the safety case before submitting an operating licence application.

With regard to other requirements, STUK's safety assessment also discusses an alternative solution (KBS-3H) for the disposal of spent nuclear fuel, in which the canisters are placed horizontally. In its preliminary review, STUK has not encountered any aspects that would prevent horizontal placement from meeting the applicable requirements. Posiva has stated that it will compare vertical and horizontal placement in 2016. STUK has stated that it is able to process the modifications to the basic solution in accordance with Section 112 of the Nuclear Energy Decree. STUK, however, comments that it is highly likely that implementing a significant modification at the construction stage postpones the planned starting time of the disposal of spent nuclear fuel.

Retrievability of disposed spent nuclear fuel

Government Decision on the Safety of Disposal of Spent Nuclear Fuel (478/1999), which was in effect when the first Decision-in-Principle on the disposal of spent nuclear fuel was issued, required that retrievability of the waste canisters is maintained to provide for such development of technology that makes it a preferred option. This Government Decision was repealed by Government Decree on the Safety of Disposal of Nuclear Waste (736/2008), which does not contain any requirements on the post-closure opening of the disposal facility.

As the Decision-in-Principle, which was confirmed by the Government in 2001, presented a retrievability requirement, Posiva has presented a concept for opening the disposal facility and retrieving the disposal canisters at different stages of disposal, including time periods after the closure of the disposal facility, in an appendix to the construction licence application for the Olkiluoto encapsulation plant and disposal facility. STUK has assessed that the principle of Posiva's disposal concept enables opening the facilities without compromising safety.

Nuclear safeguards, security arrangements and emergency arrangements

Posiva has submitted to STUK a plan on arranging the control required for the non-proliferation of nuclear weapons. IAEA and the European Commission monitor the operations in addition to Posiva and STUK. As Posiva's nuclear waste facility is the first of its type in the world, there are yet no detailed international regulations on all aspects of regulatory control. Therefore, Posiva's plan only discusses the general level of control and a final plan is not yet required.

According to the plans, Posiva's research facility Onkalo will form part of the nuclear waste facility. STUK has supervised the construction of Onkalo from the outset similarly to a nuclear waste facility and ensured that the disposal facility does not contain any unnecessary facilities that are significant in terms of proliferation of nuclear weapons. Posiva's plant area has been reported to IAEA in accordance with the Additional Protocol to the Safeguards Agreement and IAEA has had no comments.

Posiva has submitted to STUK a preliminary emergency plan. At the encapsulation plant and disposal facility, Posiva's own operations can only create emergency conditions when spent nuclear fuel has been brought into the encapsulation plant or

the final disposal facility. However, due to Teollisuuden Voima Oyj's (TVO) operating nuclear power plants in Olkiluoto, there are emergency plans and organisations also for the Onkalo worksite and the worksite is considered in the emergency plans of the nuclear power plants. Posiva's emergency plan will be specified in greater detail in connection with the operating licence application.

The Commission recommends co-operating with TVO but also finds it important that Posiva has its own expert resources for emergency planning and arrangements.

When planning and assessing the security arrangements, Posiva has used the design basis threat and risk analyses and analysed protection needs. STUK finds that the administrative, technical and operational security arrangements, e.g. regarding information security, still need further development before starting the construction of the nuclear waste facility but the preliminary plan is sufficient for issuing a construction licence. The Advisory Commission on Nuclear Safety has not received any detailed (confidential) plans for the security arrangements. The Advisory Commission on Nuclear Security will issue a statement on such documents.

Summary

In conclusion, the Advisory Commission on Nuclear Safety finds that the requirements concerning safety are up to date with regard to issuing a construction licence. It is the considered opinion of the Commission that STUK has carried out a comprehensive and professional safety assessment on the construction licence application. In its assessment, STUK has indicated aspects for which the design documentation must be supplemented as work progresses closer to the implementation of the disposal system and ultimately up to the preparation of an operating licence application. Considering that the project for the disposal of spent nuclear fuel is pioneering on a global scale, it is justified to advance gradually in planning and implementation. STUK has found that the prerequisites for issuing a construction licence are met. The Commission is not aware of any aspects of operational or long-term safety that would prevent issuing a construction licence.

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