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Ministry of Employment and the Economy
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Statement by the Radiation and Nuclear Safety Authority on the operating licence of the Olkiluoto 1 and 2 nuclear power plant units

In its reference letter, the Ministry of Economic Affairs and Employment (MEAE) has requested the Radiation and Nuclear Safety Authority (STUK) to provide a statement under Section 23 of the Nuclear Energy Act on the operating licence application regarding Teollisuuden Voima Oyj's (TVO) Olkiluoto 1 and 2 nuclear power plant units. In its application, TVO applies for a licence under Section 20 of the Nuclear Energy Act for the following activities:

- to operate the Olkiluoto 1 and 2 power plant units of the Olkiluoto power plant at a nominal thermal power of 2,500 MW to produce electricity from the beginning of 2019 to 31 December 2038
- to use the interim storage for spent nuclear fuel (KPA storage) for the interim storage of spent nuclear fuel generated by the operations of the Olkiluoto nuclear power plant from the beginning of 2019 to 31 December 2038
- to use the interim storage for intermediate-level waste (KAJ) storage, interim storage for low-level waste (MAJ storage) and component storage for the interim storage of low- and intermediate-level waste generated by the operation of the nuclear facilities on the Olkiluoto island from the beginning of 2019 to 31 December 2038, and
- to temporarily store the low- and intermediate-level waste generated by the operations of the nuclear facilities on the Olkiluoto island at Olkiluoto 1 and Olkiluoto 2 from the beginning of 2019 to 31 December 2038

TVO has provided the MEAE with an operating licence application and requisite appendices necessitated by Section 33 of the Nuclear Energy Decree. For the performance of STUK's safety assessment, TVO has submitted to STUK directly the safety-related descriptions and reports specified in Section A.4 of Annex A to Guide YVL A.1.

STUK has prepared the safety assessment, which is included as Appendix 1 to this statement, based on reviewing the documents provided by TVO and

the results of oversight measures on the Olkiluoto 1 and 2 nuclear power plant units. Appendix 2 is a description of the requisite documents specified in Section 36(1) of the Nuclear Energy Decree. Appendix 3 is the statement required from the Advisory Committee on Nuclear Safety, as referred to in Section 56(2) of the Nuclear Energy Act, in accordance with Section 37 of the Nuclear Energy Decree.

General safety principles for the use of nuclear energy

The following provisions on the safety of the use of nuclear energy are laid down in Sections 5–7 of Chapter 2 of the Nuclear Energy Act.

Section 5: The use of nuclear energy, taking into account its various effects, shall be in line with the overall good of society.

Section 6: The use of nuclear energy must be safe; it shall not cause injury to people, or damage to the environment or property.

Section 6 a: 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.

Section 7: Sufficient physical protection and emergency planning as well as other arrangements for limiting nuclear damage and for protecting nuclear energy against illegal activities shall be a prerequisite for the use of nuclear energy.

STUK's supervisory work has not revealed any issues that would keep the licence holder and the Olkiluoto 1 and 2 plant units from meeting the principles laid down in Sections 5–7 of the Nuclear Energy Act.

Preconditions for granting the operating licence

The use of nuclear energy is subject to a licence (Nuclear Energy Act, Section 8). According to Section 20 of the Nuclear Energy Act, the granting of an operating licence requires the following conditions to be met:

- 1. the nuclear facility and its operation meet the safety requirements laid down in this Act, and appropriate account has been taken of the safety of workers and the population, and environmental protection; (23 May 2008/342)*
- 2. the methods available to the applicant for arranging nuclear waste management, including final disposal of nuclear waste and decommissioning of the facility, are sufficient and appropriate;*
- 3. the applicant has sufficient expertise available and, in particular, the competence of the operating staff and the operating organisation of the nuclear facility are appropriate;*
- 4. the applicant is otherwise considered to have the financial and other prerequisites to engage in operations safely and in accordance with Finland's international contractual obligations; and*

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the planned nuclear facility and the operation thereof otherwise fulfils the principles laid down in sections 5–7.

Operation of the nuclear facility shall not be started on the basis of a licence granted:

- 1. until the Radiation and Nuclear Safety Authority (STUK) has ascertained that the nuclear facility meets the safety requirements set, that the physical protection and emergency planning are sufficient, that the necessary control to prevent the proliferation of nuclear weapons has been arranged appropriately, and that the licensee of the nuclear facility has, as provided, arranged indemnification regarding liability in case of nuclear damage; and*
- 2. until the Ministry of Trade and Industry has ascertained that provision for the cost of nuclear waste management has been arranged in accordance with the provisions of chapter 7.*

In the safety assessment in Appendix 1, STUK has evaluated compliance with the provisions relevant to its area of responsibility and states the following.

As regards Sections 20(1)(1–3) of the Nuclear Energy Act, the preconditions for granting an operating licence for the Olkiluoto 1 and 2 nuclear power plant units and the buildings and storages belonging to them required for the management of nuclear fuel and nuclear waste are met.

As regards Section 20(1)(4) of the Nuclear Energy Act, STUK notes that it lacks the authority and competence to assess the licence holder's financial capacity for operating the power plant. In this statement and the appendices thereto, STUK's assessment has focused particularly on the licence holder's capabilities to conduct the operations safely and, with regard to matters under STUK's regulatory control, in accordance with Finland's international agreement obligations.

In relation to Section 20(2)(1) of the Nuclear Energy Act, STUK states that the Olkiluoto 1 and 2 nuclear power plant units meet the relevant safety requirements, with the specifying requirements listed below. Furthermore, STUK states that the Olkiluoto NPP's security and emergency response arrangements fulfil the set requirements and that the control necessary for preventing the proliferation of nuclear weapons has been arranged appropriately and that the nuclear plant's owner's liability for nuclear damage has been taken care of as required by legislation.

STUK has assessed the safety of the Olkiluoto nuclear power plant based on the STUK regulations brought into force in 2016, in addition to the Nuclear Energy Act. These include STUK's regulations on the safety of a nuclear power plant, the emergency arrangements of a nuclear power plant, security in the use of nuclear energy, and the safety of disposal of nuclear waste. The safety regulation (STUK Y/1/2016) takes into account that operating plants must meet certain requirements set for new plants to the

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extent that their application is justified with due consideration to the technical solutions of the nuclear power plant unit in question and the principle laid down in Section 7(a) of the Nuclear Energy Act (STUK Y/1/2016, Section 27, Transitional provision). In accordance with the principles set forth in Section 7 a of the Nuclear Energy Act, the safety of nuclear energy use must 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, safety research and advances in science and technology.

The design bases concerning the structures, systems and components of the Olkiluoto 1 and 2 nuclear power plant units were primarily issued in the 1970s. The goal for the operating period of the plant has been to ensure the continuous improvement of plant safety. TVO has updated the Olkiluoto 1 and 2 plant units to a significant degree and, during the facility's operating history, carried out extensive modifications on the plant systems, structures and components to improve safety. In the coming operating licence period, it is important to continue the implementation of the safety-improving measures. Based on the documentation submitted to STUK, TVO is committed to continuing the efforts to improve plant safety during the coming operating licence period. Based on its own periodic safety review, TVO has presented to STUK a set of action plans relating to the improvement needs observed, which can be used to ensure the safe operation of the Olkiluoto 1 and 2 plant units until the next periodic safety assessment. STUK finds the presented plans sufficient to ensure the safe operation of the plants. STUK has approved the periodic safety review summary and action plan to develop safety at the facility by decision 5/C42213/2017, 31 May 2018.

The detailed safety requirements concerning the implementation of the level of safety prescribed in the Nuclear Energy Act are set forth in the YVL Guides published by STUK. A total reform of the YVL Guides was completed in 2013. Over the course of 2015, STUK comprehensively assessed how well the Olkiluoto 1 and 2 nuclear power plant units meet the requirements of the updated YVL Guides and issued decisions on the application of the requirements and the areas where safety improvements were still needed. Significant needs for technical changes did not arise in the context of these implementation decisions since the most essential ones of the new requirements had already been met or the implementation was under way based on the safety assessments conducted after the Fukushima Daiichi nuclear disaster.

Based on STUK's previous periodic safety assessment (C213/55, 30 October 2009), TVO was required to provide a comprehensive report on the sufficiency of the safety functions secured with the diversity principle at the Olkiluoto 1 and 2 nuclear power plant units as well as an action plan for development measures to reduce the risk caused by common cause failures in accordance with the diversity principle. Based on the report delivered as a response and the safety assessments conducted on the basis of the Fukushima incident, the Olkiluoto 1 and 2 nuclear power plant units

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have initiated and partially completed a wide range of plant modifications to strengthen the fulfilment of the diversity principle. STUK finds it extremely important for the ongoing plant that the modifications aimed at securing safety functions in the event of possible common cause failures, seawater loss and electricity loss be completed as quickly as possible within the next few years.

During the current operating licence period, the probabilistic risk analysis (PRA) has been utilised to systematically identify and eliminate risk factors. The Olkiluoto 1 and 2 nuclear power plant units also meet the core damage frequency target value set for operating plants by the International Atomic Energy Agency (IAEA). Furthermore, the Olkiluoto 1 nuclear power plant unit meets the numerical design objectives set for new nuclear power plants in Guide YVL A.7 with regard to core damage frequency. The Olkiluoto 2 unit does not meet the core damage frequency limit value set in Guide YVL A.7 for new nuclear power plants, as some of the modifications that are important to safety are yet to be implemented at the Olkiluoto 2 nuclear power plant unit. The modifications at the Olkiluoto 2 unit are estimated to be completed during 2018 and 2019. In addition to this, a steam turbine-driven high-pressure make-up water system and a low-pressure make-up water system based on utilising firewater supply are in the implementation phase for the Olkiluoto 1 and 2 units. The plan is to complete these systems in 2018. Based on the PRA assessment on them, the core damage frequency will drop to some two-thirds of the current level.

In accordance with the principle of continuous improvement, TVO has significantly reduced the risk of core damage and large release at the Olkiluoto 1 and 2 nuclear power plant units over the course of the operating licence period. However, among the risk reduction opportunities, the share of a common cause failure in the protection I&C system's terminal relays, which is currently about 8% of the total core damage frequency, remains to be examined. Based on its own periodic safety assessment, STUK has required TVO to investigate in more detail how this risk could be reduced. TVO must analyse the significance of common cause failures in the reactor protection system's terminal relays from the perspective of the reliability of the safety functions and the core damage frequency and use these analyses to determine the necessary measures to reduce the core damage risk caused by the aforementioned common cause failures.

TVO's application for the continuation of the operating licence in such a way that the original design-basis service life of 40 years will be exceeded by 20 years is largely based on ageing management. TVO's goal is to keep the systems, structures and components of the Olkiluoto 1 and 2 plant units in up-to-date and good condition in terms safety and production capacity. TVO has an ageing management programme which entails the functions, tasks and responsibilities to ensure the operability of the SSCs related to safety for the entire duration of their service life. Early identification of the relevant SSCs and the related ageing phenomena makes possible far-reaching predictions and plans on the requisite basic improvements and

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maintenance tasks. According to STUK's assessment, ageing management at the Olkiluoto 1 and 2 power plant units has been organised in an appropriate manner.

Alongside maintenance, ageing management involves systematic modernisation aimed at improving the safety of the facility and the availability, reliability and performance of the systems and components, and ensure the availability of product support from the manufacturer and spare parts. Large plant unit modifications are primarily implemented as long-term design projects in plant update projects. Extensive modifications have continued during the past operating licence period. Examples of on-going projects are modernisations of the emergency diesel generators, main circulation pumps and feedwater distributors and the installation of a new steam turbine-operated high-pressure make-up water system.

In conjunction with the renewal of the operating licence, TVO updated the strength analyses of the primary circuit to correspond to a service life of 60 years. The analyses cover the Safety Class 1 pipes, the reactor pressure vessel and the reactor pressure vessel internals. The strength analyses cover dimensioning against pressure and other mechanical design loads as well as tension and fatigue analyses for critical points. The design loads account for the various operating and accident situations of the primary circuit as well as the effects of the environmental conditions. Based on the analyses, the safety margins remain sufficient for the entire planned 60-year service life of the plant unit.

At the Olkiluoto 1 and 2 nuclear power plant units, the primary circuit's periodic pressure test has not been performed after the commissioning of the plant units. By STUK's decisions, periodic pressure tests have been replaced with tightness tests (1.02 x operating pressure) conducted at 8-year intervals, which is permitted by ASME XI for reactor plants designed and inspected in accordance with ASME requirements. When the pressure test was originally replaced with a tightness test compliant with ASME XI, it was not known that the service life of the plant units would be longer than the 40 years presumed in the ASME version valid at the time. For this reason, STUK has, based on its own periodic safety assessment, required that the periodic primary circuit tightness test prescribed by the current procedure must be replaced with a periodic pressure test conducted every eight year at the maximum allowable operating pressure. The purpose of the pressure test is to demonstrate through tests that the known or any possible latent ageing mechanisms have not weakened the integrity of the primary circuit once the plant units have reached their original design life span. The first pressure tests on the Olkiluoto 2 nuclear power plant unit must be conducted in 2019 and the first tests on the Olkiluoto 1 nuclear power plant unit must be performed in 2020.

In 2015, TVO carried out an organisational change in which the TVO organisation was divided into business units and service functions. TVO has exhibited significant problems related to work atmosphere in recent years and staff turnover has increased from previous years. Staff motivation and

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competence are essential in maintaining a good safety culture. TVO's work atmosphere issues and the high staff turnover in recent years during the commissioning of the Olkiluoto 3 nuclear power plant unit present a challenge for high-quality and safety-informed work. Due to the challenges with work atmosphere, TVO has initiated extensive programmes aiming towards a strong safety culture, good work atmosphere and management. In 2017 and 2018, STUK has carried out intensified oversight of the implementation and effectiveness of TVO's measures. Based on STUK's oversight activities, it can be stated that TVO has implemented development measures related to management, safety culture and development measures related to staff resourcing and competence in a systematic manner. In STUK's assessment, the aspects necessitated by Section 25 of STUK Regulation Y/1/2016 are at an acceptable level. The implementation of development measures related to management, safety culture as well as staff resourcing and competence must be continued. STUK has processed the aforementioned aspects and matters in conjunction with its own period safety assessment, and it will monitor the development of the situation and the effectiveness of the development measures as part of its continuous oversight.

Conclusion

Teollisuuden Voima Oyj applied for a licence for the following activities:

- to operate the Olkiluoto 1 and 2 power plant units of the Olkiluoto power plant at a nominal thermal power of 2,500 MW to produce electricity from the beginning of 2019 to 31 December 2038
- to use the interim storage for spent nuclear fuel (KPA storage) for the interim storage of spent nuclear fuel generated by the operations of the Olkiluoto nuclear power plant from the beginning of 2019 to 31 December 2038
- to use the interim storage for intermediate-level waste (KAJ) storage, interim storage for low-level waste (MAJ storage) and component storage for the interim storage of low- and intermediate-level waste generated by the operation of the nuclear facilities on the Olkiluoto island from the beginning of 2019 to 31 December 2038, and
- to temporarily store the low- and intermediate-level waste generated by the operations of the nuclear facilities on the Olkiluoto island at Olkiluoto 1 and Olkiluoto 2 from the beginning of 2019 to 31 December 2038

Pursuant to Section 24 of the Nuclear Energy Act, an operating licence is granted for a fixed term and, in considering the length of the term, particular attention must be paid to ensuring safety and to the estimated duration of operations.

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TVO is applying for the operating licence for a period of 20 years.

In this statement, STUK has assessed that the operations intended by the licence applicant are safe and meet the requirements laid down in the applicable legislation. STUK has found no reasons that would prevent the granting of the licence for the applied period of 20 years. The nuclear energy legislations provides STUK with the means to intervene with the use of nuclear energy when safety concerns require it to do so.

In summary with regard to the inspections and reviews of matters and documents related to the periodic safety assessment and the results of continuous monitoring, STUK states that TVO has ensured the safety of the Olkiluoto 1 and 2 nuclear power plant units in accordance with the valid provisions, for the parts applicable to operating facilities. TVO has presented measures to improve safety at the Olkiluoto 1 and 2 nuclear power plant units during the upcoming operating licence period. In STUK's assessment, TVO has the required capabilities, procedures, competence and resources to continue safe operations. STUK will monitor the timely and compliant implementation of TVO's safety-improving methods.

In conclusion, STUK's overall assessment is that, as regards its sphere of authority and operations, the requirements of Sections 5–7 and 20(1) of the Nuclear Energy Act for granting an operating licence for the Olkiluoto 1 and 2 nuclear power plant units and the included buildings and storages required for the management of nuclear fuel and waste are met. In connection with preparing this statement, STUK has found that the matters and arrangements referred to in Section 20(2)(1) of the Nuclear Energy Act are in order, with the specifications presented above.

The documents specified in Section 36(1) of the Nuclear Energy Decree are up to date and sufficiently comprehensive, and STUK has approved them. If the operating licence is granted for the period indicated in the application, a periodic safety assessment must be conducted on the Olkiluoto 1 and 2 nuclear power plant units in accordance with the Nuclear Energy Act. The relevant procedures are described in more detail in Guide YVL A.1. As a proposed licence condition, STUK presents that the licence holder must prepare a periodic safety assessment on the Olkiluoto 1 and 2 nuclear power plant units and deliver it to STUK for approval by the end of 2028.

Director General

Petteri Tiippana

Director

Kirsi Alm-Lytz

Appendices

1. STUK's safety assessment of the Olkiluoto 1 and 2 nuclear power plant units and the KPA, KAJ, MAJ and component storages, 21 May 2018
2. Assessment of the documents prescribed in Section 36 of the Nuclear

Energy Decree, 21 May 2018

3. Statement from the Advisory Committee on Nuclear Safety, 24 May 2018