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REPORT ON THE SUPERVISION OF WELDING WORK AT OLKILUOTO 3

The Ministry of Employment and the Economy has, through its letter 2743/091/2008 dated 13 August 2008, asked the Radiation and Nuclear Safety Authority (STUK) to produce a report as a response to the comments made in public regarding the regulatory oversight by STUK of welding work carried out at the OL3 site.

Summary

The Radiation and Nuclear Safety Authority (STUK) has studied the comments made in public on 12 August, according to which the safety regulations regarding the supervision of welding work have not been observed at the Olkiluoto 3 nuclear power plant construction site. STUK is of the opinion that these comments are based on a misunderstanding. The safety-critical welds are of good quality.

Public concern has focused on the welds on steel concrete reinforcements that are used to ensure that the steel concrete reinforcement and the anchoring parts remaining at the surface of the concrete do not move during the casting process. The strength of these so-called installation welds is not taken into account when designing the concrete structure. STUK does not systematically inspect installation welds. According to the report by TVO, instructions were available for installation welds before commencing the work. Installation work was only carried out by qualified welders, and the quality of the installation welds has been inspected in work stage inspections carried out by Bouygues Travaux Publics (BTP), Areva and TVO before starting concrete casting. In addition, STUK carries out a visual inspection of completed welds in safety-critical structures before permission to begin the concrete casting is granted. No movement of steel structures has been observed during or after the casting work.

The reinforced concrete structures also contain some load-bearing welded joints which affect the strength of the structure. A total of 35 of such welds have been made since April 2008. The welds were made in compliance with the welding instructions approved by STUK. The welds and their welders have been empirically qualified before actual production welding. STUK has systematically inspected the load-bearing welded joints and has not detected any defects in their design or implementation. The reports submitted to STUK indicate that the load-bearing joints were made under the supervision of competent welding coordinators.

It has also been alleged in the media that the French company's employees have been requested to sign an undertaking that they will not divulge any safety problems that they may observe. Should this allegation be true, it would be a serious indication of callous disregard of the safety culture. However, according to STUK's observations, the working practice on site is such that safety- and quality-related matters are brought

up. The importance of openly bringing up any defects is emphasised both during the induction training that all new employees undergo, and in conjunction with inspections. The project manager of BTP, the company responsible for the construction work, has given STUK a written statement to the effect that all of the company's employees are obliged to report any deviations with potential safety or quality implications to their company's quality and project management. The safety culture includes a policy whereby the employees can take the matter further, all the way to STUK, in case they feel that their observations have not been dealt with in an appropriate manner. The deviations are recorded and rectified in compliance with the company's quality system, and the related documentation is made available for inspection by STUK. According to the report submitted by TVO, the site personnel have also been given instructions regarding how the situation on site and in the project, or the technical and commercial details associated with the project, may be discussed with external parties. These rules are associated with normal confidentiality regulations used in business life. They do not prevent openly bringing up safety and quality deviations on site.

General information on welding work carried out on site

The following steel structures ensuring the leak tightness and integrity of structures have been welded on site:

- steel liner of the inner shell of the reactor building
- steel liners of pool structures
- pipe joints
- structure penetrations

The welds in the above structures and equipment are load-bearing joints, and thus constitute part of the manufacture of the corresponding structure. STUK supervises and inspects the stages in manufacturing these items by approving the respective plans and designs and by supervising the actual work and the organisation carrying it out. STUK also supervises the operations of the construction contractor, TVO and independent inspection organisations. In addition, STUK carries out its own structural inspections to ensure that the respective structures have been appropriately manufactured.

In addition to the above, the steel reinforcements of massive reinforced concrete structures have also been welded in exceptional cases at the Olkiluoto 3 site, due to reasons pertaining to the technical execution of work. The welds have been associated with load-bearing joints between concrete reinforcement steel bars in cases where individual steel bars have been joined together so that the joints form part of the load-bearing structure. Installation welds are made on site mainly in joints between concrete reinforcement steel bars and anchorage plates remaining on the surface of the structure. In exceptional cases, due to reasons pertaining to the technical execution of work, the concrete reinforcement steel bars are joined using welding instead of the normal procedure of tying with steel wire. It is the quality and oversight of these very installation welds that has now been questioned in public.

Load-bearing joints of reinforced concrete structures and welding them

In a steel-reinforced concrete structure, the reinforcement steel forms a composite structure with the concrete, capable of bearing the loads it has been designed to withstand without breaking, and maintains leak tightness while also ensuring long-term durability against corrosion. Structurally continuous steel reinforcements are formed using ribbed steel bars, and the load-bearing joints between these bars are primarily made by overlapping the bars and tying them together, or by screwing them together using threaded muffle-type couplings. The structures of Olkiluoto 3 contain tens of thousands of load-bearing joints made by using overlapping or threaded couplings. In exceptional cases at Olkiluoto 3, reinforcing bars have been joined using load-bearing welded joints due to reasons pertaining to the technical execution of the work. A total of 35 of such joints have been made in the safety-classified structures of Olkiluoto 3 during the period 14 April 2008–30 July 2008. Of these, 13 are in the containment building or its internal structures.

The planning, design, implementation and inspections of load-bearing joints are subject to the requirements that joints are made by overlapping the bars at a sufficient length, and that threaded coupling joints or welded joints are made and tested in such a manner that their load-bearing capacity is equal to the corresponding plain steel bars. STUK has overseen the construction work of the Olkiluoto 3 plant by inspecting the design plans of all the structures that are important from a nuclear safety point of view, as well as their implementation and control of implementation before casting the concrete. Regarding the load-bearing welded joints, STUK has, during the autumn of 2007, approved the welding instructions for load-bearing joints as well as the general description of the organisation carrying out the welding work, together with descriptions of the duties and responsibilities. In addition to these, STUK has received as information the results of the qualification and production tests carried out in compliance with the above-mentioned welding instructions, as well as details of the welding coordinators in charge and of the welders who have passed the qualification tests before the load-bearing joints were welded.

In order to ensure safety, the structural design contains safety margins. Structural solutions in designed reinforced concrete buildings take into consideration the possibility that all design assumptions may not be realised. The exact location of steel reinforcement or the strength of material, for example, may deviate somewhat from the design parameters, and yet the structure is still capable of bearing the design loads.

To summarise, STUK states that the welding work of load-bearing joints has been carried out in compliance with the plans approved by STUK in such a manner that the welding work instructions and welding organisation deployed for the load-bearing joints have been approved before commencing the work. Furthermore, the inspector from STUK has verified in inspections ensuring the readiness to start concrete casting work that appropriate qualification and production test results exist regarding the load-bearing joints and the persons making them, and that appropriate documents (welding

records and inspection protocols) have been kept when implementing and inspecting the load-bearing joints.

Installation joints of reinforced concrete structures and welding them

The steel reinforcement of concrete as well as the anchoring components intended for supporting equipment and pipes are fixed so that they will not move during the concrete casting process. During the concrete casting process, the poured concrete mass, vibrating it and the employees walking on the reinforcement all require that the components in question are properly fixed. Should the fixing be too weak, the reinforcement steel bars and anchoring components will move during the casting process, which in the worst scenario would result in extensive repairs being required. Displacements of components due to poor fixing will be detected during and after the casting work by the anchoring components on the surface of the casting and by the reinforcement at the casting joints. To date, such displacements of steel reinforcement or anchoring components have not been detected at the Olkiluoto 3 site.

At the Olkiluoto 3 site, steel reinforcement bars are primarily joined together by tying with steel wire, and in exceptional cases by welding. The anchorage plates used for anchoring equipment and pipes are fixed in the steel reinforcement mesh by welding, less often by tying with wire. These kinds of attachments accomplished by welding are called installation welds, and they are only intended for keeping the reinforcement steel bars and anchoring components in place during the concrete casting process. Their strength is not taken into account when designing the concrete structure.

Since the installation welds of reinforcement steel bars and anchoring components have no effect on the load-bearing capacity of the final structure, they have no nuclear safety classification either. However, installation welds are only made by qualified welders. STUK does not require the plans and welding instructions related to installation welds to be sent to STUK. However, STUK does supervise the making of installation welds on steel reinforcement bars and anchoring components in compliance with the National Building Code of Finland and the standards referred to therein, because incorrectly and incompetently welded installation welds may damage the load-bearing steel reinforcement and anchoring. According to the report by TVO, instructions were available for installation welds before commencing the work. The quality of installation welds has been inspected in work stage inspections carried out by BTP, Areva and TVO before starting the concrete casting. In addition, STUK carries out a visual inspection of completed welds in safety-critical structures before permission to begin the concrete casting is given. No movement of steel structures has been observed during or after the casting work. During summer 2007, STUK detected defects in installation welds and pointed them out to TVO. No defects have been observed in installation welds since then.

Organisation of welding work, coordinators and qualifications

In order to ensure the implementation of welding work of high quality, the duties and responsibilities of the organisation carrying out the welding work must be clearly defined with regard to planning, manufacturing, supervision and inspection. The requirements pertaining to the manufacturing and organisation of reinforcement steel welding are set out in several standards. TVO has submitted to STUK that in its work, the manufacturer observes the standards SFS-EN ISO 17660-1, EN ISO 14731 as well as EN ISO 3834-3 and 4. In its decisions regarding load-bearing welded joints, STUK has required that the above standards must be complied with, and that the details of the organisation carrying out the welding work must be supplied in order to ensure that the duties and responsibilities have been clearly defined. These details were supplied to STUK, and the decisions were made before welding the load-bearing joints.

As discussed above, STUK must receive, for information purposes, the names of the welding coordinators coordinating the welding of concrete reinforcement steels on site. However, it is not up to STUK to approve them for the post. During a site audit carried out in November 2007, a person appointed as welding coordinator declined the appointment. The situation was required to be rectified. A new welding coordinator was appointed for the site in January 2008. During the period when load-bearing welded joints were welded (spring and summer 2008), the BTP's welding coordinators and also AREVA's welding coordinator were on site.

The National Building Code of Finland does not contain any regulations regarding the welding of concrete reinforcement steel bars, but Section B4 of the Code does contain instructions for welding concrete reinforcement steel bars. The instructions do not require a welding coordinator, only competent workers and qualification tests of the welded joints. The duties and qualification requirements of a welding coordinator responsible for load-bearing welded joints are set out in SFS-EN ISO 17660-1, which entered into force on 1 September 2006.

According to the material received by STUK, welding coordinators with sufficient competence were available on site during the time when safety-critical load-bearing joints were welded.

Supervision by STUK

According to the Nuclear Power Act, the licensee must ensure safety. Through its supervision, STUK makes sure that the licensee bears its responsibility for safety. In the Olkiluoto 3 project, the regulatory oversight by STUK includes the inspection of plans and the supervision of work carried out in compliance with them. The basic principle is that the plans for the most safety-critical equipment and structures are approved by STUK before commencing their manufacture and construction. Through its inspections, STUK verifies during the construction and manufacturing phase that the implementation is carried out in compliance with the plans submitted to STUK. This

entails, in particular, that the manufacturer/building contractor, plant supplier and licensee have honoured their respective obligations regarding the supervision of implementation and that the equipment or structure has been subjected to all the required tests, inspections and analyses and that these have produced acceptable results.

STUK does not inspect everything. The inspections are targeted on the basis of the safety importance of the subject. The plant is divided into systems, structures and components, which are further divided into safety classes 1, 2, 3 and 4 on the basis of their respective safety importance. There is also a separate class for systems, structures and equipment that are not important with respect to safety. STUK inspects in particular the design and implementation of systems, structures and equipment in safety classes 1 and 2. These classes include, for example, the reactor coolant circuit, safety systems and safety-critical buildings, such as the containment building and its internal structures. The inspections of components and structures in safety classes 3 and 4 have been entrusted to inspection organisations approved by STUK. STUK oversees the work of inspection organisations.

In spite of regulatory oversight, the responsibility for the oversight and implementation of systems, structures and components in all safety classes lies with the licensee. The party responsible for the Olkiluoto 3 project is TVO. The plant suppliers and their subcontractors are also responsible for the implementation. Self-monitoring by the plant supplier and its subcontractor is also an essential element of this. The licensee carries out its own supervision and inspections in order to satisfy itself of the high quality of implementation by the plant supplier and its subcontractors. In addition to supervision, it is also important that all parties openly bring up any defects detected in the operations or products, so that they can be jointly discussed and handled. Supervision and openness in line with a good safety culture ensure the high quality of the end product.