

FINNISH EXPERIENCE IN SAFE SHUTDOWN AND DECOMMISSIONING LICENSING OF THE FIR 1 TRIGA RESEARCH REACTOR

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ABSTRACT

VTT Technical Research Centre of Finland decided in July 2012 to decommission the FIR 1 TRIGA research reactor as soon as it is technically and legally justified. Environmental Impact Assessment (EIA) and a new operating license for the decommissioning phase are legal prerequisites for actual dismantling operations.

VTT submitted its final EIA report to the coordinating authority in October 2014 and it was approved end of February 2015. The reactor was brought into extended shutdown end of June 2015. This was in the middle of a process to evaluate the applicability of new nuclear regulatory guides to FIR 1. The outcome of this process is explained.

After the environmental impact assessment preparations for decommissioning license have continued. Prerequisites and required documents for filing the application are described. A dismantling plan prepared by and in collaboration with Babcock Noell (Germany) forms the background documentation for the license application documents.

Bottle necks in the SNF and dismantling waste management are described. Currently there does not exist any national nuclear waste management service in Finland. For the so called small item waste the government has organized a solution in collaboration with TVO. This pathway can be used for single items also from the decommissioning of FIR 1 but not all the dismantling waste. Technically the Finnish nuclear power companies have the capability for intermediate storage and will have for final disposal, but solutions for licensing this are still open and under negotiations between VTT and the companies. Even changes in legislation and other government actions might be needed to facilitate this.

Preferred option for SNF management is shipping to Idaho, USA. Technical and contractual bases for this is clear if State of Idaho will settle its disputes with DOE and release the ban for import of spent nuclear fuel in time before the Foreign Research Reactor SNF Acceptance Program is expiring in spring 2019.

An agreement with TVO/Posiva exist for final disposal of the FIR 1 SNF in the Posiva site if the US option does not come true. To realize this domestic option additional environmental impact assessments and even changes in legislation might be required before it can be licensed.

1. Introduction

FiR 1 –reactor located in Otaniemi, Espoo, Finland is a TRIGA Mark II type research reactor manufactured by General Atomics (San Diego, CA, USA). The FiR 1 started operation in 1962 and reactor power was increased in 1967 from 100 kW to 250 kW. Boron Neutron Capture Therapy (BNCT) patient treatments dominated the utilization of the reactor since late 1990's. The weekly schedule allowed still three days for other purposes such as isotope production, neutron activation analysis as well as education and training [1]. The operating

licence of the reactor was extended for the period 2011 to 2023 by the government of Finland in December 2011.

In June 2012 VTT Technical Research Centre of Finland as the licensee of the government owned research reactor decided to close down the reactor as soon as it is technically and legislatively possible [2]. An environmental impact assessment of the decommissioning was conducted as a prerequisite for the application to the government for renewing the license of the reactor for decommissioning [3,4].

2. Permanent shut down of FiR 1 and renewal of the Finnish regulatory guides

In March 2015 VTT sent a letter to Finnish Radiation and Nuclear Safety Authority (STUK) asking for possible guidance to consider when it planned to permanently shut down the reactor end of June 2015. In this letter VTT noticed that after the environmental impact assessment report for decommissioning of the reactor had been approved by The Ministry of Economic Affairs and Employment (MEAE) end of February VTT now could step forward with its decommissioning plans. VTT noticed though that starting of decommissioning activities requires a change in the operating license of the reactor. Further VTT noticed that neither legislation nor the operating license require operation of the reactor and that the STUK regulatory guides do not give any special requirements for such a situation.

VTT proposed based on IAEA guides a list of actions to bring the reactor into a permanent shutdown phase [5]. The reactor core would be made subcritical by removing part of the fuel and the control rods would be deactivated to assure that the reactor would not be restarted even accidentally. Reactor tank water conditioning, ventilations, radiation monitoring and all other systems in the reactor hall would be kept operational or ready to operate. Only the operational limits and conditions would not be needed to follow any more.

STUK replied that VTT should keep STUK informed about the changes in plans and ways of action and seek approval by STUK when necessary.

After amending the Finnish nuclear energy legislation in 2008, also the revision of all YVL Guides for nuclear safety was commenced to reflect the enhanced safety requirements. The TEPCO Fukushima Dai-ichi accident delayed the completion of the new guides. WENRA's updated Safety Reference Levels were taken into account in the revised YVL guides [6]. The new set of YVL guides was published 1st December 2013. In February 2014 VTT, like all the other nuclear facility operators, received from STUK a request to review the new guides and to indicate which parts of the guides can be applied at FiR 1.

VTT replied in December 2014 with detailed reviews of eleven guides it considered most relevant to FiR 1. Regular operation was considered in the review. In February 2015 STUK requested VTT to review five more guides, including one for nuclear waste management. In reviewing the guide for nuclear waste management STUK asked VTT also to consider the foreseen phase of reactor dismantling. End of August VTT delivered final versions of all the reviews.

In November 2015 STUK decided that eleven of the new guides would be applied at FiR 1 and of each of them STUK made a detailed decision for application at FiR 1. 28 of the new guides would not be applied but the old guides would apply with a graded approach as before. Although VTT explicitly informed STUK that it had reviewed the documents for an operating reactor, STUK made its decision for a permanently shut down reactor. It informed VTT that if a restart of the reactor would be planned for VTT should submit to STUK for approval measures that would be needed to meet the requirements of the new guides. STUK did not inform what it meant with this statement. With this decision STUK de facto acted according to the Nuclear Energy Act section 67 Interruptions or limitations of operation

without the procedures described in sections 64 and 65. VTT did not appeal against this decision as it did not have any intention to restart the reactor.

3. Finnish regulation for decommissioning of nuclear facilities

According to the Finnish Nuclear Energy Act Section 7 g Decommissioning: “ ...When the operation of a nuclear facility has been terminated, the facility shall be decommissioned in accordance with a plan approved by the Radiation and Nuclear Safety Authority (STUK). Dismantling the facility and other measures taken for the decommissioning of the facility may not be postponed without due cause.”

During operation of the reactor provision for decommissioning are kept updated to show that decommissioning can be carried out as planned and that the cost estimations for the National Nuclear Waste Management Fund are valid. This decommissioning plan is not sufficient for the decommissioning license but a much more comprehensive plan has to be prepared as mentioned above.

4. Preparing the application for new operating license for decommissioning

A new operating license is required for decommissioning. The legislation does not include separate guidelines for this so the required list of documents to be submitted to the government and STUK is the same than for regular update of the operating license. As the decommissioning of a nuclear reactor has similarities to a construction phase VTT decided to prepare for STUK a licensing plan according to the YVL guide A.1, appendix A for new builds. The licensing plan was submitted in February 2017. It contains schedules for the licensing and decommissioning, lists of all required documents and short descriptions if and how the content of each document will be changed compared to the previous operating license application made in 2011.

YVL guide D.4 paragraph 709 requires that *the licensee shall submit to STUK for approval a final decommissioning plan no later than two years following the date when the operation of all those nuclear facilities that are intended to be decommissioned concurrently was terminated. In this connection, the licensee shall also submit to STUK for approval the safety analysis report referred to in para. 605 and updates to the documents referred to in Section 36 of the Nuclear Energy Decree, where applicable. The final decommissioning plan shall be kept up-to-date during the decommissioning of the facility.*

As the operation of FiR 1 was terminated 30.6.2015 VTT has to submit the decommissioning plan by 30.6.2017. Actually VTT plans to submit the whole license application in summer 2017. It contains the following documents.

Application to the government:

- Settlement and town planning
- Nuclear materials and nuclear waste
- Tech. operating principles for safety
- Fulfilment of safety principles
- Environment
- Expertise and organization
- Nuclear waste management
- Financial status
- Financial statements
- Compliance with old license
- References to old decisions
- Other, e.g. EIA

Supporting documents to STUK

- FSAR
- PRA
- Safety classification
- Quality management
- Technical specifications
- Periodic inspections
- Security and emergency
- Safeguards
- Administrative rules
- Radiation monitoring
- Fulfilment of safety requirements
- Ageing management
- Decommissioning plan

Supporting detailed technical reports:

- Dismantling plan (by BNG 2017)
- Work instructions (by BNG 2017)
- Safety classification (by Fortum 2017)
- Waste management and packaging plan (by BNG & Fortum 2017)
- LILW interim storage (by Fortum 2016, TVO 2017)

Fundamental reports:

- Environmental Impact Assessment Report (Pöyry&VTT 2014)
- Clearance (by VTT: Ruokola 2016, Rätty 2017)
- Inventory report (by VTT: Kotiluoto & Rätty 2016)
- Inventory measurements (by VTT: Rätty 2017)
- Transports (by VTT: Suolanen 2014)
- Graphite & aluminium waste (by VTT: Carlsson 2014)
- Radiation effects to environment (by VTT: Rossi 2014)
- SNF accident analysis (VTT: Rossi 2016)

The dismantling plan prepared by and in collaboration with Babcock Noell (Germany) forms one of the cornerstones for the license application documents. Currently VTT is preparing the comprehensive decommissioning plan.

5. Nuclear waste management for FiR 1

Currently there does not exist any national nuclear waste management service in Finland. For the so called small item waste the government has organized a solution in collaboration with TVO. This pathway can be used for single items also from the decommissioning of FiR 1 but not for all the dismantling waste. Technically the Finnish nuclear power companies have the capability for intermediate storage and will have for final disposal, but solutions for licensing this are still open and under negotiations between VTT and the companies. Even changes in legislation and other government actions might be needed to facilitate this.

Safety analysis for the intermediate storage of the dismantling waste in the medium level waste facility at Olkiluoto has been made and no contradicting items were identified. A contract for the storage has been prepared with the owner TVO company. The license of that facility has to be renewed to incorporate the FiR 1 decommissioning waste and this will take place in 2019 after the renewal of the OL1&2 NPP operating licenses. The FiR 1 dismantling waste would later be transferred for final disposal into the already existing Olkiluoto VLJ repository or to the decommissioning waste repository to be built in Olkiluoto for the dismantling of the Olkiluoto units 1,2 and 3 in the 2070's [6]. The VLJ repository at Olkiluoto

consist of two underground silos where low and intermediate level waste generated at TVO's plant units in Olkiluoto is stored. Small radioactive waste items from the Finnish health care sector, industry and research institutions are also disposed of in the VLJ repository.

As an alternative for the storage in Olkiluoto storage and even final disposal at the Loviisa NPP owned by the Fortum company is prepared for as was considered already in the past and analysed in the environmental impact assessment of the decommissioning of the FiR 1 reactor [3].

VTT will prepare plans for short term intermediate storage of the dismantling waste at its premises for the case that there would be delays in TVO's or Fortum's capability of receiving the waste. The real estate owner in Otaniemi will not allow long term intermediate storage of nuclear waste in Otaniemi.

6. Spent fuel management for FiR 1

Preferred option for management of the spent fuel from FiR 1 is shipping to Idaho, USA. Technical and contractual bases for this are clear if State of Idaho will settle its disputes with DOE and release the ban for import of spent nuclear fuel in time before the Foreign Research Reactor SNF Acceptance Program is expiring in spring 2019. Plans for intermediate storage of the spent fuel at one of the nuclear power plant sites in Finland are made for the case the transfer to US would be delayed [7].

An agreement with TVO/Posiva exists for final disposal of the FiR 1 SNF in the Posiva site if the US option does not come true. To realize this domestic option additional environmental impact assessments and even changes in legislation might be required before it can be licensed. Currently the construction license of Posiva granted by the Government in November 2015 includes only spent fuel from the NPP units Olkiluoto 1, 2 & 3 and Loviisa 1 & 2 [6]. VTT has performed criticality safety [8,9] and radiation risk assessment [9] to support the licensing of this solution. Spent fuel transport and intermediate storage options for the final disposal of the FiR 1 spent fuel in the Posiva repository have also been studied and are reported in another paper at this conference [7].

7. Conclusions

The final decommissioning plan for FiR 1 currently under preparation shows that adequate knowledge exist about the expected radioactive waste from the dismantling of the reactor, technical solutions exist for safe and economical dismantling of the activated parts and structures and practical technical solutions exist for safe intermediate storage of this waste. Only the location of the intermediate storage will remain open some year to come. Therefore VTT will prepare for a short term store of the dismantling waste at its premises. Final solutions for the dismantling waste remain open.

Dismantling of the reactor can start only after removal of the spent fuel from the reactor. VTT, Finnish government and US DOE will continue collaboration aiming at returning the spent fuel to the United States. VTT is hoping for a direct transfer from the reactor to Idaho within a couple of years. But also here VTT is preparing for delays and therefore for intermediate storage at one of the nuclear power plants in Finland. If the return of the fuel to US finally fails the back end option will be the Posiva repository in Finland.

Current understanding is that the government will reflect positively on the decommissioning license application although the final solutions for both the spent nuclear fuel and dismantling waste are open – but not unknown.

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