Regulatory Review and Assessment of the 2012 Construction License Application for an SNF Disposal Facility at Olkiluoto, Finland - 14243

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ABSTRACT

In Finland over 30 years of systematic R&D has been carried out to develop the disposal concept for SNF. The Government issued in 2000 the Decision in Principle deciding that Olkiluoto will be the site for the SNF repository and that Posiva Oy (Posiva) was allowed to proceed by constructing the underground rock characterization facility, Onkalo, there. KBS-3V is the proposed multi-barrier disposal concept. In it the SNF is encapsulated in a copper canister that is emplaced in a vertical borehole and then surrounded by a bentonite-buffer. These engineered barriers are supplemented by the host rock, which serves as the natural barrier. The disposal facility is planned to be located at a depth of 400-420 meters. The packaging of SNF will take place in an encapsulation facility situated on the ground above the repository. Posiva, the implementer, submitted the construction license application and supporting documentation to the authorities at the end of 2012. The Radiation and Nuclear Safety Authority of Finland, STUK, started the review and assessment (R&A) with an initial review in early 2013. At the moment STUK is performing thorough R&A against safety requirements and the outcome is documented in STUK's safety evaluation report. The planned duration for STUK's R&A is 1.5 to 2 years. After passing the construction license step STUK will have comprehensive oversight over the detailed design, construction, fabrication and pre-operational testing, which will be followed by the review of the operation license application. The final repository for SNF is planned to be in operation in early 2020.

INTRODUCTION

Finland is one of the foremost countries in the world in developing the first disposal solution for SNF. The Construction License application for the Olkiluoto SNF disposal facility was submitted to the Finnish authorities at the end of 2012 and the facility is expected to start operations around 2020. [1] This has been a long-term project with over 30 years of parallel development of the project and the regulatory approach to SNF management.

In 1983 the Government made a strategy decision on the objectives and target time schedule for the research, development and technical planning of nuclear waste management. While SNF export and an international disposal solution was still the preferred option, this decision required the licensees without existing contracts for exporting SNF to prepare for disposal in Finland. It also gave the timeline for the milestones on the way to an operating disposal facility by 2020.

The licensing procedure for a disposal facility has several steps that are similar to all nuclear facilities in Finland and that are defined in the Nuclear Energy Act and Decree. [2, 3] These licensing steps (Figure 1) are:

- A Decision in Principle (DiP) from the Finnish Government is required for a nuclear facility having considerable general significance. This is essentially a political decision: the Government decides if the construction project is in line with the overall good of society. The decision can be applied for one or more sites, the host municipality has a veto right and the parliament has the choice of ratifying or not ratifying the decision.
- Construction License is granted by the Government and authorizes the construction of the disposal facility. The actual construction is regulated by the Radiation and Nuclear Safety

Authority of Finland (STUK) and includes several review and approval steps, hold points and viewpoints.

- Operating License is granted by the Government and authorizes the operation of the facility for a certain period. The operation license is needed before nuclear waste can be disposed.

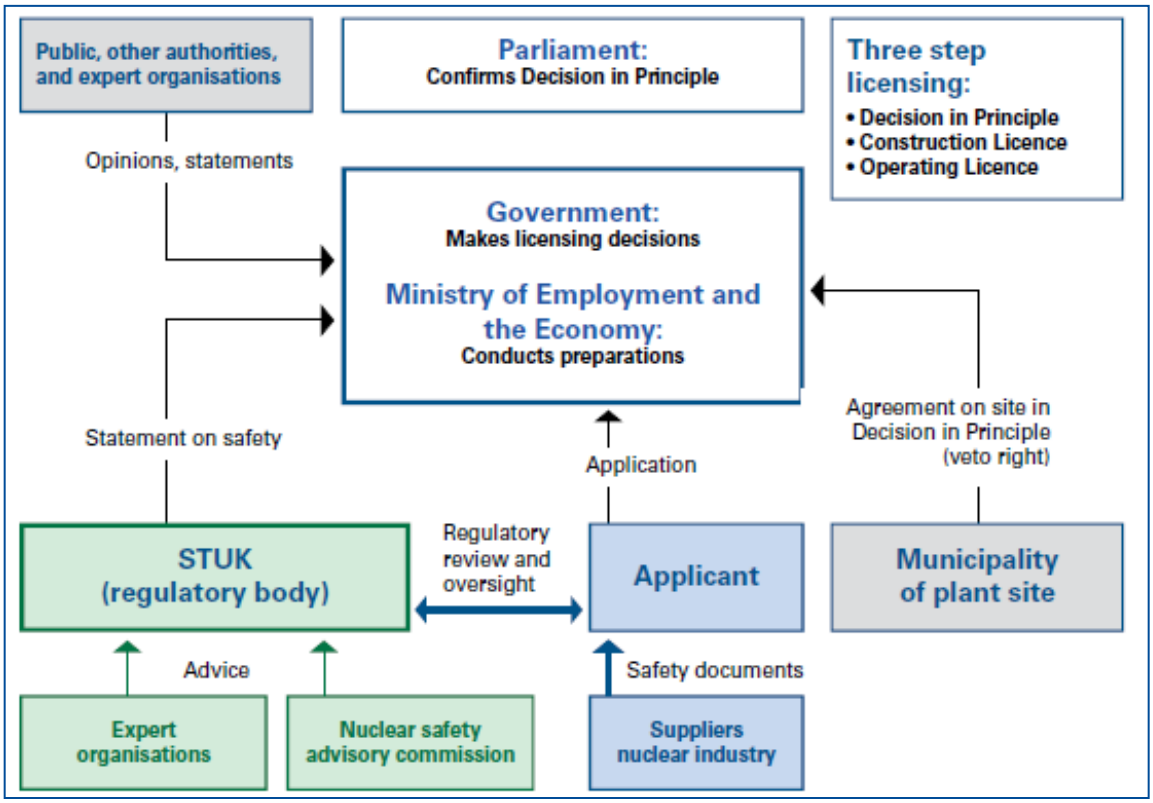

Fig. 1. Licensing process for nuclear facilities in Finland.

The first step in the licensing process was reached at the end of 1999 when Posiva Oy (Posiva), the current implementer of the SNF-disposal program, submitted the application for a DiP for an SNF disposal facility at Olkiluoto. The DiP was given by the Finnish Government in late 2000, approved by the host municipality, Eurajoki, and ratified by the Finnish Parliament in early 2001. It also authorized Posiva to start the construction of an underground rock characterization facility (URCF) at the Olkiluoto site down to the depth of the planned underground disposal, as required by regulation. [4]

Posiva, the implementer, submitted the construction license application and its supporting documentation to the authorities at the end of 2012. [1] STUK started the related review and assessment (R&A) in early 2013. At the end of 2013 STUK was performing a thorough R&A against safety requirements and the outcome will be documented in STUK's safety evaluation report. The planned duration for the R&A is 1.5 to 2 years. After approving the construction license step STUK will continue to have comprehensive oversight over the subsequent detailed design, construction, fabrication and pre-operational testing, which will be followed by R&A of the pending operation license application.

STUK PREPARATORY WORK FOR LICENCE APPLICATION REVIEW

The regulatory approach taken by STUK has been to closely follow Posiva's safety case development and to perform reviews of draft safety case documents (Table I). Another aspect has been to follow Posiva's R&D activities which are described in programs submitted to regulatory review every three years. [5] In

practice this has been implemented through regular visits to research laboratories, factories and workshops where safety related studies or demonstrations has been performed.

TABLE I. Main phases and steps in the program for SNF disposal from Loviisa and Olkiluoto nuclear power plants in Finland.

Period	Implementation	Regulatory oversight
1983 -1999	-Conceptual design, research and development -Site selection process: 100 > 5 > 3 -Detailed site investigations	-Government's policy of 1983 -STUK's safety reviews of 1987, 1994 and 1997
1997 -2001	-EIA program and report -DiP application for a disposal facility at Olkiluoto	-Safety regulations 1997 -EIA hearings and judgement -STUK's preliminary safety appraisal as part of DiP process
2000 -2012	-Confirming site investigations, including underground rock characterization facility ("Onkalo") -Research and technical development, start detailed design	-Updated safety regulations 2008 -Oversight of site investigations and construction of "Onkalo" -Review of the status and plans of research and technical development, in three year periods
2012 -2020	-Construction licence application -Construction of the facilities	-Review of licence application -Oversight of construction
2019 -	-Operating licence application -Operation of the facilities	-Review of licence application -Oversight of operation

Posiva has submitted preliminary documentation of safety argumentation for regulatory review since the DiP was ratified in 2001. These draft parts has supported the development of license application documentation. STUK has already been reviewing and assessing for 11 years how the developing safety documentation meets regulatory safety requirements. STUK's preliminary findings have been communicated to Posiva and the target has been to identify and address the main safety related concerns as early as possible. Parts of the safety case was updated for authorization of Onkalo construction and submitted to STUK in 2003. This documentation included:

- URCF design requirements and layout
- Description of site baseline characteristics
- Assessment of construction disturbances
- Description of monitoring program for construction period

The Ministry of Employment and Economy required Posiva to submit preliminary (draft) license documentation by the end of 2009. The reasoning was to have a regulatory review of the status of construction license application development. STUK reviewed the draft safety case and the process was used as an exercise for the actual license application review. In STUK this was seen as a possibility to test review process, review organization and assessment of preliminary safety case status.

The aim of the step-wise review, close follow-up and regular meetings with Posiva has been to identify the safety relevant issues and especially key safety concerns already before Posiva finalizes and submits the construction license application. During the license application preparatory phase STUK had a process for collecting and updating the position of key safety concerns with regular dialogue between STUK and Posiva. However after a while it was acknowledged that addressing single safety concerns did not in

many cases lead to better overall understanding and sometimes the linkage to safety was not very clear. From this experience a need for more structured R&A process.

THE PLANNING FOR THE REVIEW AND ASSESSMENT OF CONSTRUCTION LICENCE APPLICATION

The review process, organization, time schedule and resources are described in a STUK's internal project plan for the license application review. The main element of the project is of course the review of the extensive safety documentation. The assessment of safety requirement fulfillment and implementer organizations readiness for construction activities is supported with STUK inspection program for pre-construction phase. The inspection program is broadened later for construction inspection program for encapsulation and disposal facility construction oversight.

The regulatory assessment of safety is, of course, done against regulatory safety requirements. As mentioned above STUK's approach was initially safety issue oriented and a bottoms-up assessment. However for having a more regulatory requirement oriented and safety related review basis for the detailed R&A, STUK started the development of the so called review plan. This review plan contains a collection of earlier regulatory observations and expectations for the construction license application that were derived from and linked to regulatory safety requirements. The review plan is used as guidance for all experts participating in STUK's review. It is also planned to be the structure for STUK's safety evaluation report.

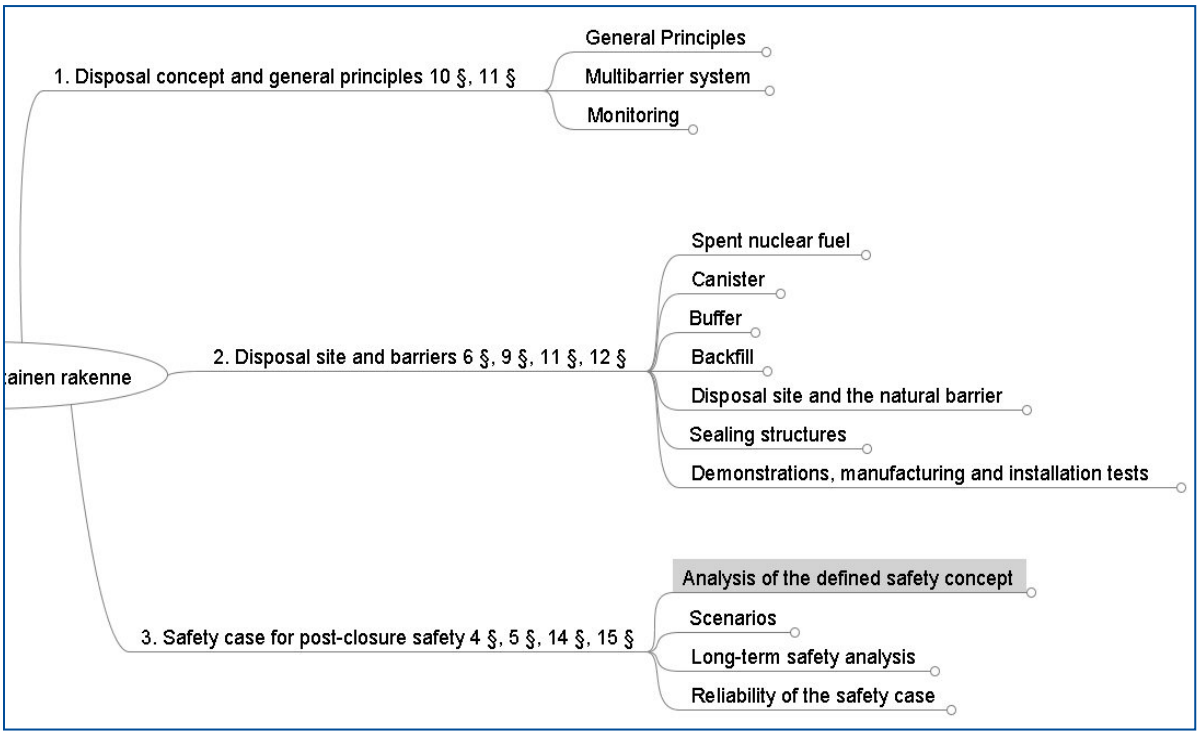

Fig. 2. Example of STUK's review plan structure for post-closure part. Each mentioned topic (e.g. Disposal site and the natural barrier) is structured to several Review areas and each area further to Review topics.

The review plan covers all areas of construction license application review (Figure 2). However it only generally mentions areas that STUK has comprehensive and detailed safety regulations. These areas

include for example encapsulation operational safety or management system. The majority of review plan content is focusing on post-closure safety where there is not yet enough experience to develop detailed safety requirements.

STUK has allocated for the project waste management and nuclear facility expertise we have in-house. Important parts of the safety case focus on the post-closure safety and the related safety assessments are wide and need to be carefully assessed in a timely manner. For this reason STUK has signed agreements with Technical Research Centre of Finland (VTT) and several international experts for supporting its review and to conduct independent modeling. The total number of experts supporting STUK's review during 2013 ranged between 60-70 persons and was on the order of 13 man years.

REGULATORY REVIEW OF CONSTRUCTION LICENSE APPLICATION

According to the Nuclear Energy Act and Decree when applying for a construction license, the applicant shall submit the following to STUK: [2, 3]

- The preliminary safety analysis report, which shall include the general design and safety principles of the nuclear facility, a detailed description of the site and the nuclear facility, a description of the operation of the facility, a description of the behavior of the facility during accidents, a detailed description of the effects that the operation of the facility has on the environment, and any other information considered necessary by the authorities.
- A probabilistic risk assessment of the design stage.
- A proposal for a classification document, which shows the classification of structures, systems and components important to the safety of the nuclear facility on the basis of their significance with respect to safety.
- A description of quality management during the construction of the nuclear facility, showing the systematic measures applied by the organizations that take part in the design and construction of the nuclear facility in their operations affecting quality.
- Preliminary plans for the arrangements for security and emergencies.
- A plan for arranging the safeguards control that is necessary to prevent the proliferation of nuclear weapons.

In addition to the documentation concentrating mostly on operational safety the regulation for nuclear waste disposal requires licensee to submit a safety case concentrating of post-closure safety. [6] This is in practice the widest part of construction license application documents. STUK YVL regulations give more details for the content of these documents.

STUK's task in the license application process is to R&A the fulfillment of all applicable radiation and nuclear safety requirements. STUK shall also prepare a statement and safety evaluation report for the Government. In the appraisal STUK has the possibility to highlight issues that need further attention or propose license conditions.

During the first quarter of 2013 STUK performed the first initial review phase. The aim of the initial phase, sometimes compared to docketing, was to check that the license application contained all main elements requested in STUK YVL regulations. In other words, to check that the content of the application is adequate for detailed safety review. The first STUK decision concentrated on the completeness of the operational safety documents. Based on the initial review the review progressed for most parts to the detailed review phase. However, some application documents were not accepted for detailed review. The most important ones are related to safety classification where the basis of safety relevance needs to be re-evaluated and when needed also the encapsulation system descriptions updated. The initial review for

post-closure safety documentation is being finalized. Posiva's post closure safety documentation is named TURVA-2012 and it consists of synthesis report, 10 main reports and several supporting reports (Figure 3). [7]

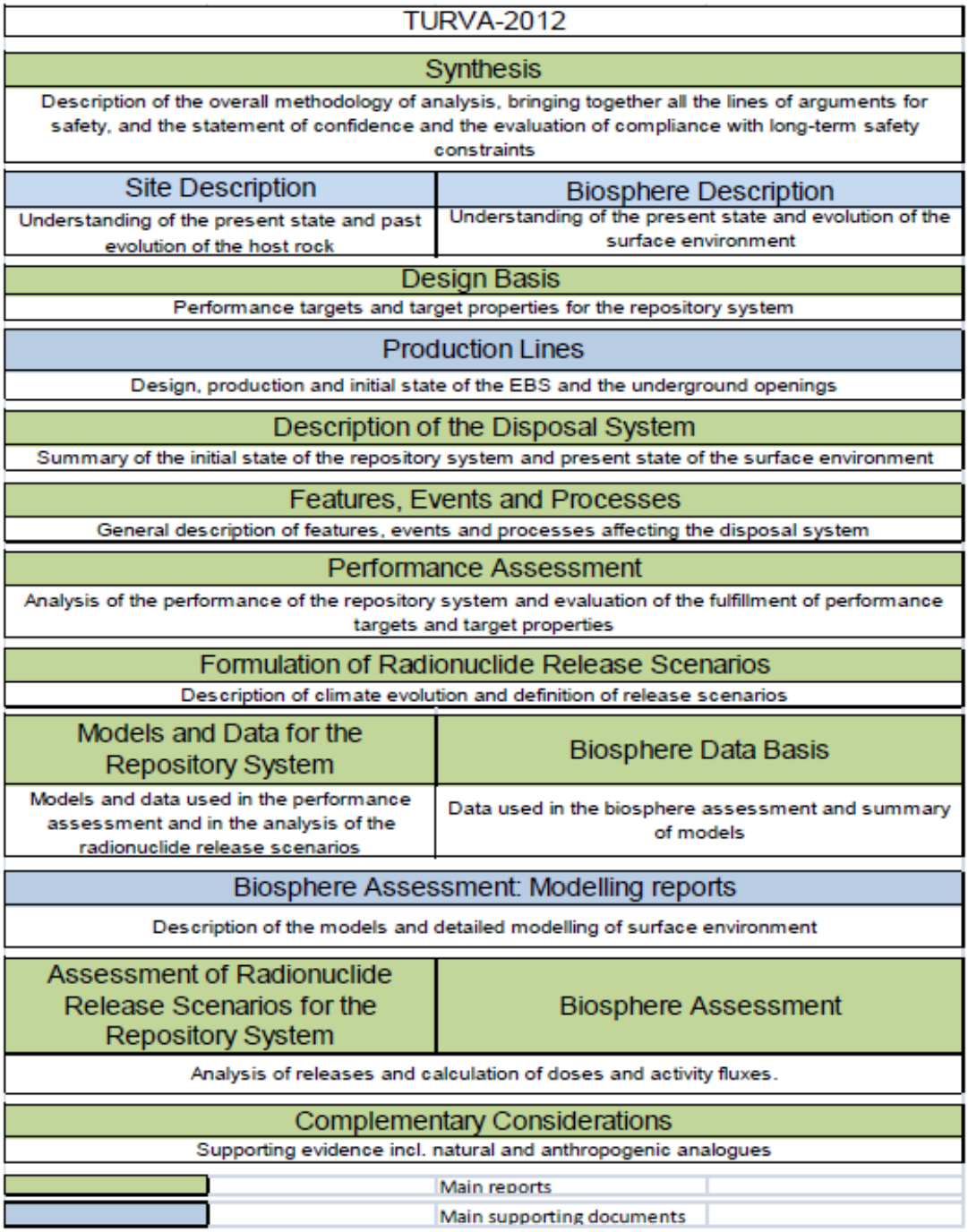

Fig. 2. The TURVA-2012 safety case portfolio prepared by Posiva. [7]

The assessment of safety requirement fulfillment and implementer organizations readiness for construction activities is supported with STUK inspection program for pre-construction phase. The inspection program is broadened later for construction inspection program, for encapsulation and disposal

facility construction oversight. After passing the construction license step, STUK will have comprehensive oversight for the detailed design, construction, fabrication and pre-operational testing, which will be followed by the R&A of the pending operation license application.

The objective of the inspections performed by STUK during the pre-construction phase is to support the review and decision making process by verifying the license applicant's processes and procedures and also technical issues described in the license application documentation. Through these inspections STUK will have realistic view of the status of the licensee's activities and progress of its development work. STUK focuses the inspections on the license applicant and the organizations responsible for the nuclear facility's design and any organizations involved in the project whose work can be deemed to have major implications on safety. The main topics for these Rs&As are the management system of the organization concerned, in particular the organization of operations and management of resources, competence management, management system processes and procedures, management of non-conformances, interface management and reporting, and supply chain management as well as data security. STUK's inspections will cover all the main processes and major parts of sub- processes defined in the license applicant's management system.

CONCLUSION

At the end of 2012, Posiva submitted to the Finnish Government a license application for encapsulation and disposal facility construction at the Olkiluoto site. Therefore the disposal project has entered into a new phase. This long-term project with over 30 years of parallel development of the repository project and the regulatory approach to SNF management has been enabled through the key features of the Finnish waste management framework that consists of:

- **A clear licensing process**
  - Long term political commitment to resolve the nuclear waste issue
  - National strategy and discipline in implementation
  - Stepwise licensing and implementation including veto-right for the local community regarding hosting the repository
  - Timely and focused communication to public
- **Early establishment of a national framework**
  - Well defined liabilities and roles
  - Early on established funding system
- **Active regulatory work**
  - Development of a regulatory approach parallel with R&D and in analogy with nuclear plant safety regulations
  - Regular regulatory follow-up of progress in the SNF disposal program

STUK has carried out comprehensive preparations for its review related license application. The preparatory work has included close monitoring of Posiva's activities, review of preliminary safety documentation, planned increase of STUK's own competence and resources and preparation of internal review guidance. At the moment STUK is performing thorough R&A against applicable safety requirements, which will be documented in the authority's pending safety evaluation report. The aforementioned review is planned to be finalized during 2014.

REFERENCES

1. Posiva Oy, Rakentamislupahakemus Olkiluodon kapselointi- ja loppusijoituslaitoksen rakentamiseksi käytetyn ydinpolttoaineen loppusijoitusta varten, (2012), In Finnish

2. Nuclear Energy Act, (990/1987), (1987). Unofficial translation by Ministry of Employment and the Economy. Available online: http://plus.edilex.fi/stuklex/en/lainsaadanto/19870990 (6.1.2014)
3. Nuclear Energy Decree, (161/1988), (1988). Unofficial translation by Ministry of Employment and the Economy. Available online: http://plus.edilex.fi/stuklex/en/lainsaadanto/19880161(6.1.2014)
4. Decision in Principle, DiP. Valtioneuvoston periaatepäätös 21 päivänä joulukuuta 2000 Posiva Oy:n hakemukseen Suomessa tuotetun käytetyn ydinpolttoaineen loppusijoituslaitoksen rakentamisesta, (2000), In Finnish
5. Posiva Oy, YJH-2012 Nuclear Waste management at Olkiluoto and Loviisa Power Plants: Review of Current Status and Future Plans for 2013-2015, (May 2013). Available online: http://www.posiva.fi/files/3056/YJH-2012eng.pdf (6.1.2014)
6. Government Decree on the safety of disposal of nuclear waste (736/2008), (2008). Unofficial translation by Ministry of Employment and the Economy. Available online: http://plus.edilex.fi/stuklex/en/lainsaadanto/20080736 (6.1.2014)
7. Posiva Oy, Safety Case for the Disposal of Spent Nuclear Fuel at Olkiluoto – Synthesis 2012, (December 2012). Available online: http://www.posiva.fi/files/2992/Posiva_2012-12web2.pdf (6.1.2014)