Regulatory experiences from the spent fuel disposal step-wise implementation

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40 years’ of development and oversight

Late 1970’ - 2000
Spent fuel policy & strategy

2001 - 2015
Decision-in-Principle

2016 - 2020
Construction license

Test operation, commissioning

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Elements of the Finnish step-wise approach

• The overall step-wise licensing and authorization system
• Step-wise development of the safety regulations
• Step-wise review of the developing safety case documentation
• Construction of the Onkalo underground rock characterization facility (step-wise construction)
Step-wise repository licensing

Government Decision

STUK’s safety appraisal on the technical and organisational aspects of the repository

Government Decision

STUK’s Safety appraisal on the design phase safety demonstration, organisational aspects and technical principles of the repository

Construction license

Decision-in-Principle

Environmental impact assessment (EIA)

Research and development
Siting
Disposal Concept

Operating license

Construction

Renewal of operating license, PSR, closure

Research (and Onkalo Construction)

Political and public debate about the overall good of society - Government decision and Parliament ratification/rejection – municipality veto - STUK’s preliminary safety appraisal
Regulatory activities in the main phases so far…

**Conceptualization and siting phase**
- R&D plans regulatory review
- First safety requirements
- Evaluation of early “safety cases”
- Dialogue with implementer and stakeholders

**Pre-license phase**
- R&D plans regulatory review
- Update of requirements
- Competence and resource building
- Preliminary opinions on key safety topics
- Review strategy planning
- Dialogue

**Construction license review**
- Application review in phases
- Inspection programme
- Preparation of overall safety evaluation
- Dialogue with license applicant
Disposal conceptualization and siting – from early 1980’s to 1999
Site selection

Site Identification
1983 - 1985

More than 100 candidate sites were identified

Preliminary Site
Characterisation 1986 - 1992

Five sites were subject to extensive investigations

Detailed Site
Characterisation 1993 - 2000

Olkiluoto site was finally selected in 2000
“Safety cases” during site characterisation

- Swedish SKB submitted in 1983 description of KBS-3 disposal concept to Swedish authorities
- STUK reviewed safety documentation and provided preliminary opinions about site characteristics and needs for further work.
  - In 1985 – safety documentation to support selection of sites for more detailed site characterization
  - In 1992 – safety case based on site characterization work done for sites selected in previous phase.
  - In 1996 – safety documentation based on finalized of detailed phase site characterization.
- R&D plan submitted to regulatory authorities for review
Lessons learnt from siting phase

• STUK’s opinions in late 1990’s
  – Transition from idealism: ”discovering a geologically superior site” to realism: ”selection of a societally favourable, geologically adequate site”
  – The main safety function of the host rock has changed from containment provided by the far-field geology to favourable and stable near field geology
  – The site specific data derived from the surface based investigations, were not very usable for the performance assessments and respectively, the role of performance assessment was fairly limited in the site selection process
Pre-license phase 2001- 2012

- Onkalo URCF oversight
- Resource and competence building
- Review of draft safety case
- Planning of license application review
STUK’s activities prior to license application

- After Decision-in-Principle STUK reviewed
  - step-wise developed safety case parts prepared by Posiva
  - Draft construction license documentation submitted in 2009
  - R&D-plans submitted every three years
- Oversight of Onkalo underground rock characterization facility construction
- Update of safety regulations (YVL guide)
- Continuous dialogue between STUK and Posiva
Strengthening STUK’s competence

- STUK started year 2006 to further develop its own resources and broaden the expertise
  - Assessment of knowledge gaps and estimate of resources needed
  - Decision to have key expertise in-house, but realizing the need to use also external resources
- Committing and educating STUK’s own NPP experts for review of Posiva’s facility system design and operational safety
- Planning and executing of procurement program for ensuring the use of interdependent outside experts
- International peer reviews for regulatory effectiveness (EU27 and IRRS)
Planning for the construction license application review

- The main tasks during 2010-2012 were to
  - Prepare the **Review plan**, which compiles regulatory requirements and safety concerns
  - Prepare a **Project plan**, describing review process and organisation
  - Plan a **inspection programme** for review phase
  - Describe internal policy on identified **key safety concerns** in STUK position papers
  - Develop and implement regulatory **safety analysis capabilities**
  - Plan, go through procurement and contract **external resources**
Lessons learnt from the pre-license phase

• Active regulatory participation is important for successful licensing
  – Preliminary review in pre-license phase
  – Step-wise development of regulatory requirements

• Rehearsal of licensing
  – In Posiva’s case pre-license application was important for STUK and Posiva to have more concrete idea what the actual license application contains.
  – For STUK it also helped in organizations of the actual review

• Competences
  – Orientation to regulatory work takes time and increase of staff should start early enough
  – Now after CLA review STUK’s experts have clearly better understanding of disposal and safety
Review of Posiva’s construction license application
STUK’s review stages and time schedule

License application
Initial review
Detailed review
Conclusions on different areas
Overall conclusions on safety

Decision to continue the review
Requests for additional information
Decisions on NEA 35 § licensing documents, requirement level YVL-guides
Safety assessment report and statement to MEE, requirement level Government decree

1-4/2013
5/2013-8/2014
10/2013-2/2015
6/2014-2/2015

Active review period 2 years
Number of experts involved ~70
Workload ~20 man years
Supporting activities for CLA review and assessment

Inspection program during review of construction license application

– STUK has assessed Posiva’s readiness to start the construction of encapsulation and disposal facility
  • Focus on Posiva’s management system, organization and work processes
– In total 17 inspections during two year review period
– Topics: Quality assurance, Sub-contractor management, design process, Requirement management, Readiness for construction phase, ...

Analysis and modeling work supporting STUK’s review

– Scenario process, radionuclide transport, THMC-modeling, Fracture zone model evaluations

Co-operation with Swedish Radiation Safety Authority (SSM)

– Mutual understanding of key safety issues
Conclusions of Posiva’s construction license application

- The Government has granted Posiva a construction license 12th November 2015
- STUK gave statement and safety assessment report to Ministry of Employment and Economy 11th February 2015
- STUK’s main conclusion: Encapsulation plant and disposal facility can be built to be safe
- STUK emphasized in its statement to the Government that:
  - Level of safety and facility design is satisfactory for the construction license stage
  - Further work needed in facility detailed design, demonstration of disposal system performance and preparation of a comprehensive safety case for Operating license application
- Translations are also available in English and Swedish at STUK website (http://www.stuk.fi/web/en/topics/nuclear-facility-projects/the-encapsulation-and-final-disposal-facility-of-spent-nuclear-fuel)
How to ensure regulatory readiness in different steps?

| Criteria for decision making | • Up-to-date safety requirements  
• What is enough in this licensing step? |
|-------------------------------|-----------------------------------------------------------------------------------|
| Review strategy               | • What is relevant in this licensing step?  
• How to address (top-down or bottom-up review, own analysis, inspection)? |
| Expertise                     | • Strategy for developing regulatory competences and resources  
• Adapted to licensing step in question |
| Interaction with applicant    | • important for mutual understanding  
• Address main safety questions during pre-licensing – **no surprises!** |