Challenges in Developing the Basic Design of the KBS-3 System into a Qualified and Industrially Viable Operation

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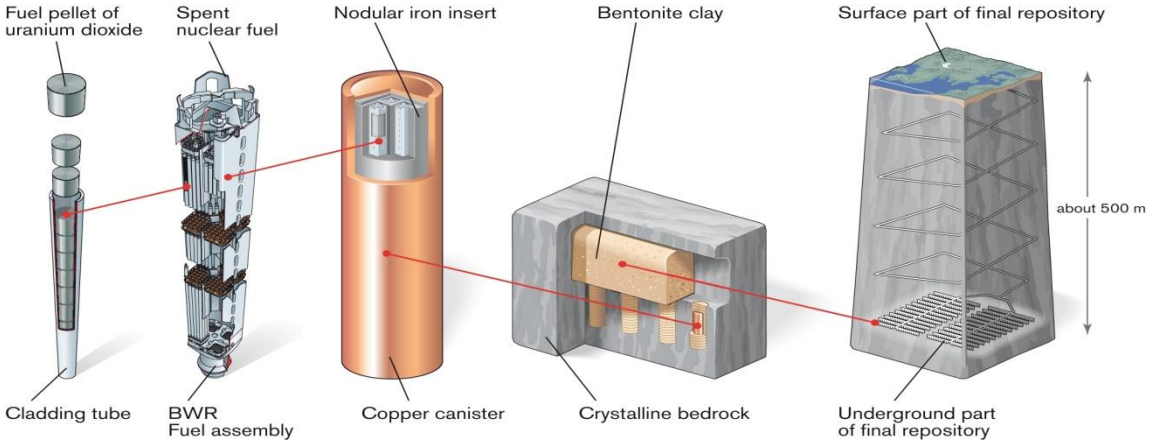
Introduction

- Programs for final disposal of spent nuclear fuel similar in Sweden and Finland
- Extensive cooperation countries over the years
  - KBS-3 concept in common
- Swedish Nuclear Fuel and Waste Management Co. (SKB)
  - License applications in 2011for a final repository at Forsmark, Sweden.
  - Currently reviewed
- Posiva, Finland
  - STUK's statement on construction license application just published
- Soon a stage of final design and implementation
  - cooperation will be deepened, aiming when possible for the same technical design.



Posiva's 40 years' effort

Commissioning of NPP's

Studies into geologic disposal started

1978

Site selection research

1983

Government's decision on time table

Selection of Olkiluoto

2001

Decision in principle by the Government and the Parliament

Construction of ONKALO and site confirmation studies in Olkiluoto

2012

Application for the construction license

Construction of disposal facilities

Application for the operation license

Test operation, commissioning

Start of disposal in 2020's

STUK's review of Posiva's application

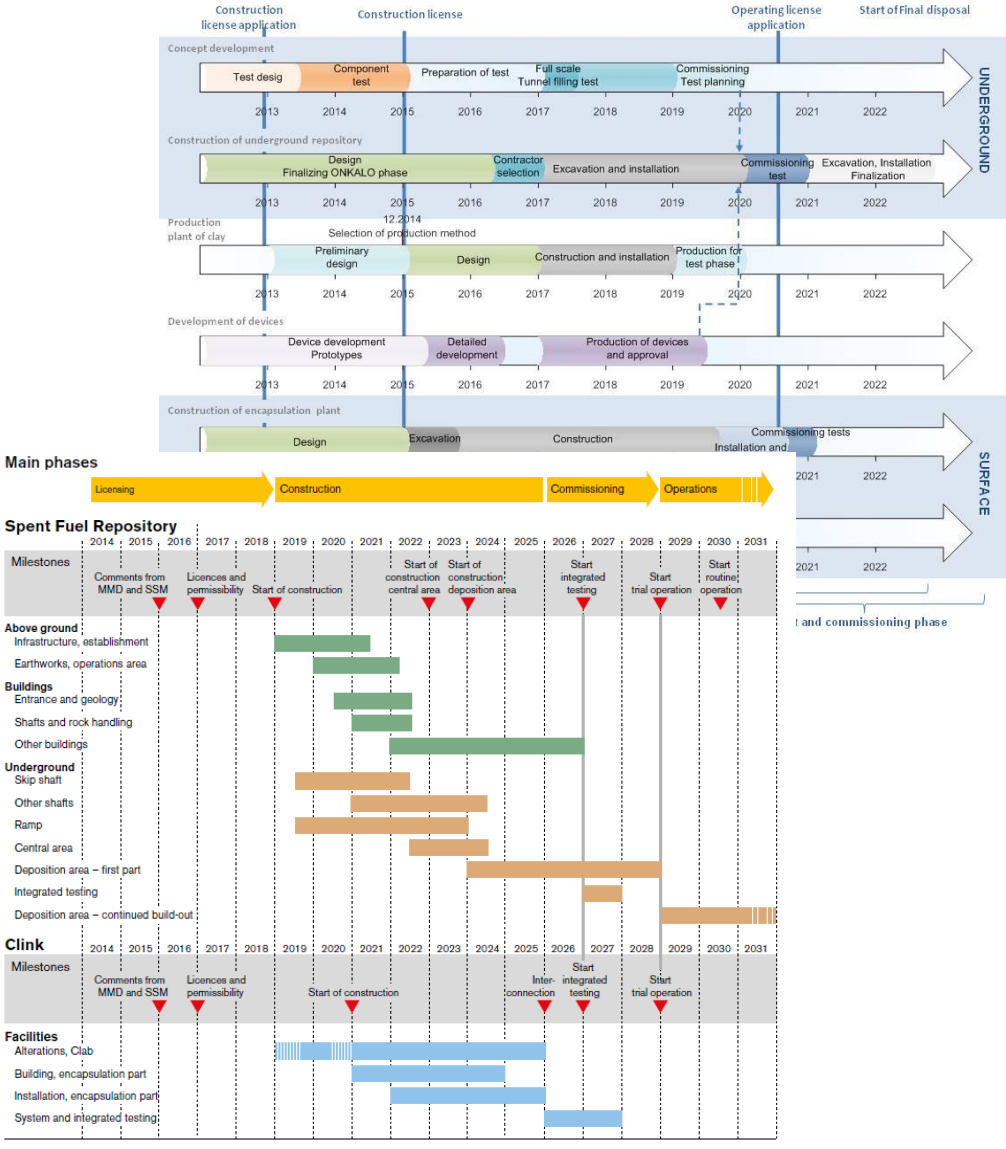
- Green light for next step – clear statement of safety!
  - Along with SKB in Sweden, Posiva is a forerunner in arguing that a repository for spent nuclear fuel in crystalline basement rocks will be safe. Both organizations have adopted the same, KBS-3 disposal concept (with much common development work), and both have compiled and presented a post-closure safety case to their national regulatory authorities within a year of each other.
  - Based on our review, STUK concludes that Posiva provides, overall, a clear and credible case that the proposed repository will be safe and will meet our regulatory requirements. The safety case is also in accordance with international best practices.
- Work needed before operational license and some already before construction of deposition tunnels
  - In STUK's opinion there remains a need to develop safety argumentation and methodologies further, and there is also a need to reduce some uncertainties regarding performance of the barriers.
  - No real surprises and most issues to resolve are in our common plans – but a stress on the urgency to resolve
- The repository will remain passively safe after closure without monitoring or supervision of the site

Posiva/SKB common vision: ”Operating optimized repositories and other facilities in 2030”

- Technical designs as well as the design basis and requirements shall be similar
  - Harmonize requirements
  - Canister design, welding and testing.
  - Development of manufacturing technology and design of production system.
  - Bentonite materials supply and production chain.
  - Buffer and backfill design, Deposition tunnel plug, (Installation techniques).
  - Detailed investigations and tunnel production
  - Research on long term safety and foundation of the ongoing technology development.
- Quality objectives
  - The joint work and documentation shall enable both parties to get the licenses needed
- Timely objectives
  - Detailed design targeted to be finished by 2018.
  - Joint optimized facilities - 2030.
- Efficiency in costs and resources
- Potential to expand cooperation to design, construction and operation of facilities ongoing.

Joint work plan (JWP)

- Detailed technical design in time for the detailed design of the planned facilities
  - i.e. the encapsulation plant, the facility for buffer and backfill bentonite component production and the underground repository
- Aims for a common holistic view
  - identifies the various development efforts needed in relation to the program plan for the spent nuclear fuel program with regard to time and resources.
- The joint work agreed in the JWP will be implemented through Joint Projects

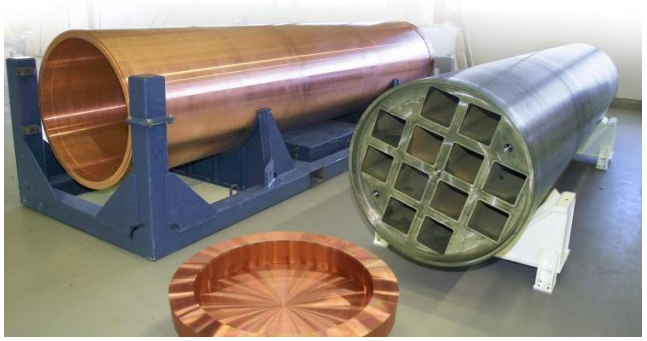


Design Requirements

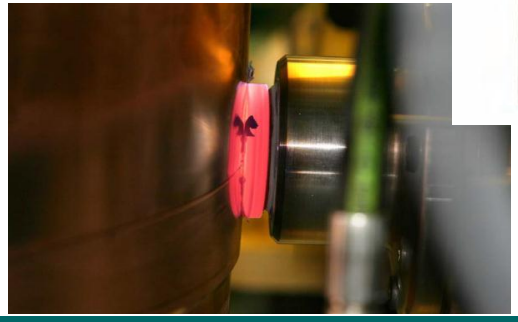
- Design requirements (design premises)
  - Requirements which the KBS-3 facilities with their barriers must satisfy in order to ensure safety both during operation and after closure
- Harmonize the requirements ongoing since August 2013
  - Based on experience from the ongoing technology development work and the safety assessments
  - Cross-check between requirements for operation and post-closure safety
  - requirements that are practically achievable and verifiable for all considered barriers.
  - Strive for requirements that entail simple, robust and effective solutions.
- Common report ("KUPP/VAHA") planned end June 2015
  - Need to consider implications of STUK comments on safety functions

Canister

- Overall aim to settle the detailed design and its fulfilment of all requirements
- Ongoing (or soon to be started) joint projects
  - Welding technology FSW
  - Design analysis
  - Sulphide project (corrosion aspects)
- Still discussed cooperation
  - Copper corrosion
  - Testing (NDT)
  - Insert manufacturing
  - Production system

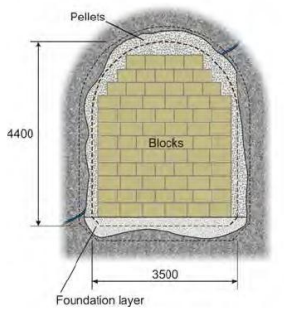


$2\ Cu + HS^- + H^+ \rightarrow Cu_2S + H_2$



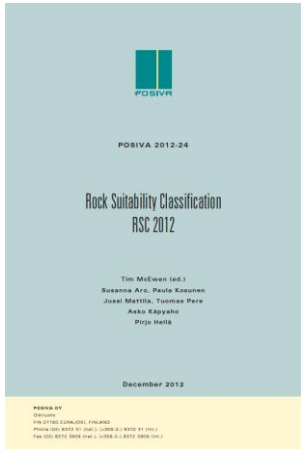
Buffer and backfill

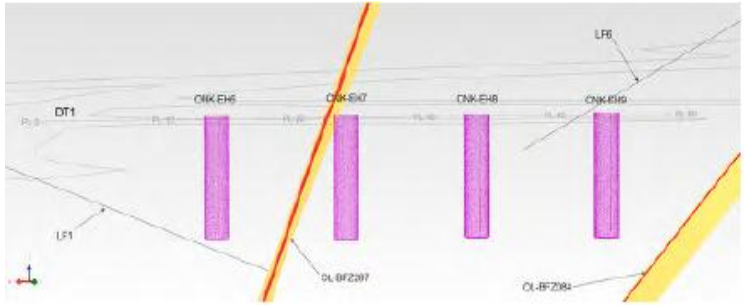
- Overall aim to settle the detailed design and its fulfilment of all requirements
- Ongoing (or soon to be started) joint projects
  - Requirement specifications for the bentonite materials
  - Pressing technology
  - Deposition tunnel plugs
  - Handling of water
  - Sulphide project (corrosion aspects)
  - Updated BBC design project
  - Common clay advisory group
- Still discussed cooperation
  - Additional R&D on clay issues
  - Production system and quality control



Deposition areas

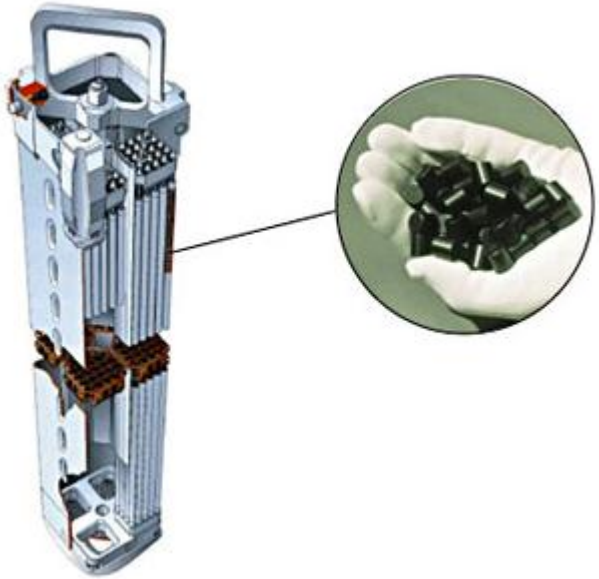
- Ongoing (or soon to be started) joint projects
  - Earthquake assessment
  - Developing acceptance criteria for deposition holes based on geological and hydrogeological data
- Still discussed cooperation
  - DFN-modelling
  - EDZ assessment
  - Rock and underground construction advisory group





Spent fuel

- Joint fuel cooperation
  - A joint advisory group established.
- Areas discussed
  - Long-term criticality – joint activity proposed with joint meetings and perhaps joint reports
  - Cr- and Al-doped fuel dissolution experiments
  - Safeguards issues
  - Fuel measurements – Spire project
  - Data bases



Full scale testing and monitoring

- Ongoing (or soon to be started) joint projects
  - A few full scale buffer tests
  - Plug tests (DOMPLU/POPLU)
  - Joint planning of FISST
  - KBS-3H multipurpose test
  - Plans for monitoring the EBS (part of EU project Modern 2020)
- Still discussed cooperation
  - What tests to conduct and to what extent they should be mutual
  - Cooperation on technical equipment

Conclusions

- License applications for a final repository for spent nuclear fuel at Forsmark, Sweden, and at Olkiliuoto, Finland
  - a technically feasible reference design and site-adapted layouts presented
  - shown to comply with the regulatory acceptance criteria in the respective countries.
  - Clear statement from the Finnish authority (STUK). Statement from Swedish authority (SSM) pending
- Detailed designs adapted to an industrialized process designed to fulfilling specific requirements on quality, cost and efficiency remain to be developed.
  - Implementation cooperation will be deepened, aiming when possible for the same technical design.
  - Plans for these common developments are now being made jointly by the two companies.

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