



SAFIR2022

KYTY2022

Summary of the Seminar

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Overall safety and organisation

- The tested and developed new tools (VR, semantic modelling, video based, risk assessm.) are seen promising.
- Different aspects of human performance and organisational aspects are covered taking into account Finnish characteristics.
- Development of overall safety approaches and societal studies benefit from future combined progr.

Fuel and reactor

- Successful work for developing software for reactor design and licensing analyses, and improving transient analyzing codes continues.
- Experimental studies of nuclear fuel behavior generate new ideas.
- Various studies to improve knowledge of spent fuel disposal continue.
- Research for transport of radionuclides in different materials and in ecosystem continues.



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Plant level analysis & Severe accidents

- Summary of key results of research
- Modelling of interaction between electric grid and mechanic systems in electric disturbances
- Validation of fire analysis tools against fire tests decreases uncertainties in analyses
- Fukushima verification calculations improves severe accident models and helps understanding phenomena

Thermal hydraulics

- Thermal hydraulic capabilities are one of the corner stones of nuclear safety assessments.
- Long-term experimental and computation R&D is needed, and done in Safir2022 to maintain and develop these capabilities.
- Experimental and computational thermal hydraulic R&D are greatly supporting each other in projects!



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Host rock & alternative solutions

- Optimize methods to characterize mm-cm-m scale fracture patterns of host rock
- Find and validate upscaling methods for host rock fracture patterns from cm, metre to 10-100 metre scale
- Identify the evolution and properties of brittle systems of the bedrock
- Constrain the relation between host rock groundwater flow and fracturing



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Research infrastructure

- Preparation for the next generation of MTR at JHR is progressing in many fronts by the Finnish parties
- CNS is an operational and capable nuclear materials research facility, working both in research collaborations and for individual customers
- BRUTE, a key Nordic collaboration has helped show the capabilities of CNS and VTT in RPV materials research

Low and Intermediate level waste management

- Progress has been made in the research for surface-type disposal facilities which are new to Finland
- Corrosion processes have been studied from a wide variety of perspectives, showing effects of both material irradiation and microbial processes
- Effects of microbes to gas generation and corrosion have been studied.



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Mechanical integrity & Structures and materials

- R&D to enhance primary circuit safety, e.g:
 - Advanced fracture mechanics testing with material saving miniature specimens
 - Machine learning with in-service inspections
- New ways to prepare for critical spare parts by applying Additive Manufacturing
- R&D progress with safety of non-metallic materials and structures (concrete and polymers)

Engineered barrier system, interactions and microbiology

- Despite COVID-19 restrictions, all three coordinated projects progressed without bigger challenges.
- Positive to see that the research areas has moved from studying only certain engineered barriers to study interfaces and interactions -> maybe, in the future more towards overall safety related questions.



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Image 6. Establishing scenarios are part of the YES report

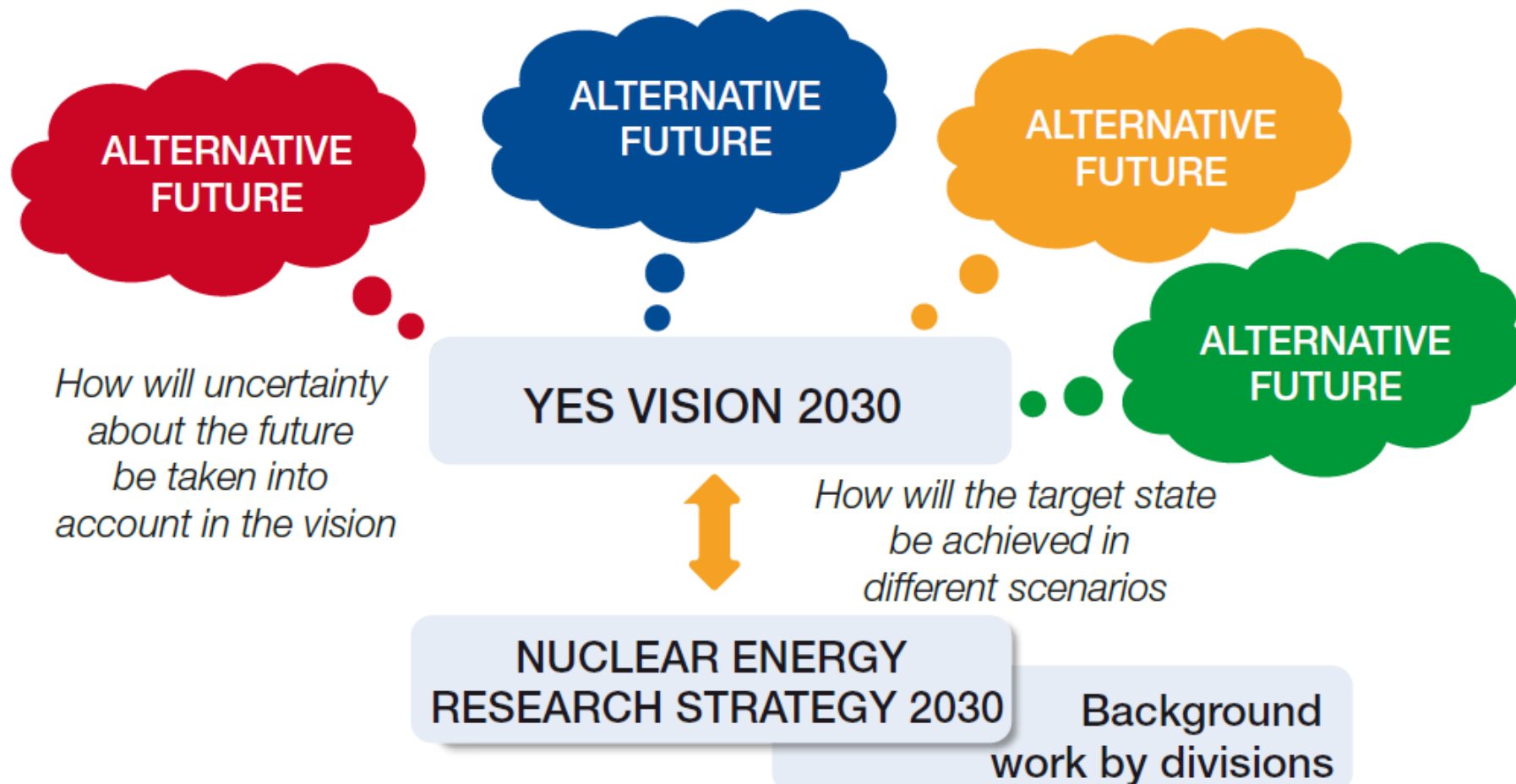


Image 7. The four scenarios outlined in the YES report

<i>What is expected to happen to nuclear energy production and new plant projects?</i>	The field will grow	"Growth Scenario"	"Breakthrough Scenario"
	The field will shrink	"Sunset Scenario"	"Revolutionary Scenario"
		Current technology	New technology
<i>Is a technological breakthrough expected to take place during the time period in question?</i>			



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The key hypotheses of the Revolutionary Scenario are:

- Finland will have a total of five functioning reactor units (Loviisa 1 and 2, Olkiluoto 1, 2 and 3).
 - There are no new plants under construction or being planned.
 - The licences for the old reactors at Loviisa and Olkiluoto will not be renewed after 2030.
- Adoption of new reactor technology is beginning worldwide, but the industry has remained at low trajectory growth post-Fukushima.
 - The focus areas of new construction are in the Far East and Russia.
 - From 2025, there will no longer be any new projects for the construction of the current light water reactors. Instead, SMR and GEN4 type solutions will move forward.
 - ITER is living up to expectations and DEMOs are being designed.
- Adoption of a facility for the final disposal of spent nuclear fuel in Finland in the early 2020s based on the KBS-3 concept.



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The Finnish Nuclear Energy Research Strategy to 2030 (YES)

Published 2014

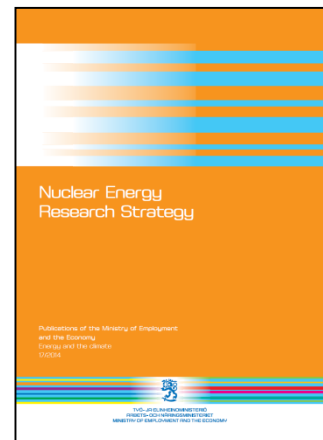
Safety research has a key role in competence building in Finland

VISION FOR THE NUCLEAR ENERGY RESEARCH STRATEGY:

Internationally high-quality Finnish expertise and research will secure the safe, sustainable, and competitive use of nuclear energy and promote business opportunities.

Recommendations:

1. Broad scope national programmes, according to national target and significance
2. High scientific level, international competitiveness and visibility
3. Active participation to international programmes, multidisciplinary national co-operation
4. A broad and comprehensive national doctoral programme network
5. Building, maintaining, and utilising infrastructure requires coordination at the national level
6. From research to innovations, growth and internationalization of business
7. Proposal to establish an advisory committee on nuclear energy research and use of nuclear energy



SAFER = SAFety and wastE management Research

Liisa Heikinheimo

19.03.2021



Työ- ja elinkeinoministeriö
Arbets- och näringsministeriet

SAFER = SAFety and wastE management Research



- New programme will be started in the beginning of year 2023, the first call will be opened around August 2022
- Planning of the SAFER2028 programme has started
- Working group of 24 experts nominated by MEAE in February 2021
- The main parts of this planning:
 - Structure of the programme (SAFIR + KYT)
 - Governing structure and procedures for management
 - **Research programme, the substance of the programme.**
 - **Environment**
 - **Needs**
 - **Goals**
 - **Specific topics**
 - **Needs and modes for international co-operation**
- The planning is demanding and it takes time – there is a bit over one year now before the first call.
- This is also an opportunity for all the stakeholders to have more than 1+1 =2

New legislation for the research funds



- The legislation will be ready for the merging from 1st May 2021 and in force.
- There are changes for the fees for the research funds, the funds will be merged for a feasible governing.
- There are changes for the scope of the programme; infrastructure/facilities and doctoral school.
- The duration of the common one research programme will be 6 years, 3+3. So the first midterm seminar is anticipated in March 2026 [the final seminar of current SAFIR2022 and KYT2022 will take place in March 2023].
- We will facilitate by MEAE an international review next year for the programmes and especially for the contents of the new SAFER208 programme plans.

Funding principles from the VYR funds



	Nuclear Safety	Nuclear Waste Management part
v. 2023 – 2025 (no changes to 2021)	390 € / MW thermal licensed	0,1 % of the amount of responsibility for nuclear waste management
v. 2026 – 2032	320 k€*) + 285 € / MW thermal	0,09 % -" -

*) A new fee 320 000 € /nuclear installation site is introduced.

- *As a result we expect the availability of good and high level skills and facilities in our community widely but especially for the specific needs of the safety authority.*
- The research funding should support high level and topical projects. The research project results should be published and open to the stakeholders and for international reviews.
- No proprietary projects of the companies, no projects directly related to specific licensing projects or control or inspection functions of STUK are included.

National energy and climate policy work – policies for nuclear energy, ongoing work...



- **CLIMATE NEUTRALITY IS THE BIG TARGET > EU 2050 and FINLAND 2035 CARBON NEUTRALITY**
- **FOR NUCLEAR ENERGY (SOME 30 – 40 % of the electricity production in in 2020's):**
 1. **To enable up to date licensing and licensing of new technologies/new concepts (SMRs and nuclear waste management etc).**
 - To renew the Nuclear Energy Act and related guides.
 2. **To ensure safe and complete nuclear- and radioactive waste management solutions in Finland for all the wastes generated in Finland.**
 - To ensure that the Nuclear Energy Act and other legislation will support this.
 - To have a national nuclear and radioactive waste management programme for international reworking.
 3. **Security of energy production/energy supply – changing environment (combustion will be less, the energy systems will be electrified, new needs for flexibility?)**
 - Development of the security of supply legislation, development and agreements for the storages etc.



**Success in your
Research work!**