

SMR activities in Finland

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SMR-related activity in Finland

- Public has had general increasing interest in SMRs as solution to hard to decarbonize applications
 - District heating, industry
- Related activity by Finnish nuclear energy field actors
 - Renewal of Finnish nuclear law
 - SMR related activities at the regulator STUK
 - SMR related activities at Finnish utilities
 - Fortum
 - TVO
 - SMR related activities in R&D organizations
 - VTT
 - Lahti-Lappeenranta University of Technology

Renewal of nuclear energy legislation: REILA working group recommendations



Työ- ja elinkeinoministeriö
Arbets- och näringsministeriet

Renewal of Finnish nuclear energy legislation



**Use of
nuclear
energy**

**Construction, operation and
decommissioning of nuclear facilities**

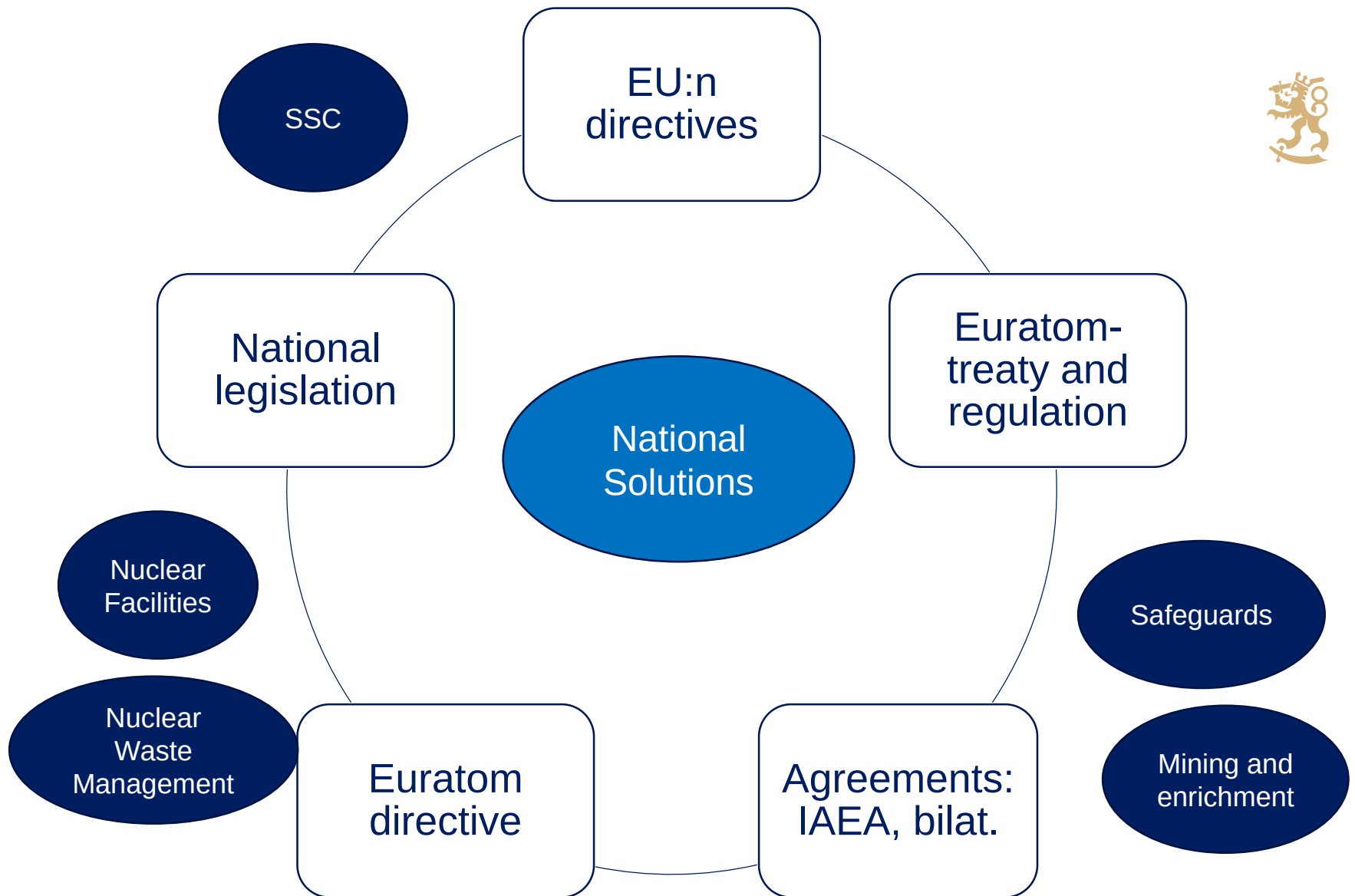
Systems, structures, components

Nuclear waste management

Safeguards

Mining and enrichment

Nuclear liability



REILA-Working group

Assignment for the working group was to assess :

- Current status and the future development of the use nuclear energy
- Development needs for the requirements, regulation and licencing of the design, construction, operation and decommissioning of nuclear facilities
- Needs for legislation development related to the fuel cycle and especially the final disposal of spent nuclear fuel
- Regulation in other countries

Main topics:

- Different types of nuclear facilities and the assessment of the applied requirements based on the safety importance
- Applicability of the licencing system for new technologies and projects and implementation of possible new licencing steps
- Relations between different licences required in the nuclear legislation and the procedures for changes and renewal (including EIA)
- Legislation for spent nuclear fuel and other nuclear waste especially from final disposal point of view
- Definitions (Nuclear material, nuclear waste, radioactive waste...)



REILA report released 27.8.2020



- Working group: Comprehensive reform of nuclear energy legislation necessary
- According to the working group, the key principles of the comprehensive legislative reform would be:
- Finland will continue to ensure compliance with international agreements, commitments and best practices related to the use of nuclear energy.
- Licencing system covering the life cycle of a nuclear facility (government resolution that can be adopted or rejected by Parliament, construction permit, operating licence and licence for decommissioning of a nuclear facility) should be continued, respecting democratic decision-making in a transparent and effective manner.
- However, there is room for improvement in the licencing system. At the initial stage of the process, matters should be dealt with at a general level and detailed processing should take place at a later stage of the process. It should be easier to anticipate the acceptability of the solutions, for example by means of prior approvals, and overlapping processes should be reduced. The licence for decommissioning of a nuclear facility should be reformed.
- Requirements and expectations for the safety and technology of a nuclear facility as well as for the relevant actors and authorities must be clearly specified at different stages of the life cycle of the nuclear facility and they must be proportionate to the risks arising from the operations to people, the environment and society.
- The concepts and definitions used must be clear and understandable.

Alignments related SMRs in REILA report



⇒ SMRs are necessary to take into account in the development of legislation

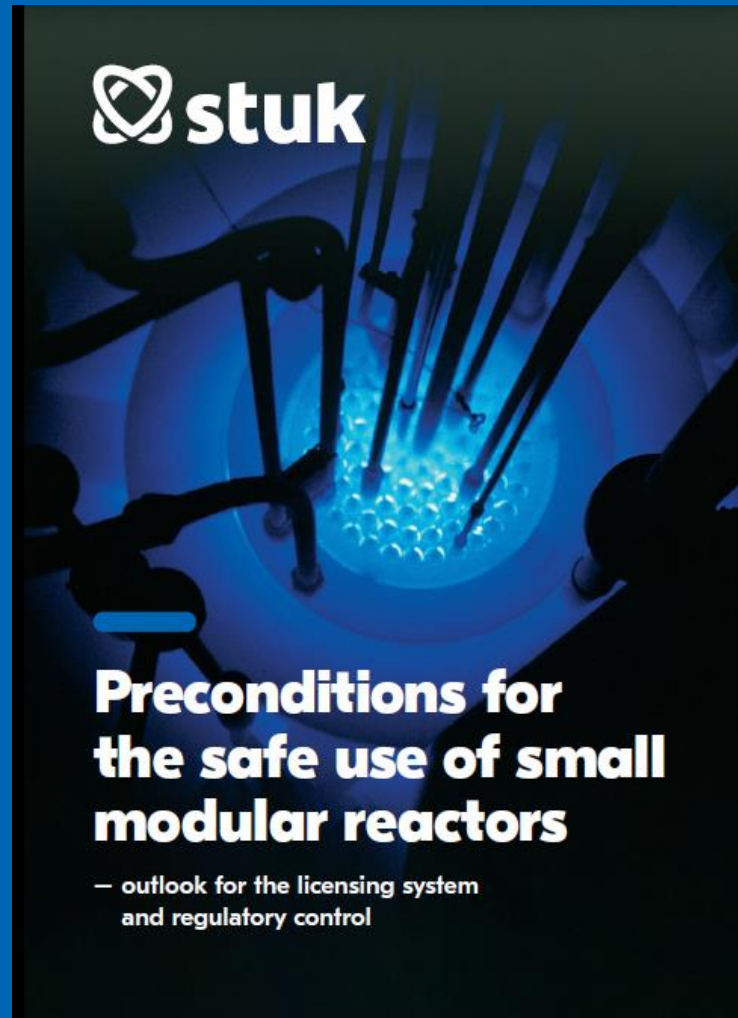
⇒ No separate legislation for SMRs

⇒ The recognised development needs for SMR improve also the construction and operation of the "traditional" nuclear facilities

Activities in STUK

- **STUK is preparing itself for potential license applications of SMRs by**
 - Competence building, e.g. participation in SMR Regulators' Forum
<https://www.iaea.org/topics/small-modular-reactors/smr-regulators-forum>
 - Participation in international cooperation. STUK is for example leading the WENRA RHWG subgroup on SMRs. STUK is also participating in IAEA's project "Safeguards by design for SMRs".
 - Involvement in preparations for possible renewal of the Nuclear Energy Act and Nuclear Energy Decree (lead by Ministry of Economical Affairs and Employment).
 - Evaluation of the needs to revise STUK's regulations and YVL Guides.
 - Purpose of the renewal would be to modify the requirements to be more goal setting and technology neutral. SMRs would be considered in the renewal.
 - Internal study concerning releases and dispersal of radioactive substances into the environment is on-going, to support drafting requirements for sizing the emergency planning zone.

STUK has recognised several questions specific to SMRs that should be considered in the renewal of the legislation, in licensing and in safety assessment of SMRs. The questions are discussed in a [report](#) published in January 2020.



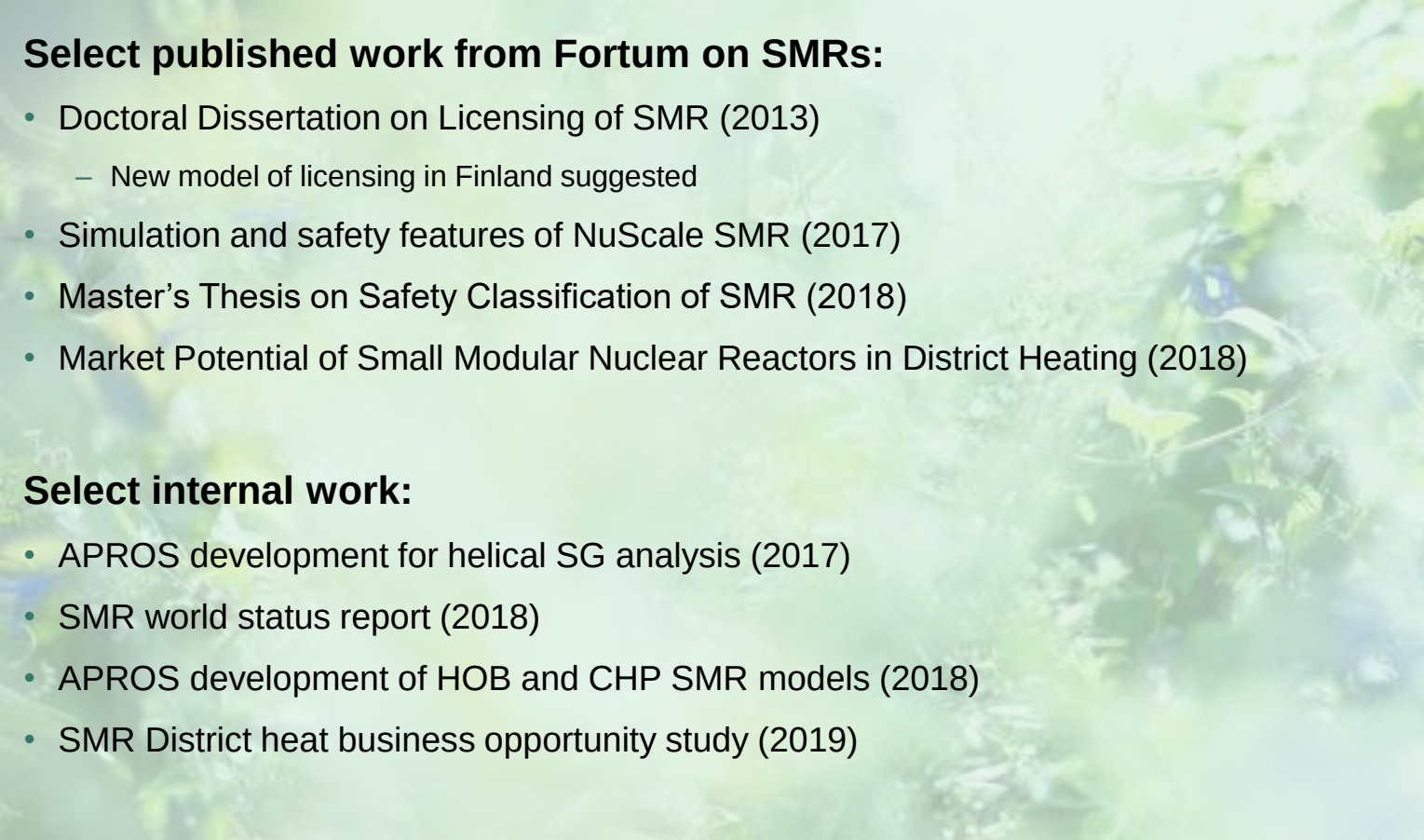
Preconditions for
the safe use of SMR

SMR R&D Project in Fortum

- Part of broad R&D Program
- Actively monitor international activities, different concepts and participation to various activities
- Main focus
 - Licensing, safety design issues
 - Development of thermal hydraulic simulation tool (Apros)
 - SMRs and CHP/DH studies

Work done at Fortum on SMR's

Suggested modifications to Finnish licensing process

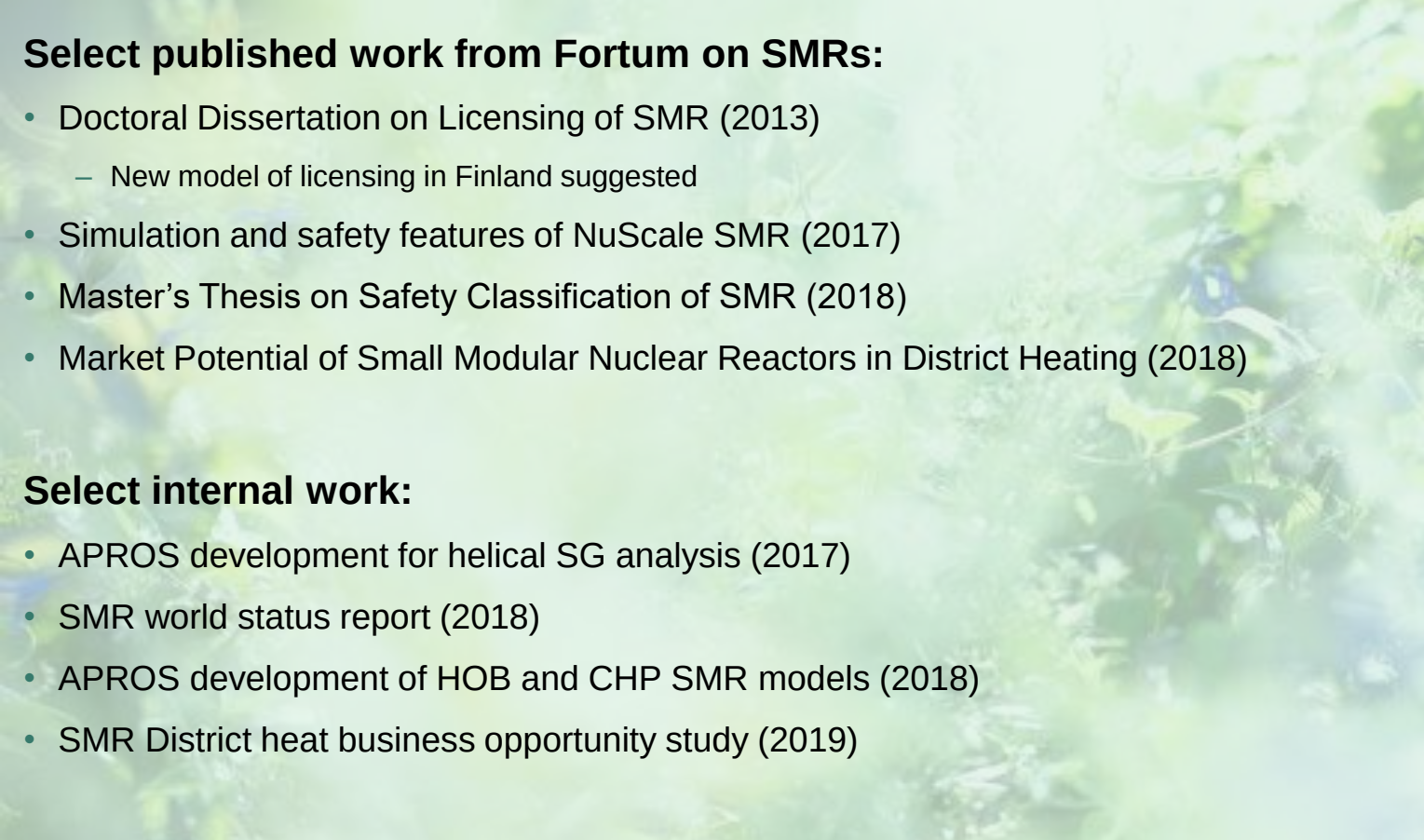


Select published work from Fortum on SMRs:

- Doctoral Dissertation on Licensing of SMR (2013)
 - New model of licensing in Finland suggested
- Simulation and safety features of NuScale SMR (2017)
- Master's Thesis on Safety Classification of SMR (2018)
- Market Potential of Small Modular Nuclear Reactors in District Heating (2018)

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Ongoing collaborations

- EU project - ELSMOR, Work package leader
- Business Finland project - EcoSMR
- EU project - Gemini+

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Suggested modifications to Finnish licensing process

The diagram illustrates the suggested modifications to the Finnish licensing process, divided into two main sections: Political decision and Official Licensing Steps.

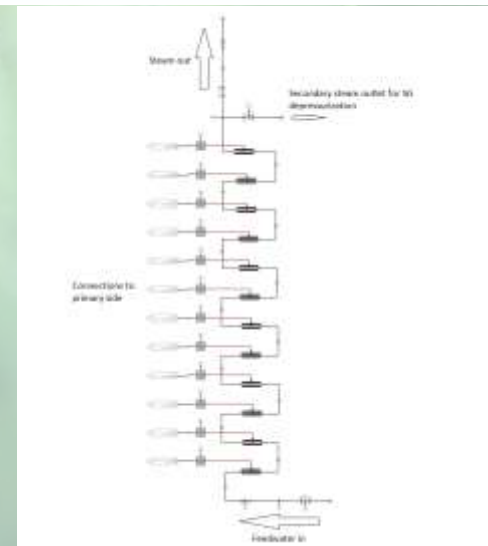
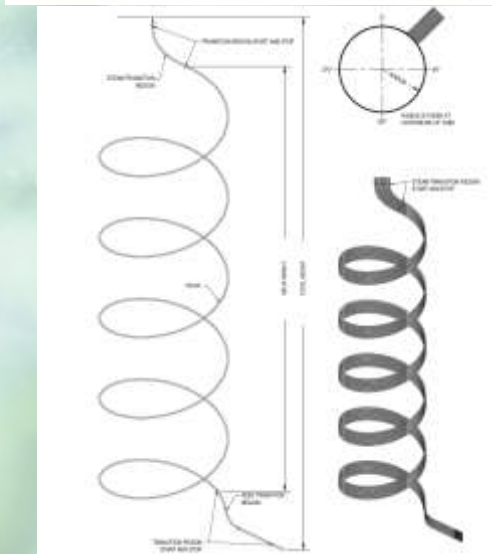
Political decision:

- Independent from licensing steps
- New step:** Standard Design Certification of Module

Official Licensing Steps:

- Environmental Impact Assessment (EIA)
- Decision in Principle
- Construction License
- Regulatory Approvals
- Operating License

The process flow is indicated by arrows, showing a sequence from the Political decision section through the Official Licensing Steps. A large blue arrow points from the 'New step' box to the 'Decision in Principle' box.

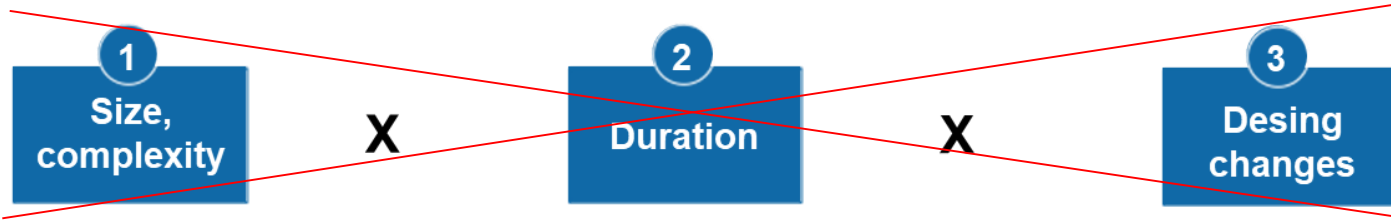




TVO ja Small Modular Reactor

Nuclear industry has to renew it's business

From large, first-of-a-kind investments...



... to SMR's

- modular, quick to build
- small & simplier desing
- more factory manufacturing
- standard, serial production
- quick to license, type approved
- close to city's
- better readiness for load following

SMR-project is important for TVO



- Demand for clean energy, including clean heat is increasing. Acceptability of combustion based energy is decreasing.
- TVO wants to...
 - ... be part of the Finnish SMR ecosystem and create new business internationally
 - ... promote the implementation of a domestic thermal reactor solution
 - ... create readiness to invest into the first SMR pilot in Finland

TVO's is a credible builder and operator for future SMR's, we manage the entire lifecycle of nuclear power:

- Licensing expertise
- Experienced, world class operator
- Fuel and waste know how – world leader in spent fuel repository - ONKALO®
- Experience from Olkiluoto 3
- Possibility to utilize Olkiluoto's infra

TVO's SMR-project includes

- Evaluation of suitable SMR-concepts
- Technical and economic study of reactor types
- Utilization of Olkiluoto infrastructure and the need for new infra

VTT SMR activities

- Active in European R&D context
 - ELSMOR coordinator, McSAFER WP lead, EEC SMART
- SMR-focused business ecosystem being formed
 - Nuclear utilities, cities' energy companies, consultants, subcontractors
 - Potential international offerings, potential Finnish uses of SMRs
- Preconceptual design of district heating SMR
 - Suitability to European context
- Future intent on R&D on hydrogen production with nuclear energy

FinnReactor technology, LUTHER

Low temperature and low pressure light water reactor, innovative core design, scalable 24..120 MWth

- Plug-and-play compatible with current district heating infrastructure
- Annual refuelling need ~200 kg UO_2 (@ 24 MWth)
- Around 0.22 m³ Medium Level Waste, 1 m³ Low Level Waste annually (@ 24 MWth)

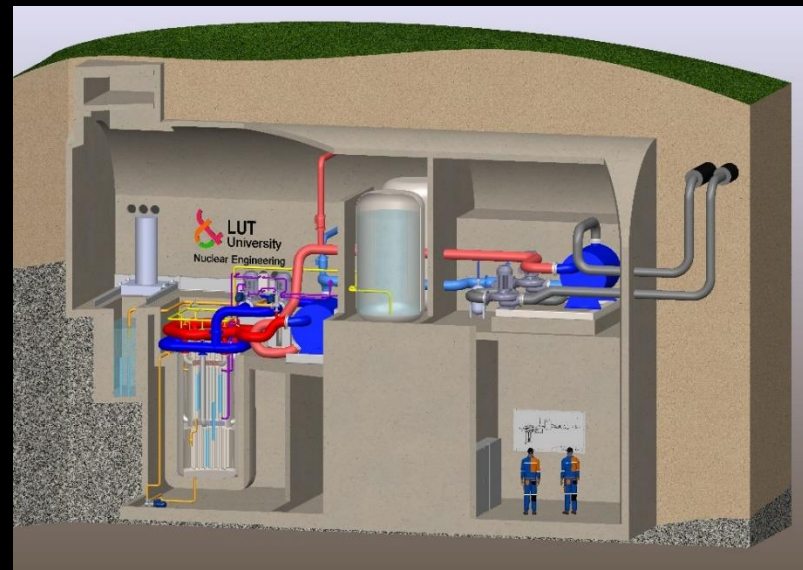
Technologies ready for management of all wastes

Domestic design, manufacture and construction

Simple: low cost, easy regulation, inherent safety, high security and stringent nuclear material control incorporated

LUT Heating Experiment Reactor, LUTHER, a 6 MWth demonstration plant, planned

- Research reactor to complement the Green Campus energy infrastructure
- Same hardware as 24 MWth but smaller core



bey⁰nd

the obvious

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