Evolution of the Finnish safety regulations and implementation

Workshop on Innovations in Water Cooled Reactor Technologies

OECD/NEA

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Deputy Director

Marja-Leena Järvinen

Nuclear Power Plants in Finland

Fennovoima
• Decision in Principle for FH1, Hanhikivi/Pyhäjoki

Olkiluoto (TVO)
• 2 - ABB BWR
• OL3 (EPR) under construction
• OL4 Decision in Principle
•Spent fuel storage
•VLJ cave
• Posiva "Onkalo"

Photo: TVO

Loviisa NPP (Fortum)
• 2 - VVERs
•Spent fuel storage
• VLJ cave

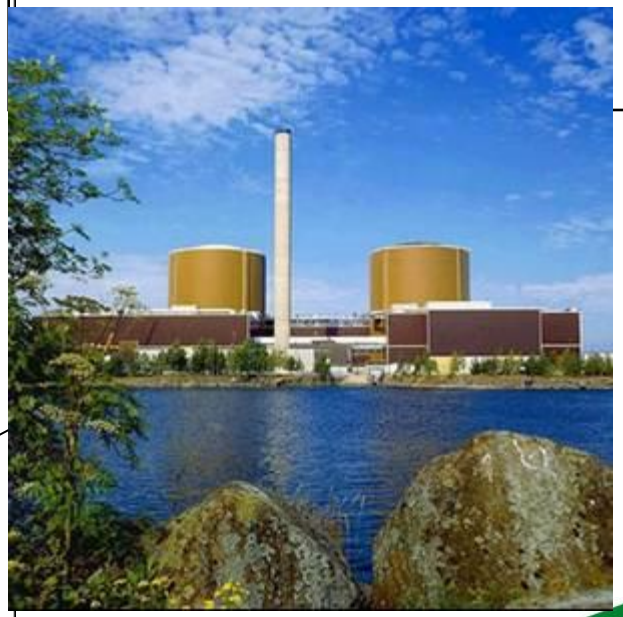
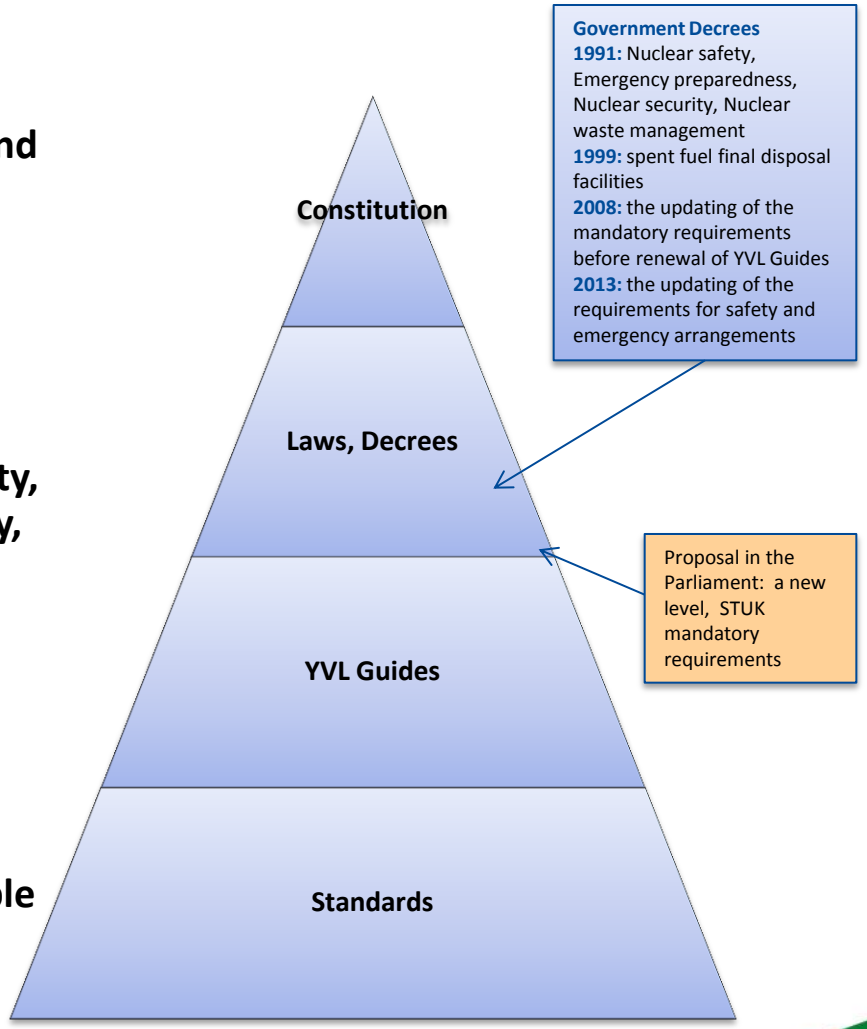


Photo: Fortum

Finnish nuclear legislation and safety requirements

- **Nuclear Energy Act**
  - **"nuclear energy utilisation shall be safe"; "licensee is responsible for safety", other principal safety req's (including security and on-site EP)**
- **Nuclear Energy Decree**
  - **administrative details for licensing and regulatory oversight**
- **Government Decrees**
  - **mandatory requirements for Nuclear safety, Emergency preparedness, Nuclear security, Nuclear waste management**
  - **general principles, fundamental technical requirements, radiological acceptance criteria etc.**
- **YVL Guides**
  - **status as Reg. Guides in USA**
  - **detailed technical requirements, acceptable practices, guidance for licensee-STUK interaction, STUK's oversight**



Nuclear safety in Finland

International and national OPEX is systematically reflected in the regulations and YVL guides

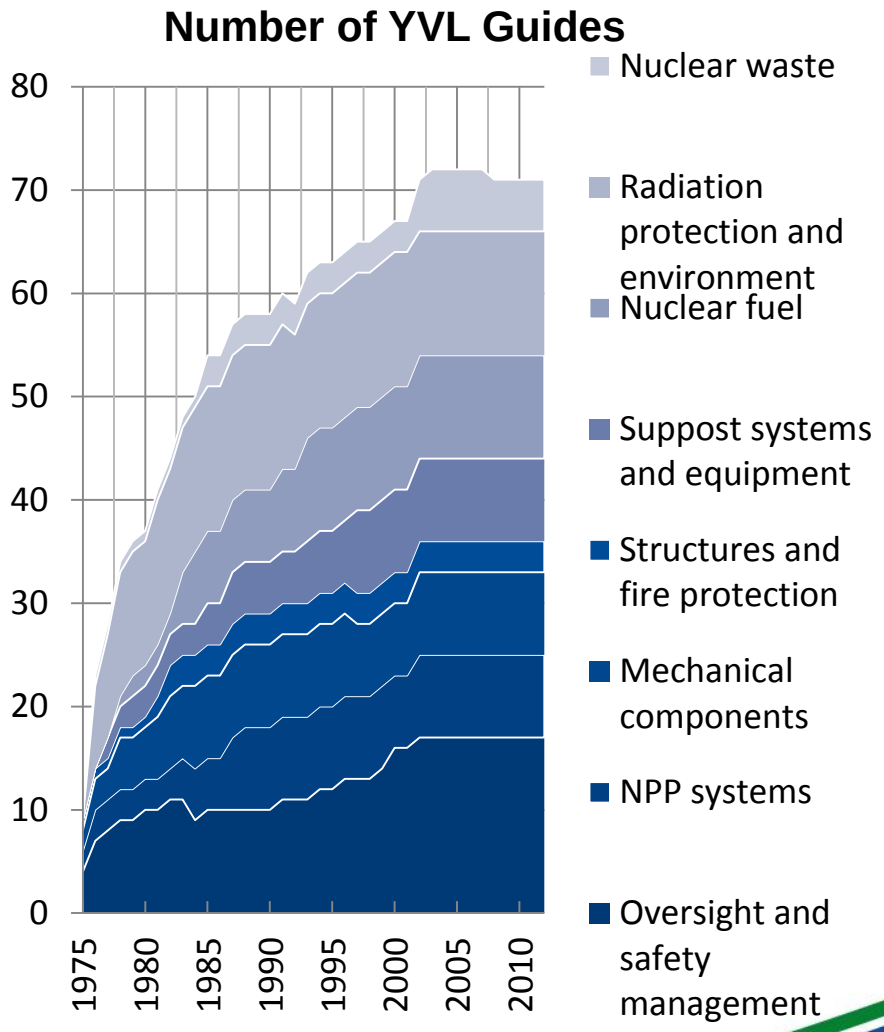
Nuclear Accident	Requirement
TMI	DiD design, Severe accident management
Chernobyl	Safety culture
TEPCO Fukushima Dai - ichi	External hazards

Inputs to rule making are such as national legal framework, benchmarking, OPEX and research.

Evolution of the Finnish YVL Guides in 1975 - 2012

References in the YVL Guides

- General Design principles of a Nuclear Power Plant, 1976
  - 55 criteria
  - Based on 10CFR50, Appendix A
- YVL 1.0 Design principles of a Nuclear Power Plant, 1982
  - State of the Art requirements
- Consideration of the IAEA Safety Series after midd-1980



The safety level of updated regulations and guides

IAEA

- The new Finnish nuclear safety regulations are at least as stringent as the existing IAEA Requirements documents

WENRA

- The WENRA SRLs (2008) are implemented with the new YVL Guides
- WENRA Safety Objectives for new reactors (2010) and WENRA report Safety of new NPP designs (2013) were taken into account in the new regulations

Lessons from the TEPCO Fukushima Daiichi accident

- all available information from the Fukushima accident and different review reports were considered in drafting YVL Guides, also the IAEA Action Plan and the WENRA report Safety of new NPP designs

The new Finnish nuclear safety regulations ensure a high level of safety, the requirements are very advanced and up-to-date as well as demanding in international comparison

The updating of the Finnish nuclear safety regulations and YVL guides in 2006 - 2013

The safety issues included in the YVL guides revision are such as:

- a severe accident at a NPP shall not cause the need for **extensive protective measures** of the public nor cause long-term restrictions on the use of extensive areas of land and water,
- introduction of a new DiD sublevel, the protection levels shall be **as independent from each other as is possible to achieve with reasonably practicable measures**.
- diversification of the ultimate heat sink,
- the removal of the decay heat in **reactor and spent fuel** pools for the duration of **three days** independently of external power and water supply in a situation caused by **a rare external event** or **a disturbance in the internal electrical supply system**
- safety and security aspects

- enhancement of the on-site EP; multiple units, long duration, enhanced provisions for emergency arrangements

DiD levels, event categories and frequencies

Level 1	Normal operation (DBC 1)	
Level 2	Anticipated operational occurrences (DBC 2)	$f > 10^{-2}/a$
Level 3a	Postulated accidents Class 1 (DBC 3)	$10^{-2}/a > f > 10^{-3}/a$
	Postulated accidents Class 2 (DBC 4)	$f < 10^{-3}/a$
Level 3b	Design extension conditions (DEC)	Multiple failures DEC A – CCF combined with DBC2 / DBC3 DEC B – Complex failure combination DEC C – Very rare external event
Level 4	Severe accidents (SA)	Safety goals CDF $<10^{-5}/a$; LRF $< 5\times10^{-7}/a$

Updated set of YVL Guides

Safety, security and safeguards in the same set of YVL Guides

- **Safety security interface**

There are 45 YVL Guides under five topics:

- **A Safety management of a nuclear facility**
- **B Plant and system design**
- **C Radiation safety of a nuclear facility and environment**
- **D Nuclear materials and waste**
- **E Structures and equipment of a nuclear facility**

YVL Guides are available in English at STUK website

http://www.stuk.fi/julkaisut_maaraykset/viranomaisohjeet/en_GB/yvl/

Acceptance criteria for radioactive releases / max doses to general public in different event categories

- ***DBC 1, Normal operation***
  - radiation dose limit 0,1 mSv / year for the entire site
- ***DBC 2, Anticipated operational occurrences***
  - radiation dose limit 0,1 mSv
- ***DBC 3, Class 1 postulated accidents***
  - radiation dose limit 1 mSv
- ***DBC 4, Class 2 postulated accidents***
  - radiation dose limit 5 mSv
- ***DEC, Design extension conditions***
  - radiation dose limit 20 mSv
- ***SA, Severe accidents***
  - no extensive protective measures for the public
  - no long-term restrictions on the use of extensive areas of land and water
  - release < 100 TBq Cs-137 equivalent

Structure of the new YVL guides				
A Safety management of a nuclear facility	**B Plant and system design**	**C Radiation safety of a nuclear facility and environment**	**D Nuclear materials and waste**	**E Structures and equipment of a nuclear facility**
A.1 Regulatory oversight of safety in the use of nuclear energy A.2 Site for a nuclear facility A.3 Management system for a nuclear facility A.4 Organisation and personnel of a nuclear facility A.5 Construction and commissioning of a nuclear facility A.6 Conduct of operations at a nuclear power plant A.7 Probabilistic risk assessment and risk management of a nuclear power plant A.8 Ageing management of a nuclear facility A.9 Regular reporting on the operation of a nuclear facility A.10 Operating experience feedback of a nuclear facility A.11 Security of a nuclear facility A.12 Information security management of a nuclear facility	B.1 Safety design of a nuclear power plant B.2 Classification of systems, structures and components of a nuclear facility B.3 Deterministic safety analyses for a nuclear power plant B.4 Nuclear fuel and reactor B.5 Reactor coolant circuit of a nuclear power plant B.6 Containment of a nuclear power plant B.7 Provisions for internal and external hazards at a nuclear facility B.8 Fire protection at a nuclear facility	C.1 Structural radiation safety at a nuclear facility C.2 Radiation protection and exposure monitoring of nuclear facility workers C.3 Limitation and monitoring of radioactive releases from a nuclear facility C.4 Assessment of radiation doses to the public in the vicinity of a nuclear facility C.5 Emergency arrangements of a nuclear power plant C.6 Radiation monitoring at a nuclear facility C.7 Radiological monitoring of the environment of a nuclear facility	D.1 Regulatory control of nuclear safeguards D.2 Transport of nuclear materials and nuclear waste D.3 Handling and storage of nuclear fuel D.4 Predisposal management of low and intermediate level nuclear waste and decommissioning of a nuclear facility D.5 Disposal of nuclear waste D.6 Production of uranium and thorium	E.1 Authorised inspection body and the licensee's in-house inspection organisation E.2 Procurement and operation of nuclear fuel E.3 Pressure vessels and piping of a nuclear facility E.4 Strength analyses of nuclear power plant pressure equipment E.5 In-service inspection of nuclear facility pressure equipment with non-destructive testing methods E.6 Buildings and structures of a nuclear facility E.7 Electrical and I&C equipment of a nuclear facility E.8 Valves of a nuclear facility E.9 Pumps of a nuclear facility E.10 Emergency power supplies of a nuclear facility E.11 Hoisting and transfer equipment of a nuclear facility E.12 Testing organisations for mechanical components and structures of a nuclear facility
Collected definitions of YVL-guides: same data is shown both as the collection and within the guides.				

Nuclear energy act 7a§

Guiding principles

The safety of nuclear energy use shall be maintained at as high a level as practically possible. For the further development of safety, measures shall be implemented that can be considered justified considering operating experience and safety research and advances in science and technology.

The new guidance will be taken into use simultaneously

- New YVL guides are applied as such to the new NPPs i.e. those for which Decision in Principle was made in 2010
- For the operating NPPs or other nuclear facilities and the NPP under construction an implementation decision is made
  - the approach is the same as in the PSR or licence renewal or publication of an updated YVL guide
  - the nuclear facility is reviewed against new YVL guides
  - the modifications considered reasonably practical are implemented

STUK received the licensees assessment of the fulfilment of the requirements 31th December 2014.

YVL Guides and the reactor types

YVL Guides are written for a new light water cooled reactors

- Next PSR for Loviisa NPP 2017
- Renewal of the operating license of Olkiluoto NPP in 2018
- Evaluation of the Olkiluoto OL3 against new set of YVL Guides as the operating license is applied

→ Improvement programmes

YVL Guides have been written the current type of power reactors in mind

- Future reactor considerations such as Small Modular Reactors (SMR), Nuclear District Heating Plants, GENIV
- New features in the safety concepts
- Safety should be considered in the early phase of the design
- Safety requirements and safety demonstration should be based on research

Thank You!

www.stuk.fi