



Authority for Nuclear Safety and
Radiation Protection

Regulatory framework for Molten Salt Reactors in the Netherlands

Authority for Nuclear Safety and
Radiation Protection



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Nuclear Installations and Transport

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Authority for Nuclear Safety and Radiation Protection

- Dutch regulatory body
- Main tasks include:
 - Authorisation (licensing),
 - Oversight & enforcement,
 - Policy advisement,
 - Emergency preparedness,
 - Public communication,
 - International collaboration.



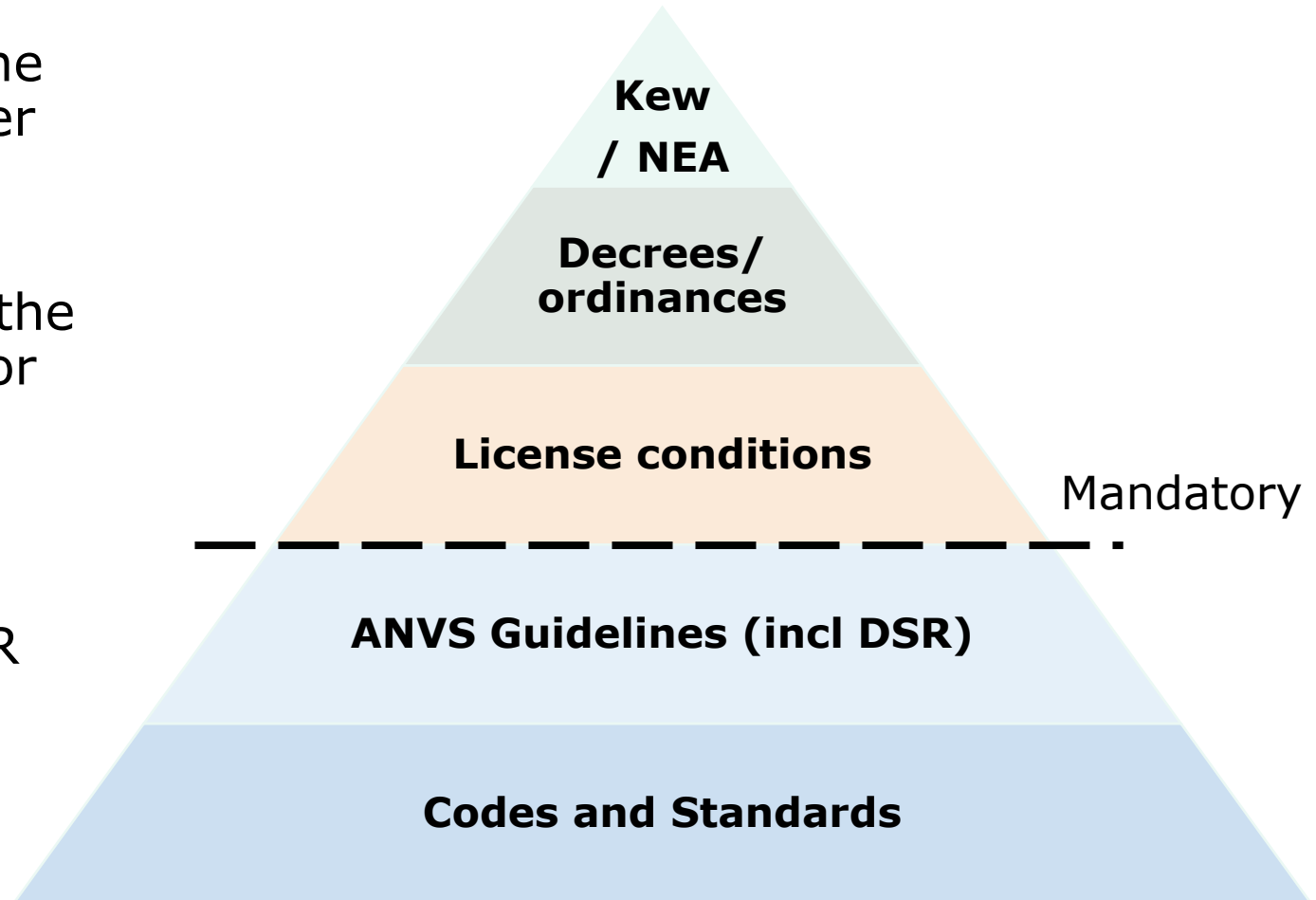
~ 150 people





The regulatory framework

- Nuclear Energy Act (Kew) sets the frame (most prominent law, other laws do also apply)
- Governmental Decrees contain additional regulation, as well as the subordinate Ministerial Decrees or ordinances
- Further Conditions specified in License
- ANVS Guidelines, e.g. VOBK/DSR
- Various industrial codes and standards, as well as IAEA standards may be part of the licensing base





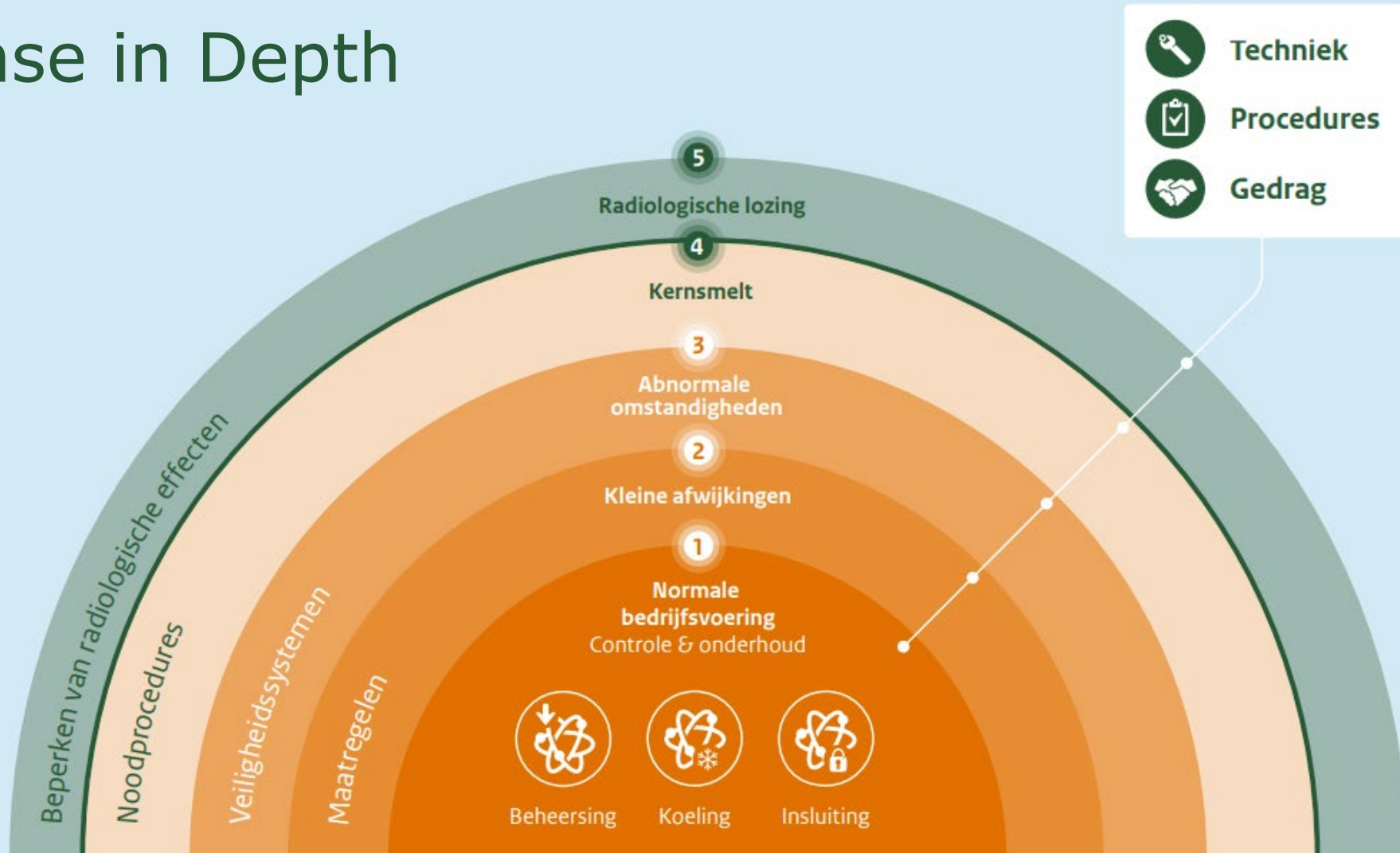
Legally binding requirements

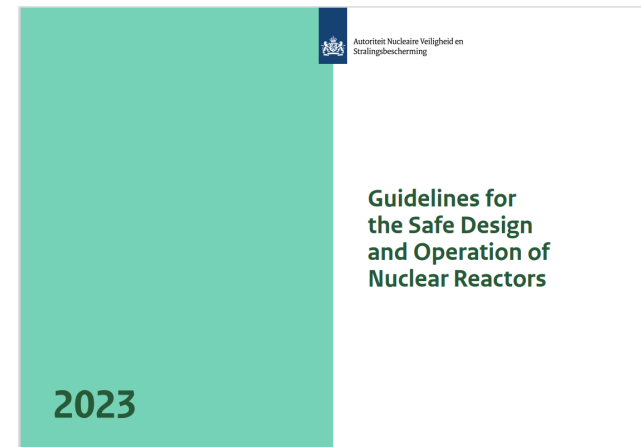
- Formal legal framework is goal oriented, allows for specific implementation.
- 2014/87/EURATOM (implemented in 'regeling nucleaire veiligheid')
 - Principle of defence in depth
 - Practical elimination of early and large releases
- Nuclear facilities, ores and fissile materials decree:
 - Dose limits for anticipated operational occurrences->
 - Individual risk $< 10^{-6}$ per year.
 - Group risk $< 10^{-5}$ per year for 10 direct fatalities
(Or n^2 times smaller for n times direct fatalities)

Frequency	Allowed effective dose	
	Adults	Children
$F \geq 10^{-1}$	0,1 mSv	0,04 mSv
$10^{-1} > F \geq 10^{-2}$	1 mSv	0,4 mSv
$10^{-2} > F \geq 10^{-4}$	10 mSv	4 mSv
$F < 10^{-4}$	100 mSv	40 mSv



Defense in Depth





Technical requirements (DSR) scope

- VOBK / DSR (Dutch Safety Requirements)
- Written for (large) **LWR's**, grading applies
- Based on IAEA Safety Standards Series
- Subject to 'Comply or Explain principle'
- Main topics include requirements for:
 - Safety objectives, technical requirements ---->
 - Postulated events and (external) hazards
 - Application of the single failure criterion
 - Safety demonstration & documentation

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Some specific requirements from the DSR:

- Outline DiD design principles: redundancy (N+2), diversity, physical separation;
- DiD acceptance criteria: $k_{eff} < 0,99$, $T_{Cladding} < 1.200\text{ }^{\circ}\text{C}$, < 1.1 design pressure;
- The NPP shall have 30 minutes autarchy time (no manual actions necessary);
- For external hazards: 10 hr autarchy with respect to cooling and operating agents;
- Residual-heat removal incl. power supply to meet 72 hr self-sufficiency criterion;
- Emergency UPS for accident instrumentation shall last at least 10 hours;
- Fast shutdown + independent and diverse system for long-term sub-criticality;
- Physically separated, independently power-supplied supplementary control room;
- Fuel storage pool water shall not exceed 45°C under normal operating conditions;





But what for Molten Salt Reactors?

- Part of LWR requirements not applicable;
- Approach will however be roughly similar:
- (conceptual) design -> internal / external hazards -> Defence in Depth -> Postulated initiating events -> deterministic analyses showing success -> probabilistic assessment to show remaining weaknesses and optimisation chances -> suitable codes & standards to show required quality;
- This requires an iterative approach
- Exchange of positions between regulator and reactor designer.
- Final decision making and position of regulator will only take place when the complete safety documentation is assessed.





(Pre-)Licensing proces

Orientation

Review and assessment

Decision making

Start pre-licensing

Start Procedure

