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Czech regulator perspective on Long-Term Operations (LTO)

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She is a mechanical engineer with nearly 19 years of experience in the nuclear field.

She began her career as an NDT technician and is now the Head of the Mechanical Components and Material Issues Assessment Division at the State Office for Nuclear Safety.

Throughout her career, she has been responsible for a wide range of assessment activities related to primary components and regulatory inspection activities for those components.

Another important activity she is responsible for is related to ageing management and long-term operation.

Outline

- Czech Nuclear Installation
- State Energy Policy of the Czech Republic
- Czech Regulatory Framework (Nuclear Safety)
- Implementation of the international good practice
- Examples of the latest operator activities
- Regulator perspective on LTO challenges
- Regulatory aspects of LTO

Dukovany NPP

- WWER 440/213, 4 units
- PWR, 6 main circulation loops, 2 turbines
- Each reactor loop has a horizontal steam generator, main circulation pump and main gate valve
- Confinement
- 1444 MWt, 510 MWe
- Operation since 1985 -1987 (now in „LTO“ phase)
- Operator: CEZ Company

Temelín NPP

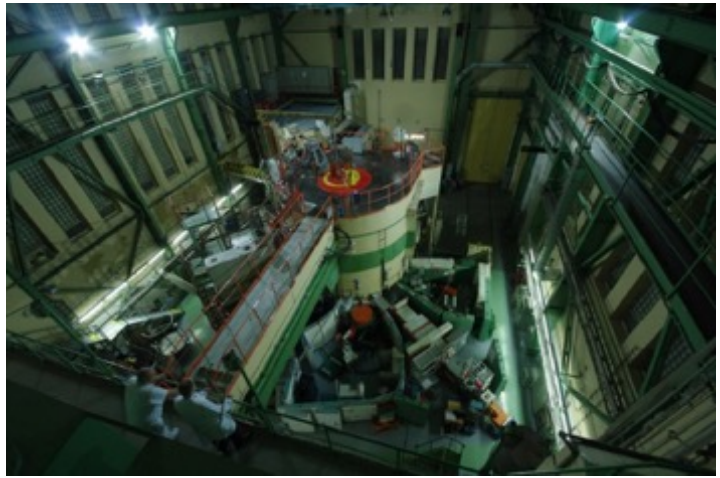
- WWER 1000/V320, 2 units
- PWR, 4 main circulation loops, 1 turbine
- Each reactor loop has a horizontal steam generator and main circulation pump
- Full-pressure containment
- 3120 MWt, 1078 MWe
- Operation since 2000 – 2002
- Operator: CEZ Company

Research Reactors

Řež:

CVŘ Centrum výzkumu Řež

- LVR-15 RR; Below 10 MWt; 06/1989 (1957)
- LR-0 RR; 0 MWt; 1982

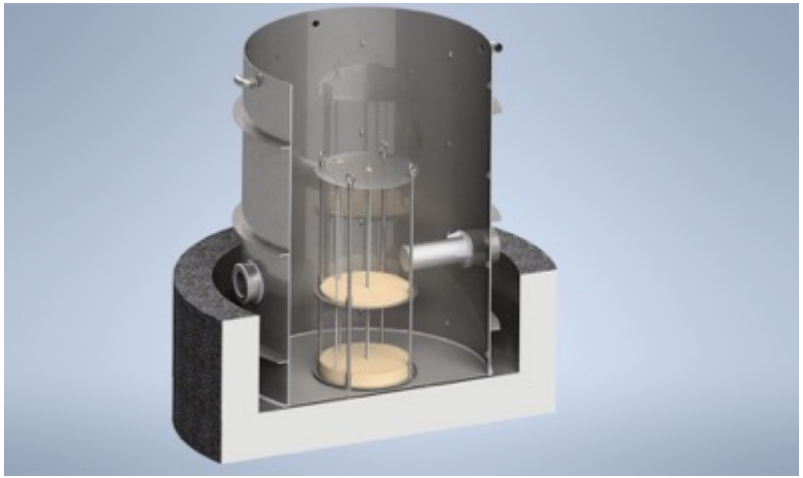


Prague:

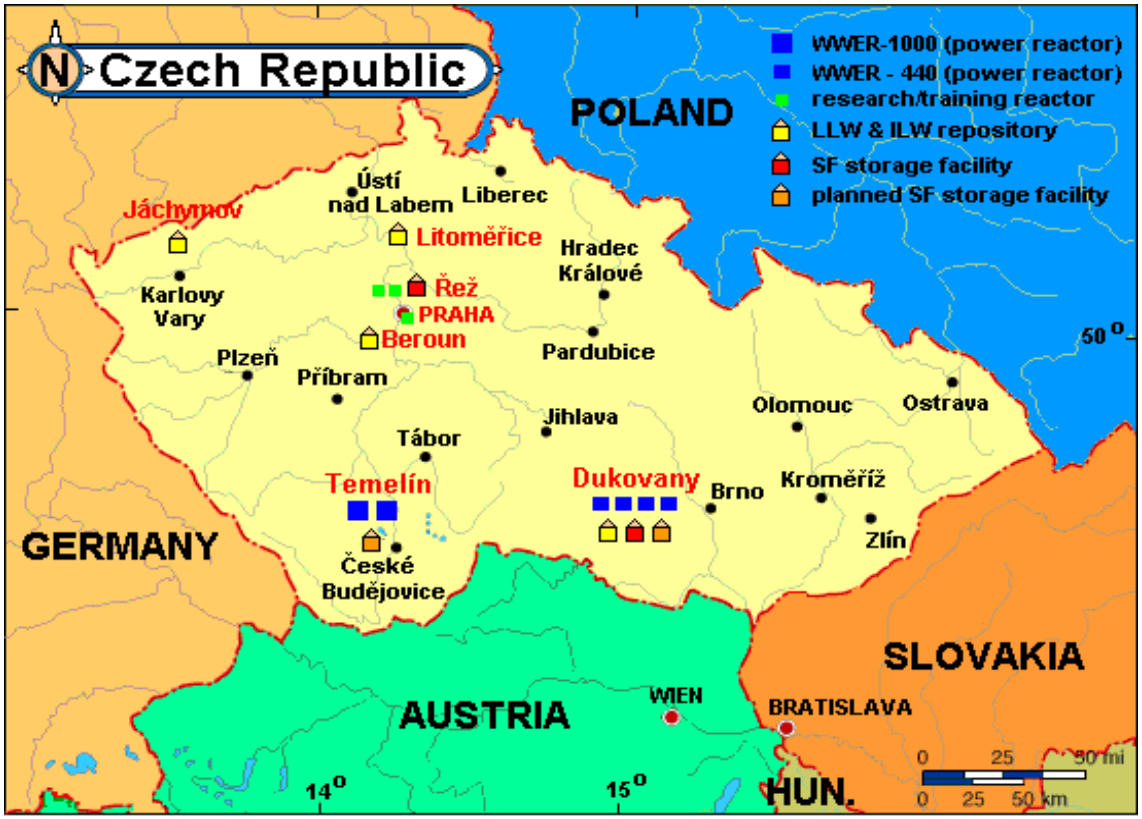
ČVUT ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE

FJFI

- VR-1 RR; 0 MWt; 1992
- VR-2 RR; subcritical assembly controlled by a neutron generator; 2023



Other Nuclear Installations



- ***Dukovany Site:***
  - Two spent fuel storage facilities
  - near surface disposal facility for operational L+ILW
- ***Temelín Site:***
  - One spent fuel storage facility
- ***Řež site:***
  - HAW storage facility
- 2 other ***underground disposal facilities*** (Richard, Bratrství)

Update of the Czech State Energy Policy

- Prepared by Ministry of industry and trade; now under the commenting procedure in 2/24
- Considering the climate and energy goals of the EU

Update of the Czech State Energy Policy

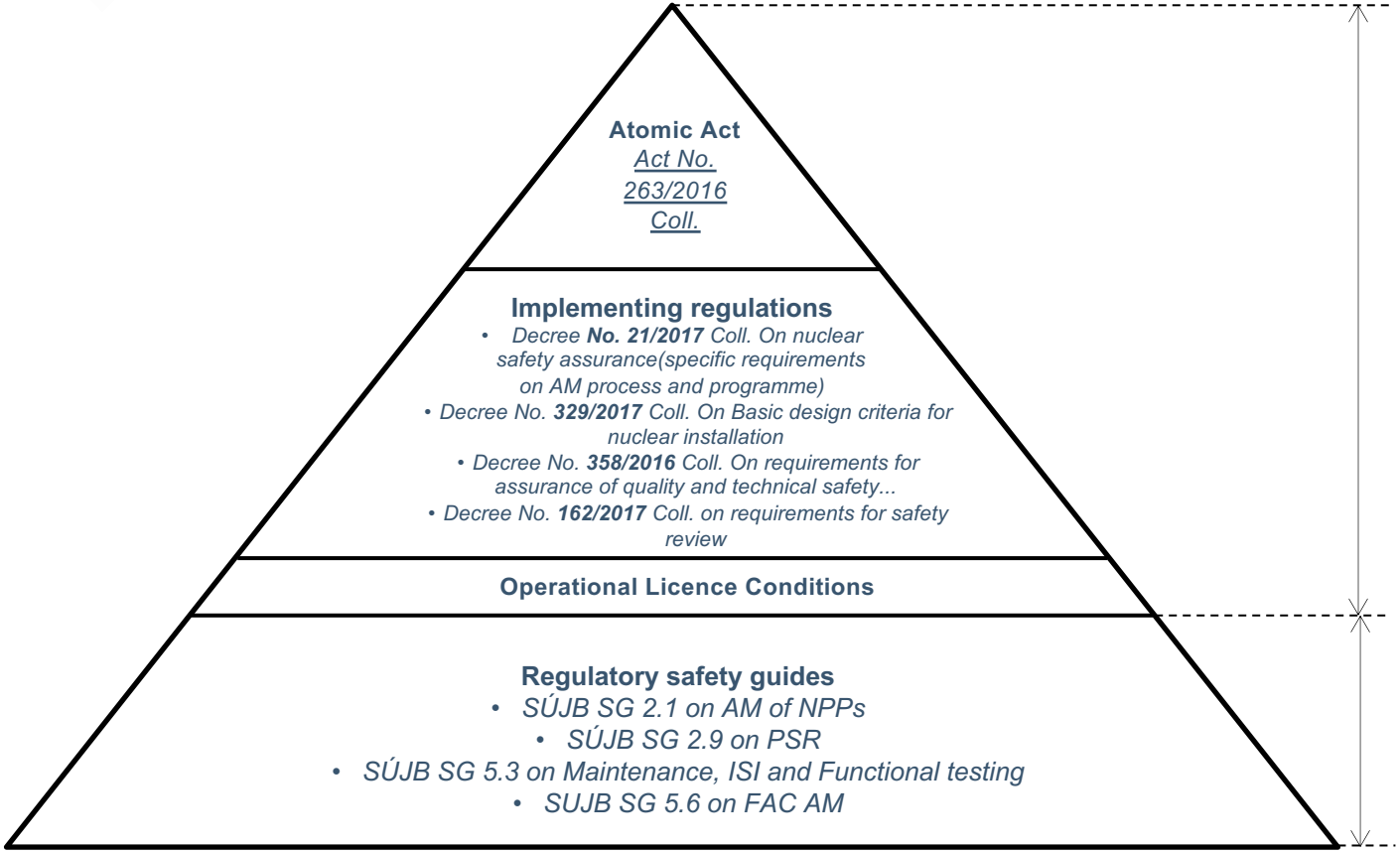
Entry conditions at the level of the Czech Republic with respect of nuclear industry:

- Completing the construction of the **new nuclear power plant** at Dukovany by 2036 and other nuclear power plants at Dukovany and Temelín by the 40s and maintaining the installed capacity at least at the current level and aiming to increase the share of nuclear in the energy mix by 2050; use the heat from Temelín and Dukovany NPPs

- **Ensuring the long-term operation of the existing nuclear units - NPP Dukovany until 2047 and NPP Temelín until 2062**

- Based on the strategy of the concept of development of **small and medium modular reactors (SMR)** in the Czech Republic, inclusion of this technology in the SEP for electricity, heat and hydrogen production; and preparation of conditions for the first SMR project in the Czech Republic in the 30s

Czech Regulatory Framework (Nuclear Safety)



Legally binding (requirements)
Act No. 263/2016 Coll. („Atomic Act") ***in force from 1th of January 2017 (2 years transitional provisions)***
- Transposition of the Euratom Nuclear Safety Directive,
- Implementation of IAEA Safety Fundamentals

Operating licence without time limit

Implementing Regulation
Implementation of:
- WENRA Safety Reference Levels (Criteria)
- IAEA General Safety Requirements, partially IAEA Safety Guides

Legally non-binding (recommendations)
Implementation of:
- IAEA Safety Guides
- World practice

Regulatory requirements on ageing management

Act No. 263/2016 Coll. (Atomic Act):

§ 49 - General obligations of holders of a licence for an activity related to the use of nuclear energy

s) The licence holder shall continuously monitor the state/condition of the nuclear installation and its SSCs in terms of the **implementation of ageing management process that is conducted in accordance with the ageing management programme** from the initiation of construction to the decommissioning of the nuclear installations

§ 24/1 - Licence holders shall act in accordance with the documentation for the licensed activity.
(AMP is one of the documentation for the licensed activity according to the list in Annex 1 of the Atomic Act)

SÚJB Decree No. 21/2017 Coll. On nuclear safety assurance

§ 11 – Procedures for ageing management process – defines criteria for scope-setting and the necessary activities in the process;

§ 12 – Requirements for the Ageing Management Programme – defines the content of the documentation according to which the process is conducted

Requirements are based on the 9 attributes of the effective ageing management programme as specified in SSG-48

Regulatory requirements on AM and LTO

Decree No. 162/2017 Coll. :

- Requirement on **verification of scope setting**: Results of PSA shall be used for verification whether the ageing management process is applied to all SSCs with relevance to nuclear safety
- Requirements on **Special Safety Review for design modification in the case of operation beyond designed lifetime** (ageing rate of SSCs relevant to nuclear safety, reliability of SSCs, fulfillment of acceptance criteria and maintaining of safety margins due to ageing affect, validity of TLAAs etc., system of employees knowledge)
- Requirements on **PSR**

Licence conditions:

- The licencee shall continuously update the documentation demonstrating the **state of ageing management and the physical condition of safety relevant SSCs** (i.e. AMR, HR, TLAA documents incl. set of the maintenance templates) and shall submit this documentation to the regulatory body on regular basis **(every 5 years)**
- The licence holder will submit the **documentation of the Dukovany NPP preparation for operation beyond the 2025** which is based on a long-term concept of site and that is documenting the provision on further safe operation of Dukovany NPP **(every 5 years)**

Implementation of the IGALL results in the Czech Republic (background)

§ 5/2 of Atomic Act

Anyone who uses nuclear energy, manages a nuclear item or performs activities in exposure situations shall, as a matter of priority, ensure nuclear safety, safety of nuclear items and radiation protection, while respecting the present level of science and technology and **good practice**

IGALL results are considered as a possible source of good practice

The Czech Republic participates in IGALL programme ***from Phase 1***, currently in all IGALL working groups (regulatory body from Phase 4)

IGALL results are implemented by both parties, the licencee and the regulatory body

Implementation of the IGALL results by regulatory body

SÚJB oversight:

- implementation of the applicable legislation to the submitted AMPs (documentation for the licensed activity)
- if the licensees´ activities are carried out according to the documentation for the licensed activity (included ***„good practice“)***

- SÚJB internal procedures on how to perform assessment of the documentation demonstrating the state of ageing management and physical condition of SSCs; ***IGALL result serves as a basis***
- DM/AF identification completeness review by comparison/check with different sources of information:
  - Degradation mechanisms catalogue developed by our TSO; Public information from project **IGALL, GALL report**
  - Internal/external operation experience and SÚJB inspection activities
  - Results from research/development programs
- Existence of necessary AMPs for managing all identified degradation mechanisms/ageing effects (comparing also with IGALL recommended AMPs or other plant programmes)
- Evaluation of AMPs from the perspective of nine attributes of the effective ageing management programmes correctness of AMPs (9 attributes)

Implementation phase of LTO programme

LTO action plan

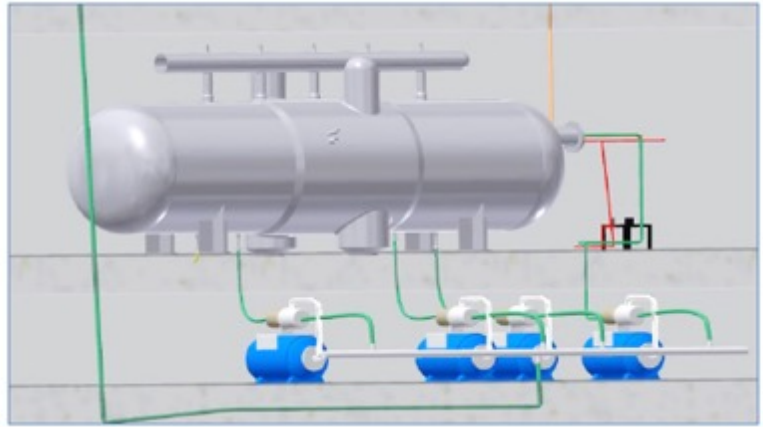
- Implementation of corrective measures resulting from preparation of LTO programme, licence conditions, PSR results
- Updates based on results of PSR, Special Safety Review and updates of AM documentation (AMR etc.) and Adaptation to new regulations and technological advancements

Continuous Improvement

Progress status submitted to SÚJB every year (licence condition)

Corrosion products in SG and their cleaning at Dukovany NPP

- Issue of accelerated degradation of the SGs heat exchange surface in Dukovany NPP (the number of plugged tubes at the same area began to be an issue)
- Due to the repetitive heat input from welding – SCC; complicated repair
- Multi-professional expert team as part of AMP SG was established
- The areas of solution:
  - Optimization of Chemical regimes
  - Optimization of SG blowdown
  - Cleaning of corrosion products
  - ISI interval
- Feasibility study on SG replacement

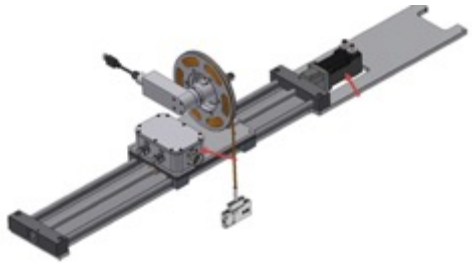


Corrosion products in SG and their cleaning at Dukovany NPP

- Pilot mechanical cleaning in 2021 – SG26
- **Unique technology invented in cooperation of Framatome, CEZ and SKODA JE–used for the first time on VVER 440MW NPPs**

Manipulator for cleaning

Manipulator for visual inspection



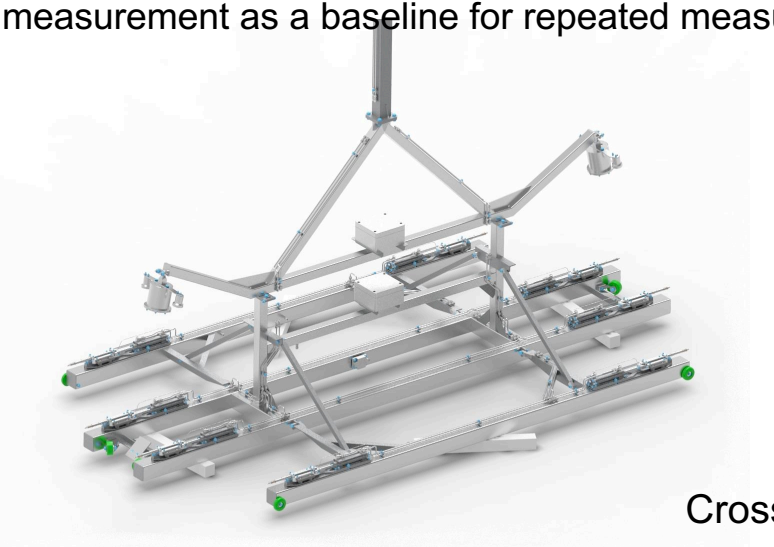
Limitations of the cleaning manipulator (pilot cleaning vs. subsequent cleaning

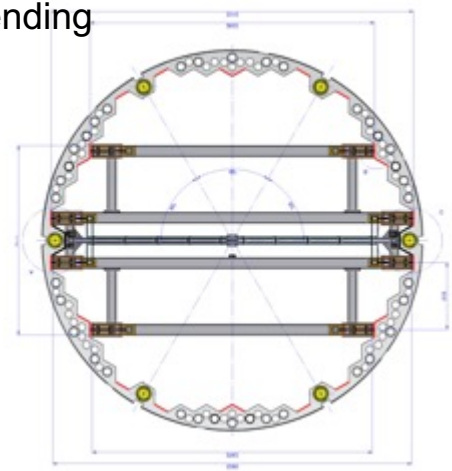
Inspections (VT- manipulator + manual; ET – probes Bobbin, Z6 and X-Probe) before/during/after cleaning, including inspections to check existing or new flaws (probe MRCP)

- Confirmed that the cleaning process did not have negative impact on condition of SG tubes

Measurement of Core Shroud at Temelín NPP

- Combination of high fluence and temperature leading to macroscopic change in the geometry of RPV internals
- Radiation swelling identified in core baffle of some VVER-1000
- Development of NDT- dimensional inspection manipulator **by NRI Řež**
- Verification of radiation swelling calculation + computation model calibration
- First measurement as a baseline for repeated measurement and trending



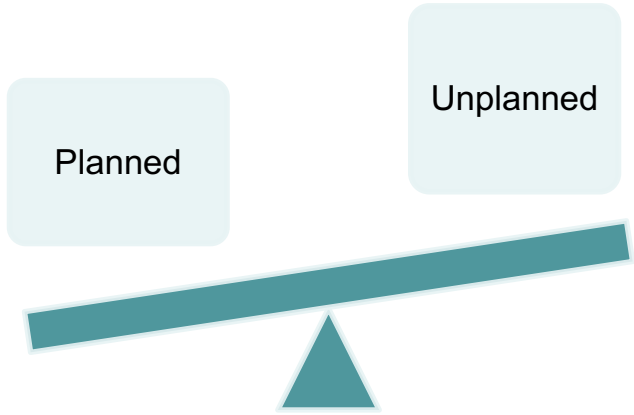


Cross – section view at the measuring device in the core shroud

Regulator perspective on LTO - challenges

Physical status of SSCs

- Increasing number of repair and replacement due to the age of NPPs?



Availability of original materials and spare parts?

Availability of repair procedures?

Regulatory Framework for implementation of novel / advanced technologies?

Regulatory aspects of LTO

Regulation:

- Continuous updates of the regulatory framework to incorporate latest scientific and technological development.

Public Confidence:

- Transparent regulatory processes
- Transparent communication with public

International Collaboration:

- Active participation in international regulatory forums and adherence to global best practices (set by IAEA, WENRA etc.)

Regulatory Capacity Building:

- Enhancing the skills and knowledge of regulatory staff (and its TSO) through the continuous training and international exchange programs to be able to cope with future challenges (novel repair and manufacturing technologies, use of AI for predictive maintenance or real-time monitoring (e.g. digital twins)

THANK YOU FOR YOUR ATTENTION

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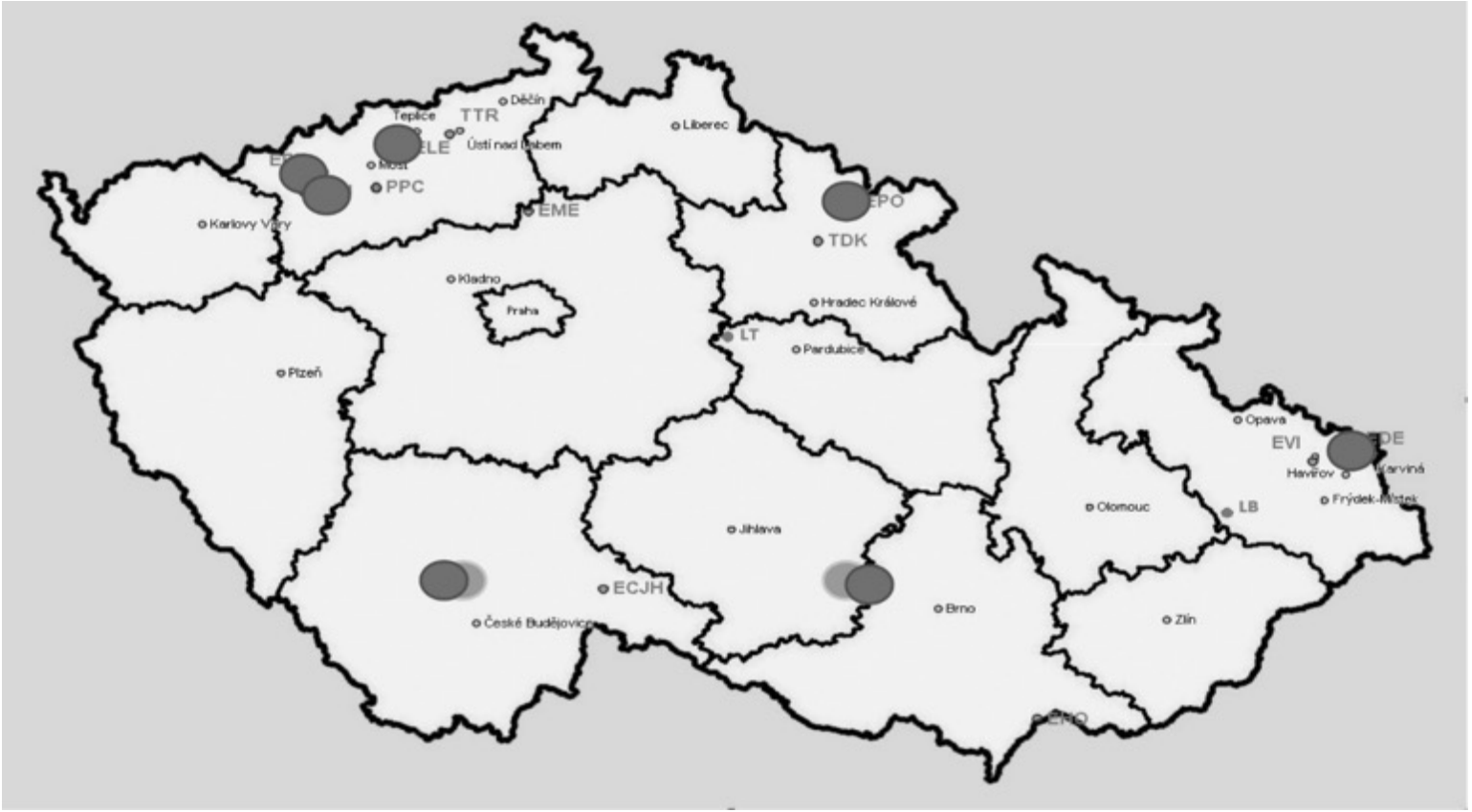
BACK UP

Potential SMR sites (ČEZ)



List of implemented component specific AMPs

CEZ_ME_0999 AMP Valves with drives *(IGALL AMP 143)*
CEZ_ME_1030 AMP Monitoring the status of civil Structures *(IGALL AMP 304)*
CEZ_ME_1124 AMP Reactor Coolant Pumps *(IGALL AMP 138)*
CEZ_ME_1126 AMP Reactor Pressure Vessels *(integrated IGALL AMP 104, 110, 113, 118, 152, 160, 161)*
CEZ_ME_1128 AMP Main Gate Valves *(IGALL AMP 153)*
CEZ_ME_1129 AMP Pressurizers *(IGALL AMP 154)*
CEZ_ME_1131 AMP Oil-type Power Transformers *(IGALL AMP 211)*
CEZ_ME_1134 AMP High Energy Pipelines
CEZ_ME_1135 AMP Pipelines of Safety Class 1 *(IGALL AMP 156)*
CEZ_ME_1168 AMP Pools for Spent Fuel Storage and Refuelling *(IGALL AMP 315)*
CEZ_ME_1169 AMP Containments *(integrated IGALL AMP 301, 304, 311, 313)*
CEZ_ME_1170 AMP Steam Generators *(IGALL AMP 116)*
CEZ_ME_0791 AMP Safety-relevant Cables *(integrated IGALL AMP 201, 202, 203, 221)*

List of implemented degradation specific AMPs

CEZ_ME_0773 AMP Low cycle fatigue *(IGALL AMP 101)*
CEZ_ME_0778 AMP Flow-accelerated corrosion *(IGALL AMP 114)*
CEZ_ME_0780 AMP Radiation embrittlement of reactor pressure vessels *(covers IGALL AMP 152 and 160)*
CEZ_ME_0941 AMP Visual inspections of cables
CEZ_ME_0980 AMP Risk places with welded joints at nuclear power plants
CEZ_ME_1125 AMP Service water pipelines *(IGALL AMP 125)*