



# Nuclear Power Plant Krsko, Slovenia

## Preparation for safe LTO at NPP Krsko

### Keywords:

- Long term operation,
- Aging management,
- Periodic safety review,
- Environmental impact assessment ,
- Pre-SALTO,
- Organisation optimization,
- LTO committee



# Short BIO

## Stanko Manojlovic

Engineering Support for LTO Superintendent

2010 – Univeristy degree in Physics – Monte-Carlo sim.

2010 – 2012 Technical enginner for new build (JEK 2)

2012 – 2013 Probabilistic safety analysis engineer

2013 – 2015 Reactor Operator

2015 – 2020 Lead Licensing Engineer

2020 – 2021 LTO Project Team Lead

2021 – 2022 Lead LTO engineer

2022 – Engineering Support for LTO Superintendent



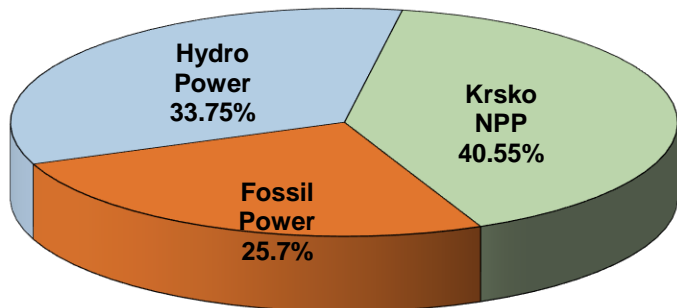
# Unit description



- Owners: **GEN-energija 50%, HEP 50%**
- Operator: **Krško Nuclear Power Plant**
- NSSS Supplier: **Westinghouse**
- Reactor Type: **PWR, 2-loop**
- Engineering: **Gilbert Architect Engineer**
- Commercial Operation: **1983**
- Renewed Operating License: **2012**
- Operating Life Time: **40+20+... years**
- Gross Plant Output: **727 MW**

**Single unit, with corporate integration**

Electricity production in Slovenia



# History of Aging management implementation

- Aging management subject **introduced by PSR1 in 2003**
  - Selected and agreed approach – following US NRC requirements 10 CFR 50.54.
  - Action from PSR1 - **Scoping and screening** implemented by 2007
  - Aging management programs and **USAR/TS changes** prepared and submitted to SNSA in **2009**
  - AMP and USAR/TS changes review by independent authorized organization-positive **final independent evaluation (FIER)** submitted in 2011 to SNSA
  - **Regulatory (SNSA) approval in 2012** – this implicitly (operational license without specific time limitation) means NEK can operate until 2043 if it performs:
    - Every **10 years periodic safety review** with implementation of action plan approved by the regulator,
    - Implementation of **Safety upgrade program** (within Slovenia post-Fukushima action plan),
    - Operation within **operational license**.

# Background to LTO – AM for NEK

NEK conforms to Slovenian and follows US regulation, for instance:

- 10 CFR 50.65; - NEK Maintenance rule
- AP 913 – Equipment reliability process desc.
  - Scoping
  - Performance monitoring
  - Corrective action – CAP (program)
  - ER improvement
  - Long term planning
  - Preventive maintenance implementation
- AMP: 10 CRF 54; - REQUIREMENTS FOR RENEWAL OF OPERATING LICENSES
  - PSR 1- Action to develop AMP
  - 2010 - Development of AMR and TLAA analysis
  - Implementation of Aging management programs (NUREG-1801)
  - Independently reviewed by authorised institution

# LTO requirements for NEK

- Periodic safety review (3rd review)
  - additional Safety factors than IAEA SSG-25 (extended scope)
    - Plant security, Safety culture, RA waste.
    - External reviewer with plant sponsors for each SF

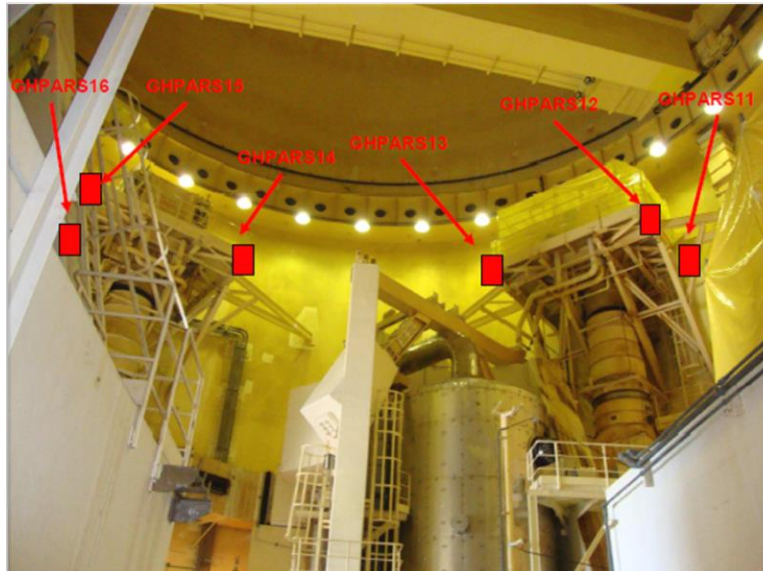
## Additionally

- An environmental impact assessment is in preparation
  - Slovenia signed the Aarhus and ESPOO convention
    - Aarhus conv.: public participation in decision Making
    - ESPOO conv.: EIA of transboundary context (Austria, Croatia...)
- Pre-SALTO mission
  - Check alignment to IAEA recommendations and guidelines
    - **SSG-48** - Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants:
    - **SRS-82** - Ageing Management for Nuclear PowerPlants: International Generic Ageing Lessons Learned (IGALL)

# SUP: Phase 1 (2013)

- **PCFVS and PAR** - ensuring containment integrity – passive pressure & hydrogen control

**Passive Autocatalytic Recombiners: 2 SR + 22 NSR**



**PCFVS**





# SUP: Phase 2 (2019)

- **BB1** – Upgrade/relocation of **Emergency Control Room** and Technical Support Center **COMPLETED**
- **New Independent system for RCS depressurization, COMPLETED**
- **SFP alternative cooling** (installation of permanent spray and pipes to allow quick connection of mobile Hx) **COMPLETED**
- **RCS/CNT alternative long term cooling** (additional alternative RHR pump being able to recirculate primary coolant form RCS/CNT via Hx cooled by mobile means **COMPLETED**)
- **Upgrade of NSSS flood protection** - ensuring flood safety even in the case that plant site would be flooded **COMPLETED**



Emergency Control Room



SFDS Spray System



Flood retaining walls



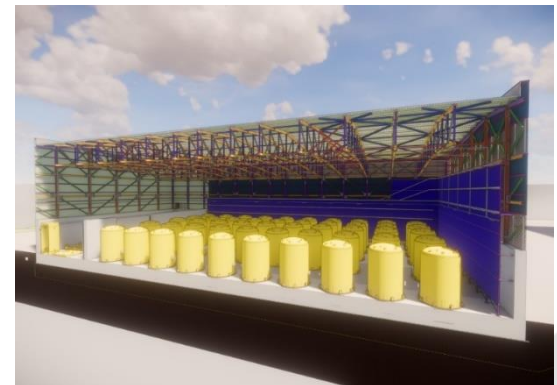
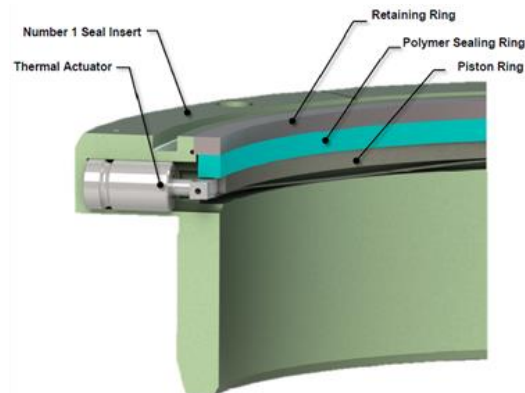


# SUP: Phase 3 (2021)

- **Upgrade of the OPC** – upgrade of the existing operation support center to assure safety atmosphere and food for all required personnel during severe accident – **COMPLETED**
- **BB2 – Bunkered Building 2 COMPLETED**
  - additional Borated and unborated water, **COMPLETED**
  - additional injection capabilities,
    - Alternative Safety Injection, **COMPLETED**
    - Alternative Auxiliary Feedwater **COMPLETED**
- **Installation of Passive Safe Shutdown RCP seals COMPLETED**
- **Spent Fuel Dry Storage - IN PROGRESS**

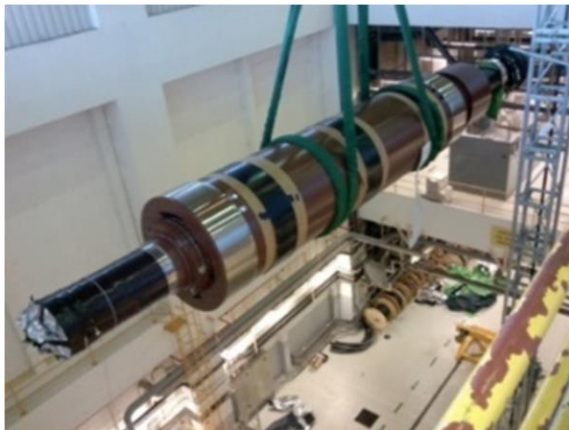
**Phase 3  
2021**

**Phase 3 2023**



# Major Equipment replacements

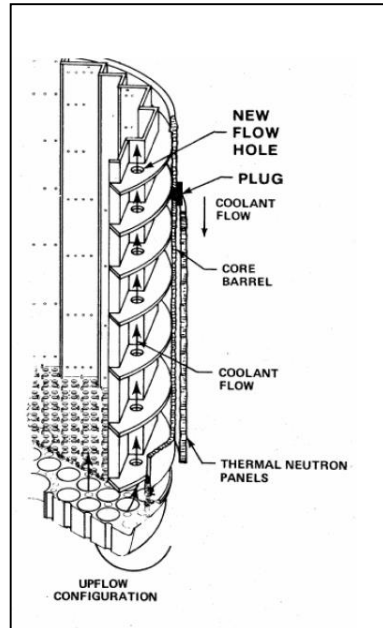
- Steam Generator Replacement & Power Uprate (2000)
- Full-Scope Simulator (2000)
- Low-pressure Turbine Replacement (2006)
- Spent Fuel Pit Re-racking (2003)
- RCP Motor Replacement (2007 in 2010)
- Secondary Heaters & MSR Replacement (2007)
- Turbine Control System Replacement (2012)
- Main Generator Stator & Rotor Replacement (2010 in 2012)
- Reactor Vessel Head Replacement (2012)
- RTD Bypass Elimination (2013)
- Main Transformers Replacement (2006 in 2013)
- Emergency AC Power – DG 3\* (2012)
- Extreme Flood Protection (2010)



# Investments for Long Term Operation (LTO)

## Major investments – cont.

- ✓ Renewal of 400 kV switchyard
- ✓ Both main transformers 500 MVA
- ✓ Reactor vessel reconstruction for flow stabilization
- ✓ 110 kV Transformer replacement



# LTO concept in NEK

- A **dedicated project team** was organized to prepare a self-assessment As preparation for external review on these areas (Pre-SALTO)
- Self-assessment performed in the following areas:

Values of the organization or. employee culture

Staffing

Training, knowledge management

Long-term planning and modification process

Equipment aging - Passive Equipment

Equipment aging - Active Equipment

Technological obsolescence

- Using the SSG-48 and SALTO Working Notes and Outlines
  - External reviewer for support
- Action plan was prepared to improve existing processes

# Implemented changes for LTO

## Action plan prepared and implemented

- **USAR changes** regarding Long term operation (Approved by SNSA)
- Organizational changes: Restructuring of previous „Engineering support department“ to „Engineering support for Long term operation“ with an additional LTO team
- Procurement of **iSTREAM** software for more efficient Aging Management
- **Upgrades** to existing **Corrective action program** to better manage aging OE
- Preparation of new **Aging management programs** for active equipment and integration in existing maintenance practices
- Formation of **LTO committee**
- Preparation of new plant management programs for:
  - Long term operation,
  - Technological obsolescence,
  - Aging management of Active components.
- Update of **Time limited aging analysis** (TLAA) – in progress
- General training on LTO for NEK personnel

# Organisational changes

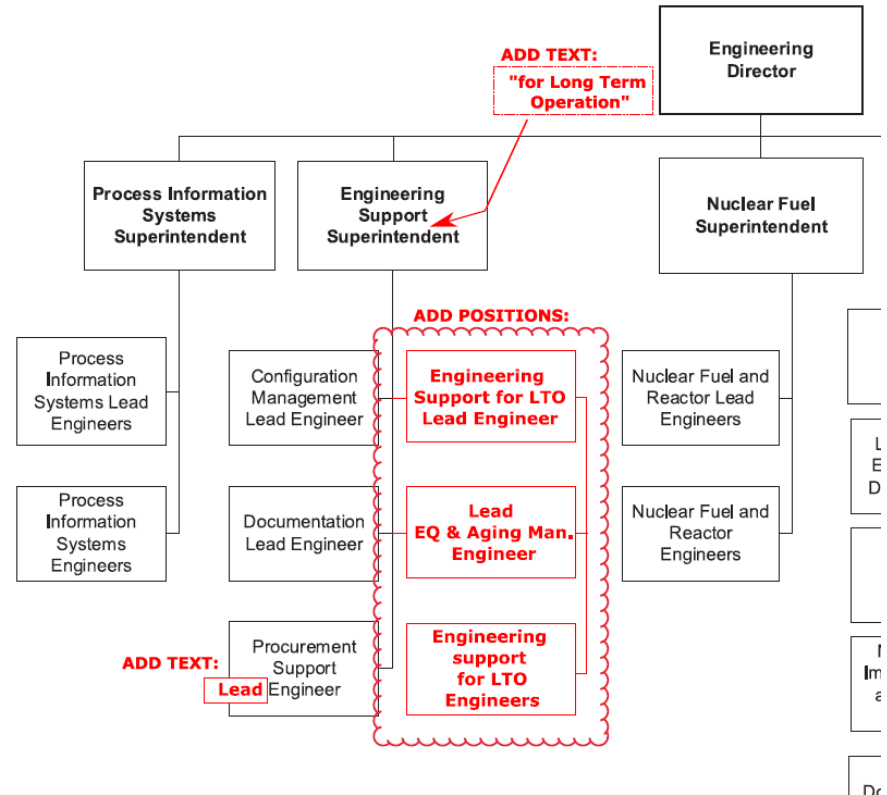
More effective aging management. LTO support is very interdisciplinary.

LTO team encompasses:

- EI&C engineer (EQ engineer)
- mechanical engineer
- civil engineer
- aging management expert
- computer engineer (Tech. Obs.)

Within the engineering support dept:

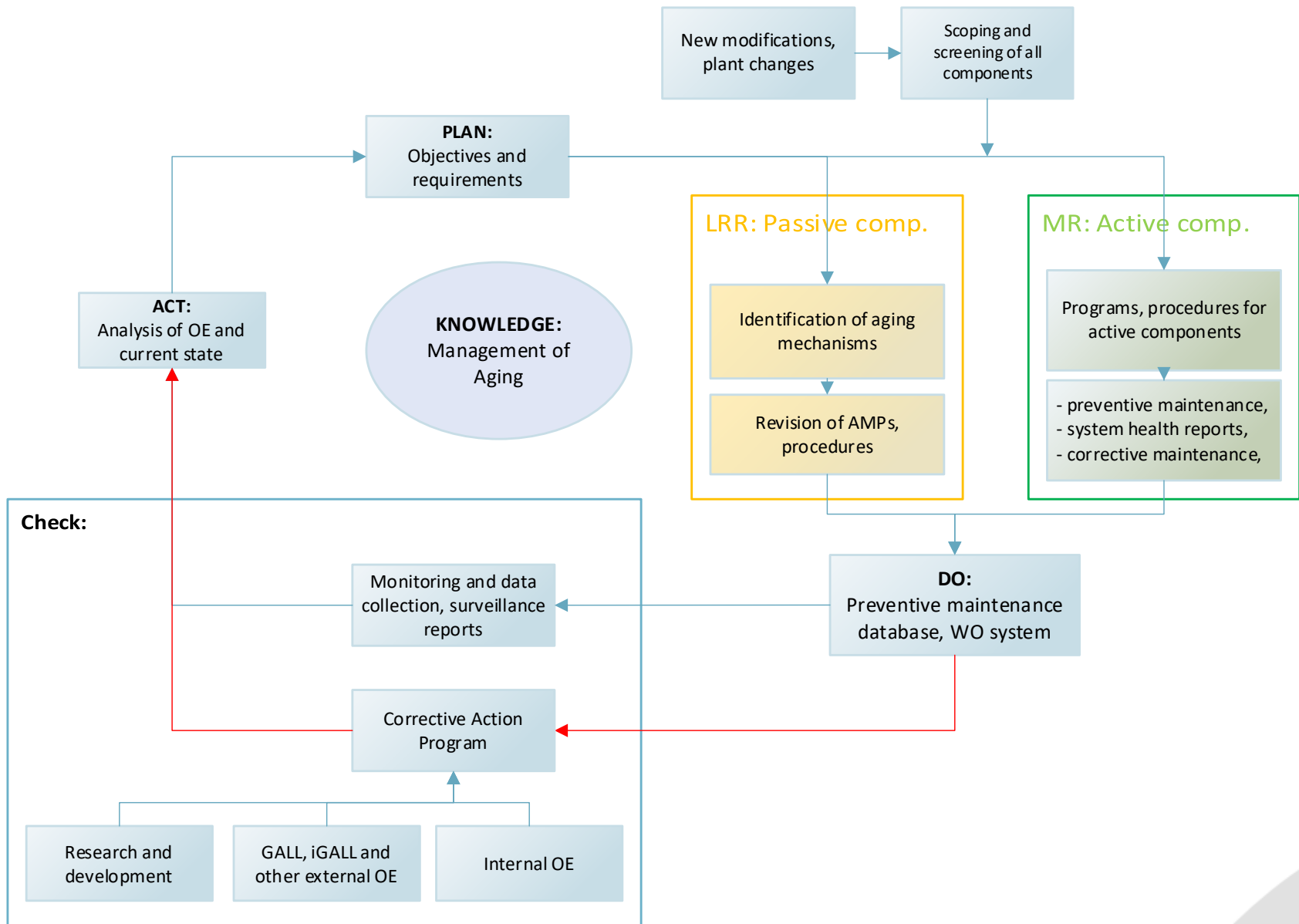
- Configuration management
- Procurement support
- Documentation
- **LTO support**



**Not owners of AM programs, this is Technical Operations – Maintenance**

- provide engineering support to maintenance, technological obsolescence,
- review OPEX: internal and international,
- support inspections, missions, prepare yearly report, analysis of events...

# Aging management process



# LTO committee

The Long-Term Operation Committee (LTO Committee) is responsible for the systematic examination of processes and projects which are required for safe and stable long term operation

The membership consists of the following:

- The President of the Management Board- chairman,
- Member of the Management Board - vice chairman,
- Technical Director,
- Engineering Director,
- Quality and Nuclear Oversight Director,
- Production Manager,
- Maintenance Manager,
- Lead System Engineer,
- Engineering Support for LTO Superintendent

Periodicity:

At least once per year, additional as need.



TOPICS:

- Long term investment plan approval,
- Yearly review of maintenance works,
- HR report and plan,
- Training and Knowledge management, report and plan,
- Other topics which may affect LTO.



## Conclusions

- NEK has been preparing and working for LTO **since first PSR in 2003**,
- Initially all **AM activities** were based on **US NRC regulation** and standards 10 CFR50.54 and NUREG 1801- GALL,
  - After self assessment of AM/LTO against SSG-48, SRS-82 – iGALL, additional changes have been implemented,
- First major milestone **achieved in 2012 with SNSA** approval of **USAR** and **Technical Specification** changes – first part LTO approval,
- **SUP implemented in 2021** (except Spent fuel dry storage - 2023),
- In addition to SUP, NPP Krško invested in almost **all major equipment replacement**,
- Organizational changes to improve AM effectiveness,
- **As part of 3rd PSR** SNSA and NEK agreed for **IAEA Pre-SALTO mission** to be implemented. **PSR action plan** will include resolution of findings from this Pre-SALTO mission.
- **EIA is being performed**. Currently cross-boundary consultation is in progress



THANK YOU,  
Any Questions?

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