Ageing Management in the Slovak Republic NPPs
Experience in NPP Bohunice

2nd Int. Symposium on NPPLiM, Shanghai, China, 15-18 Oct 2007

Ľudovít Kupča, PhD., Technical Engineering Division, SE, Bohunice NPP
Prof. Ľudovít Kupča, PhD., Diagnostic Division VUJE Inc. Trnava
## UNITS IN BOHUNICE

<table>
<thead>
<tr>
<th>UNIT</th>
<th>MWe</th>
<th>START</th>
<th>UPGRADED</th>
<th>DECOMMISSIONED</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>440 *</td>
<td>1984</td>
<td>2000-2008</td>
<td>PLiM → LTO</td>
</tr>
<tr>
<td>4</td>
<td>440 *</td>
<td>1985</td>
<td>2000-2008</td>
<td>PLiM → LTO</td>
</tr>
</tbody>
</table>

* UP TO 486 (NEW TYPE OF FUEL, HARDWARE MODIFICATIONS)
AGEING MANAGEMENT - OBJECTIVES

DEFINE AM RULES & PROCEDURES IN ORDER TO MANAGE TECHNICAL LIFETIME OF ALL SELECTED SSCs AND THUS ENSURE THEIR FULL CAPABILITY WITHIN PLANT LTO

...TO BE CONTINUED...
AGEING MANAGEMENT - OBJECTIVES (2)

...FOCUSING MAINLY ON:

- THE AM LIST OF SSCs AND ITS REGULAR UPDATE
- IDENTIFICATION & REPORTING OF PREDOMINANT DEGRADATION PROCESSES AND FURTHER ISSUES WHICH HAVE ANYTHING TO DO WITH NEGATIVE IMPACT ON TECHNICAL LIFETIME OF SELECTED SSCs,
...FOCUSING MAINLY ON:

- OPTIMIZATION OF SYSTEMS PROVIDE MONITORING OF PREDOMINANT DEGRADATION PROCESSES AND THEIR INFLUENCE ON AGEING OF SSCs,

- DATA SPECIFICATIONS & RECORDING,
AGEING MANAGEMENT
- OBJECTIVES (4)

...FOCUSBING MAINLY ON:

- DEVELOPING & UPDATE OF AMP FOR EACH SELECTED SSC (OR ITS GROUP REPRESENTATIVE) CONSIDERING TRENDS, ALTERATIONS / MODIFICATIONS AND REGULATORY REQUIREMENTS WITH RESPECT TO LEGAL / PROCEDURAL MANAGEMENT / NEW OBSERVATIONS / LESSONS LEARNED BY CONTINUOUS STUDY OF DEGRADATION OF A SSC.
AGEING MANAGEMENT - OBJECTIVES (5)

...FOCUSING MAINLY ON:

- EVALUATION OF EACH PARTICULAR AMP / APPROPRIATE & EFFECTIVE ACTIONS TO ELIMINATE / MITIGATE DEGRADATION PROCESSES AND / OR THEIR INFLUENCE ON AGEING OF SSC.
AGEING MANAGEMENT – BASIC PRINCIPLE

GOAL-DIRECTED MANAGEMENT OF OPERATION /
MAINTENANCE & MODIFICATIONS TO ENSURE SAFE
PERFORMANCE OF ALL SELECTED SSCs WITH PREDETERMINED
SAFETY MARGINS WITHIN LTO (60 YEARS) UTILIZING
RESOURCES REASONABLY & EFFECTIVELY.
MAIN PRINCIPLES

• THE UNIT LIFE MUST BE MANAGED WITHIN SUSTAINMENT OF LONGTERM INTEGRITY OF HARDLY-/NON-REPLACEABLE SSCs.

• MANAGE PROGRAMMES / OPERATING CONDITIONS TO KEEP REMAINING LIFETIME OF EACH SSC UNDER SAFETY MARGIN LIMIT *

* THE SAFETY MARGIN IS DERIVED FROM AND DEFINED BY ACCEPTANCE CRITERIA BASE.
MAIN GOALS

- NPP = RELIABLE & SAFE OPERATION,
- NO-FAILURE OPERATION OF EACH SSC IN RELATION TO
  - MINIMIZATION OF ELECTRICITY PRODUCTION UNPLANNED FAILURE,
  - MAINTENANCE & REFURBISMENT EFFICIENCY OF SSCs:
- TOP ELECTRICITY PRODUCTION COSTS EFFICIENCY,
- SET CONDITIONS FOR LTO (60y)
SELECTED SSCs, LISTED IN THE 6-ZOZ-056, ARE DIVIDED INTO LISTS OF

- **MECHANICAL** SSCs,
- **ELECTRICAL** AND **I&C** SSCs,
- **STRUCTURAL** SSCs.
**AGEING MANAGEMENT**

**Responsible:** Tech Support

**LIST of SSCs for AM (PLiM)**

**R:** TechSupport

**Identification of DEGRADATION MECHANISMS,** specifying methods and periodicity on monitoring of SSC’s real (current / actual) condition.

**Responsible:** TechSupport, C-R: PlantAdmin

**DATABASE ON REAL CONDITION OF SSCs**

**Responsible:** TechSupport  
**C-R:** Operator, Maintenance Division., Inspection & Metrology Department, PlantAdmin

### AMPs

**Responsible:** TechSupport

**Report on AMPs**

**Responsible:** TechSupport

**Condition of SSC**

**NON-SATISFACTORY**

**SATISFACTORY**

**Alteration of AMPs**

**YES**

**Optimized AM**

**Proposal on alteration of AMPs**

**Responsible:** TechSupport

**Implementation into operating procedures, operator / maintenance / modification / ISI programs / AMPs.**

**Responsible:** PlantAdmin  
**C-R:** Operator, Maintenance, TechSupp

**Evaluation of chemical regimes and their optimization in accordance with OP-08 rule.**

**Responsible:** Operator

**Initial & operational ISI performance / data records of SSCs listed in List of SSCs for AM in accordance with MN-14 rule.**

**Responsible:** Maintenance Division

**Records on expertises, testing, inspections of SSCs listed in List of SSCs for AM in accordance with SE/SM-029.03 rule.**

**R:** Inspection & Metrology Department

**Maintenance data records - refurbishment, reconstruction, modifications of SSCs listed in List of SSCs for AM.**

**Responsible:** PlantAdmin, C-R: Maintenance

**SSC’s replacement / refitting.**

**R:** PlantAdmin

**Proposal on SSC’s replacement / refitting.**

**R:** TechSupport  
**C-R:** PlantAdmin

**Proposal on process of elimination.**

**R:** TechSupp  
**C-R:** Operator, Maintenance

**SSC’s lifetime exhaust**
AM DATABASE

• DESIGNED FOR ITS ADMINISTRATION AND MANAGEMENT BY IMPLICITLY ESTABLISHED ‘AM TEAM’

• DATA RECORDING / PROCESSING / ADMINISTRATION / PRESENTATION
THE DATABASE FEATURES

- SQL DATABASE (ORACLE)
- INDEPENDENT SYSTEM & MODULES
- ARCHIVING OF ALL DATA STORED
- SHEET / GRAPHICS ENVIRONMENT / INTERFACE
- HIGH LEVEL OF DATA PROTECTION
- SOPHISTICATED SYSTEM OF USER GROUPS & ACCESS RIGHTS
- OPEN / DYNAMIC SYSTEM
- COMPATIBLE WITH OTHER APPLICATIONS
DEVELOPED MODULES

- VESSELS + ACTIVE COMPONENTS (RCPs)
- REACTOR COOLANT MAIN PIPELINE
- CABLING
- EROSION-CORROSION (SG-TG carbon steel pipelines)
- EQUIPMENT QUALIFICATION
- SEISMICITY
- SERVICE WATER
ANNUAL AM EVALUATION - 'AM EVALUATING REPORT'

- EVALUATION OF EACH PARTICULAR AMP,
- PROPOSAL OF ARRANGEMENT ON ELIMINATION / MITIGATION OF DEGRADATION,
- EVALUATION OF TAKEN ACTIONS EFFICIENCY.
EVALUATION OF AM PROCESS:

- DOCUMENTATION and THE LIST OF SELECTED SSCs MUST BE RELEVANT AND COMPLETE,

- SELECTION OF DATA WITH THE IMPACT ON AGEING / DEGRADATION AND DATA IDENTIFYING SSC's LIFETIME CONDITION,
AM EVALUATION AFTER 10y (2)

- IDENTIFYING OF SSC's DETERMINING (PREDOMINANT) DEGRADATION MECHANISMS, ACTUAL SAFETY MARGIN OF EACH SSC etc.
- RESULTS ON MONITORING OF SSC's TECHNICAL LIFETIME,
- RESULTS ON MONITORING OF AMPs EFFICIENCY,
- ACCEPTANCE CRITERIA, ACTUAL AND REQUIRED SAFETY MARGINS, POSSIBILITIES OF MITIGATING DEGRADATION CONSEQUENCES.
ONGOING AMPS (1)

- RPV SURVEILLANCE SPECIMEN PROGRAMME
- LIFETIME EVALUATION OF MAIN SSCs HOT SPOTS (LOW CYCLE FATIGUE)
- CORROSION LOOP (SURVEILLANCE SPECIMEN PROGRAMME)
- EROSION-CORROSION MONITORING PROGRAMME
- AMP OF PLANT SAFETY IMPORTANT CABLING
ONGOING AMPS (2)

- SUPPORTING ANALYSES:
  - IMPACT OF NPP LONGTERM OPERATION ON SG TUBE MATERIAL DEGRADATION,
  - SG's PRIMARY COLLECTOR BOLTS - MATERIAL ANALYSES
Effective Ageing Management

PLAN
2. Co-ordination of SSC ageing management programme

Co-ordinating ageing management activities:
• Document regulatory requirements and safety criteria
• Document relevant activities
• Describe co-ordination mechanism
• Optimize AMP based on current understanding, self-assessment and peer reviews

1. Understanding SSC ageing
The key to effective ageing management:
• Materials and material properties
• Stressors and operating conditions
• Ageing mechanisms
• Degradation sites
• Condition indicators
• Consequences of ageing degradation and failures

DO
3. SSC operation/use
Managing ageing mechanisms:
• Operation according to procedures and technical specifications
• Chemistry control
• Environment control
• Operating history, including transient records

CHECK
4. SSC inspection, monitoring and assessments
Detecting and assessing ageing effects:
• Test and calibration
• In-service inspection
• Surveillance
• Leak detection
• Assessment of functional capability / fitness for service
• Record keeping

ACT
5. SSC maintenance
Managing ageing effects:
• Preventive maintenance
• Corrective maintenance
• Spare parts management
• Replacement
• Maintenance history

Improve AMP effectiveness

Minimize expected degradation

Correct unacceptable degradation

Check for degradation
IAEA proposal on SSCs clustering for AM

- SSCs important to PLANT LIFE
- SSCs important to SAFETY
- All other plant SSCs
- SSCs important to SAFETY for AM STUDIES

All plant SSCs
Thanks for your attention