REVIEW AND DEVELOPMENT OF AGING MANAGEMENT PROGRAMS OF THE MAIN COMPONENTS AT PAKS NPP

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Contents

INTRODUCTION

AMP Development

- Extension of operational lifetime of Paks NPP
- Renewal of operational license
- Safety and good plant condition!
- Systematic review of AMPs
- AMP review of main components

Passive and long-lived system components

Regulator guide 4.14

Passive components

Fulfilling their safety functions appointed in the final safety analysis report without moving parts and without changing their properties or states

Long-live components

Design does not contain their substitution in shorter duration than the designed lifetime of the installation due to the expiration of their qualified lifetime or to other specific duration.

Main components

Selected components

- Reactor vessels
- Steam generators
- Pressurizers
- Primary circuit piping
- Branch pipes of the primary circuit
- RPV Internals
- Primary circulating pumps
- Primary circuit gate valves

AMP review stages (Based on NRC's 10 attributes)

1. Identification of potential degradation mechanisms
2. Preventive or mitigating actions
3. Parameters to be controlled
4. Detection of specified aging effects
5. AMP related Monitoring and Trending
6. Acceptance Criteria
7. Corrective actions
8. Confirmation process
9. Administrative control
10. Operational experience

1. Identification of potential degradation mechanism

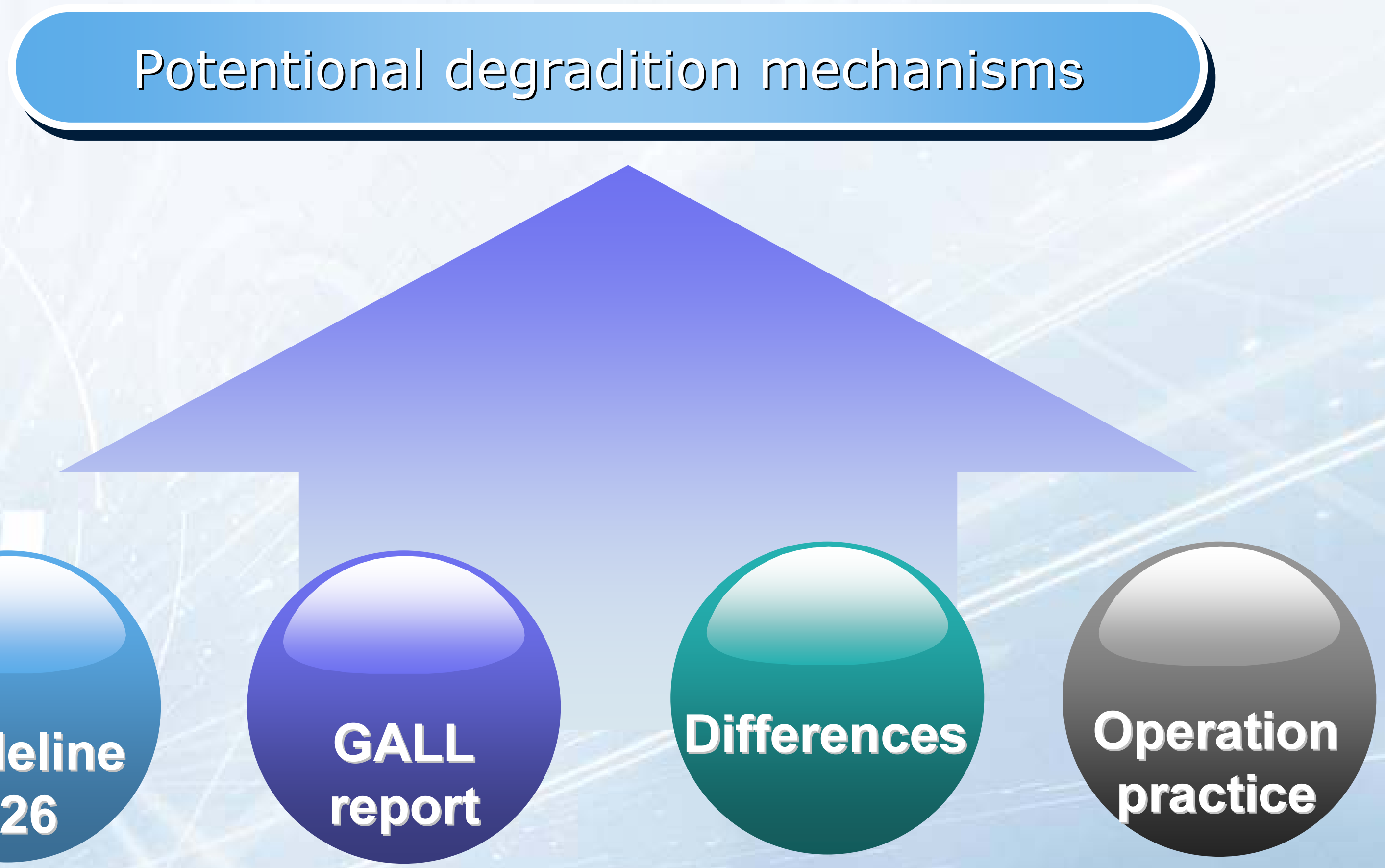
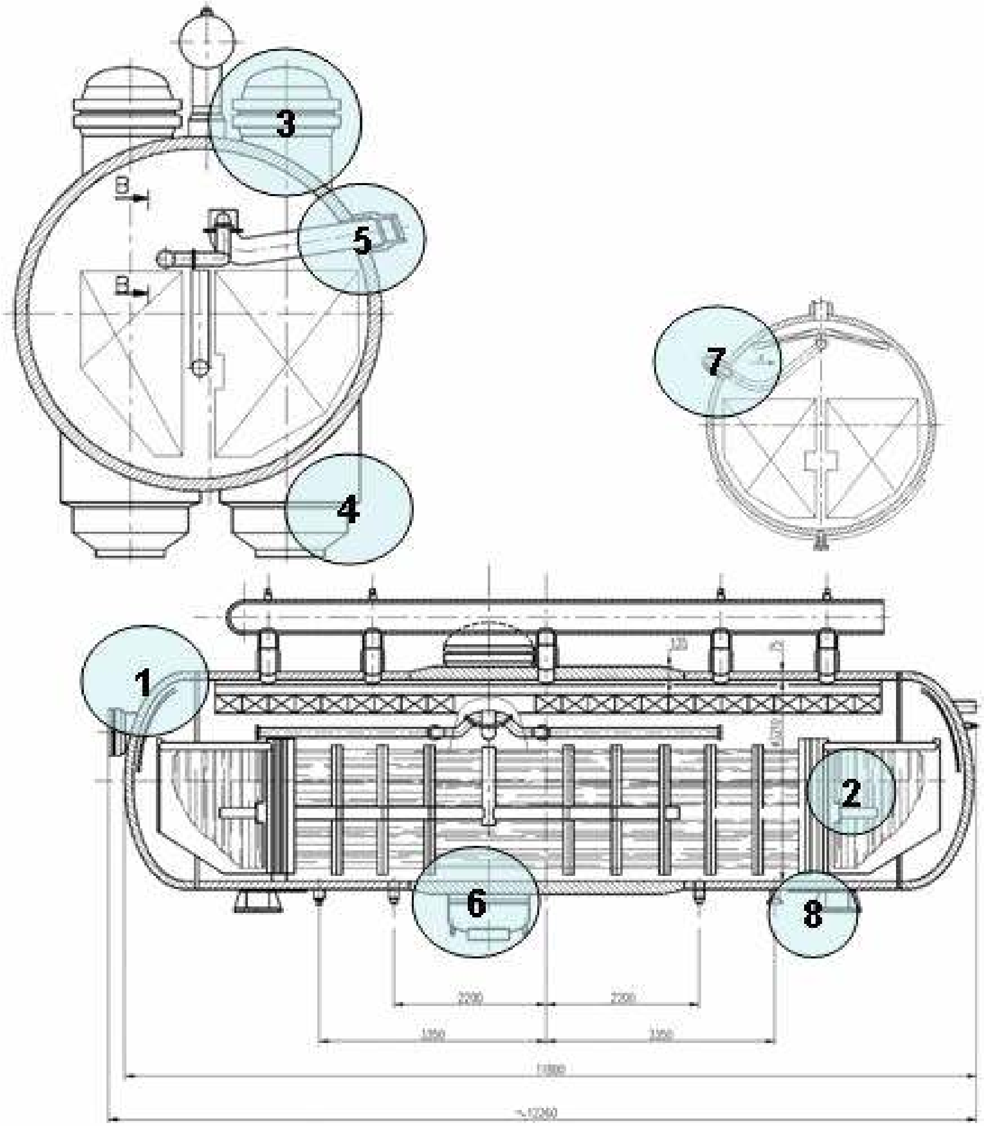


Table of potential degradation mechs of main VVER comps

	Low Cycle Fatigue	Radiation Embrittlement	Thermal Embrittlement	SC Cracking	Stress Corrosion Irradiation Assisted	Corrosion in Boric Acid Environment	Erosion-Corrosion	Swelling	General Corrosion	High Cycle Fatigue	Change of Properties	Stratification
Reactor vessels	■	■	■	■		■			■		■	
RPV Internals	■	■	■	■	■			■		■	■	
Pressurizers	■		■	■		■	■		■		■	■
Steam generators	■		■	■			■		■	■	■	
Primary circulating pumps	■		■	■		■	■		■	■		
Primary circuit gate valves	■		■	■		■	■		■		■	
Primary circuit piping	■		■	■		■	■		■			■
Branch pipes of the primary circuit	■		■	■		■	■		■			■

Critical locations of the VVER steam generators



Example: Critical locations of possible degradation mechanisms in the VVER steam generators

	CRITICAL LOCATIONS	POSSIBLE DEGRADATION MECHANISMS					
		WEAR	GENERAL CORROSION / LOCAL CORROSION	FATIGUE	THERMAL AGING/CHANGE OF PROPERTIES	EROSION-CORROSION	STRESS RELAXATION
1	SG WALL/WELDS/NOZZLES		+	+	+	+	
2	HEAT EXCHANGER TUBES		+	+	+	+	
3	THREADED JOINTS OF THE PRIMARY COLLECTORS AND OTHER BOLTED CONNECTIONS	+	+	+			+
4	PRIMARY COLLECTORS, WELDS		+	+		+	
5	FEED WATER INLET NOZZLE		+	+		+	
6	SG/PRIMARY PIPING CONNECTION		+	+			
7	EMERGENCY FEED WATER INLET NOZZLE		+	+			
8	DIRECTLY CONNECTED SUPPORT ATTACHMENTS		+				

2. Identification of preventive or mitigating actions

1

Corrosion mitigation:

Properly adjusted primary / secondary circuit water chemistry parameters

2

Prevention boric acid corrosion of outer surfaces:

Leak detection system: YC

3

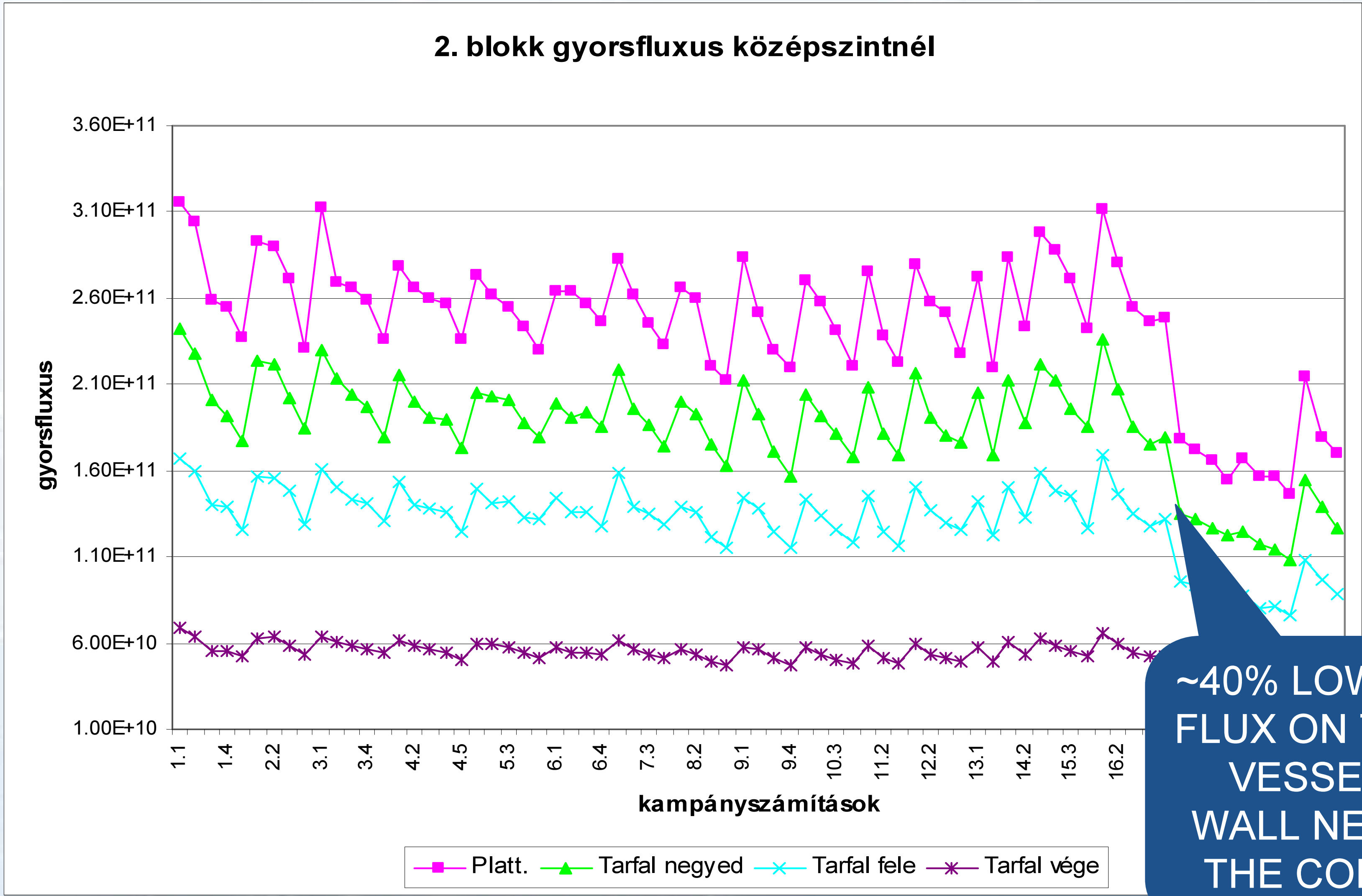
Mitigation of RPV wall radiation embrittlement:

Low leakage core arrengement

Tube plugging data of the Paks NPP steam generators

UNIT	1.SG	2.SG	3.SG	4.SG	5.SG	6.SG	TOTAL
1.	24	37	3	10	3	2	**79** **0,23 %**
2.	61	166	195	174	69	99	**764** **2,27 %**
3.	104	42	42	36	95	26	**345** **1,02 %**
4.	22	44	29	29	58	12	**194** **0,57 %**

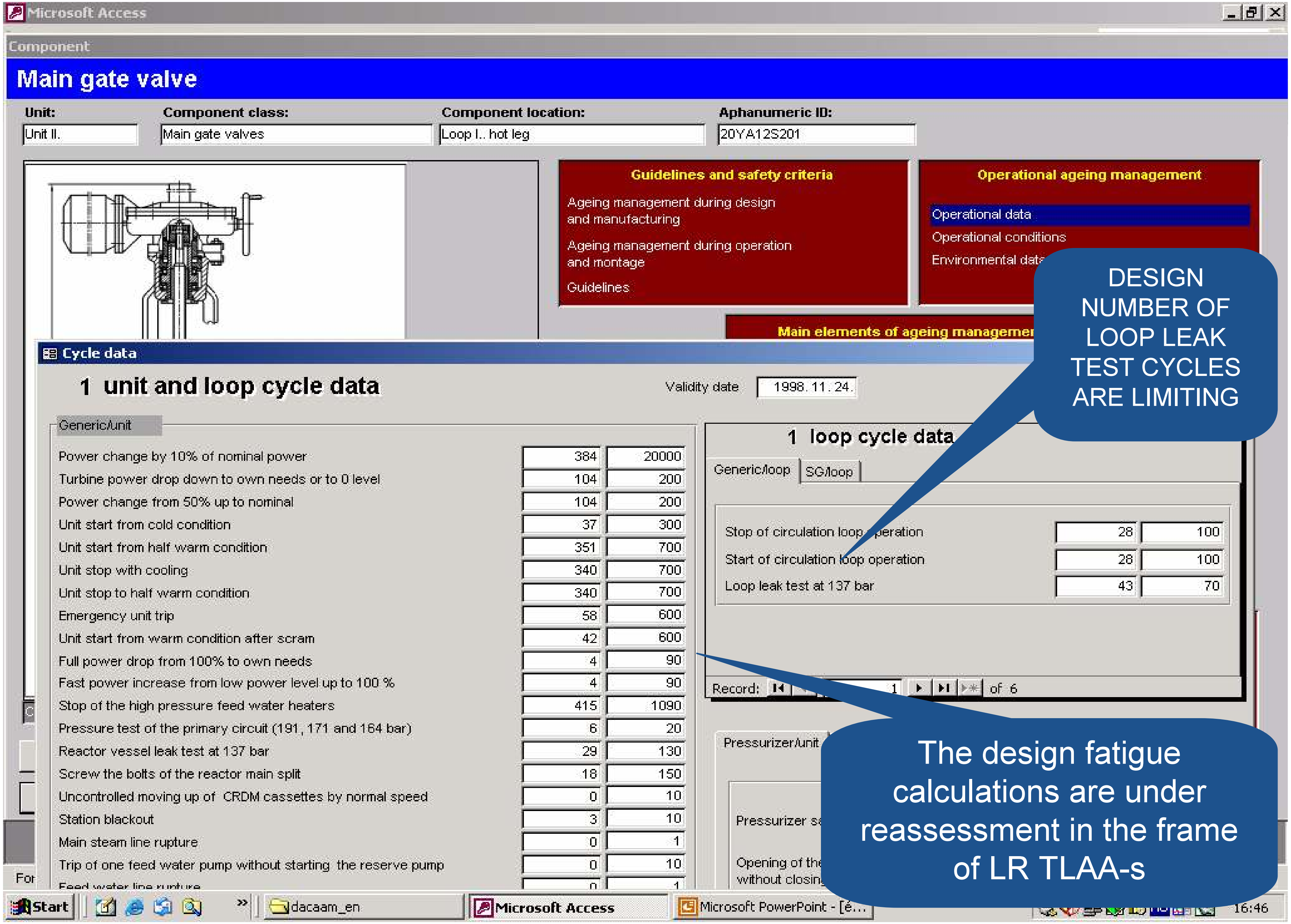
Low leakage core arrangement



~40% LOWER FLUX ON THE VESSEL WALL NEAR THE CORE

3. Identification of parameters to be controlled

1. **Fatigue and thermal aging**
2. **Corrosion processes**
3. **Radiation embrittlement**
4. **Cavity dosimetry**


Microsoft Access
Component
Main gate valve
Unit: Unit II.
Component class: Main gate valves
Component location: Loop I.. hot leg
Aphanumeric ID: 20YA12S201
Guidelines and safety criteria
Ageing management during design and manufacturing
Ageing management during operation and montage
Guidelines
Operational ageing management
Operational data
Operational conditions
Environmental data
Main elements of ageing managemen
Cycle data
1 unit and loop cycle data
Validity date 1998. 11. 24.
Generic/unit
Power change by 10% of nominal power 384 20000
Turbine power drop down to own needs or to 0 level 104 200
Power change from 50% up to nominal 104 200
Unit start from cold condition 37 300
Unit start from half warm condition 351 700
Unit stop with cooling 340 700
Unit stop to half warm condition 340 700
Emergency unit trip 58 600
Unit start from warm condition after scram 42 600
Full power drop from 100% to own needs 4 90
Fast power increase from low power level up to 100 % 4 90
Stop of the high pressure feed water heaters 415 1090
Pressure test of the primary circuit (191, 171 and 164 bar) 6 20
Reactor vessel leak test at 137 bar 29 130
Screw the bolts of the reactor main split 18 150
Uncontrolled moving up of CRDM cassettes by normal speed 0 10
Station blackout 3 10
Main steam line rupture 0 1
Trip of one feed water pump without starting the reserve pump 0 10
1 loop cycle data
Generic/loop
SG/loop
Stop of circulation loop operation 28 100
Start of circulation loop operation 28 100
Loop leak test at 137 bar 43 70
Record: 1 of 6
Pressurizer/unit
DESIGN NUMBER OF LOOP LEAK TEST CYCLES ARE LIMITING
The design fatigue calculations are under reassessment in the frame of LR TLAA-s
Start
dacaam_en
Microsoft Access
Microsoft PowerPoint - [é...
16:46

4. Detection of specified aging effects

1

Fatigue, all forms of stress corrosion and several types of local corrosion:

Crack initiation and crack propagation

2

Thermal and radiation emrittlement:

Loss of fracture toughness

3

Boric acid corrosion, general corrosion, wear and erosion/corrosion:

General or local loss of material

These aging effects in the majority of cases were found detectable using following NPP Paks current programs

NPP Paks current programs

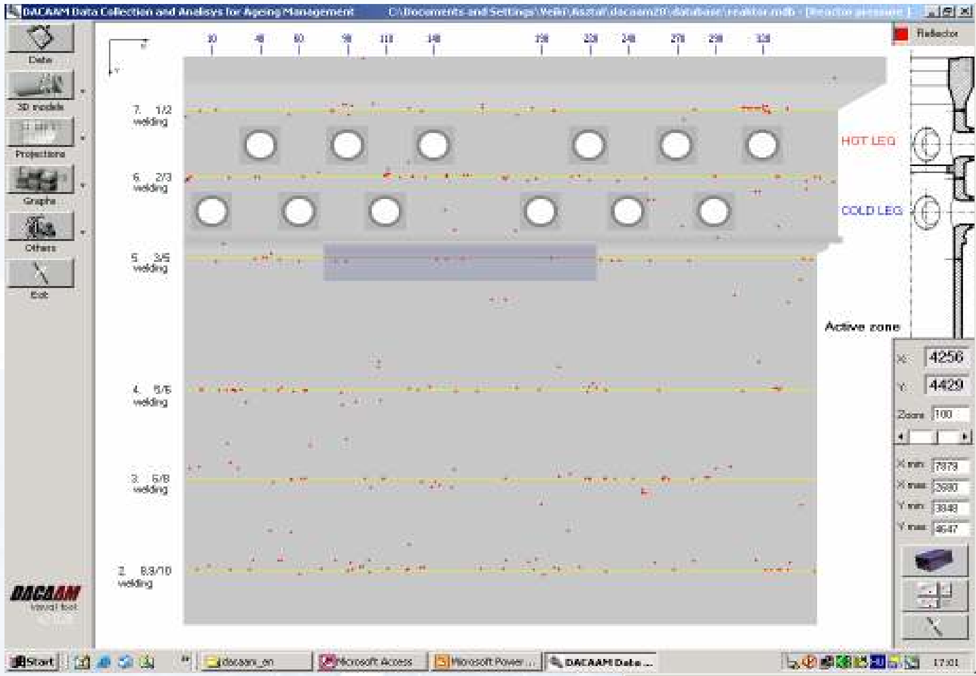
- In-service Inspection Programs, Periodic Condition Monitoring Programs
- Visual inspections in the frame of Maintenance Programs
- Pressure tests
- Special one time inspection programs
- RPV material Surveillance program
- Walk down programs of the operational personal

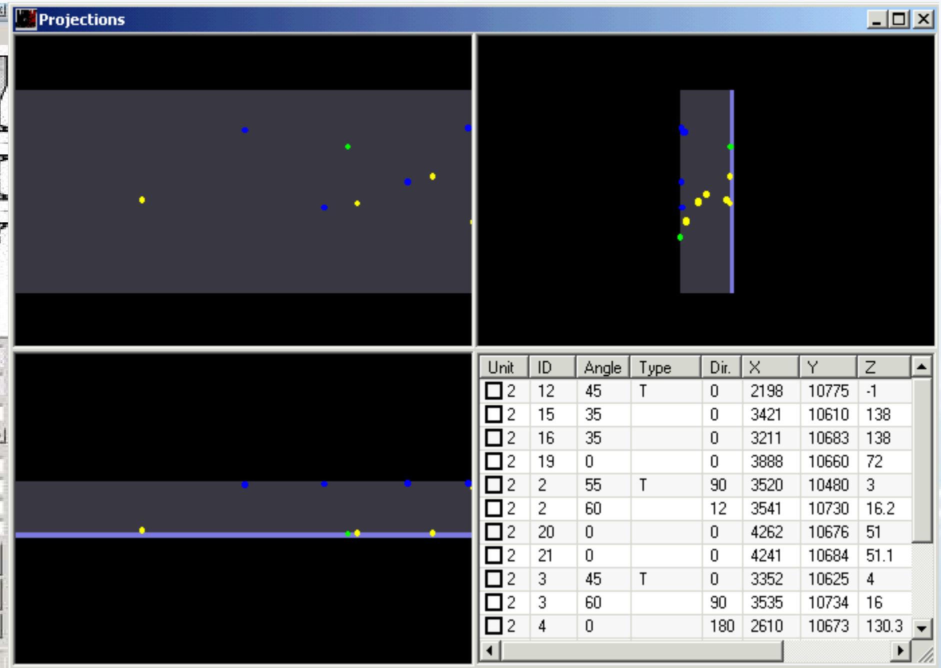
5. AMP related monitoring and trending(examples)

Monitoring and trending

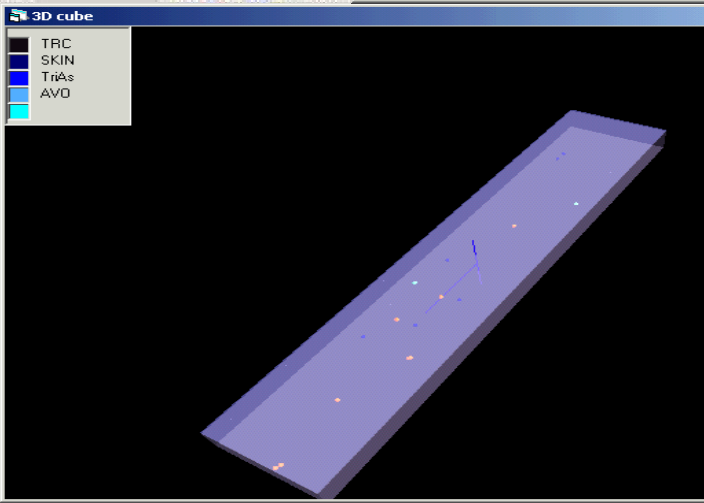
- Surface corrosion
- Boric acid corrosion
- Fatigue and for other type of crack propagation
- Local effects related degradation forms, like SCC
- Steam generator ODSCC
- Degradations with loss of material
- Radiation emrittlement

Monitoring the detected indications of the RPV (DACAAM database)

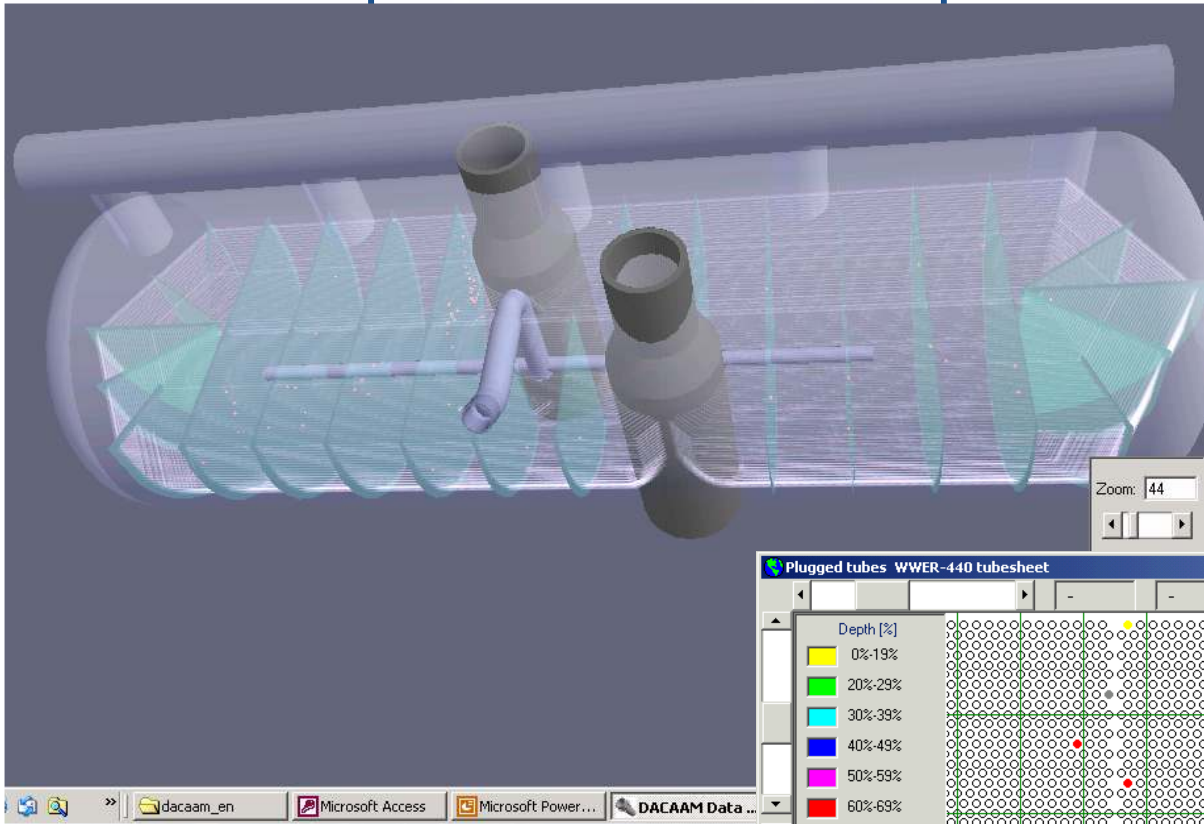


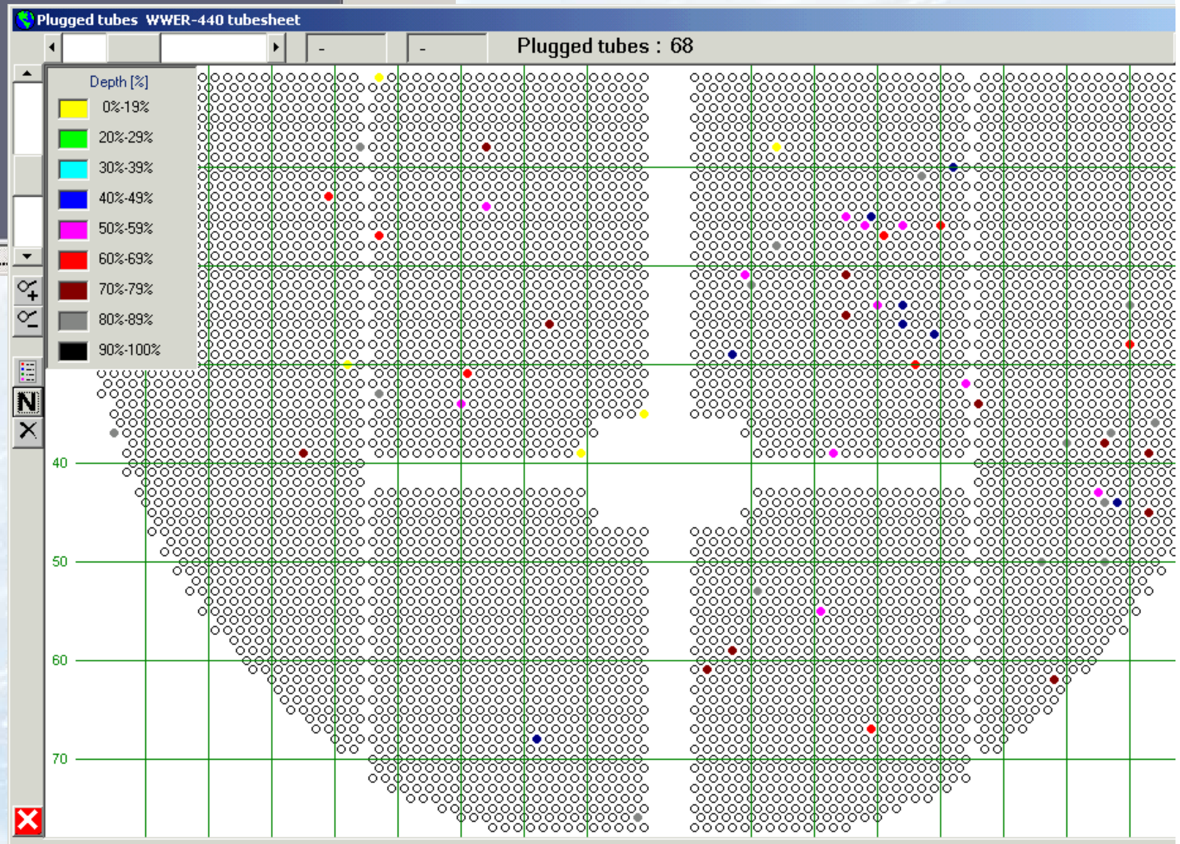


Unit	ID	Angle	Type	Dir.	X	Y	Z
2	12	45	T	0	2198	10775	-1
2	15	35		0	3421	10610	138
2	16	35		0	3211	10683	138
2	19	0		0	3888	10660	72
2	2	55	T	90	3520	10480	3
2	2	60		12	3541	10730	16.2
2	20	0		0	4262	10676	51
2	21	0		0	4241	10684	51.1
2	3	45	T	0	3352	10625	4
2	3	60		90	3535	10734	16
2	4	0		180	2610	10673	130.3



Monitoring of SG tube degradation (DACAAM database)





6. AMP related acceptance criteria

1. Criteria catalog of the ISI programs
2. Periodic material condition inspection programs and maintenance programs
3. Criteria for primary/ secondary water chemistry parameters
4. Criteria from TLAA computations

7-9. AMP related confirmation process, corrective actions and administrative control

1

A new complex AMP procedure was compiled.

2

A new central AMP division was recently organized.

10. AMP related operational experience

1. All available PWR/VVER age related operating experience
2. IAEA IRS, WANO and NRC LER
3. Current AMP programs, certain possible critical locations
4. Collecting age related operational experience

CONCLUSION

Recommended Modifications

- One time inspection programs
- Cavity dosimetry
- Additional temperature monitoring and fatigue calculations
- Modification of several internal procedures

Thank You !