

Comparison of Scandinavian recommendations for water chemistry of drum boilers

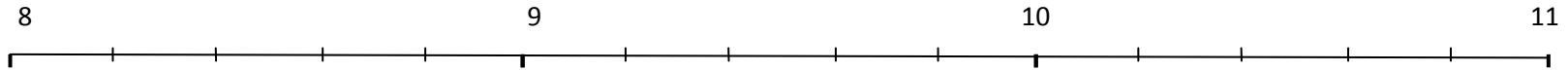
SIAPWS General meeting
Copenhagen 10 March 2011
Karol Daucik

Comparison of Scandinavian Guidelines for drum boilers

	Denmark	Finland	Sweden
Feedwater			
Ammonia	1	1	1
Amines			2
Scavengers		1	
Boiler water			
Phosphate		1	1
Caustic	1		3
AVT	2		2

		Comparison of Action Level systems								
DK		Action level 3	AL2	1	Optimum	1	2	AL 3		
SE		Action level 3	2	1	Optimum		1	2	AL 3	
SF		Normal operation					AL 3			

Boiler Water pH solid alkalizer



DK	P (MPa)	Boiler Water pH Caustic treatment							
	< 2	Action level 3	Action level 2		AL1	Optimum	AL1	2	Action level 3
	2 – 8	Action level 3	AL2	AL1	Optimum		AL1	AL2	Action level 3
	> 8	Action level 3	AL2	AL1	Optimum	AL1	AL2	Action level 3	

SE	P (MPa)	Boiler Water pH Caustic treatment and Phosphate treatment								
VGB	< 4	Action level 3	Action level 2	AL1		Optimum		AL1	2	AL 3
	4 – 10	Action level 3	AL2	AL1		Optimum		1	AL2	AL 3
	10-16	Action level 3	AL2	AL1	Opt	AL1	AL2	Action level 3		

SF	P (MPa)	Boiler Water pH Phosphate treatment			
Fortum				Normal	
DENÅ	2,4	Normal			
	3,5			Normal	
	9			Normal	
	16		Normal		

EPRI	P(MPa)	HRSG	Boiler Water pH		Phosphate treatment L		
	4	Action level 3	Normal		AL1	AL2	Action level 3
	8	Action level 3	Normal		AL1	AL2	Action level 3
	10	Action level 3	Normal		AL1	AL2	Action level 3
	16	Action level 3	Normal	AL1	AL2	Action level 3	

Feedwater pH AVT

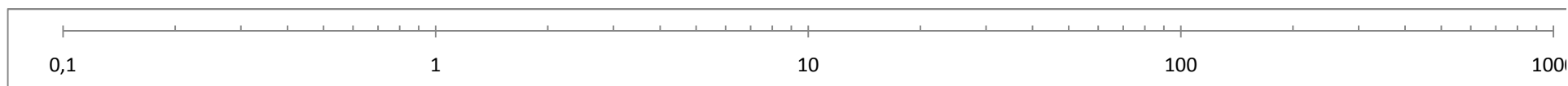


SE	Metal	Feedwater pH AVT							
Cu		AL 2	AL1		Optimum	AL1	AL2		
Fe		AL2	AL1			Optimum		1	AL2

VGB	Metal	Feedwater pH AVT								
	Cu	AL 3	AL 2	AL1		Opt.	1	2	AL 3	
	Fe	Action level 3		AL2	AL1	Optimum		1	AL2	AL 3

DK	P (MPa)	Feedwater pH AVT								
	All	Action level 3					2	1	Optimum	AL2

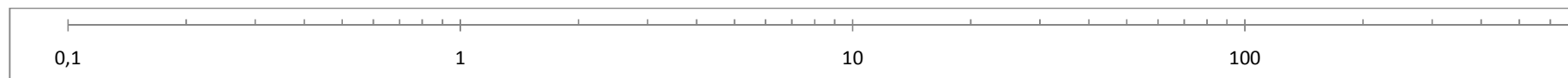
Boiler Water Specific Conductivity Solid alkalizer



	P (MPa)	Boiler Water Specific Conductivity ($\mu\text{S}/\text{cm}$)		Phosphate treatment		
SE +	< 4		Optimum	AL1	AL2	AL3
+VGB	4 – 10		Optimum	AL1	AL2	AL3
SE VGB	> 10		Optimum	AL1	AL2	AL3
SF	< 6,2	Normal operation				
DENÅ	< 8,4	Normal operation				
	< 11	Normal operation				

	P (MPa)	Boiler Water Specific Conductivity ($\mu\text{S}/\text{cm}$)		Caustic treatment		
DK	< 2	Action level 3	AL2	AL1	Optimum	1 2 AL3
	2 – 8	Action level 3	AL2 AL1	Optimum	1 2	AL3
	> 8	Action level 3	AL2 AL1	Optimum	1 2	AL3
SE +	< 4	Action level 3	AL2 AL1		Optimum	AL1 AL2 AL3
+VGB	4 – 10	Action level 3	AL2 AL1		Optimum	1 AL2 AL3
SE VGB	> 10	Action level 3	AL2 AL1	Opt	AL1 AL2	AL3

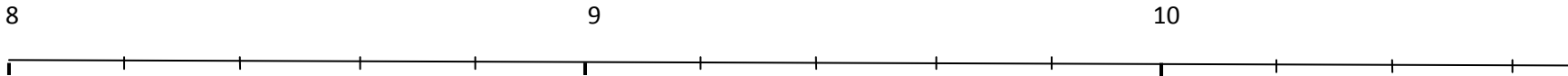
Boiler Water Acid Conductivity AVT and Caustic Treatment



	P (MPa)	Boiler Water	Acid conductivity (μS/cm)	Caustic treatment		
DK	< 2	Optimum	1	2	AL 3	
	2 – 8	Optimum	1	2	AL 3	
	> 8	Optimum	1	2	AL 3	
SE+	< 4	Optimum		AL1	AL2	AL 3
VGB	4 – 10	Optimum		AL1	AL2	AL 3
	> 10	Optimum		AL1	AL2	AL 3

	P (MPa)	Boiler Water	Acid conductivity (μS/cm)	AVT		
DK	< 2	Optimum	AL1	AL2	AL 3	
	2 – 8	Optimum	AL1	AL2	AL 3	
	> 8	Optimum	AL1	AL2	AL 3	
SE	< 8	Optimum	AL1	AL2	AL 3	
VGB	8 – 16	Optimum	AL1	AL2	AL 3	
	> 16	Optimum	AL1	AL2	AL 3	

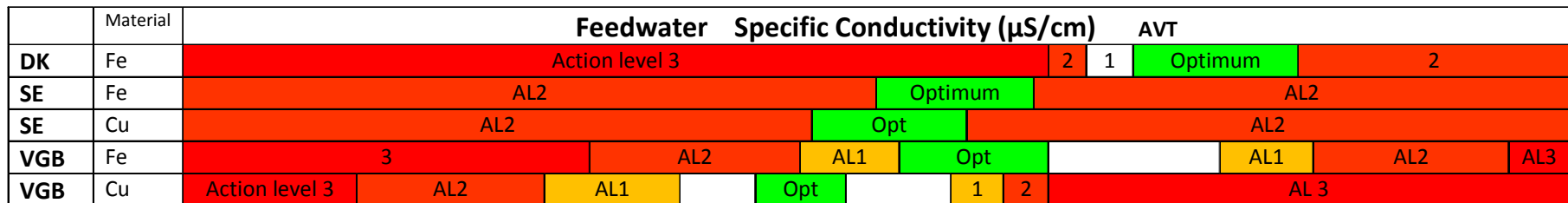
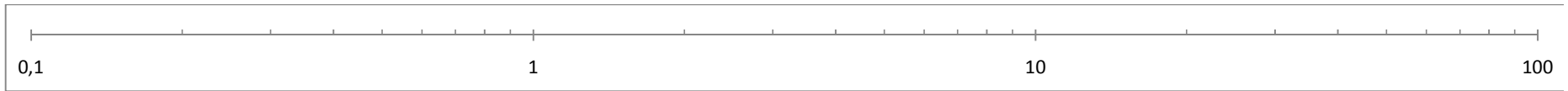
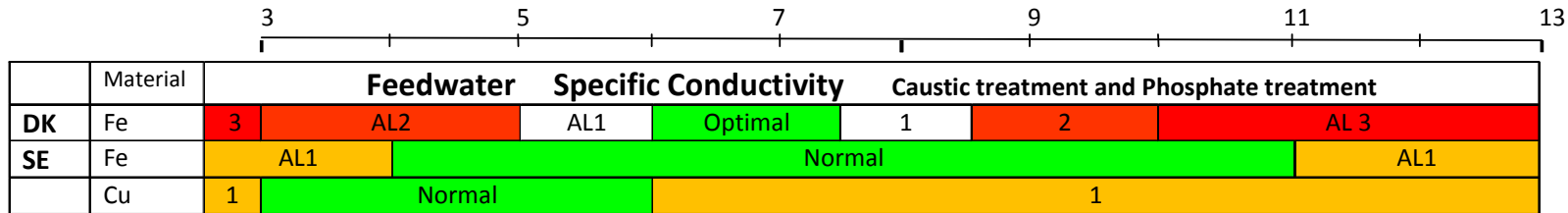
Feedwater pH



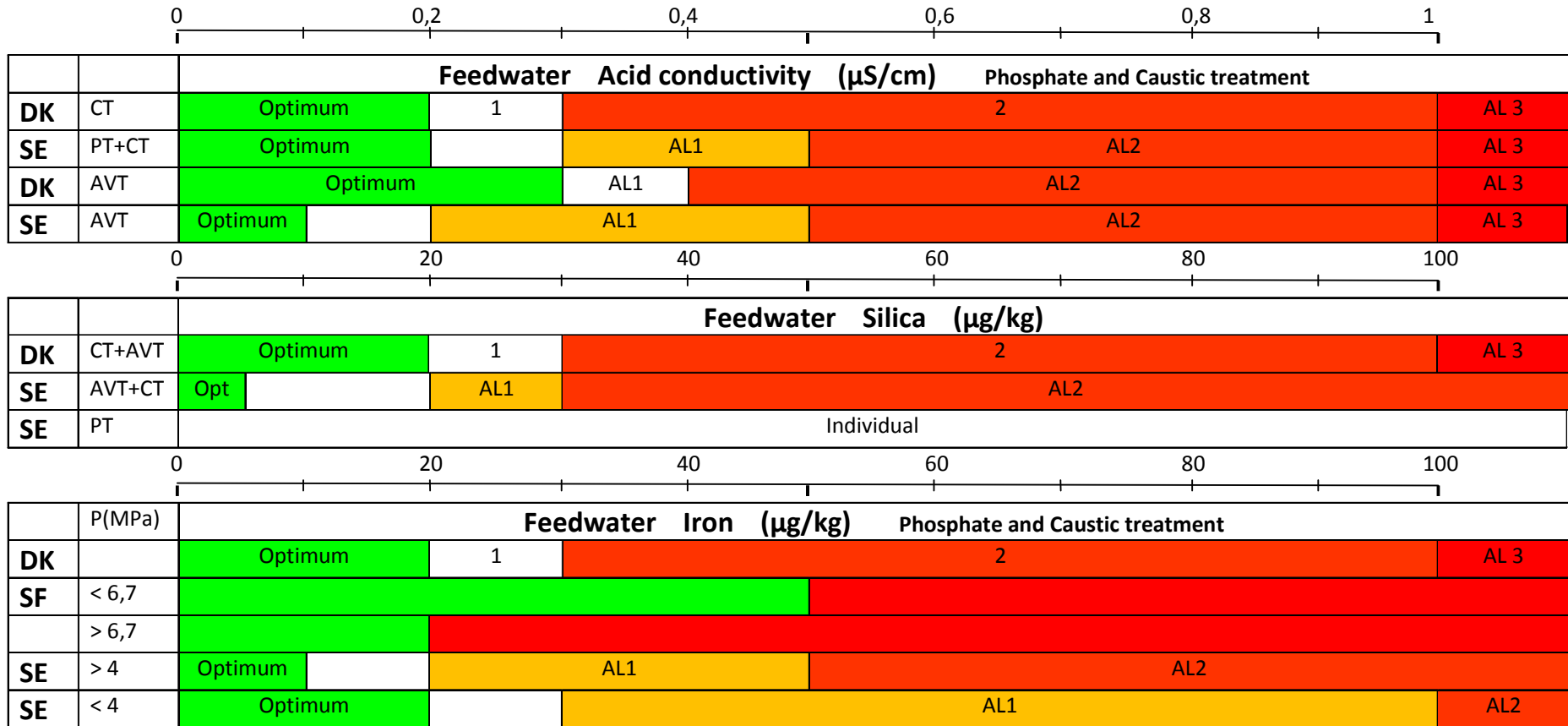
	Material	Feedwater pH Caustic treatment and Phosphate treatment										
DK	Fe	Action level 3				AL2	AL1	O	1	2	AL 3	
SF		[Red bar from pH 8 to 9.2, Green bar from pH 9.2 to 9.8, Red bar from pH 9.8 to 10]										
SE	Fe	AL1			Opt					AL1	2	
	Cu	2	1	Optimum			1	2				

	Material	Feedwater pH AVT										
DK	Fe	Action level 3						2	1	O	2	AL 3
SE	Fe	AL1			Optimum					1	2	
	Cu	2	AL1	Opt			1	AL2				

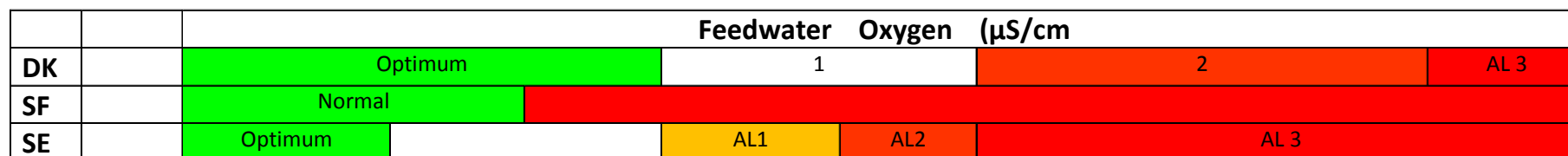
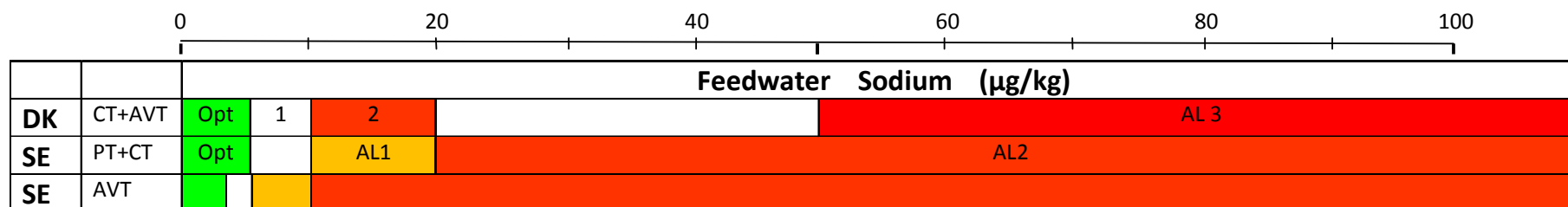
Feedwater Specific Conductivity



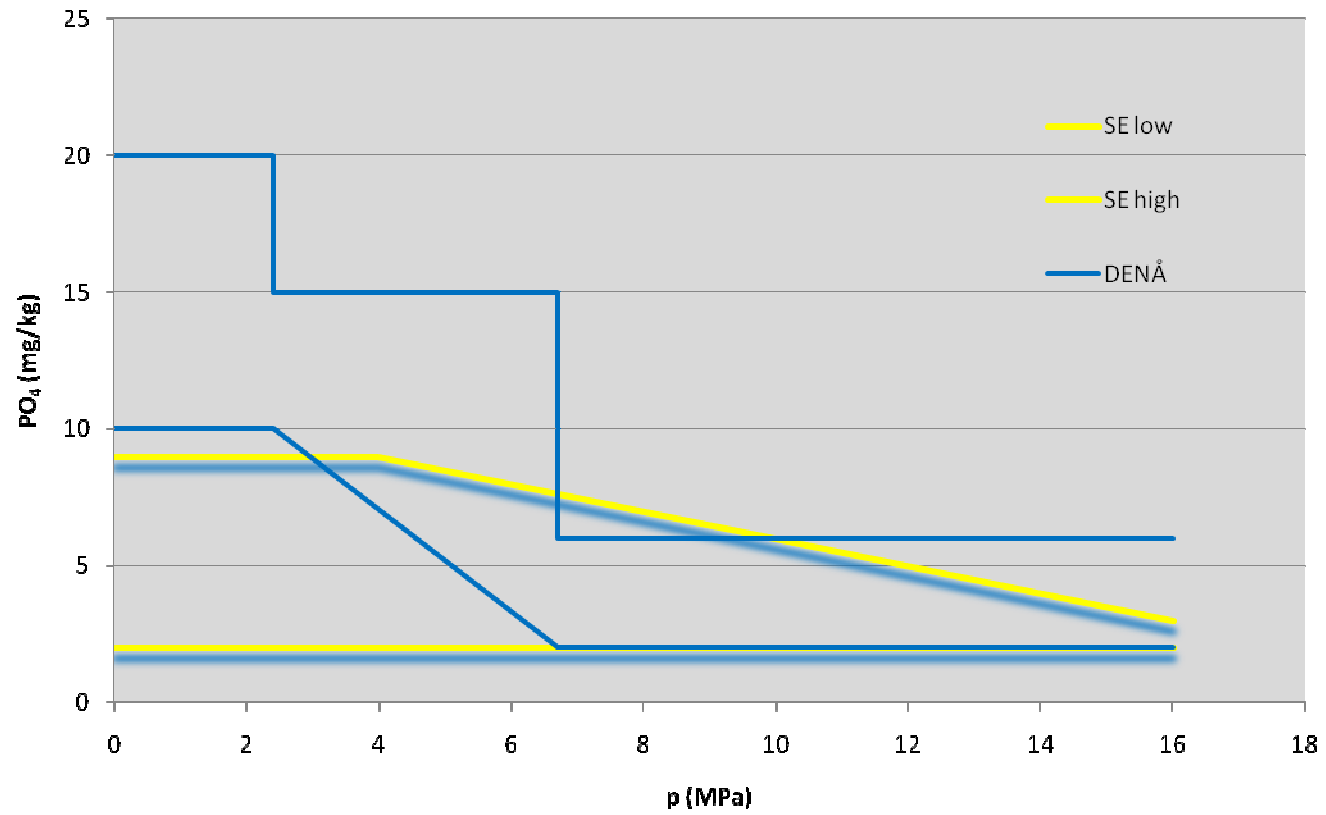
Feedwater Contamination - AC SiO₂ Fe



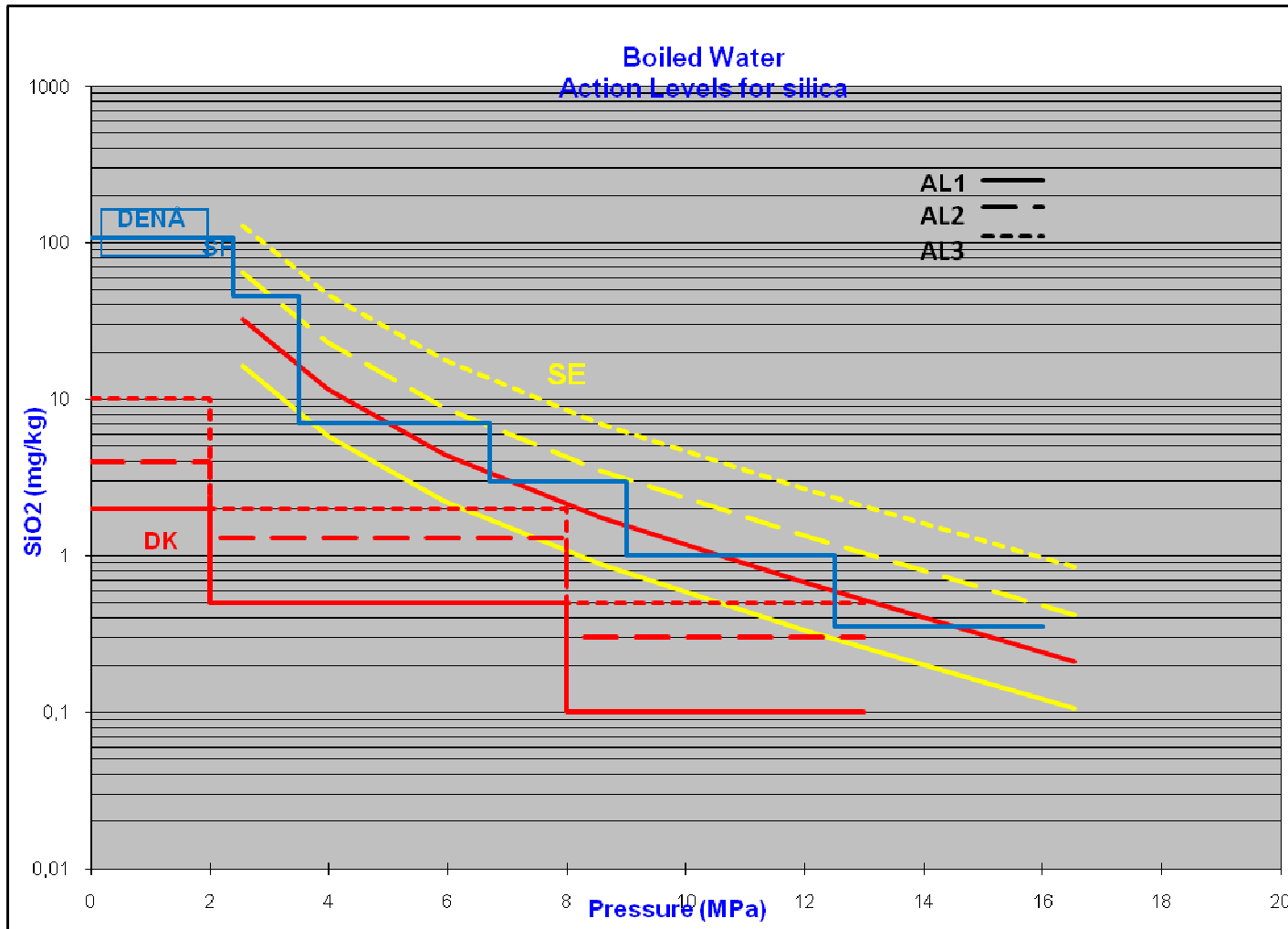
Feedwater contamination - Na and O₂



Phosphate limits in Boiler Water



Boiler Water - Silica limits



Summary

- **Difference in limit system**
 - DK – Optimum + 3 Action Levels
 - SE - Optimum + Acceptable + 3 Action Levels (Close to VGB)
 - SF - Normal operation + Out of specs
- **Difference in priorities for boiler water pH control**
 - DK – Caustic treatment - AVT
 - SE - Phosphate Treatment – AVT – Caustic treatment
 - SF O₂ - Phosphate Treatment
- **Difference in AVT**
 - DK – High ammonia level in feedwater + higher Acid Conductivity
 - SE - Normal ammonia level in feedwater + lower Acid Conductivity
- **Difference in Phosphate treatment**
 - SE - Low concentration (VGB)
 - SF - High concentration (DENÅ)
- **Difference in Feedwater Contamination**

DK – SiO ₂ BW low – FW high	Fe FW medium	O ₂ FW high
SE - SiO ₂ BW high – FW low	Fe FW low	O ₂ FW low
SF - individual	Fe FW high	O ₂ FW medium