

# Comparison of Scandinavian recommendations for water chemistry of drum boilers

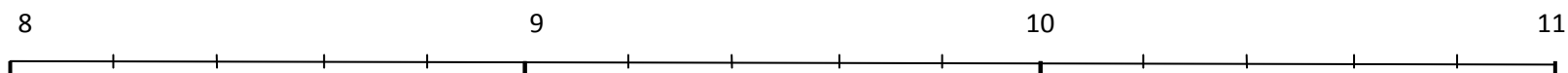
SIAPWS General meeting  
Copenhagen 10 March 2011  
Karol Daucik

# Comparison of Scandinavian Guidelines for drum boilers

	Denmark	Finland	Sweden
<b>Feedwater</b>			
Ammonia	1	1	1
Amines			2
Scavengers		1	
<b>Boiler water</b>			
Phosphate		1	1
Caustic	1		3
AVT	2		2

		Comparison of Action Level systems							
<b>DK</b>		Action level 3	AL2	1	Optimum	1	2	AL 3	
<b>SE</b>		Action level 3	2	1	Optimum		1	2	AL 3
<b>SF</b>		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

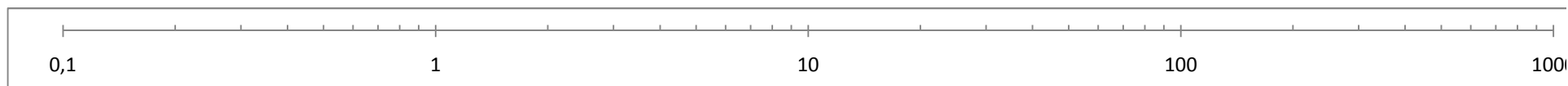


SE	Metal	Feedwater pH AVT							
Cu		AL 2	AL1		Optimum	AL1	AL2		
Fe		AL2	AL1			Optimum		1	AL2

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 (µS/cm)					Phosphate treatment		
<b>SE +</b>	< 4				Optimum	AL1	AL2	AL3	
<b>+VGB</b>	4 – 10			Optimum	AL1	AL2	AL3		
<b>SE VGB</b>	> 10				Optimum	AL1	AL2	AL3	
<b>SF</b>	< 6,2	Normal operation							
<b>DENÅ</b>	< 8,4	Normal operation							
	< 11	Normal operation							

	P (MPa)	Boiler Water Specific Conductivity (µS/cm)					Caustic treatment			
<b>DK</b>	< 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	
<b>SE +</b>	< 4	Action level 3	AL2	AL1		Optimum		AL1	AL2	AL3
<b>+VGB</b>	4 – 10	Action level 3	AL2	AL1		Optimum	1	AL2	AL3	
<b>SE VGB</b>	> 10	Action level 3	AL2	AL1	Opt		AL1	AL2	AL3	

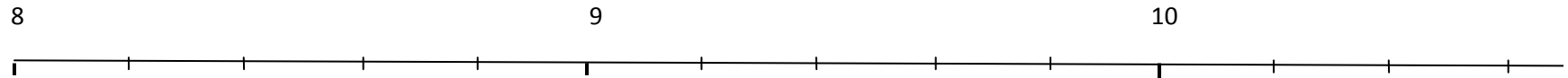
# Boiler Water Acid Conductivity AVT and Caustic Treatment



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

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

# Feedwater pH

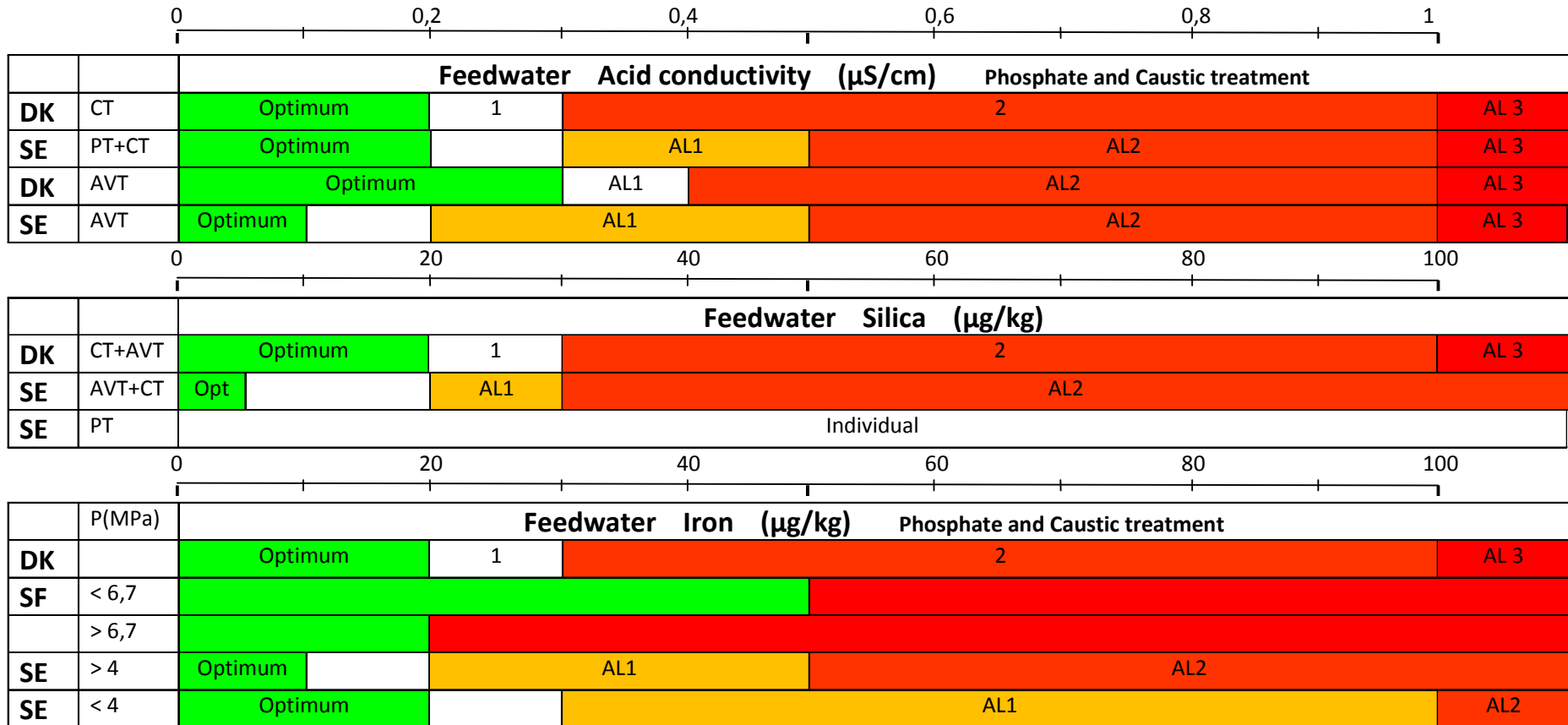


	Material	Feedwater pH Caustic treatment and Phosphate treatment										
DK	Fe	Action level 3				AL2	AL1	O	1	2	AL 3	
SF		[Red bar]										
SE	Fe	AL1			Opt				AL1		2	
	Cu	2	1	Optimum			1	2				

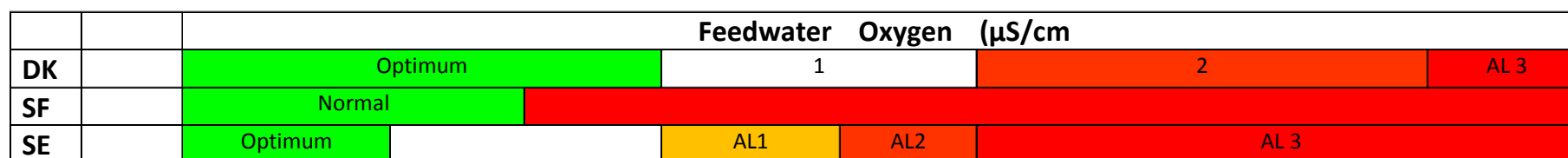
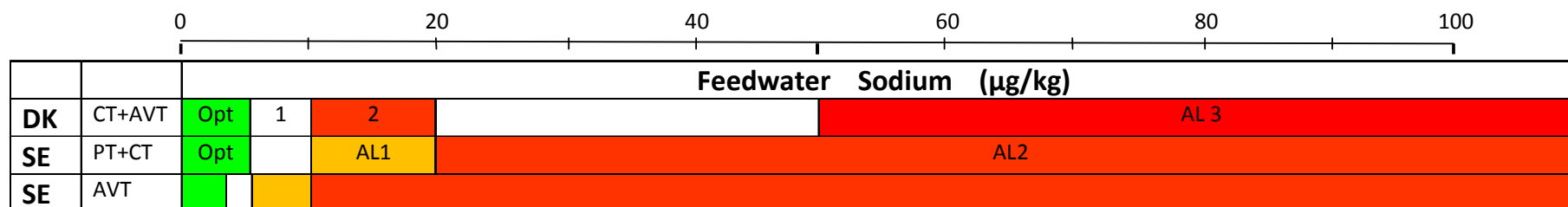
	Material	Feedwater pH AVT											
DK	Fe	Action level 3						2	1	O	2	AL 3	
SE	Fe	AL1			Optimum				1		2		
	Cu	2	AL1	Opt			1	AL2					



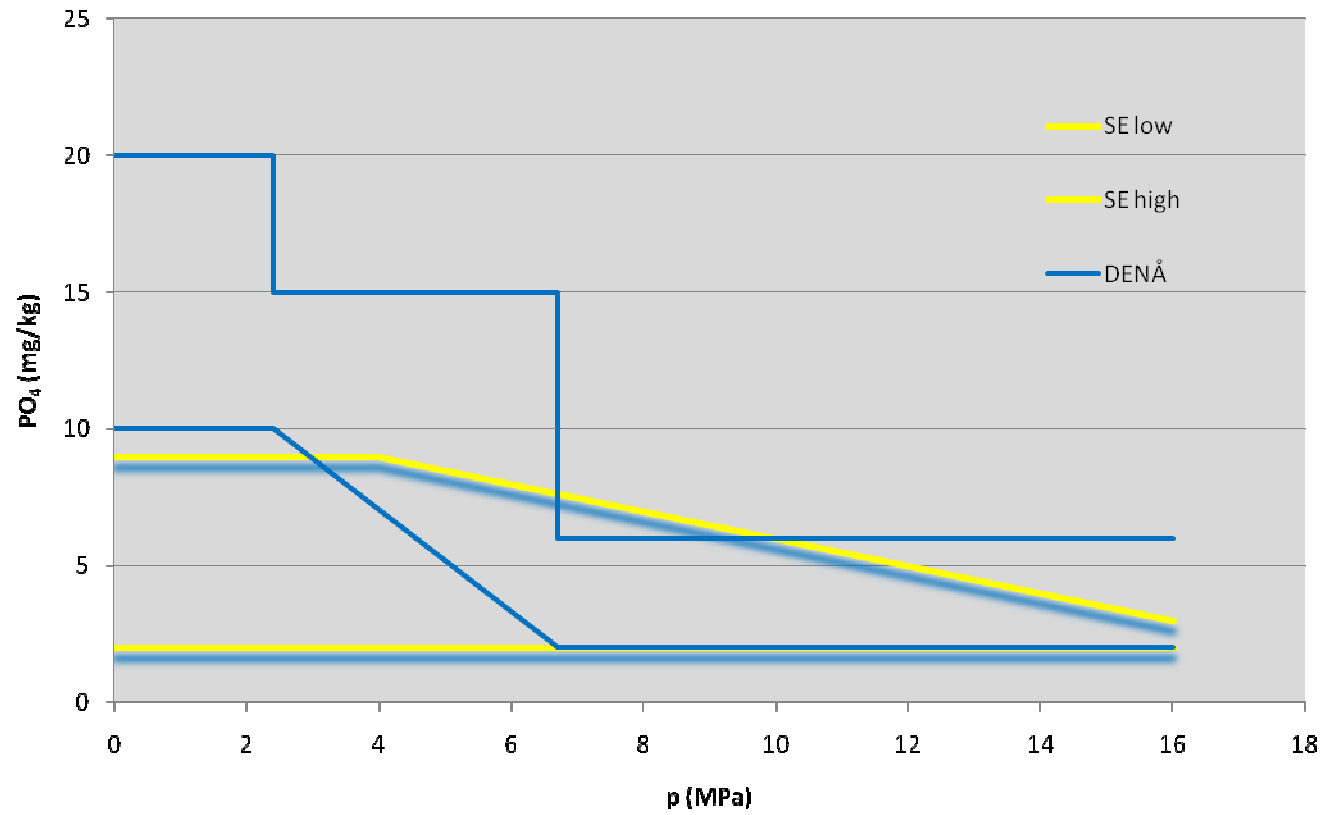
# Feedwater Contamination - AC SiO<sub>2</sub> Fe



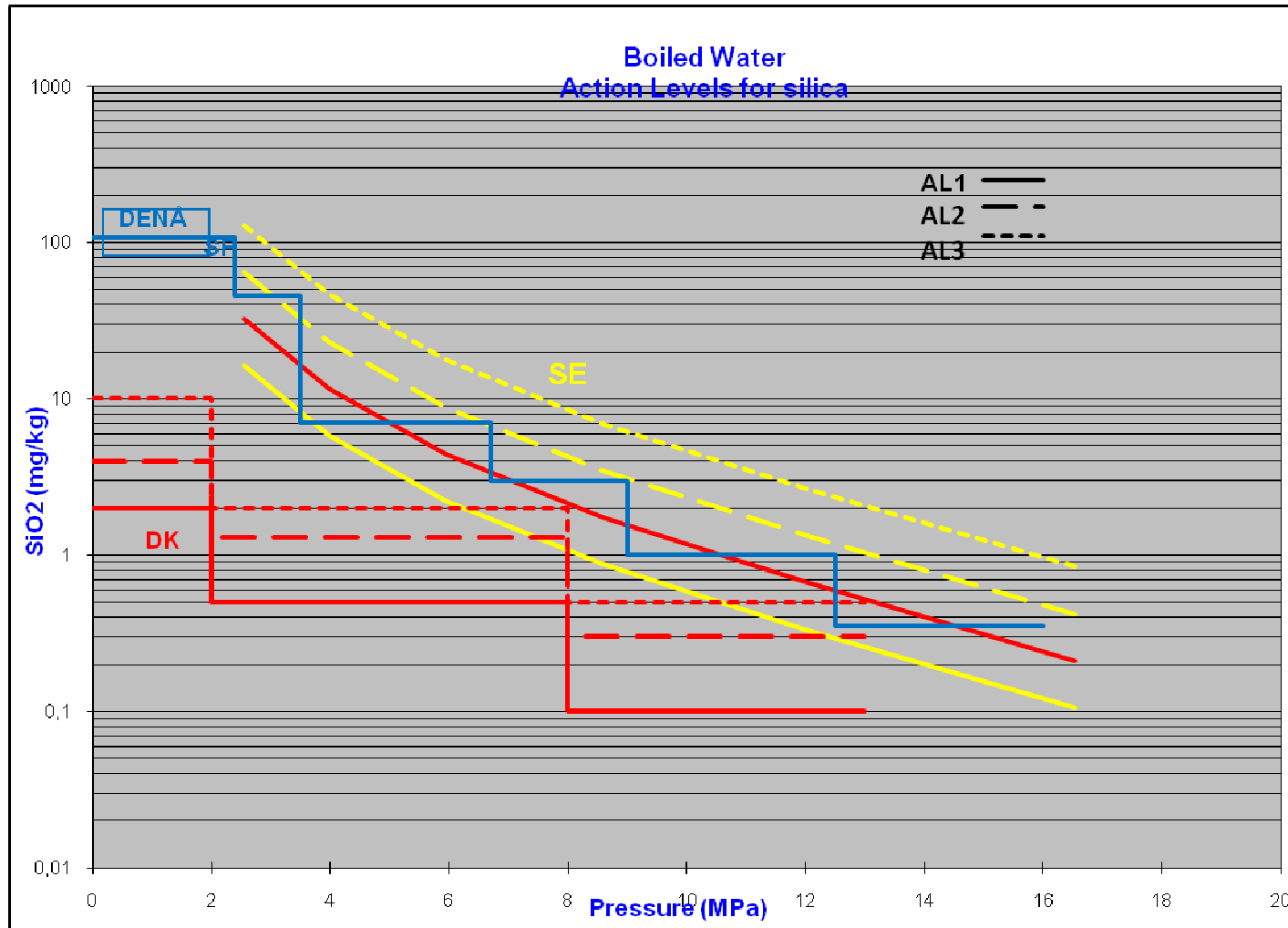
# Feedwater contamination - Na and O<sub>2</sub>



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 O<sub>2</sub> - 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 <sub>2</sub> BW low – FW high	Fe FW medium	O <sub>2</sub> FW high
SE - SiO <sub>2</sub> BW high – FW low	Fe FW low	O <sub>2</sub> FW low
SF - individual	Fe FW high	O <sub>2</sub> FW medium