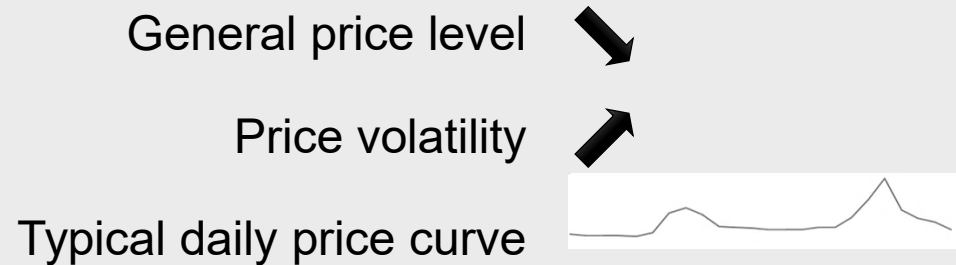


Improving flexibility of hard-coal fired power plants by means of APC

Major changes in the German energy market



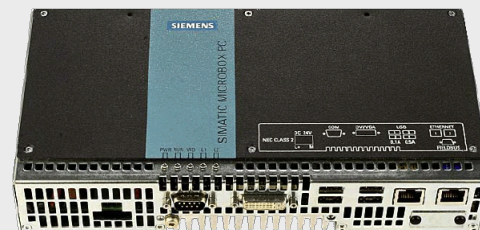
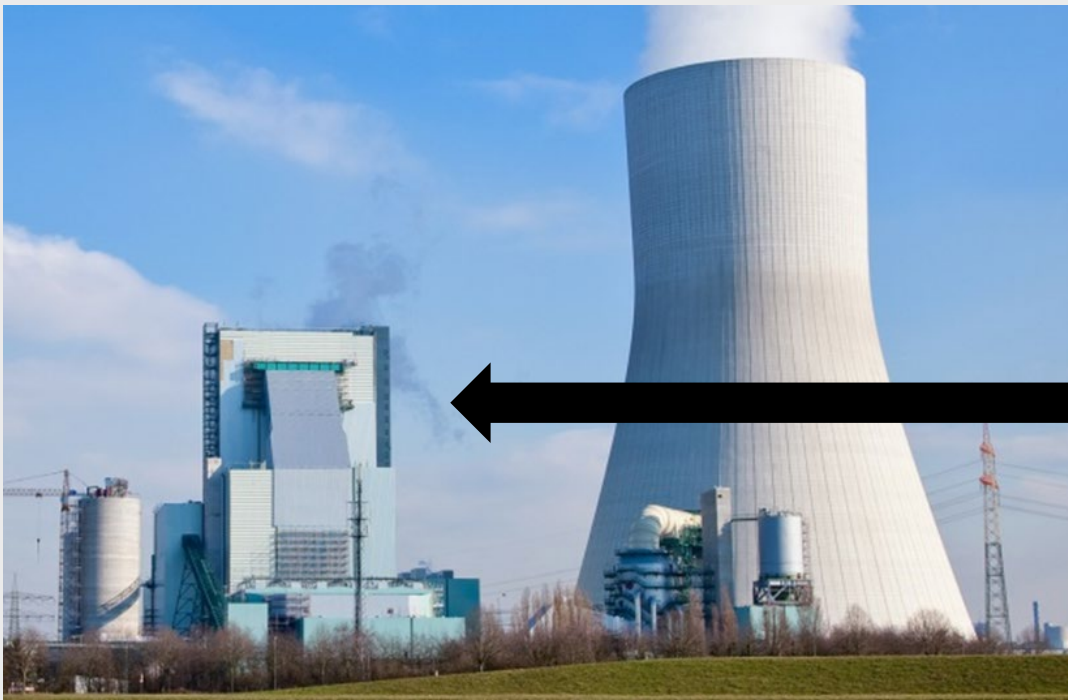
“Mid-load” operation

not only less operation hours, but also

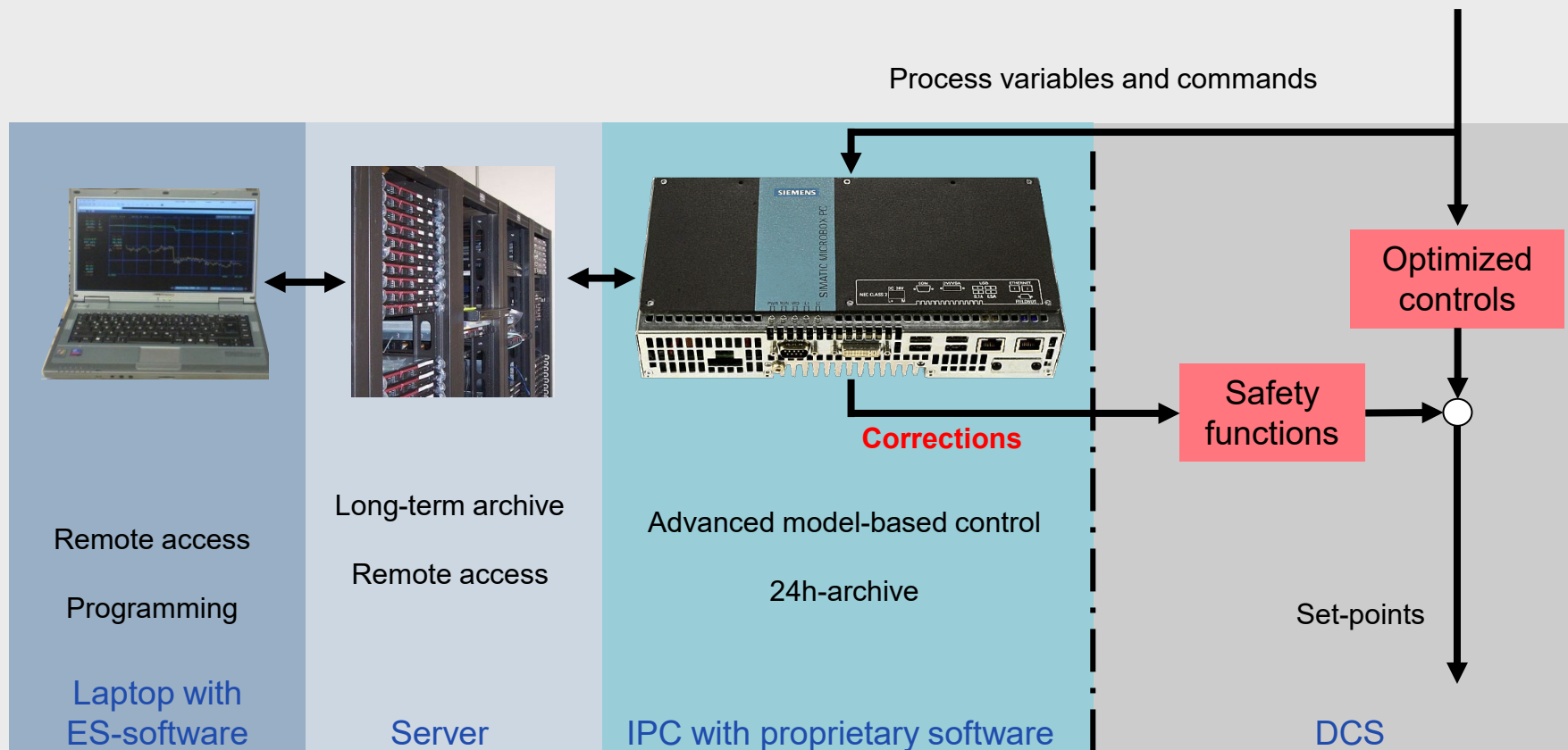
- More frequent load changes
- More frequent operation at partial and even at minimum load
- **More frequent start-ups**

Implementation by means of tailor-made control optimization using APC

Chip tuning of power plants

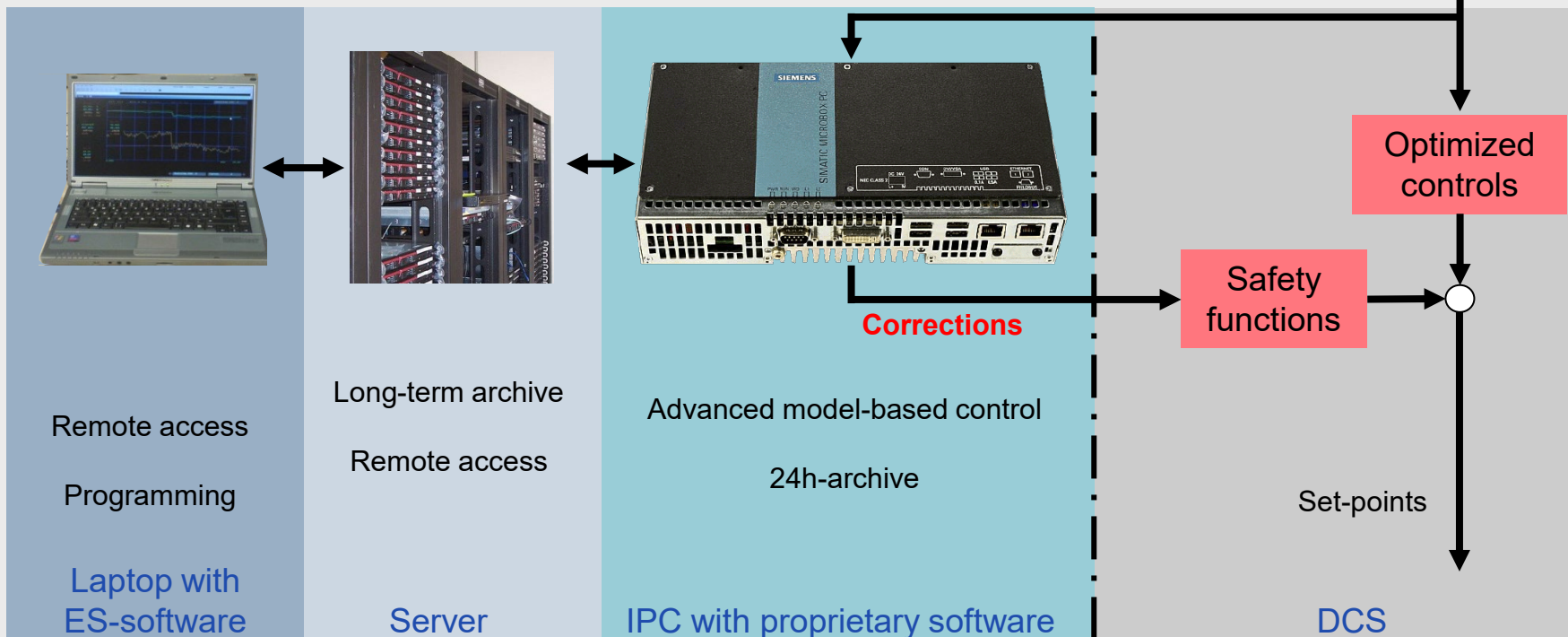


Kallina calculator



Kallina calculator

Part 3: Start-Up optimization

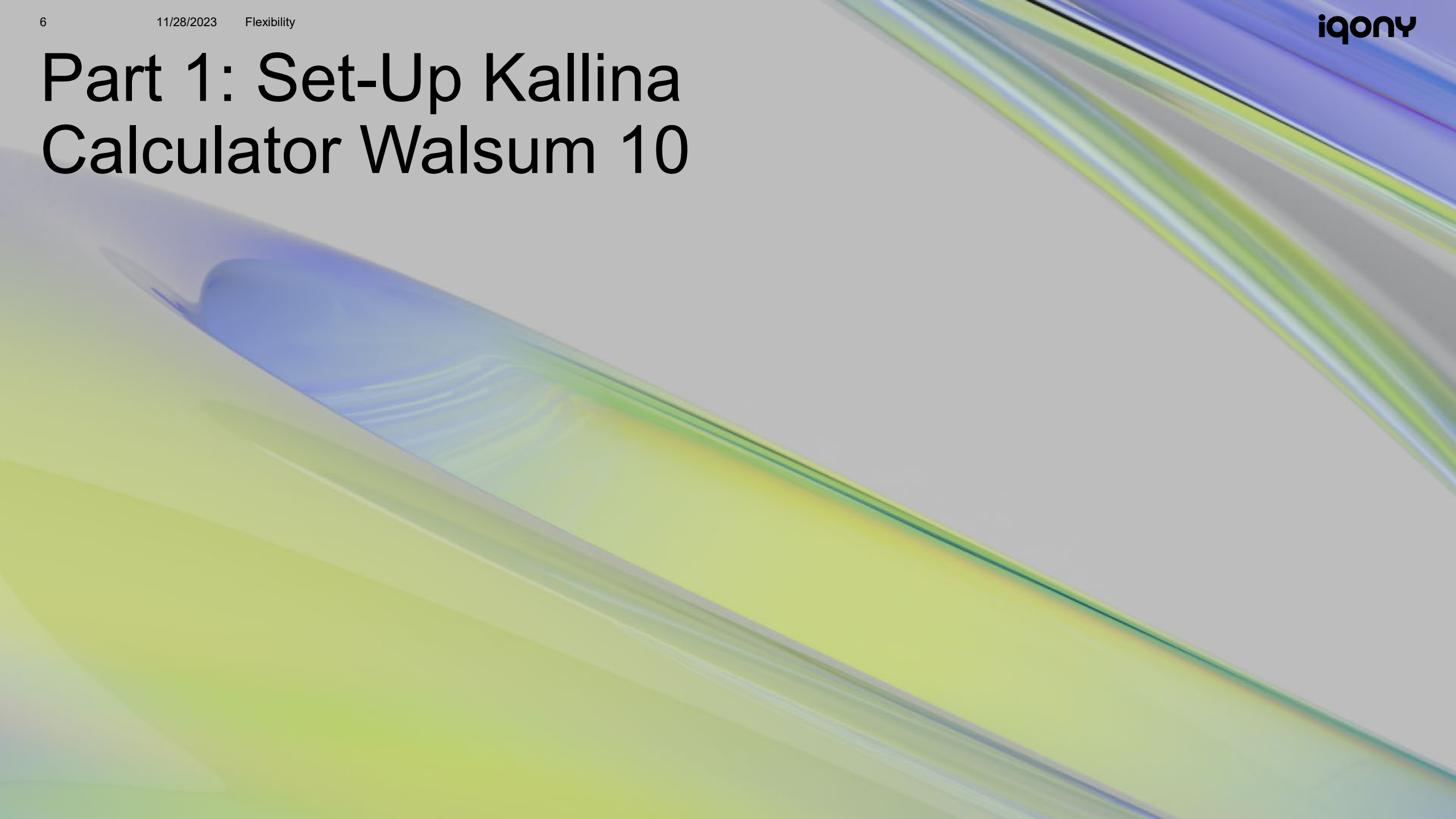


Part 2: Optimization of underlying control loops

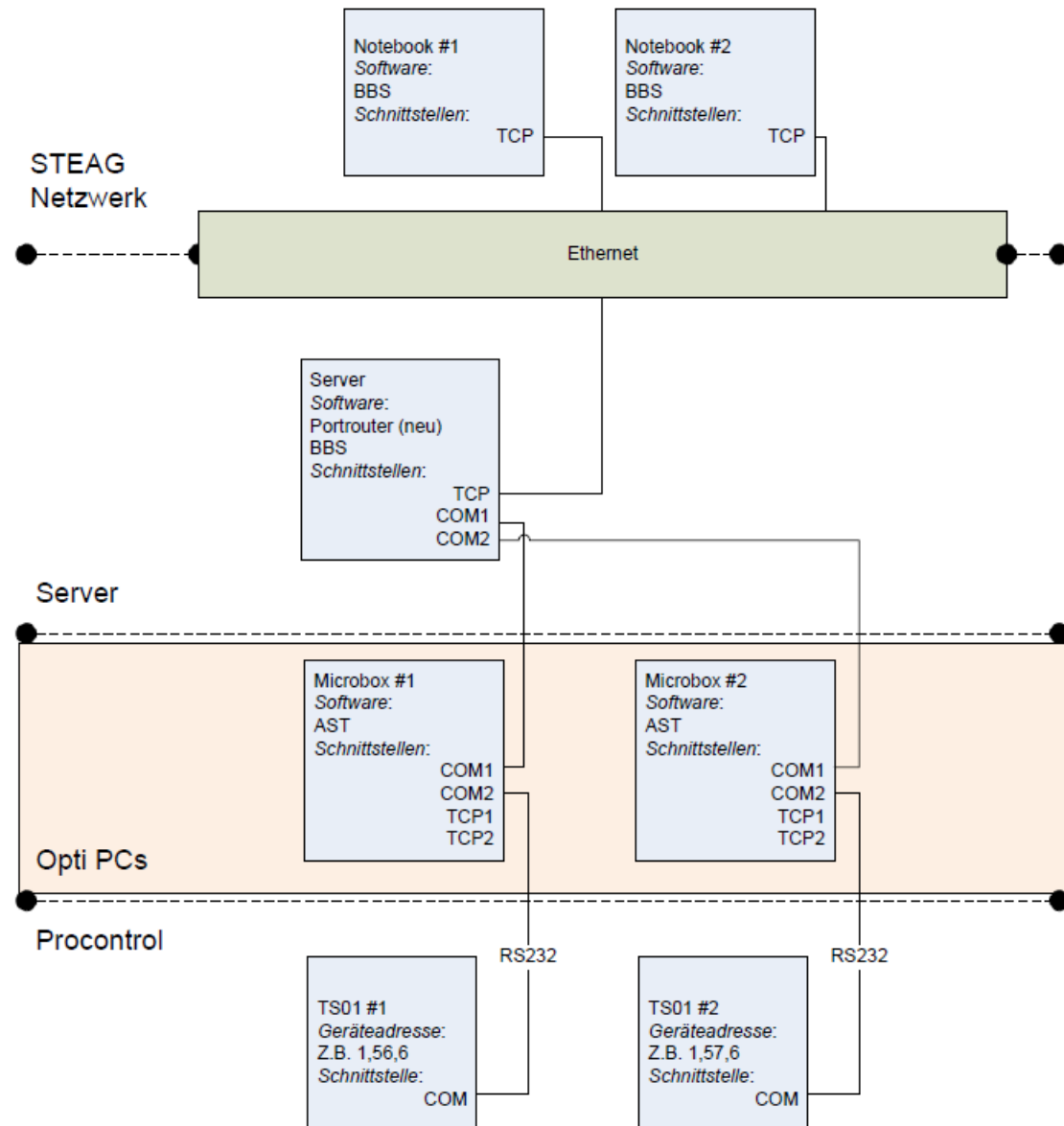


Part 1: Set-Up Walsum 10

Part 1: Set-Up Kallina Calculator Walsum 10



Part 1: Set-Up Kallina Calculator Walsum 10



Part 1: Set-Up Kallina Calculator Walsum 10



Part 1: Set-Up Kallina Calculator Walsum 10

omss01 - 17.4.1

1 2 S *? WALSUM

14.03.22
11:00:27 *

Blockoptimierung

HKW Walsum X XOPTI1 1/1

Kanal	Wert	Parameter	Status	Icon
Kanal 1	1.5	dF Kond OptiRech	Green	Red box
Kanal 2	0.0	SW -Y A4 OptiRech	Green	Grey box
Kanal 3	0.0	SW -Y A5 OptiRech	Green	Grey box
Kanal 4	0.0	SW -Y A6 OptiRech	Green	Grey box
Kanal 5	0.0	FD-Druck/Lstg d WL	Green	Grey box
Kanal 6	-0	FD-Druck/Lstg d Pi WL	Green	Grey box
Kanal 19	0.5	dSW Enthalpie OptiRech	Green	Grey box
Kanal 29	0.0	HU-Wert KoMü OptiRech	Green	Grey box
Kanal 12	0.0	dSW F SpW OptiRech	Green	Grey box
Kanal 25	0.0	s dSW SpW Pp1 OptiRech	Black	Grey box
Kanal 21	0.0	s dSW SpW Pp2 OptiRech	Black	Grey box
Kanal 23	100	SpW Pp1 OptiRech	Green	Grey box
Kanal 22	100	SpW Pp2 OptiRech	Green	Grey box
Kanal 15	-0	Mü10 MahDr KORR	Green	Grey box
Kanal 15	-0	Mü20 MahDr KORR	Green	Grey box
Kanal 15	-0	Mü30 MahDr KORR	Green	Grey box
Kanal 15	-0	Mü40 MahDr KORR	Green	Grey box

BLOCKOPTIMIERUNG

VW Opti-Rech Vorwa
Opti-Rech 1

BLOCKOPTIMIERUNG

EIN

BLOCKREGELUNG

SEITE 2

Fließbilder Kurven Bereiche Gruppen Kreise

Direktbild Bildhistorie Hardcopy auf Drucker Bildtableaus Systempflege

ABB

Part 2: Optimization of underlying control loops

Part 2: Optimization of underlying control loops

In total: 15 measures identified

partly implemented in DCS or in Kallina Calculator

such as, e.g.

Unit control

Pressure control of turbine

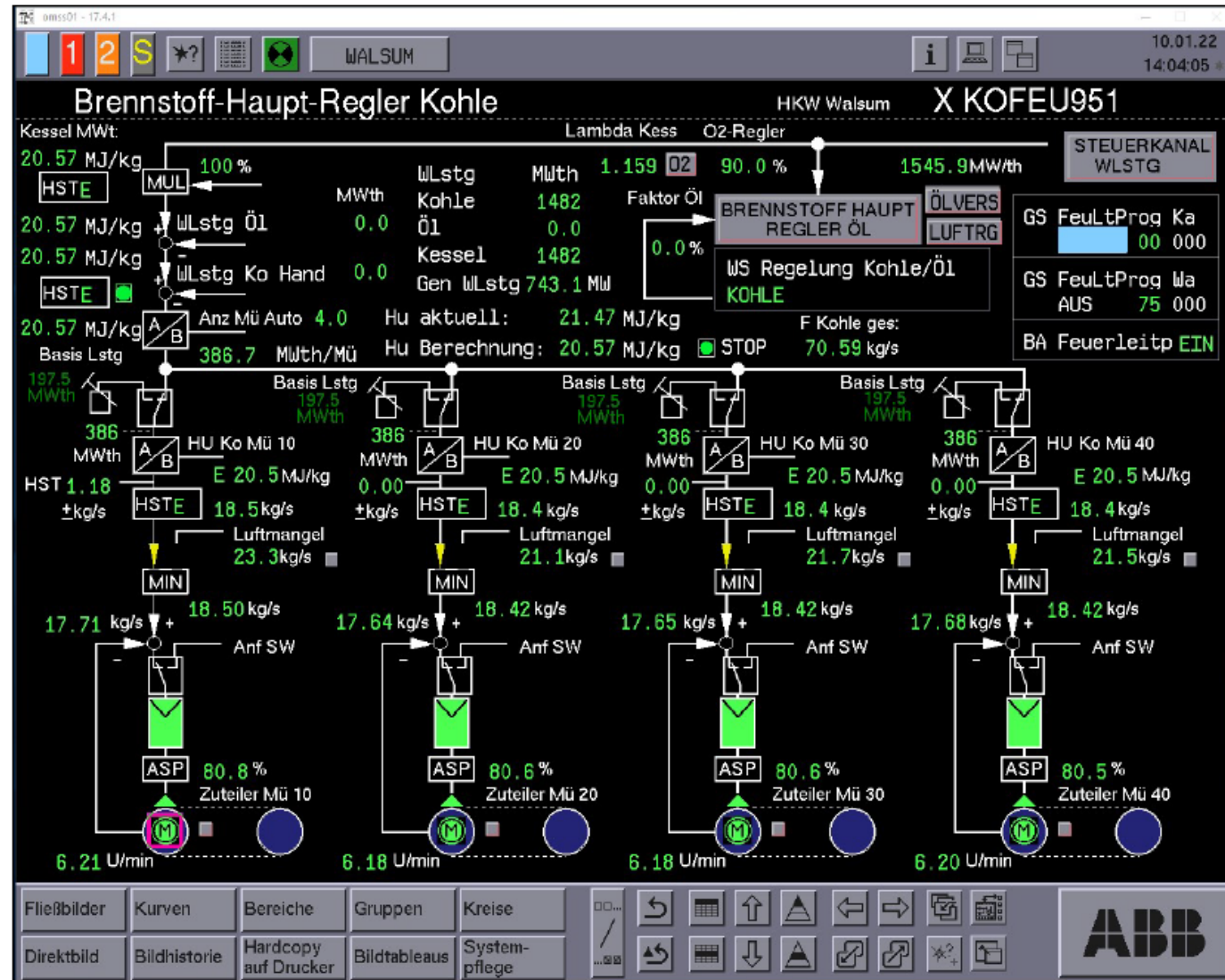
Feedwater control

Enthalpy control

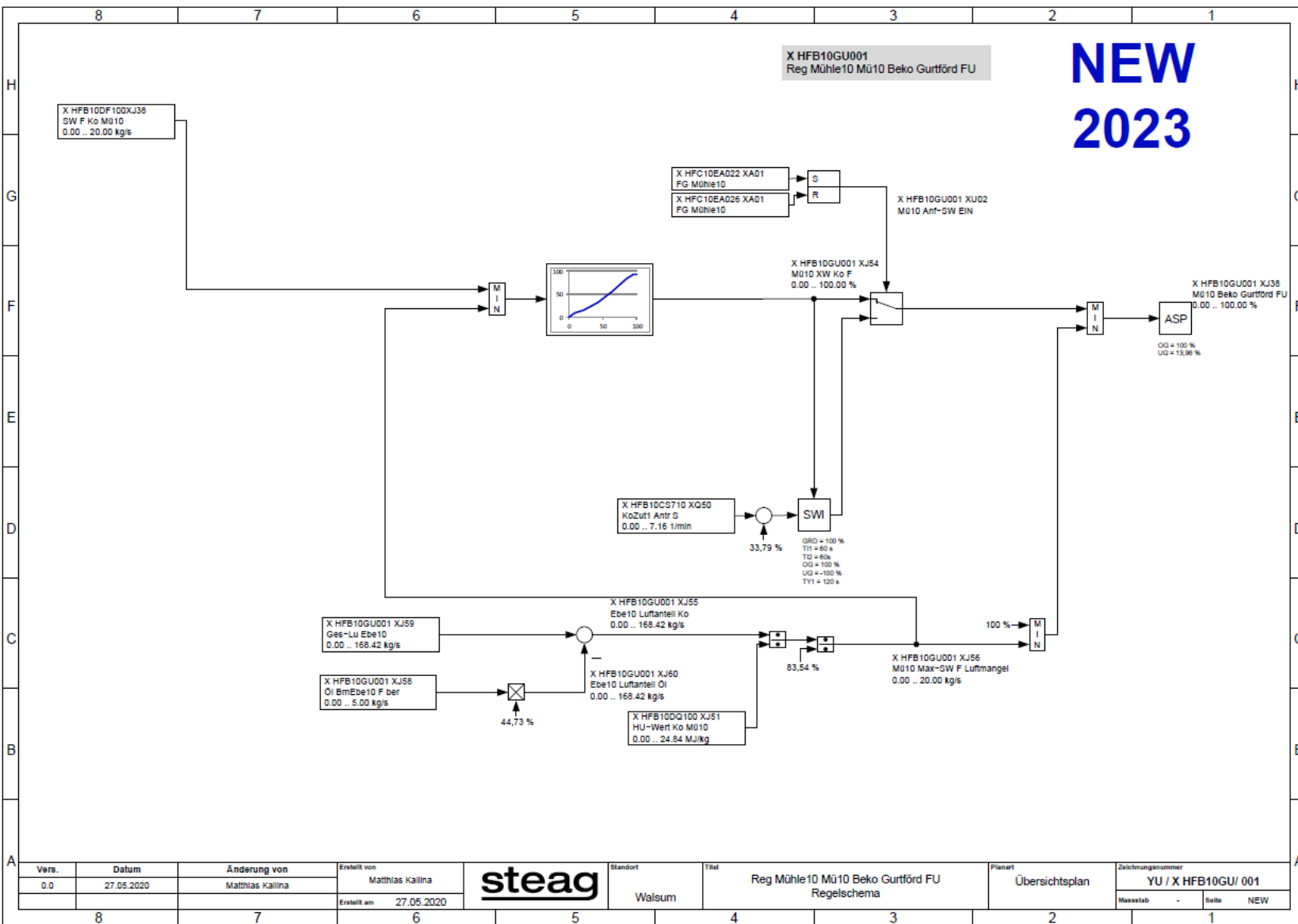
Spray water control

Coal feeder control

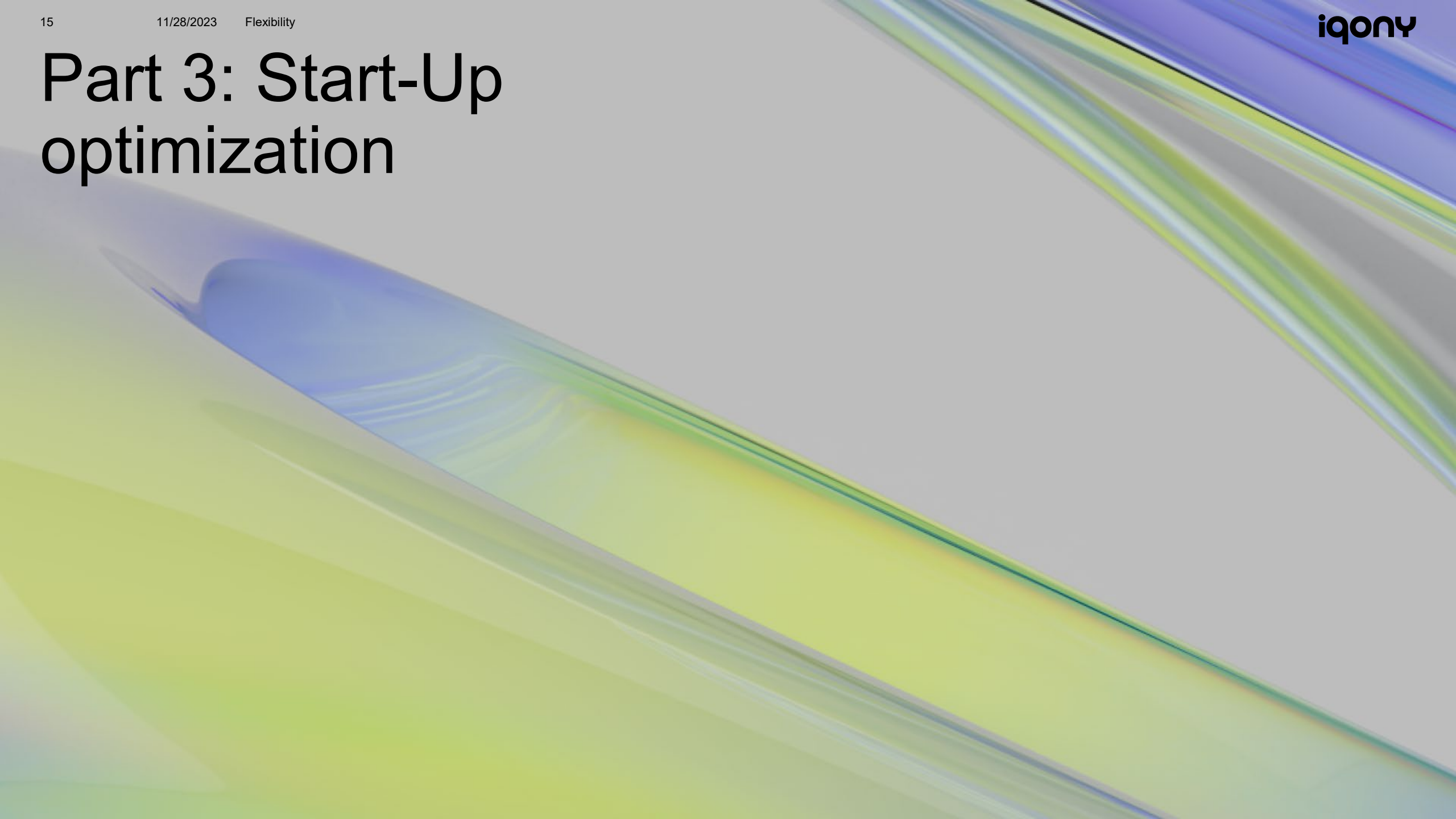
Part 2: Optimization of underlying control loops – coal feeder



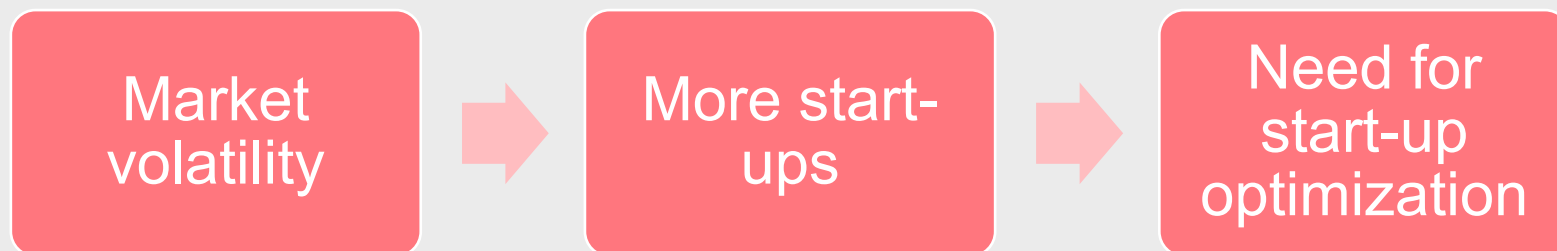
Part 2: Optimization of underlying control loops – coal feeder



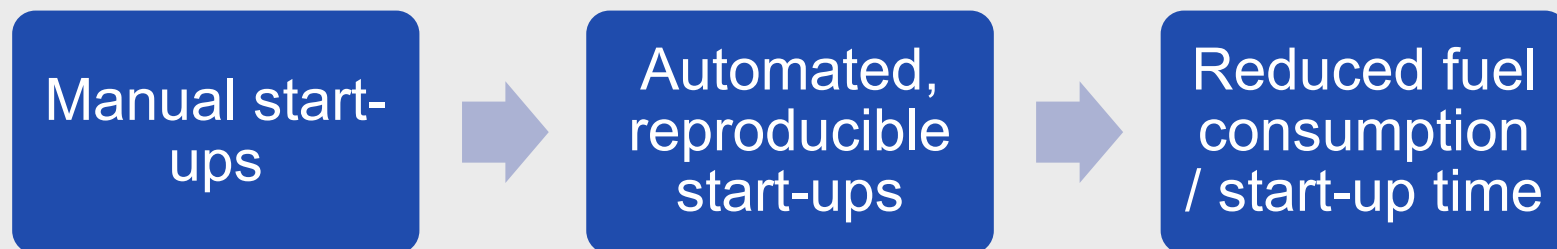
Part 3: Start-Up optimization



Part 3: Start-Up optimization



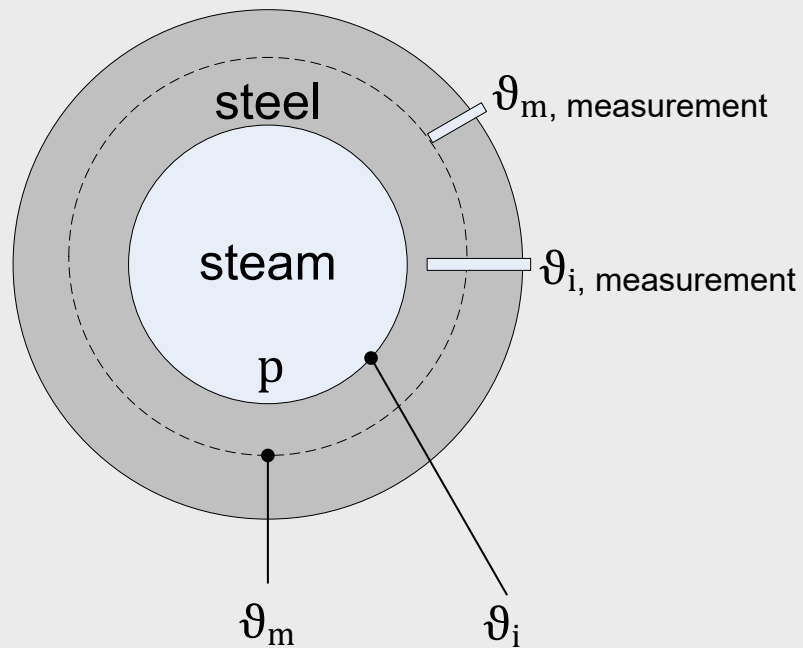
Areas with potential



Part 3: Start-Up optimization

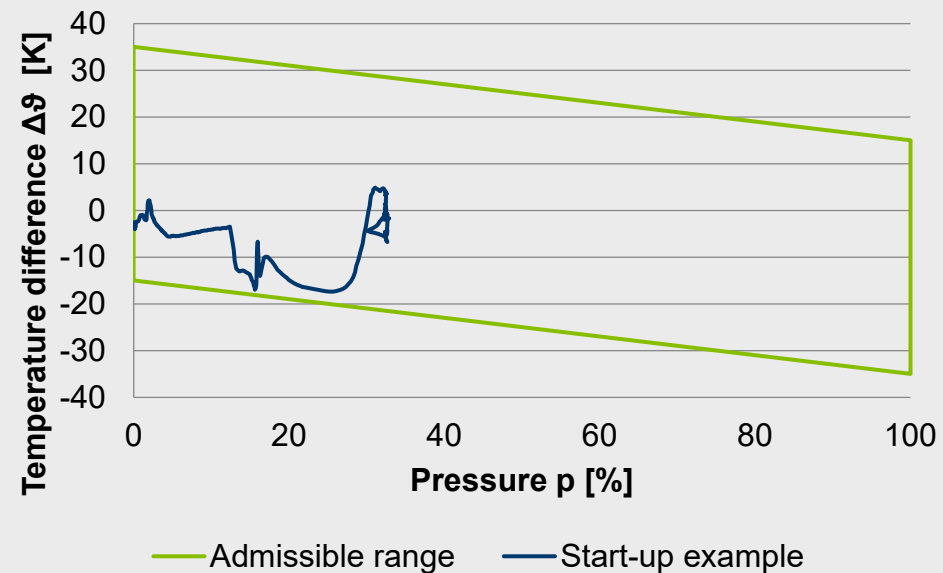
Issue: limit mechanical stress

$$\Delta\vartheta = \vartheta_m - \vartheta_i > f(p)$$

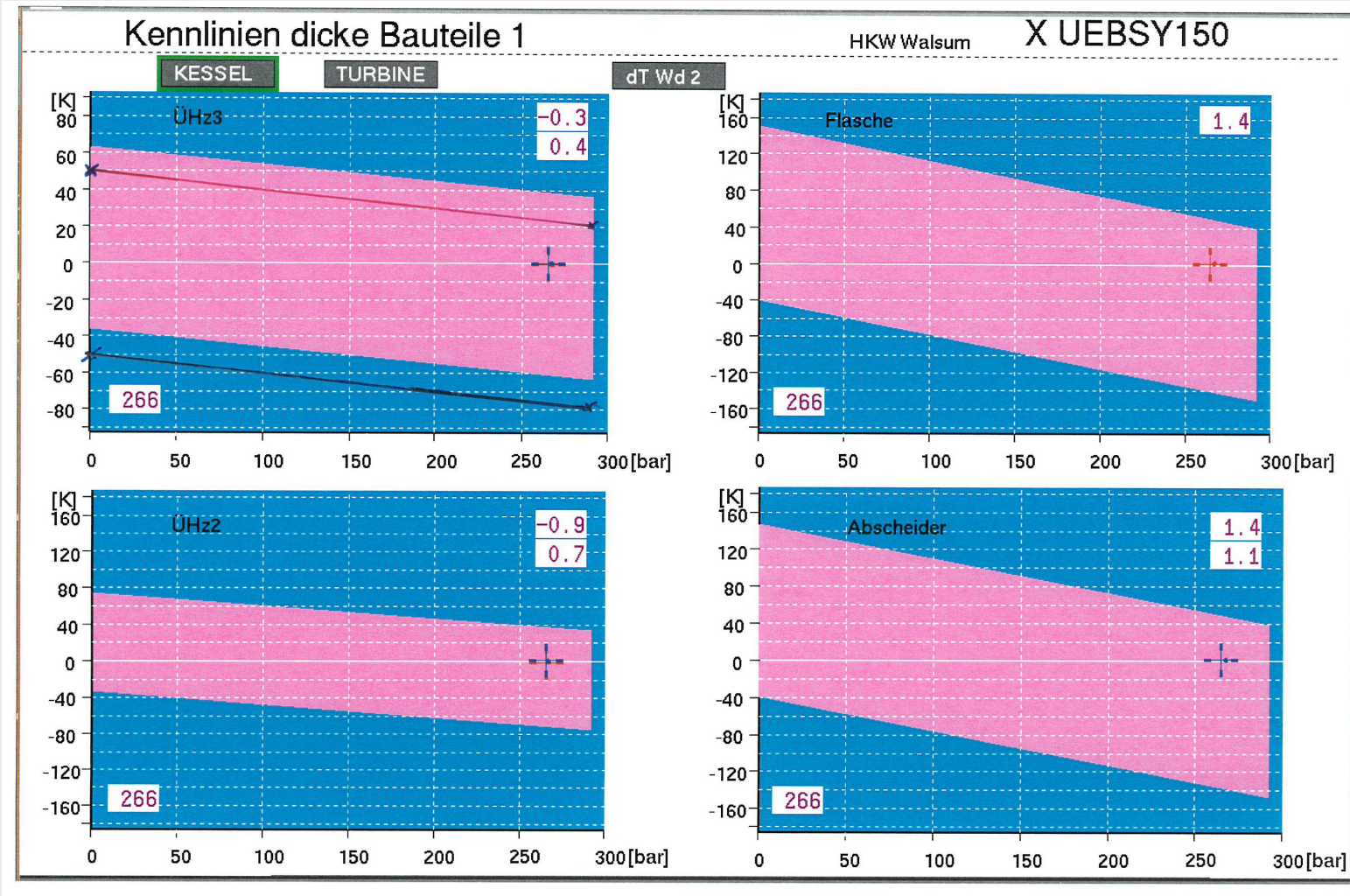


Approaches

- Limit temperature time derivatives
- **Limit difference between temperature measurements**
- **Calculate temperature difference by dynamical model and limit it by control**



Part 3: Start-Up optimization



Part 3: Start-Up optimization

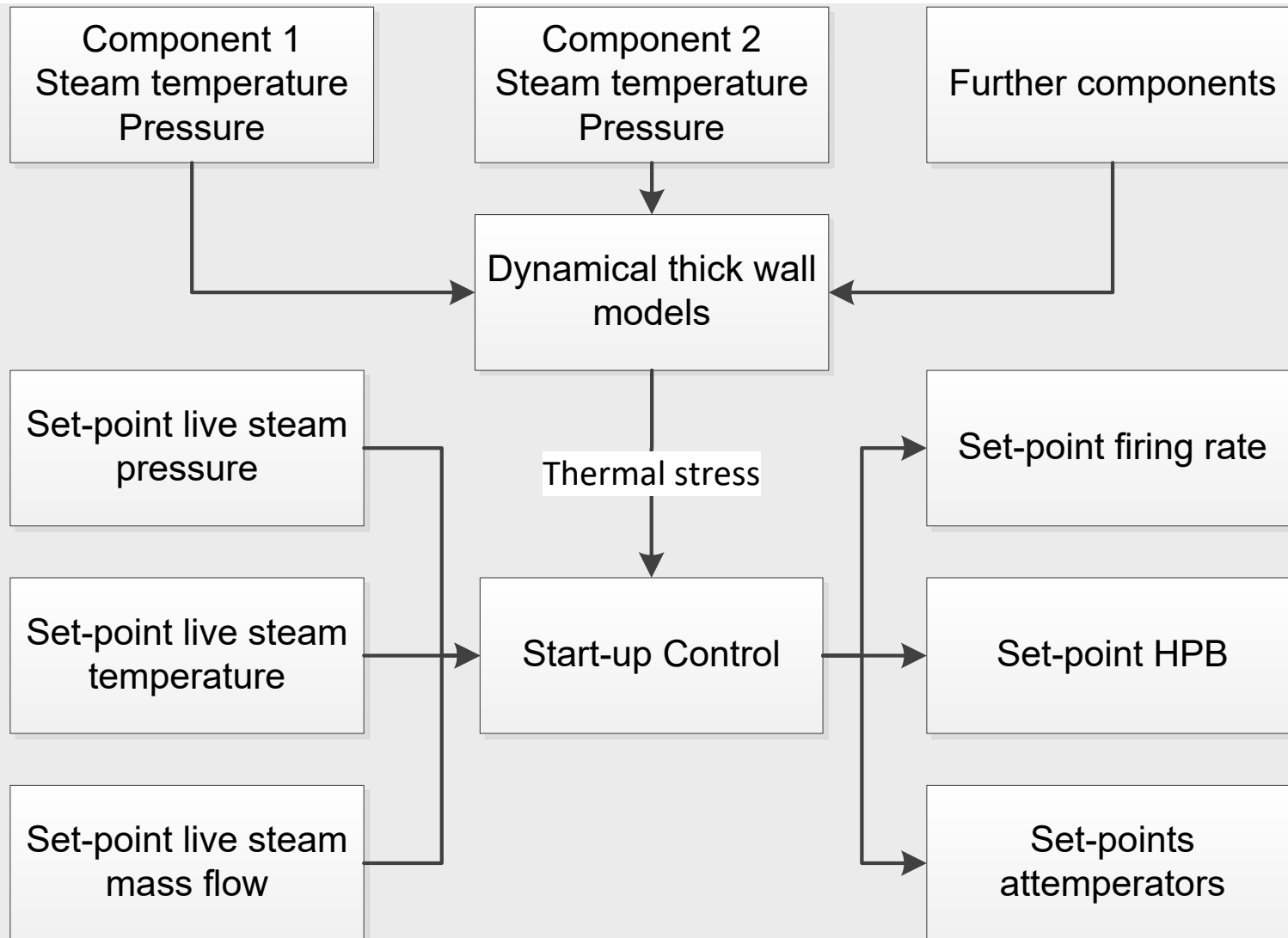
EVT		Werkstoffker X 20 Cr Mo Werkstoffnr. 1.4922					N 604-261 Teil 201	
Allgemeine Hinweise zu den Werkstoffkennwerten siehe M 604-260 EVT-interne Unterlagen" Eine Weitergabe an Dritte ist unzulässig"								
Werkstoff- kennwert	E	G	v	β_L	β_L'	ρ	λ	
Polynom								
b_0	2.181E+02	8.501E+01	2.830E-01	1.030E-05	1.030E-05	7.765E+00	2.392E+01	
b_1	-4.550E-02	-1.833E-02	8.009E-06	8.250E-09	4.125E-09	-2.457E-04	4.244E-03	
b_2	-6.778E-05	-3.143E-05	7.136E-08	-3.750E-12	-1.250E-12	-6.195E-08	-1.200E-07	
b_3	0.	2.927E-09	0.	0.	0.	0.	1.000E-10	
Einheit	$\frac{kN}{mm^2}$	$\frac{kN}{mm^2}$		$\frac{1}{K}$ $\times 10^{-3}$	$\frac{1}{K}$ $\times 10^{-3}$	$\frac{kg}{dm^3}$	$\frac{W}{m \cdot K}$	
Temp. °C								
0	218.1	85.01	.283	1.03	1.03	7.765	23.9	
20	217.2	84.63	.283	1.05	1.04	7.760	24.0	
50	215.7	84.02	.284	1.07	1.05	7.753	24.1	
100	212.9	82.87	.285	1.11	1.07	7.740	24.3	
150	209.7	81.56	.286	1.15	1.09	7.727	24.6	
200	206.3	80.11	.288	1.18	1.11	7.713	24.8	
250	202.5	78.51	.290	1.21	1.13	7.700	25.0	
300	198.3	76.76	.292	1.24	1.14	7.686	25.2	
350	193.9	74.87	.295	1.27	1.16	7.671	25.4	
400	189.1	72.84	.296	1.30	1.18	7.657	25.6	
450	183.9	70.66	.301	1.33	1.19	7.642	25.8	
500	178.4	68.35	.305	1.35	1.21	7.627	26.0	
550	172.6	65.91	.309	1.37	1.22	7.611	26.2	
600	166.4	63.33	.314	1.39	1.23	7.595	26.4	
650	159.9	60.62	.319	1.41	1.25	7.579	26.7	

$a = \frac{\lambda}{\rho \cdot c}$

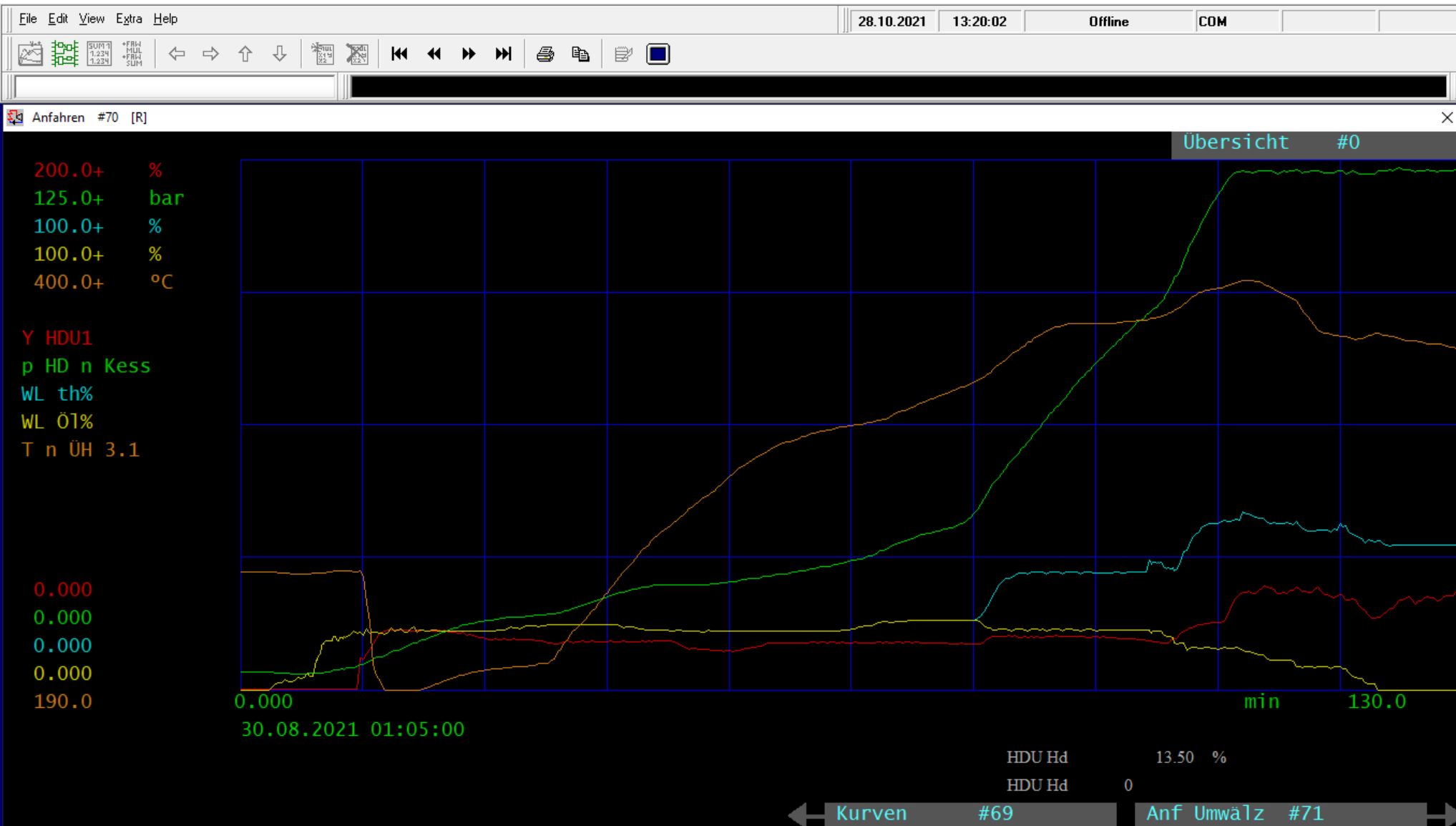
Frühere Angaben:

Die Unterlage behalten wir uns die Schutzrechte vor. Ohne unsere vorherige Zustimmung dürfen diese Unterlagen weder vervielfältigt noch geteilt werden und sie darf durch den Empfänger auch nicht in anderer Weise zugänglich gemacht werden.

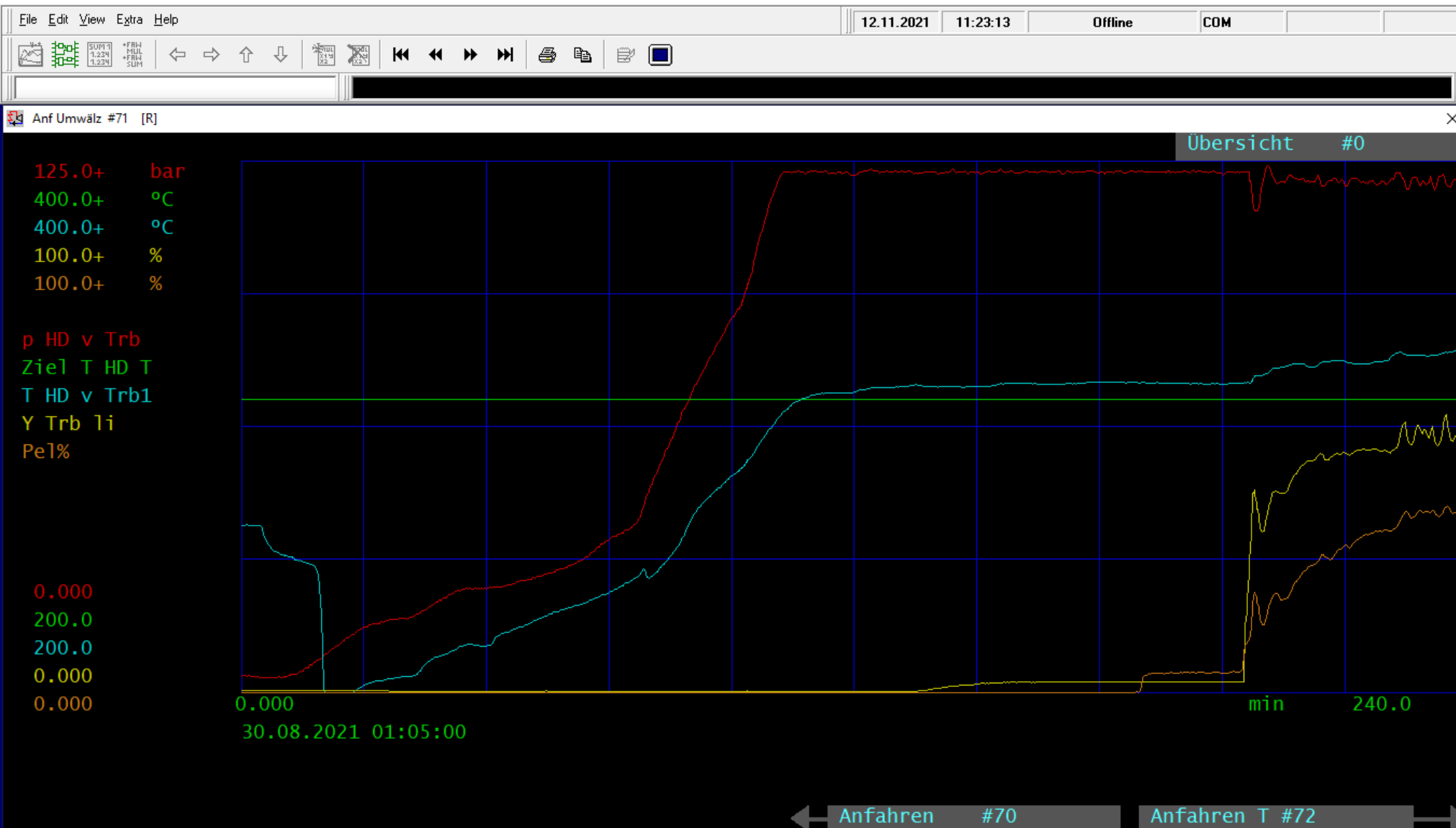
Part 3: Start-Up optimization



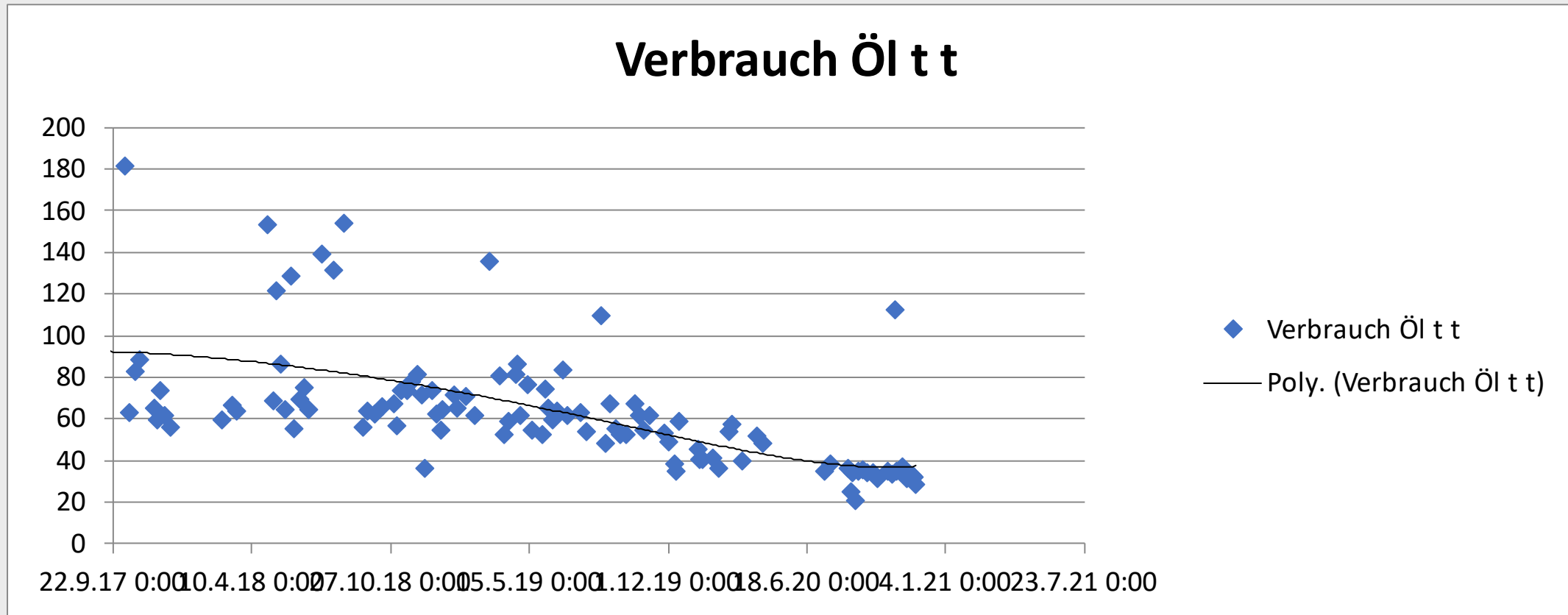
Part 3: Start-Up optimization



Part 3: Start-Up optimization



Part 3: Start-Up optimization



Dr. Daniel Lehmann

Iqony Solutions GmbH

iqony

