

## 2 TURBINE TECHNICAL DATA

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## 2.1 TURBINE

TYPE:	SST 400 condensing steam turbine with four bleeds and one extraction	
TURBOSE OUTPUT: (at generator terminals)		
- Normal	30	MW
- Maximal	31,88	MW
- Minimal	4,5	MW
SPEEDS:		
- rated – turbine	5038	rpm
- rated – generator	1500	rpm
- emergency trip (turbine) 110%	5542	rpm
- resonance (turbine)		
1. natural frequency	2620	rpm
2. natural frequency	6398	rpm
- torsional critical (complete train)	18,0	Hz
	61,3	Hz
	152,7	Hz
DIRECTION OF ROTATION	c.w. (seen in the direction of steam flow)	
LIVE STEAM:		
- pressure rated	127	bar(g)
max.	133,4	bar(g)
- temperature rated	535	°C
max.	543	°C
- temperature change		
temperature jump, max. permiss.	±20	°C
subsequent rate of temp. change	±2	°C/min
rate of temp. change, max. permiss. (without previous temp. jump)	±5	°C/min
- steam flow max.	128,6	t/h
- short time deviations acc. to IEC 45-1	see also Section 6	
pressure increase max 12 h/a	152,6	bar(g)
temperature increase max. 400 h/a	549	°C
- steam quality	see Section 6	
4 <sup>TH</sup> BLEED		
- pressure	33,377	bar(g)
- steam flow	7,67	t/h
3 <sup>RD</sup> BLEED		
- pressure	17,856	bar(g)
- steam flow	5,71	t/h
EXTRACTION		
- pressure	9,0	bar(g)
- steam flow	7,60	t/h

**2<sup>ND</sup> BLEED**

- pressure	2,811	bar(g)
- steam flow	8,16	t/h

**1<sup>ST</sup> BLEED**

- pressure	-0,104/0,896	bar(g)/bar(a)
- steam flow	8,64	t/h

**EXHAUST:**

- pressure rated	-0,932/0,068	bar(g)/bar(a)
- steam temperature	38	°C
- steam flow	82	t/h

**LOAD POINTS**

	No extraction	70 t/h extraction	
Guarantee Loadpoint	<b>T</b>		
Output at the generator terminals	<b>31230</b>	<b>17990</b>	<b>kW</b>
Turbine operating speed	5 000	5 000	rpm
Power factor cosφ	0,85	0,85	
Live steam:			
inlet pressure	128	128	bar(a)
inlet temperature	535	535	°C
inlet flow	119,77	119,77	t/h
1 <sup>st</sup> bleed			
pressure	0,896	0,115	bar(a)
flow	8,64	2,31	t/h
2 <sup>nd</sup> bleed			
pressure	3,811	0,525	bar(a)
flow	8,16	4,71	t/h
Extraction			
pressure	10	10	bar(a)
flow	7,60	87,3	t/h
3 <sup>rd</sup> bleed			
pressure	18,856	18,848	bar(a)
flow	5,71	5,71	t/h
4 <sup>th</sup> bleed			
pressure	34,377	34,345	bar(a)
flow	7,67	7,66	t/h
Outlet			
pressure	0,068	0,041	bar(a)
flow	81,65	11,70	t/h

Each turbine (in case Generator is included in Siemens scope) is guaranteed for a continuous rated output of 30750 kW at the terminal end of the generator at condenser pressure of 0,101 bar(a).

## 2.2 PROTECTION AND SAFETY EQUIPMENT

(see also Section 4.6 – Settings list)

The safety system of the turboset complies with the requirements for functional safety which are described in IEC 61508/511 standards. These requirements are comprehensive ones and relate to the whole safety circuit, i.e. sensors, control system, and actuators. The selected safety instrumented functions (SIF) must comply with the requirements of the relevant category of the safety integrity level (SIL). If a SIF has a value of  $SIL \geq 1$  then, should this SIF fail, a machine equipment failure with serious consequences (like death of people) can occur.

In the case of protection circuits with relevance to SIL ( $SIL \geq 1$ ) must be tested before first commissioning and documented in the "Test report". Follow tests must be performed at maximum intervals of 3 years and recorded.

Before first commissioning and after a longer standstill all protection and safety devices (see following Sections 2.2.1, 2.2.2 and 2.2.3) should be tested and the actual response values recorded in a special report.

All safety devices and interlocks, all protections and open loops etc. are working via system TURLOOP S7.

### 2.2.1 LIST OF SAFETY INSTRUMENTED FUNCTIONS

	CRITERION	SIL	ITEM No.:
1.	Turbine exhaust steam pressure	SIL 2	MAA10 CP002 MAA10 CP003 MAA10 CP004
2.	Turbine extraction steam pressure	SIL 2	LBG10 CP001 LBG10 CP002 LBG10 CP003
3.	Condensate level in condenser	SIL 2	MAG10 CL101 MAG10 CL102 MAG10 CL103
4.	Turbine emergency trip push button - local panel	SIL 2	MAA10 CH101
5.	Turbine emergency trip push button - control room	SIL 2	MAA10 CH102
6.	Turbine emergency trip push button - TCC	SIL 2	MAA10 CH103
7.	External emergency trip – DCS Demand	SIL 3 ready	MAA10 CH104 MAA10 CH105 MAA10 CH106
8.	Turbine speed	SIL 3	MAD10 CS001 MAD10 CS002 MAD10 CS003

## 2.2.2 PROTECTION EQUIPMENT (EMERGENCY TRIPPING)

	CRITERION	UNIT	NORMAL VALUE	RESPONSE VALUE	ITEM
1.	Extraction steam pressure	bar(g)	9	> 12,2	LBG10 CP001 LBG10 CP002 LBG10 CP003 LBG10 CP901
2.	Exhaust steam pressure	bar(g)	-0,932	> -0,75	MAA10 CP002 MAA10 CP003 MAA10 CP004
3.	Turbine emergency trip push button - local panel			binary	MAA10 CH101
4.	Turbine emergency trip push button - control room			binary	MAA10 CH102
5.	Turbine emergency trip push button - TCC			binary	MAA10 CH103
6.	External turbinetrip - DCS demand			binary	MAA10 CH104 MAA10 CH105 MAA10 CH106
7.	Turbine rotor axial displacement	mm	± 0.1	> 0,6 < -0,6	MAD10 CG001 MAD10 CG002
8.	Turbine speed	rpm	5038	> 5542	MAD10 CS001 MAD10 CS002 MAD10 CS003
9.	Axial turbine bearing metal temperature - front/rear part	°C		>120	MAD10 CT001 MAD10 CT002
10.	Front radial turbine bearing metal temperature	°C		>120	MAD10 CT003
11.	Rear radial turbine bearing metal temperature	°C		>120	MAD20 CT001
12.	Relative shaft vibration (2A) – turbine front radial bearing	μm		> 127	MAD10 CY011 MAD10 CY012
13.	Relative shaft vibration (2A) – turbine rear radial bearing	μm		> 127	MAD20 CY011 MAD20 CY012

CRITERION	UNIT	NORMAL VALUE	RESPONSE VALUE	ITEM
14. Condensate level in condenser			binary	MAG10 CL101 MAG10 CL102 MAG10 CL103
15. Gear box radial bearing temperature	°C		>130	MAK10 CT001 MAK10 CT002 MAK10 CT003 MAK10 CT004
16. Gear box axial bearing temperature	°C		>130	MAK10 CT005 MAK10 CT006
17. Relative shaft vibration – gear box (2A) – pinion bearing	µm		> 103	MAK10 CY011 MAK10 CY012
18. Relative shaft vibration – gear box (2A) – wheel bearing	µm		> 137	MAK10 CY013 MAK10 CY014
19. Lube oil pressure	bar(g)	2	< 1	MAV40 CP001 MAV40 CP002 MAV40 CP003
20. Lube oil temperature	°C	49	> 65	MAV40 CT001 MAV40 CT002 MAV40 CT003
21. Valve block position 2 from 3 (valve 1,2,3)	bar(g)	140	< 90	MAX40 CP001 MAX40 CP002 MAX40 CP003
22. Generator protection action (summary pulse)			binary	MKA10 CE101
23. Generator front/rear radial bearing temperature	°C		> 95	MKD10 CT001 MKD20 CT001
24. Shaft vibration generator front radial bearing	µm		>190	MKD10 CY011 MKD10 CY012
25. Shaft vibration generator rear radial bearing	µm		>190	MKD20 CY011 MKD20 CY012

### 2.2.3 SAFETY DEVICES – ALARM SIGNAL

	CRITERION	UNIT	NORMAL VALUE	RESPONSE VALUE	ITEM
1.	Live steam pressure to turbine	bar(g)	127	> 133,4 < 120,6	LBA10 CP001
2.	Live steam temperature to turbine	°C	535	> 549 > 543 < 527	LBA10 CT001
3.	Extraction steam pressure	bar(g)	9	> 11,1 < 7,1	LBG10 CP001 LBG10 CP002 LBG10 CP003 LBG10 CP901
4.	Steam pressure behind control stage	bar(g)		>65,6	MAA10 CP001
5.	Exhaust steam pressure	bar(g)		> -0,8	MAA10 CP002 MAA10 CP003 MAA10 CP004 MAA10 CP901
6.	Exhaust steam temperature	°C		>120	MAA10 CT001 MAA10 CT002 MAA10 CT003 MAA10 CT903
7.	Turbine casing temperature difference – inside/center	°C		> 102	MAA10 CT901
8.	Turbine casing temperature difference – top/bottom	°C		> 39	MAA10 CT902
9.	Turbine rotor axial displacement	mm	± 0.1	> 0,4 < -0,4	MAD10 CG001 MAD10 CG002
10.	Turbine speed	rpm	5038	<300 <4	MAD10 CS001 MAD10 CS002 MAD10 CS003 MAD10 CS901
11.	Turbine axial bearing metal temperature	°C	max. 95	> 110	MAD10 CT001 MAD10 CT002
12.	Turbine front radial bearing metal temperature	°C	max. 90	> 110	MAD10 CT003



	CRITERION	UNIT	NORMAL VALUE	RESPONSE VALUE	ITEM
13.	Relative shaft vibration (2A) – turbine front radial bearing	μm		> 97	MAD10 CY011 MAD10 CY012
14.	Turbine rear radial bearing metal temperature	°C	max. 90	> 110	MAD20 CT001
15.	Relative shaft vibration (2A) – turbine rear radial bearing	μm		> 97	MAD20 CY011 MAD20 CY012
16.	Condensate level in condenser	-	-	binary	MAG10 CL101 MAG10 CL102 MAG10 CL103
17.	Turning gear cover position	-	-	binary	MAK10 CG101
18.	Gear box radial bearing temperature	°C	90	> 125	MAK10 CT001 MAK10 CT002 MAK10 CT003 MAK10 CT004
19.	Gear box axial bearing temperature	°C	90	> 125	MAK10 CT005 MAK10 CT006
20.	Relative shaft vibration – gear box (2A) – pinion shaft	μm		> 69	MAK10 CY011 MAK10 CY012
21.	Relative shaft vibration – gear box (2A) – gear shaft	μm		> 92	MAK10 CY013 MAK10 CY014
22.	Oil level in oil tank	mm	0	> 25 < -25	MAV10 CL001
23.	Oil temperature in oil tank	°C	49	>65	MAV10 CT001
24.	Oil temperature at heating elements	°C		> 65	MAV10 CT002 MAV10 CT003
25.	Pressure difference across lube oil filter	bar		> 1.2	MAV35 CP001

	CRITERION	UNIT	NORMAL VALUE	RESPONSE VALUE	ITEM
26.	Lube oil pressure	bar(g)	2	< 1,7	MAV40 CP001 MAV40 CP002 MAV40 CP003 MAV40 CP901
27.	Lube oil temperature	°C	49	> 55 < 35	MAV40 CT001 MAV40 CT002 MAV40 CT003 MAV40 CT901
28.	Jacking oil pressure	bar(g)	200	< 80	MAV70 CP001
29.	Gland steam pressure	bar(g)	0,03	> 0,1 < 0,01	MAW11 CP001
30.	Gland steam temperature	°C	220	> 245 < 195	MAW11 CT001
31.	Oil level in HP oil tank	mm		> 40 < -45	MAX10 CL001
32.	Oil temperature in HP oil tank	°C	50	> 75	MAX10 CT001
33.	Pressure difference across cool system filter	bar		> 2,2	MAX30 CP001
34.	Pressure difference across HP oil filter	bar		> 5	MAX35 CP001
35.	HP control oil pressure	bar(g)	140	< 115	MAX35 CP002
36.	Valve block position 2 from 3 (valve 1,2,3)	bar(g)	140	< 100	MAX40 CP001 MAX40 CP002 MAX40 CP003 MAX40 CP901
37.	Generator active power	MW	30	>32,8	MKA10 CE001
38.	Generator protection action (summary impulse)			binary	MKA10 CE101
39.	Generator breaker open			binary	MKA10 CE102
40.	Main breaker open			binary	MKA10 CE103
41.	Reverse power protection - deblockage			binary	MKA10 CE104

	CRITERION	UNIT	NORMAL VALUE	RESPONSE VALUE	ITEM
42.	Water leakage detector (generator)			binary	MKA10 CL110
43.	Generator stator winding temperature	°C	118	> 125	MKA10 CT010 MKA10 CT011 MKA10 CT020 MKA10 CT021 MKA10 CT030 MKA10 CT031
44.	Generator – cold air temperature	°C	38	> 43	MKA10 CT050 MKA10 CT052
45.	Generator – warm air temperature	°C	77	> 85	MKA10 CT060
46.	Generator front radial bearing metal temperature	°C	80	> 90	MKD10 CT010
47.	Shaft vibration – generator (2A) – front radial bearing	µm	83	> 150	MKD10 CY011 MKD10 CY012
48.	Generator rear bearing metal temperature	°C	80	> 90	MKD20 CT010
49.	Shaft vibration – generator (2A) – rear radial bearing	µm	83	> 150	MKD20 CY011 MKD20 CY012

## 2.2.4 SAFETY AND CONTROL EQUIPMENT – INTERLOCKS, OPEN LOOPS

<b>FUNCTIONAL GROUP “TURBINE”</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start FG	FG High pressure oil ON <i>and</i> FG Drainage ON <i>and</i> FG Lube oil supply ON <i>and</i> FG Turning gear ON <i>and</i> FG Condensation ON <i>and</i> Cooling water ON <i>and</i> Turbine exhaust steam pressure < -0,8 bar(g) (MAA10 CP002,3,4) <i>and</i> Lube oil temperature > 25 °C (MAV40 CT001,2,3) <i>and</i> Turbine speed > 4 rpm <i>and</i> HP control valves position < 2% <i>and</i> Emergency oil pump no failure <i>and</i> (No more than 90 min after the turbine speed has reached 90% rpm or Live steam pressure before ESV < 12 bar(g) (LBA10 CP001)) Protection not active except safety block 2oo3	
Stop FG	Turbine trip (impulse)	

<b>GENERATOR ANTI-CONDENSING HEATER (MKA10 AH110)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Start	Turbine speed < 300 rpm	Auto-mode
Stop	Turbine speed > 300 rpm	Auto-mode
Stop	Generator breaker closed	

<b>EXHAUST SPRAY SOLENOID (LCE30 AA410)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Open	Turbine speed > 300 rpm <i>and</i> Exhaust steam temperature > 80 °C (MAA10 CT001,2,3)	Auto-mode
Close	Generator active power > 5 MW (MKA10 CE001) <i>and</i> Exhaust steam temperature < 80 °C (MAA10 CT001,2,3)	Auto-mode
Close	Turbine trip – ESV closed	

<b>FUNCTIONAL GROUP “LUBE OIL SUPPLY”</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start FG	Oil level in oil tank > -25 mm (MAV10 CL001) <i>and</i> Emergency oil pump no failure (MAV25AP110)	
Release of stop FG	Speed < 4 rpm longer than 60 s <i>and</i> Casing flange temperature – inside < 100 °C (MAA10 CT012)	

<b>OIL HEATING ELEMENT (MAV10 AH110)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start	Oil temperature at element < 80 °C (MAV10 CT002,003) <i>and</i> Oil level in oil tank > -185 mm (MAV10 CL001)	
Start	Oil temperature at element < 65 °C (MAV10 CT002) <i>and</i> Oil temperature in oil tank < 30 °C (MAV10 CT001)	Auto-mode
Stop	Oil temperature in oil tank > 35 °C (MAV10 CT001) <i>or</i> Oil temperature at element > 65 °C (MAV10 CT002)	Auto-mode
Stop	Oil level in oil tank <-185 mm (MAV10 CL001) <i>or</i> Oil temperature at element > 80 °C (MAV10 CT002)	

<b>OIL TANK FAN (MAV10 AN110)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Start	Auxiliary oil pump ON (MAV15 AP110)	Auto-mode

<b>AUXILIARY OIL PUMP (MAV15 AP110)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start	Oil temperature in oil tank > 10 °C (MAV10 CT001) <i>or</i> Turbine speed < 4534 rpm (impulse 1 s)	
Start	Turbine speed < 4534 rpm (impulse 1s)	Auto-mode
Start	Lube oil pressure < 1.5 bar(g) (MAV40 CP001,2,3) <i>and</i> (Casing flange inside temperature > 100 °C (MAA10 CT012) <i>or</i> turbine speed > 4 rpm)	
Release of stop	Casing flange inside temperature < 100 °C (MAA10 CT012) <i>and</i> Turbine speed < 4 rpm <i>or</i> Turbine speed > 4534 rpm	
Stop	Turbine speed > 4534 rpm longer than 5 s impulse 1s	Auto-mode

<b>EMERGENCY OIL PUMP (MAV25 AP110)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start	Oil temperature in oil tank > 25 °C (MAV10 CT001)	
Start	Lube oil pressure < 0,9 bar(g) (MAV40 CP001,2,3) <i>or</i> Auxiliary oil pump OFF (MAV15 AP110) <i>and</i> lube oil pressure < 1,5 bar(g) (MAV40 CP001,2,3) longer than 2 s	Speed > 4 rpm <i>or</i> casing flange inside temperature >100°C (MAA10 CT012)
Release of stop	Casing flange inside temperature < 100 °C (MAA10 CT012) <i>and</i> Turbine speed < 4 rpm <i>or</i> Lube oil pressure > 0,9 bar(g) (MAV40 CP001,2,3)	

FUNCTIONAL GROUP "TURNING GEAR"		
OPERATION	RESPONSE VALUE	CONDITION
Release of start FG	Turning gear cover closed (MAK10 CG101) <i>and</i> Lube oil pressure > 0.5 bar(g) (MAV40 CP001,2,3) <i>and</i> Rotor axial position < 0.6 mm or > -0.6 mm (MAD10 CG001,2)	
Release of stop FG	Casing flange temperature – inside < 100 °C (MAA10 CT012)	
Stop FG	Turning gear motor (MAK10 AE110) failure <i>or</i> (Turning gear cover open <i>and</i> lube oil pressure < 0.5 bar(g) <i>and</i> rotor axial position > 0.6 mm or < -0.6 mm)	Auto-mode

TURNING GEAR MOTOR (MAK10 AE110)		
OPERATION	RESPONSE VALUE	CONDITION
Release of start	Turning gear cover closed (MAK10 CG101) <i>and</i> Lube oil pressure > 0,5 bar(g) MAV40 CP001,2,3) <i>and</i> Rotor axial position < 0.6 mm or > -0.6 mm (MAD10 CG001,2) <i>and</i> (Turbine speed < 300 rpm (impulse 3 s) <i>or</i> Turbine speed < 4 rpm <i>and</i> jacking oil pressure > 20 bar(g) (MAV70 CP001) delay 10s)	
Start	(Turbine speed < 300 rpm) (impulse 3 s) <i>or</i> Turbine speed < 4 rpm) <i>and</i> FG Turning gear ON	Auto-mode
Release of stop	Turbine speed > 300 rpm <i>or</i> Turbine trip – ESV closed	
Stop	Turbine speed > 300 rpm <i>and</i> FG Turning gear ON (impulse 5 s)	Auto-mode
Stop	Turning gear cover not closed (MAK10 CG101) <i>or</i> Lube oil pressure > 0,5 bar(g) MAV40 CP001,2,3) <i>or</i> Rotor axial position < 0,6 mm or > -0,6 mm (MAD10 CG001,2) <i>or</i> (Jacking oil pressure < 20 bar(g) (MAV70 CP001) <i>and</i> Turning gear motor ON longer than 10 s	

JACKING OIL PUMP (MAV70 AP110)		
OPERATION	RESPONSE VALUE	CONDITION
Release of start	Lube oil pressure > 0,5 bar(g) (MAV40 CP001,2,3)	
Start	Turbine speed > 4 rpm <i>and</i> Turbine speed < 300 rpm	Auto-mode
Stop	Turbine speed > 300 rpm <i>or</i> Turbine speed < 4 rpm longer than 10 s	Auto-mode
Stop	Lube oil pressure < 0,5 bar(g) (MAV40 CP001,2,3)	

<b>FUNCTIONAL GROUP “DRAINAGE”</b>		
OPERATION	RESPONSE VALUE	CONDITION
Start FG	Generator active power < 3 MW (MKA10 CE001) <i>or</i> Generator breaker open	Auto-mode
Release of stop FG	Turbine trip – ESV closed <i>or</i> Generator breaker closed <i>or</i> FG gland steam OFF	
Stop FG	Generator active power > 7 MW (MKA10 CE001) <i>and</i> Casing flange temperature - inside >180°C <i>and</i> Generator breaker closed	Auto-mode

<b>DRAIN VALVE OF ESV (MAL05 AA910)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Open	Turbine trip - ESV closed	Auto-mode
Close	Turbine speed > 4534 rpm	Auto-mode

<b>DRAIN VALVE OF VALVE CHAMBER AND BEHIND 3<sup>RD</sup> CV (MAL10 AA910; MAL15 AA910)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Open	HP control valve 3 position <5% <i>and</i> Turbine no trip - ESV open	
Open	HP control valve 3 position <5%	Auto-mode
Close	HP control valve position > 10% (MAA10 CG003) longer 20 s	Auto-mode

<b>DRAIN VALVE BEHIND 2<sup>ND</sup> CV (MAL20 AA910)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Open	HP control valve 3 position <5% <i>and</i> Turbine no trip - ESV open	
Open	HP control valve 3 position <5%	Auto-mode
Close	HP control valve position > 10% longer 20 s	Auto-mode

<b>DRAIN TANK SPRAY (LCE30 AA410)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Valve open	Turbine NO TRIP <i>and</i> (Control valve chamber drain valve OPEN <i>or</i> Drain after 2. ctrl valve OPEN <i>or</i> Drain after 3. ctrl valve OPEN)	Auto-mode
Valve close	Control valve chamber drain valve CLOSE <i>and</i> Drain after 2. ctrl valve CLOSE <i>and</i> Drain after 3. ctrl valve CLOSE <i>or</i> Turbine TRIP - delay 120s	Auto-mode

<b>FUNCTIONAL GROUP “HIGH PRESSURE OIL”</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start FG	Oil level in HP oil tank > -270 mm (MAX10 CL001)	
Stop FG	Oil level in HP oil tank < -270 mm (MAX10 CL001)	Auto-mode

<b>HP OIL PUMP (MAX21 AP110)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start	Oil level HP oil tank >-270 mm (MAX10 CL001) <i>and</i> Oil temperature - HP oil tank >20°C (MAX10 CT001)	
Start	HP oil pump No.2 (MAX22 AP110) is selected as operating <i>and</i> HP oil pressure <110 bar(g) (MAX35 CP002) longer than 5s. <i>or</i> HP oil pump No.2 failure	Preselected stand by
Stop	Oil level HP oil tank <-270 mm (MAX10 CL001)	

<b>HP OIL PUMP (MAX22 AP110)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start	Oil level HP oil tank >-270 mm (MAX10 CL001) <i>and</i> Oil temperature - HP oil tank >20°C (MAX10 CT001)	
Start	HP oil pump No.1 (MAX21 AP110) is selected as operating <i>and</i> HP oil pressure <110 bar(g) (MAX35 CP001) longer than 5s. <i>or</i> HP oil pump No.1 failure	Preselected stand by
Stop	Oil level HP oil tank <-270 mm (MAX10 CL001)	

<b>HP OIL COOLING FAN (MAX30 AN110)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start	HP oil cooling pump ON (MAX30 AP110)	
Start	Oil temperature - HP oil tank >55°C (MAX10 CT001) <i>and</i> HP oil cooling pump (MAX30 AP110) ON	Auto-mode
Stop	Oil temperature - HP oil tank <50°C (MAX10 CT001) <i>or</i> HP oil cooling pump (MAX30 AP110) OFF	Auto-mode

<b>HP OIL COOLING PUMP (MAX30 AP110)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start	Oil level HP oil tank >-270mm (MAX10 CL001)	
Start	HP oil pump No.1 ON (MAX21 AP110) <i>or</i> HP oil pump No.2 ON (MAX21 AP110)	Auto-mode
Release of stop	Oil level HP oil tank <-270mm (MAX10 CL001)	

<b>HP OIL TANK HEATER (MAX10 AH110)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start	Oil level HP oil tank >-270mm (MAX10 CL001) <i>and</i> Oil temperature - HP oil tank <80°C (MAX10 CT001)	
Start	Oil temperature - HP oil tank <20°C (MAX10 CT001)	Auto-mode
Release of stop	Oil level - HP oil tank <-270mm (MAX10 CL001) <i>or</i> Oil temperature - HP oil tank >80°C (MAX10 CT001)	
Stop	Oil temperature - HP oil tank >25°C (MAX10 CT001)	Auto-mode



<b>FUNCTIONAL GROUP “GLAND STEAM”</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of start FG	Turbine speed > 4 rpm <i>and</i> FG Drainage ON	
Release of stop FG	Turbine exhaust steam pressure > -0.2 bar(g) (MAA10 CP002,3,4) <i>or</i> Turbine speed < 4 rpm (MAD10 CS001,2,3) longer than 60 s (impulse 3s)	
Stop FG	Turbine speed < 4 rpm (MAD10 CS001,2,3) longer than 60 s (impulse 3s)	Auto-mode

<b>GLAND STEAM TEMPERATURE CONTROL VALVE (LCE10 AA210)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of opening	Turbine speed > 4 rpm	
Close	Turbine speed < 4 rpm longer than 60 s	

<b>GLAND STEAM PRESSURE CONTROL VALVE (MAW10 AA210)</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of opening	Turbine speed > 4 rpm	
Close	Turbine speed < 4 rpm longer than 60 s	

<b>FUNCTIONAL GROUP “TESTING”</b>		
<b>ESV TEST</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of test	ESV open (MAA10 CG111) <i>and</i> ESV no close (MAA10 CG112) <i>and</i> ESV no close (MAA10 CG113) <i>and</i> No turbine trip	

<b>CV TEST</b>		
OPERATION	RESPONSE VALUE	CONDITION
Release of test	ESV close (MAA10 CG112,113) <i>and</i> Turbine trip <i>and</i> Speed < 300 rpm.	
OFF	(CV test ON <i>and</i> speed > 300 rpm) <i>or</i> ESV position NOT CLOSE (MAA10 CG112,113) <i>or</i> Test value failure	

## 2.2.5 EMERGENCY STOP VALVE

KKS Code MAA10AA910  
 Type SSV (single seat diffuser)  
 Size DN 200 PN 250  
 Manufacturer Siemens

## ACTUATOR

Manufacturer SIEMENS  
 Type 100/40/80  
 Working oil pressure 140 bar(g)  
 Temperature of operating medium 10÷65 °C  
 Stroke of piston rod 67+3mm

## 2.2.6 NON RETURN SWING CHECK VALVES WITH ACTUATOR

Manufacturer Armatury Group a.s.  
 Type C 09,6 - disc  
 Actuator pneumatic SERVOVALVE RHM  
 Solenoid valve supply: 24V DC  
 Type of switches: contactless, 2-wire NAMUR connection

## • BLEED 2 LBS20AA910

size DN 400, PN 16  
 actuator type AIR TORQUE AT 351 US09  
 weight 572 kg

Condition		maximal	design
pressure	barg	2,8	4
temperature	°C	142	220

## • BLEED 3 LBQ10AA910

size DN 100, PN 40  
 actuator type AIR TORQUE AT 301 US09  
 weight 148 kg

Condition		maximal	design
pressure	barg	17,8	20
temperature	°C	293,1	330

## • BLEED 4 LBQ20AA910

size DN 80, PN 63  
 actuator type AIR TORQUE AT 301 US09  
 weight 125 kg

Condition		maximal	design
pressure	barg	33,3	38
temperature	°C	367,6	385

- **EXTRACTION LBG10AA910**  
size DN 500, PN 25  
actuator type AIR TORQUE AT 401 US09  
weight 390 kg

Condition		maximal	design
pressure	barg	9	10
temperature	°C	229,5	320

### 2.2.7 SHUT-OFF FLAPS

Manufacturer Armatury Group a.s.  
Type C 09,6 - disc  
Position sensor KINAX WT 711

- **BLEED 2 LBS20AA510**  
size DN 400, PN 16  
weight 530 kg

Condition		maximal	design
pressure	barg		4
temperature	°C		220

- **BLEED 3 LBQ10AA510**  
size DN 100, PN 40  
weight 127 kg

Condition		maximal	design
pressure	barg		20
temperature	°C		330

- **BLEED 4 LBQ20AA510**  
size DN 80, PN 63  
weight 105 kg

Condition		maximal	design
pressure	barg		38
temperature	°C		385

- **EXTRACTION LBG10AA910**  
size DN 400, PN 25  
weight 358 kg

Condition		maximal	design
pressure	barg		10
temperature	°C		320

## 2.2.8 CONDENSER SAFETY DIAPHRAGM MAG10AA310

Manufacturer	REMBE GmbH
Pieces	1
Size	DN200
Type	BT-ODV-F-20
Rupture	1 bar

## 2.3 CONTROL SYSTEM

(appert. diagrams see Section 4, 6 and manuals should find at the set of components documentation)

### 2.3.1 ELECTRONIC CONTROL SYSTEM TURLOOP S7

(see also TURLOOP Manual for detail information)

The electronic system TURLOOP has the following functions:

- speed control
- load adjusting
- control – inlet steam pressure control
  - power control
  - frequency control
  - extraction steam pressure
- limiting control – outlet steam pressure max.
  - inlet steam pressure min
  - generator active power max.
  - steam pressure behind control stage max.
  - extraction steam pressure max.

#### KKS DEFINITION

MAY30 DS001	SPEED GOVERNOR
MAY30 DS002	FREQUENCY GOVERNOR
MAY30 DP001	LIVE STEAM PRESSURE GOVERNOR
MAY30 DE001	GENERATOR ACTIVE POWER GOVERNOR
MAY24 DP001	EXTRACTION STEAM PRESSURE GOVERNOR
MAY30 DP021	LIVE STEAM PRESSURE LIMITER – MIN
MAY30 DP023	EXHAUST STEAM PRESSURE LIMITER – MAX
MAY25 DP021	EXTRACTION STEAM PRESSURE LIMITER – MAX
MAY30 DP024	STEAM PRESSURE BEHIND CONTROL STAGE LIMITER – MAX
MAY30 DE021	GENERATOR ACTIVE POWER LIMITER – MAX

Moreover the safety equipment (tripping, alarms, open loops etc.) are working via the TURLOOP system too.

### 2.3.2 HP HYDRAULIC BLOCK

(see also documentation of sub-deliveries and the Description in Section 3.2))

The high pressure hydraulic block supplies the control oil for the actuators of the emergency stop valve and for the control valves.

A part of this unit is the “HP safety block 2 out of 3”, controlling the closing of emergency stop valve and of the control valves by means of tripping pressure in the case of turbine trip.

The control system, using the fire-resistant control oil, is quite separated from the lubrication oil system.

## 2.3.3 HIGH PRESSURE HYDRAULIC BLOCK (description see Section 3.2)

KKS Code	MAX10
Manufacturer of the block	REXROTH Bosch Group
Type (hydraulic diagram)	HS-058-F802-2-c
Oil quality	ISO VG 46
Oil tank capacity	250 l

### 2.3.3.1 Oil pumps for control oil

pump: manufacturer	REXROTH
KKS code	MAX21AP110, MAX22AP110
type	
number of pieces	2 pcs
speed	1450 RPM
outlet pressure	14,0 MPa(g)
oil flow	28 l/min
drive: motor type	EL-MOTOR 1LA7163-4AA96-Z L2X
speed	1450 RPM
power	7,5 kW
current	380 V/50 Hz

### 2.3.3.2 Oil pump for cooling system

pump manufacturer	REXROTH
KKS code	MAX30AP110
type	PVV1-1X/027RA15UMB
speed	1450 RPM
outlet pressure	1,0 MPa(g)
oil flow	37 l/min.
drive:	EL-MOTOR
type	1LA7090-4AA91-Z
speed	1450 RPM
power	1,1 kW
current	3 ph., 380 V, 50 Hz

filtration element	3µm
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### 2.3.3.3 Oil cooler

KKS code	MAX30AN110
Type	AC2-016-4-X -00-000-0-0
Fan electromotor	380 V/50 Hz

### 2.3.3.4 Control oil filters

KKS code	MAX35AT010
type	duplex, H3XLB00-V5,0-M-R4
filtration element	3µm

### 2.3.3.5 Oil accumulator

Manufacturer	REXROTH
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KKS code	MAX35BB010
type	EHV20,0-330/88-01125
capacity	20 l
filling pressure (without oil pressure)	9 MPa(g)

### 2.3.3.6 Oil tank heater element

KKS code	MAX10AH110
type	AB32-10/3 E220
El. values	3kW/380V

## 2.3.4 HP CONTROL VALVES WITH ACTUATORS

(see also Section 3 and Section 6 – adjusting of control vales)

### 2.3.4.1 HP control valves with actuators

Type of valves	CV30 (single seat)
Number of control valves	3 pcs
Number of actuators	3 pcs (one for each vlave)
Control valve No. 1 MAA10AA210	
difusor size	ø55 mm
number of nozzles	12
total lift	25mm
Control valve No. 2 MAA10AA220	
difusor size	ø50 mm
number of nozzles	10
total lift	25mm
Control valve No. 3 MAA10AA230	
difusor size	ø50 mm
number of nozzles	9
total lift	25mm

The control valve No. 2 starts to open when the lift of the control valve No. 1 is 10 mm.  
The control valve No. 3 starts to open when the lift of the control valve No. 2 is 10 mm.

ACTUATORS	
manufacturer	VOITH TURBO
number of pcs	3
type	SMR A 41241-S
rated stroke	50 mm
electrical input signal	4-20 mA
indication range for position 0-100%	4-20 mA
permissible ambient temperature	-20 .....+80 °C
oil pressure rated/max.	140/180 bar(g)
weight	210 kg

### 2.3.5 LP ADAPTIVE SHUTTER (ADAPTIVE STAGE) WITH ACTUATOR

(see also Section 3 and Section 6 – Control Valves Setting)

Number	1
KKS code	1MAA10 AA240
Manufacturer	WOITH
Actuator type	SMR A41241
Type	movable blades
Effective stroke	34.24 mm



## 2.4 LUBE OIL SYSTEM

(app. drawing see Section 4.6)

### 2.4.1 OIL PLANT GENERAL DATA

Oil quality (see also Section 6)	ISO VG 46
Kinematic viscosity	41,4 - 50,6 cS
Lube oil pressure	2 bar(g)
Lube oil temperature	49 °C

### 2.4.2 OIL TANK

KKS code	MAV10BB010
Manufacturer	Siemens Industrial Turbomachinery s.r.o.
Design	as base frame for gear box

(see drawing LEVELS IN OIL TANK in section 3.)

### 2.4.3 LEVEL AND TEMPERATURE INDICATOR

KKS code	MAV10CL001, MAV10CT001
Manufacturer	BÜHLER
Type	NIVOTEMP 13 K-2 LV-45950/02
Pcs	1 ks
Flange conection	DN 80 PN16
Operating temperature	60 - 65 °C
Voltage	24 V / DC ± 8V
power	2 x 0,5 W
weight	4,8 kg

### 2.4.4 LEVEL MEASURING

KKS code	MAV10CL501
Manufacturer	KSR KUBLER
Type	UTN 80/16/C-L900
Pcs	1 ks
Flange conection	DN 80 PN16
Operating temperature	60 - 65 °C
Voltage	24 V / DC ± 8V
power	2 x 0,5 W
weights	16 kg

### 2.4.5 SPRING RELIEFE VALVE

KKS code	PCB30 AA310, 320
Manufacturer	ARMATURY GROUP
Type	Fig. 67.962
design	Flange conection
dimension	DN15 PN100
Opening presure $p_0$	10 bar(g)
Operating presure max.	12 bar (g)
medium	Cooling water
Operating temperature max.	50 °C
weight	1,2 kg
pcs	2

## 2.4.6 OIL MIST SEPARATOR

KKS code	MAV10 AN110
Filter	
Manufacturer (complete unit)	Franke-Filter GmbH
Number of pieces	1
Filter type	FF2-099
flow max.	156,8 m <sup>3</sup> /h
drive :	el. motor
power	1,5 kW
speed	3000 RPM
current	3-ph, 380V, 50Hz

## 2.4.7 MAIN OIL PUMP

KKS code	MAV10 AP010
Manufacturer	ALLWEILER
Type	SNFG 1300-46
Construction	screw spindle type
Operating speed	1300 RPM
Operating pressure	8 bar(g)
Drive	low speed gearbox shaft
Capacity min.	1275 l/min
Oil type	ISO VG 46
Oil temperature operation/start up	65/20°C

## 2.4.8 AUXILIARY OIL PUMP

KKS code	MAV15 AP110
Manufacturer	ALLWEILER
Type	NSSV 50-250
Construction	impeller type
Operating speed	2900 RPM
Operating pressure app.	7bar(g)
Capacity (65°)	1250 l/min
Drive	el.motor
Manufacturer	SIEMENS
Type	200L
Design power	23 kW
Current	3ph. 380 V/50 Hz
Speed	2900 RPM
weight	285 kg

## 2.4.9 EMERGENCY OIL PUMP

KKS code	MAV25 AP110
Manufacturer	ALLWEILER
Type	VKF BS 280 R 43
Construction	screw spindle type
Operating speed app.	3000 RPM
Operating pressure	2,5 bar(g)
Capacity (65°C)	575 l/min
Drive	el.motor
Manufacturer	WINKELMANN
Type	GNFZE 132/2

Speed	3000 rpm
Voltage	220 V DC
Power	6,6 KW
weight	73 kg

## 2.4.10 OIL COOLER

KKS code	MAV30 AC010,020
Manufacturer	GEA BLOKSMA
Type	P28-1P-L=2000
Construction- size	TUBE type, 2x100%
Heat to be dissipated	596 kW
OIL SIDE	oil ISO VG46
Fluid flow	63,60 m <sup>3</sup> /h
operating pressure	16 bar(g)
inlet oil temperature	70 °C
outlet oil temperature	49 °C
pressure loss app.	0,27 bar
WATER SIDE	36% Glycol
flow (normal)	85 m <sup>3</sup> /h
inlet temperature, max.	30 °C
temperature outlet app.	36,67 °C
operating pressure	10 bar(g)
pressure loss app.	0,26 bar each
heat transfer surface	11,96 m <sup>2</sup>
weight empty app.	243 kg each

## 2.4.11 OIL FILTER

KKS code	MAV35 AT010,020
Manufacturer	BOLL
Type	BFD 330.670 DN125 PN16
Construction	twin, 2x100%
Flow nominal	1113 l/min
Operating pressure app.	6 bar(g)
Filtration level	ISO 4406-18/16/13
Fouling indication	electrical

## 2.4.12 OIL MIST SEPARATOR

KKS code	MAV10 AT020
Manufacturer	FRANKE FILTER
Type	FF2-099.10275
Flow nominal	120 m <sup>3</sup> /hod
Drive	el.motor
Manufacturer	SIEMENS
Type	1LA7083-2AA
Speed	3315 1/min
Voltage	200-240/345-415 V, 50 Hz
Power	1,3 KW

## 2.4.13 OIL PRESSURE SAFETY VALVE

KKS code	MAV20 AA330
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Manufacturer	SIEMENS
Type:	KALB DN 150 PN40
Oil flow max. at oil pressure	3000 l/min 10,7 bar(g)

## 2.4.14 OIL PRESSURE CONTROL VALVE

KKS code	MAV20 AA330
Manufacturer	DRESSER
Type:	526
Dimension	DN80 PN16
temperature range	35-49 °C
Oil flow.	200-1300 l/min
Controlled pressure	2,5 bar(g)
weight	19 kg
actuator	<b>10900 /Regulating Diaphragm</b>

## 2.4.15 OIL HEATER

KKS code	MAV10 AH110
Manufacturer	ELMESS, Germany
Type	HF-12
Power	12 kW
Current	3x380 V/50 Hz
Temperature sensor	2xPT100
Signal output	2x analog signal 4-20mA

## 2.4.16 OIL TEMPERATURE CONTROL VALVE

KKS code	MAV30 AA210
Manufacturer	AMOT, England
Type	4BR DC 115 07-00 ACU
Dimension	DN100 PN16
Controlled temperature (outlet)	49 °C
Upstream temperature, max.	70°C
Operating pressure app.	6,5 bar(g)
Oil flow max.	1600 l/min
Weight	61 kg

## 2.4.17 JACKING OIL PUMP

KKS code	MAV70 AP110
Manufacturer	PARKER Hannifin s.r.o. Czech Republic
Unit type	HPU-PRG
Pump: type	F11-019-RB-CH-K-000
speed	1460 1/min
operating pressure	200 bar(g)
flow	22 l/min
Drive	electromotor
manufacturer	SIEMENS
type	1LA7 163-4AA96
speed	1460 1/min
power	11 kW
current	3 ph., 380 V, 50 Hz

## 2.5 STEAM AND GLAND SYSTEM

### 2.5.1 STEAM QUALITY

(see Section 6)

### 2.5.2 LIMIT VALUES FOR INLET STEAM PRESSURE AND TEMPERATURE

acc. IEC Standard 45-1:1991-05

(see Section 2., 4., and 6.)

### 2.5.3 GLAND SYSTEM

#### 2.5.3.1 SEALING STEAM FOR GLANDS (NEW AND COOLED INLET STEAM)

Front gland

- pressure app. 0,03 bar(g)
- temperature 478 °C
- flow: app. 194,4 kg/hod

Rear gland

- pressure app. 0.03 bar(g)
- temperature 220°C
- flow app. 172,8 kg/h

#### 2.5.3.2 Exhausted air-steam mixture from glands

- flow app.: steam + air (new glands) 151,2 kg/h
- pressure app. 0.995 bar(a)
- temperature 299°C

### 2.5.4 PRESSURE REDUCING AND DESUPERHEATING STATION

#### Steam control valve MAW10 AA210 with pneumatic actuator

- valve: manufacturer G-TEAM
- type AZ 23
- size DN40/150 PN400/63
- Operating pressure – inlet: 25÷128 [bara] Design: 135 [bara]
- Operating pressure – outlet: 1,06÷1,23÷1,61 [bara]
- Operating temperature: 323÷535 [°C] Design: 543 [°C]
- Valve design: Straight
- Valve stroke: 18 [mm]
- Kvs: 2,5 [m3/h]
- Actuator: Pneumatic: Type 5222-2-19-2-1-0-1
- Positioner: TZID-C 18345-101016-1001, kit125
- Filter regulator: F63
- Lock up relay: EIL201
- Necessary force open / close: 7 [kN]
- Weight of valve / actuator: 28 / 33 [kg]

#### Condensate control valve LCE10 AA210 with pneumatic actuator

- valve: manufacturer G-TEAM
- type V726 DKVNA
- size DN15 PN40
- Operating pressure – inlet: 21 [bara] Design: 26 [bara]

Operating pressure – outlet:	1,17÷2÷16 [bara]
Operating temperature:	45 [°C] Design: 80 [°C]
Valve design: Straight	
Valve stroke:	10 [mm]
Kvs:	0,016 [m <sup>3</sup> /h]
Actuator: Pneumatic:	Type 5222-1-02-2-1-0-1
Positioner:	TZID-C 18345-101016-1001, kit125
Filter regulator:	F63
Lock up relay:	EIL201
Necessary force open / close:	0,58 [kN]
Weight of valve / actuator:	3 / 33 [kg]

**Desuperheater MAW11AA510**

- valve: manufacturer	G-TEAM
size	DN100 PN63
type	VCHT 1-100-15150-1S/40
Steam inlet pressure:	p1 = approx. 1,06÷1,23÷1,61 [bara]
Steam outlet pressure:	p2 = 1,03 [bara]
Steam inlet temperature:	t1 = approx 295,3÷474,8 [°C]
Steam outlet temperature:	t2 = 220 [°C]
Weight	30 [kg]
Cooling water:	
Water inlet pressure	21 [bara] Design: 26 [bara]
Water inlet temperature	45 [°C] Design: 80 [°C]
Dimension: DN15 PN40	

**Safety valve MAW11AA310**

• valve: manufacturer	BOPP & REUTHER
type	Si 6103.59 A-CrMo
size	DN80/128 PN100/40
weight	80 kg
opening pressure	6,0 barg
liquid temperature	490°C

**2.5.5 STEAM TRAPS IN THE DRAIN PIPING**

Manufacturer	GESTRA
Type	BK
DRANAGE OF VALVE CHAMBER	
KKS code	MAL15AA520
Type	MAL20AA520
Dimension	BK212
Operation pressure	DN25 PN500
Operation temperature	127 barg
Weight	535°C
	5 kg
DRAIN BEHIND CONTROL STAGE	
KKS code	MAL25AA520
Type	BK29
Dimension	DN25 PN160
Operation pressure	57 barg

Operation temperature 436°C  
Weight 5 kg

## DRAIN OF TURBINE CASING BLEED 4

KKS code MAL30AA520  
Type BK28  
Dimension DN25 PN100  
Operation pressure 34 barg  
Operation temperature 369°C  
Weight 5 kg

## DRAIN OF TURBINE CASING BLEED 3, 2,1

Type BK45

KKS code MAL40AA520  
Dimension DN25 PN40  
Operation pressure 19 barg  
Operation temperature 314°C

KKS code MAL65AA520  
Dimension DN25 PN40  
Operation pressure 3 barg  
Operation temperature 204°C  
Weight 5 kg

KKS code MAL85AA520  
Dimension DN25 PN40  
Operation pressure -1 barg  
Operation temperature 114°C  
Weight 5 kg

## DRAIN OF TURBINE BALANCE PISTON AK 2

KKS code MAL80AA520  
Type BK45  
Dimension DN25 PN40  
Operation pressure -1,0 barg  
Operation temperature 398°C

## DRAIN OF TURBINE CASING EXTRACTION

KKS code MAL55AA520  
Type BK28  
Dimension DN25 PN40  
Operation pressure 9 barg  
Operation temperature 306°C  
Weight 5 kg

## 2.5.6 DRAINAGE CONTROL VALVES

Manufacturer ARMATURY GROUP  
Type V 46 243AG  
KKS code MAL15AA910  
MAL10AA910  
MAL20AA910  
Dimension DN25 PN400

Actuator	pneumatic
Solenoid valve	24V DC
pressure air:	6kg/cm <sup>2</sup>
Tnom	40°C
Manufacturer	ARMATURY GROUP
Type	V 46 243AG
KKS code	MAL25AA910
	MAL30AA910
Dimension	DN25 PN100
Actuator	pneumatic
Solenoid valve	24V DC
pressure air:	6kg/cm <sup>2</sup>
Tnom	40°C
Manufacturer	ARMATURY GROUP
Type	V 30 124 440 FIG 218 SNP
KKS code	MAL40AA910
	MAL55AA910
	MAL65AA910
	MAL80AA910
	MAL85AA910
Dimension	DN25 PN40
Actuator	pneumatic
Solenoid valve	24V DC
pressure air:	6kg/cm <sup>2</sup>
Tnom	40°C

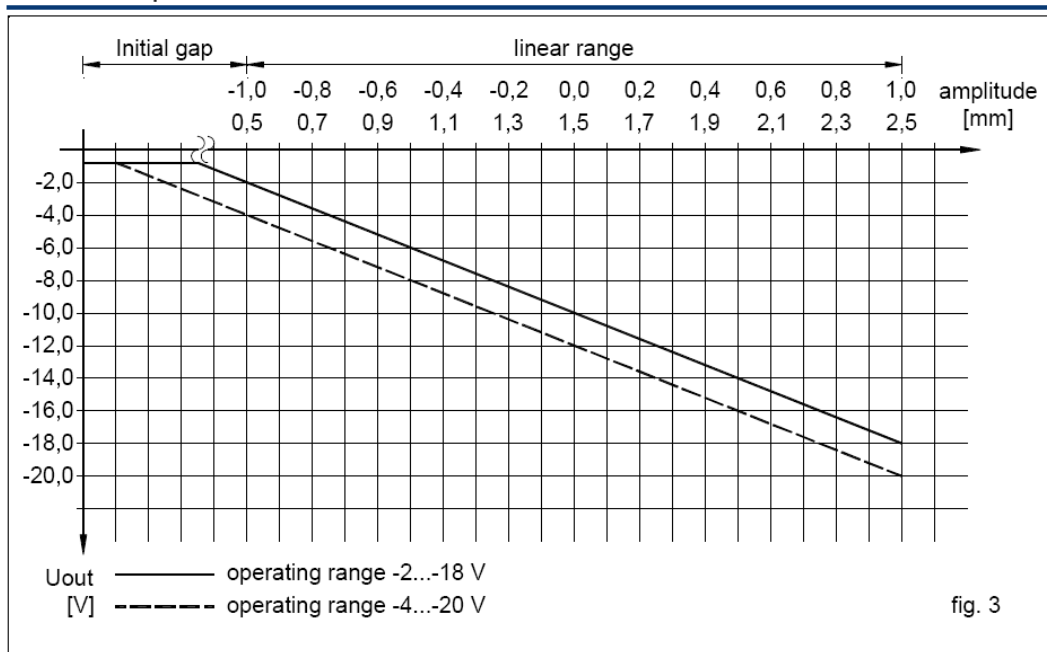


## 2.6 TURBOSET - SPECIAL INSTRUMENTATION

### 2.6.1 SPEED

Manufacturer	EPRO, Germany
Probe type	PR 6423
Speed monitor type	CON 041
Number of pieces 3	MAD10CS001,002,003
Static measuring range	$\pm 39.4$ mils [ $\pm 1,0$ mm]
Nominal gap (centre of measuring range)	59 mils [1,5 mm]
Sensitivity	8 V/mm
Operating temperature range	$-35...+180^{\circ}\text{C}$
Current output	$-4...-20$ mA
Vibration and shock (nominal values at max. 25C)	5 g at 60 Hz

Static output characteristic:



### 2.6.2 AXIAL ROTOR DISPLACEMENT

Manufacturer	BENTLY NEVADA, USA
Probe type	330103-00-03-50-02-00
Number of pieces turbine 2	MAD10CG001, 002
Linearity range	(20-100) mils [(0.5-2.5)mm]
Air gap normal	(40 $\pm$ 8) mils [(1 $\pm$ 0,2) mm]
Scale factor	7.87/40 mils [7.87 V/mm]

### 2.6.3 SHAFT RELATIVE VIBRATION

Manufacturer	BENTLY NEVADA, USA
Type	330103-00-03-50-02-00
Number of pieces: turbine 4	MAD10CY011, 012, MAD20CY011, 012
Linearity range	(20-100) mils [(0.5-2.5)mm]
Air gap normal	(40 $\pm$ 8) mils [(1 $\pm$ 0,2) mm]
Scale factor	7.87/40 mils [7.87 V/mm]

## 2.6.4 SHAFT RELATIVE VIBRATION

Manufacturer	BENTLY NEVADA, USA
Type	330103-00-03-50-02-00
Number of pieces:	gearbox 2 generator 2
	MAK10CY011, 012, 013, 014 MKD10CY011,012 MKD20CY011,12
Linearity range	(20-100) mils [(0.5-2.5)mm]
Air gap normal	(40±8) mils [(1 ± 0,2) mm]
Scale factor	7.87/40 mils [7.87 V/mm]

## 2.6.5 BEARING METAL TEMPERATURE

Manufacturer (only for turbine)	DITTMER
Type (only for turbine)	LV 057275/01
Measuring range	32-392°F [0-200 °C]
Turbine	2pcs - axial 2 pcs - radial
	MAD10 CT001 MAD10CT002 MAD10 CT003 MAD20 CT001

## 2.6.6 OIL LEVEL IN OIL TANK

A) Level and temperature measuring device	MAV10CL001, MAV10CT001
Manufacturer	BÜHLER, Germany
Type	NIVOTEMP 13 K-2
Number of pieces	1
Outlet signal: level = 0-28 in (0-175 mm)	4-20 mA
temperature = 0-212 °F (0-100 °C)	4-20 mA
Protection class	IP 65
The level gauge gives ALARM signal at min. and max. oil level in oil tank.	
The temperature measuring gives the signal for switching OFF/ON the oil heater in oil tank at oil temperature 35/30 °C.	

## 2.6.7 TURBINE CASING TEMPERATURE

Manufacturer (only for turbine)	SIEMENS
Type	7MC2021-4LC
KKS code	MAA10CT012, 013, 015, 016
Measuring range	0-600 °C
Thermocouples	Type K
Length	300 mm

## 2.6.8 LUBRICATION OIL TEMPERATURE

Manufacturer (only for turbine)	SIEMENS
Type	7MC1008-6DA14-Z
Item no.	MAV40CT001, 002, 003
Measuring range	0-100 °C
Resistance thermometers	PT100, 3 - wire connection

## 2.6.9 LUBRICATION OIL PRESSURE TRANSMITTER

Manufacturer	SIEMENS
Type	4MF4033-1CA00
Item no.	MAV40CP001, 002, 003
Measuring range	0-4 barg
Resistance thermometers	2 - wire

## 2.7 GEAR BOX MAK10

Manufacturer	FLENDER-GRAFFENSTADEN
Type	TX : 80/3 WITH PARALLEL SHAFTS
Serial No:	<b>11189 to 11205</b>

### GEAR DATA

Gear rated power :	32435 kW
Service factor :	AGMA 421/06 >=1.3
Rated speed LS :	1500 RPM
Rated speed HS :	5038 RPM
Speed ratio LS/HS :	3.36

### CONSTRUCTION FEATURES

Centerlines distance :	825 mm
Total weight :	14200 kg
Upper casing weight :	1800 kg
Lower casing weight :	4200 kg
High speed shaft weight :	793,1 kg
Low speed shaft weight :	5405.1 kg

### LUBRIFICATION

Lube oil designation :	ISO VG 46
Filtering :	25 µm
Inlet pressure :	2.0 bar act
Normal oil inlet temp. :	49 °C
Maximal oil inlet temp. :	55 °C
Oil flow :	555 l/m
Calories to evacuate :	322125 kCal/h

#### 2.7.1 DRIVEN SCREW SPINDLE PUMP

KKS code	MAV10 AP010
Manufacturer	ALLWEILER
Type	SNFG 1300-46
Construction	screw spindle type
Operating speed	1300 RPM
Operating pressure	8 bar(g)
Drive	low speed gearbox shaft
Capacity min.	1275 l/min
Oil type	ISO VG 46
Oil temperature operation/start up	65/20°C

## 2.8 TURNING GEAR

**A turning gear device is composed of :**

- Electrical motor.
- Electrical contact preventing starting of the electrical motor when handwheel is in position.
- Handwheel for manual turning operations.
- Speed reducer.
- « SSS Gears » automatic clutch.

### CARACTERISTICS

#### GENERAL FEATURES :

- Turning speed : 112,7 Rpm on HS shaft.
- Breakaway torque : 3386 mN

#### ELECTRICAL MOTOR :

- Type : 1LA4 183-4AA91-Z
- Voltage : 380 V
- Power : 18,5 kW
- Frequency : 50 Hz
- Speed : 1465 RPM.
- Protection : IP
- Shape : V1/FF
- Insulation : Classe F

#### SPEED REDUCER FG:

- Type : KAF148
- Reduction ratio : 19.84

#### « SSS GEARS » COUPLING:

- Type : 36T
- Assembly drawing : SM 17235

#### ELECTRICAL CONTACTOR :

- Type : XCKL1

#### STARTING DEVICE :

- Type : SIRIUS 3RW30-28-2BB-14

### LUBRICATION

Gear unit is filled at the factory with special lubricant, that is shown on the rating plate:

Turning gear box is filled with mineral oil ISO VG 220 (DIN 51502).

Quantity of oil 14,8 L

### Service life

Mineral oil after 10000 operating hours or 2 years

Synthetic oil after 20000 operating hours or 4 years

### Oil from lube oil system

oil type ISO VG 46  
pressure 150 kPa(a)  
temperature 49 °C

## 2.9 GENERATOR AND ACCESSORIES

Brushless synchronous generator

(See also original manufacturer documentation at the set of Components documentation)

### 2.9.1 TECHNICAL SPECIFICATION

KIND OF MACHINE :	GENERATOR	SERIAL No. :	12010556	YEAR OF MANUFACTURE :	2011
MACHINE CODE :	SGEN5-100A-4P	FREQUENCY :	50 Hz	DIRECTION OF ROTATION :	CW
NUMBER OF PHASES :	3	CONNECTION :	YYYY	PHASE SEQUENCE :	U1 V1 W1
RANGE OF RATED VOLTAGE :	10500 V +5/-5%	RATED CURRENT :	2089 A	RATED SPEED :	1500 min <sup>-1</sup>
RATED POWER :	38000 kVA	RATED POWER FACTOR :	cos φ = 0,85	CLASS OF RATING :	S1
TYPE OF EXCITATION :	SELF EXCITATION	TYPE OF COOLING :	AIR COOLING		
CLASS OF INSULATION DESIGN :	F	COOLING AIR TEMP :	38 °C	DEGREE OF PROTECTION :	IP 54
TEMP. RISE CORRESPONDS TO CLASS :	B	TYPE OF CONSTRUCTION :	IM 1005		
TOTAL WEIGHT :	57.600 kg	RATING AND PERFORMANCE STANDARD :	IEC 60034		
ROTOR WEIGHT :	15.900 kg	STATOR WEIGHT :	24.600 kg		

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### 2.9.2 MECHANICAL DATA

<b>RATINGS</b>			
POWER	38,000	MVA	
P.F.	0,85		
SPEED	1500	min <sup>-1</sup>	
DIRECTION OF ROTATION, VIEW FROM TURBINE TO GEN.	rechts/ clockwise		
VOLTAGE	10,5 +/- 5 %	kV	
CURRENT	2089	A	
FREQUENCY	50	Hz	
THERMAL TIME CONSTANT STATOR	9,04	min	
THERMAL TIME CONSTANT ROTOR	12,06	min	
CAPACITY STATOR WINDING AGAINST EARTH PER PHASE	0,210	μF	
CAPACITY ROTOR WINDING AGAINST EARTH	0,040	μF	
RATE OF COOLING AIR	12,5	m <sup>3</sup> /s	
COOLING AIR TEMPERATURE	38	°C	
HEAT LOSS (COOLER)	553	kW	
SOUND PRESSURE LEVEL (ISO 3744)	85	dB(A)	
<b>TYPE OF CONSTRUCTION</b>			
TYPE OF CONSTRUCTION	IM 1005		
DEGREE OF PROTECTION	IP 54		
METHODS OF COOLING	IC8A1W 7		
COLOR	RAL 7030		

<b>WEIGHTS</b>			
ROTOR COMPLETE	15900	kg	
STATOR ACTIV PART	24600	kg	
CASING, BEARINGS	8100	kg	
HOUSING	3200	kg	
COOLER	1200	kg	
EXCITER (STATOR)	900	kg	
MAIN TERMINAL BOX	3200	kg	
ACCESSORIES, ANCHORING	500	kg	
TOTAL WEIGHT	57600	kg	
MAX. WEIGHT ROTOR REMOVAL	17100	kg	
MAX. TRANSPORT WEIGHT	53900	kg	
MIN. ALLOWED TRANSPORT TEMPERATURE	-20	°C	
<b>EXCITATION</b>			
EXCITER MACHINE	ELR 75/11-15/16-2		
PMG	ELP 75/5-18/24		
<b>MECHANICAL DATA</b>			
MOMENT OF INERTIA ( $M \cdot R^2$ ) (ROTOR COMPLETE)	2284	kgm <sup>2</sup>	
BREAK AWAY TORQUE WITH PRESSURE OIL	66	Nm	
BREAK AWAY TORQUE WITHOUT PRESSURE OIL	5508	Nm	
MIN. TURNING SPEED WITH JACKING OIL	-	min <sup>-1</sup>	
MIN. TURNING SPEED WITHOUT JACKING OIL	55	min <sup>-1</sup>	
BEARING FRICTION LOSSES TOTAL	16	kW	
PERMISSIBLE OVERSPEED FOR FAULT CONDITION	+ 10	%	

<b>TERMINAL BOX</b>			
TERMINAL BOX	+MKA10GA010		
FOR WARM AIR RESISTANCE THERMOMETER	1	2°Pt100	
FOR COLD AIR RESISTANCE THERMOMETER	6	2°Pt100	
IN THE STATOR WINDING RESISTANCE THERMOMETER	9 (+3 Reserve) 9 (+ 3 SPARE)	Pt 100	
BEARING THERMOMETER	2 x 1	2°Pt 100	
LEAKAGE WATER MONITORING	3		
TERMINAL BOX	+MKA10GE030		
ANTICONDENSATION HEATER GENERATOR	3 x 400 50 2 x 1,6	V Hz kW	
AND EXCITER MACHINE (SEE ITEM 63)	230* 50 2 x 100	V Hz W	
* SUPPLIED BY 400V FEED			
TERMINAL BOXES	+MKD10GA010 +MKD20GA010		
PROXIMITORS SHAFT VIBRATION MEASUREMENT	Bently Nevada 3300XL		
AUXILLARY TERMINAL BOX FOR MAIN TERMINAL CUBICLE	+MKA10GE010		
GROUNDING BRUSH			
RELATIVE SHAFT VIBRATION MEASUREMENT TWO BORES WITH SCREW 3/4"-14NPT DISPLACED BY 90° ON THE BEARING COVER TE AND EE.			
VIBRATION PICKUP TYPE:	Bently Nevada 3300XL		

<b>COOLER</b>			
COOLER NUMBER OF ELEMENTS:	2x50	%	
ADMISS. GENERATOR OUTPUT WITH ONE COOLER ELEMENT (CLASS F)	67	%	
COOLING WATER RESISTANCE	< 0,5	bar	
NORMAL WATER INLET TEMPERATURE	33	°C	
MINIMUM WATER INLET TEMPERATURE	15	°C	
WATER OUTLET TEMPERATURE	37	°C	
REQUIRED WATER FLOW	118	m³/h	
DESIGN PRESSURE	6	bar	
TESTING PRESSURE	9	bar	
FOULING FACTOR	0,00009	m² °C/W	
COOLER DESIGN: GLICOL	35	%	
COOLER MATERIALS **			
TUBES	SF-Cu		
FINS	Al		
TUBE SHEETS	CuZn38SnAl		
WATERBOXES, FLANGES	Steel + Epoxy		
COOLER VENTS COCK	G1/2"		
COOLER DRAIN COCK	G1/2"		
COOLING WATER CONNECTION FLANGE WITH COUNTER FLANGE LEAKAGE WATER SENSOR	ANSI 3" B16.5 150lbs		
SAFETY VALVE			
SET UP PRESSURE	6	bar	
MATERIAL ARRANGEMENT WITHOUT COOLING WATER ANALYSIS			

<b>EXCITATION EQUIPMENT</b>			
MAIN EXCITER	ELR 75/11-15/16-2		
PMG	ELP 75/5-18/24		
DEGREE OF PROTECTION	IP 54		
VALUES	s. Erreger- und Reglerangaben!/ See excitation data sheet!		
TERMINAL BOX	+MKC20GE010		
FIELD WINDING	F1 F2		
ANTICONDENSATION HEATER			
TERMINAL	+MKC20GA010		
GROUND FAULT MEASURING INSTRUMENT	IY4 IY3 - +		
BRUSH-LIFTING GEAR	IY2 IY1 - + 220 V DC		
TERMINAL BOX	+MKC10GE010		
PMG	A1 B1 C1		
REDUNDAND SUPPLY			