CCPP OPERATIONS TRAINING COURSE

VER2.0

CONTENTS

Introduction

The CCPP station is normally controll… grams that only allow limited interference from the operator during normal plant operation. Various aut… Groups and Sequencers take care of controlling the individual process devices, such as pumps, val…

If any m… knowledge is required to safely operate the plant.

…manual such as this one available, that explains the following items of the different process functions:

- …utomation
- …ystem Components
- Normal Operation Behavior
- Release Criteria to START/STOP (open/close)
- Manual Operation (if available)

Purpose of this Training Course

The purpose of this training manual is, to allow the operator to clearly identify any process limits and criteria of every process drive, selector and function group in the plant.

For example:

-When does the condensate pump start automatically

-What permissive (release criteria) has to be fulfilled to do so

-When is the pump switched off for safety (protective) reasons

Disclaimer

Outmost care has been take to ensure, that all values and limits mentioned in this manual are correct, but in case of uncertainties the actual logic as implemented has to be consulted.

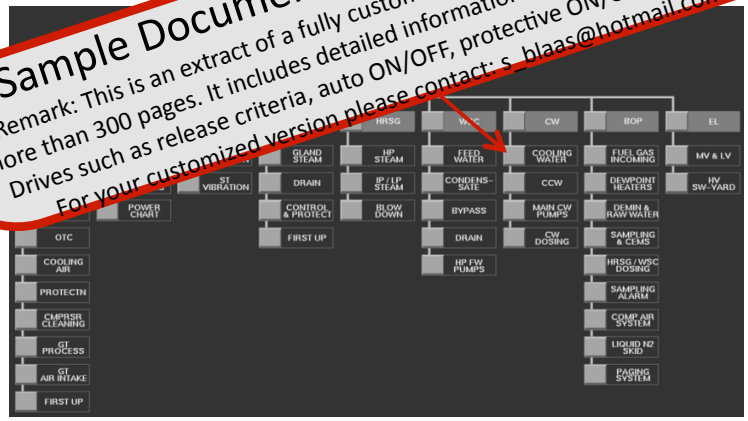
No responsibility can be taken for any mistakes or errors.

This document needs to be updated if any changes are carried out in the logic during inspections.

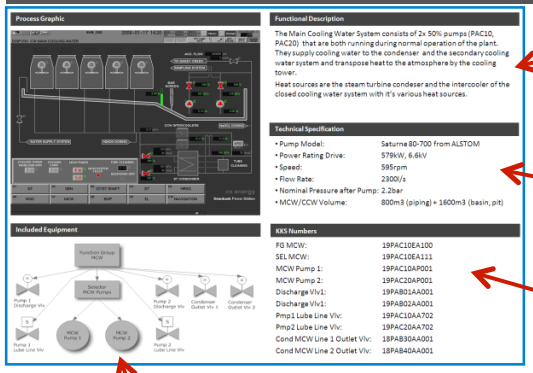
If unfamiliar with the ALSTOM KA26 combined cycle process DO NOT solely use this manual for plant operation.

Process Area Selection

In the process overview select the pr
clicking on the grey square:



Process Area General Information



Short description of general process function

Equipment technical data

KKS numbers of included equipment

Hirarchy of automation structure

The various devices and drives are explained one after each other in a top-down approach as shown in the automation hirarchy chart.

Sequencer Explanation

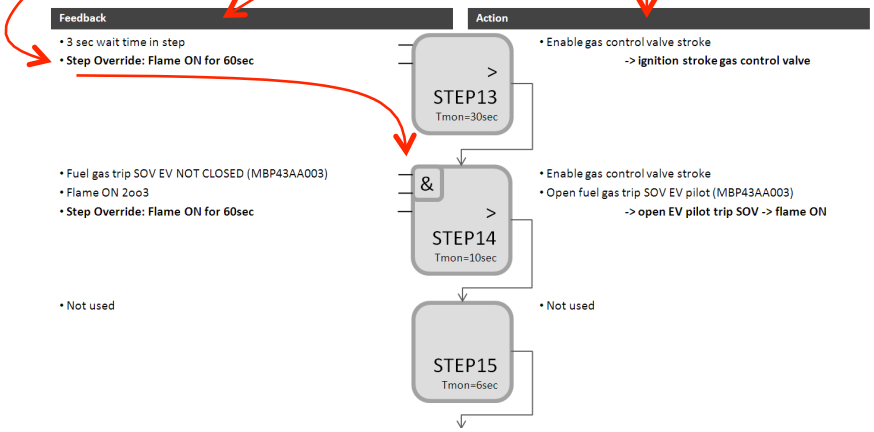
In the sequencer drawing the actions to be carried out in a particular step are shown on the right hand side. The feedbacks that have to be fulfilled once the actions are carried out are shown on the left.

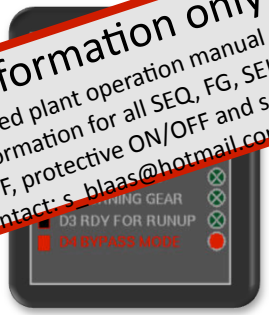
In case there is any step bypass criteria (step override) active none of the actions is initiated and none of the feedbacks have to be fulfilled.

1st is there any step bypass criteria active?

2nd Actions are carried out

3rd wait for feedbacks, if fulfilled continue





D1	D2	D3	D4	D5	Action
1	1	1	1		Load Coord OFF
2					**ST -> D1, HRSG ->D2**
3					**GT -> OFF, BOP -> D1**
4					At D1
	20				**ST -> D2, HRSG -> D2**
	21				**GT -> OFF, BOP -> D2**
	22				At D2
		30			**ST -> D3, HRSG -> D3**
		31			**GT -> OFF, BOP -> D3**
		32			At D3
			40	40	**HRSG -> D4, BOP -> D4**
			41	41	**ST -> D4**
			42	42	**GT -> ON**
			43		Not used
			44		At D4
				50	Bypasses released
				51	**Load Coord ON**
				52	**ST -> D5**
53	53	53	53	53	Finish

Execution Order

Mode Selection	D1	D2	D3	D4
Deactivation of systems	1	1	1	
	2	2	2	
	3	3	3	
	4	4	4	
	5	5		
	6			
	7			
	8			
	9			
	10			
Activation of systems		20	20	20
		21	21	21
		22	22	22
		23	23	23
		24		
		25		
			30	30
			31	31
				40
				41
Finished	60	60	60	60

Mode Selection	D1	D2	D3	D4	D5
Deactivation of systems	1	1	1	1	
	2	2	2	2	
	3	3	3	3	
	4	4	4		
	5	5	5		
	6	6	6		
	7	7	7		
	8	8	8		
	9	9	9		
	10	10			
	11	11			
	12	12			
	13	13			
	14	14			
	15				
	16				
	17				
	18				
Activation of systems		19	19	19	19
		20	20	20	20
		21	21	21	21
			22	22	22
			30	30	30
			31	31	31
			32	32	32
			33	33	33
			34	34	34
			35	35	35
				36	36
				40	40
				41	41
				42	42
				43	43
					44
					50
					51
					52
					53
					54
					55
					56
Finished	57	57	57	57	57

Mode Selection	D2	D3	D4
Deactivation of systems	1	1	
	2	2	
	3	3	
	4	4	
	5		
	6		
	7		
	8		
Activation of systems		9	9
		10	10
		11	11
		12	12
		13	13
			14
			15
			16
Finished	17	17	17

Mode Selection	ON	OFF
Activation of systems	1	
	2	
	3	
	4	
	5	
	9	
	10	
	11	
	12	
	13	
	14	
	17	
	18	
	19	
	20	
	21	
	22	
	23	
	24	
	26	
Deactivation of systems		51
		52
		53
		54
		55
		56
		57
		58
		59
		60
		61
		63

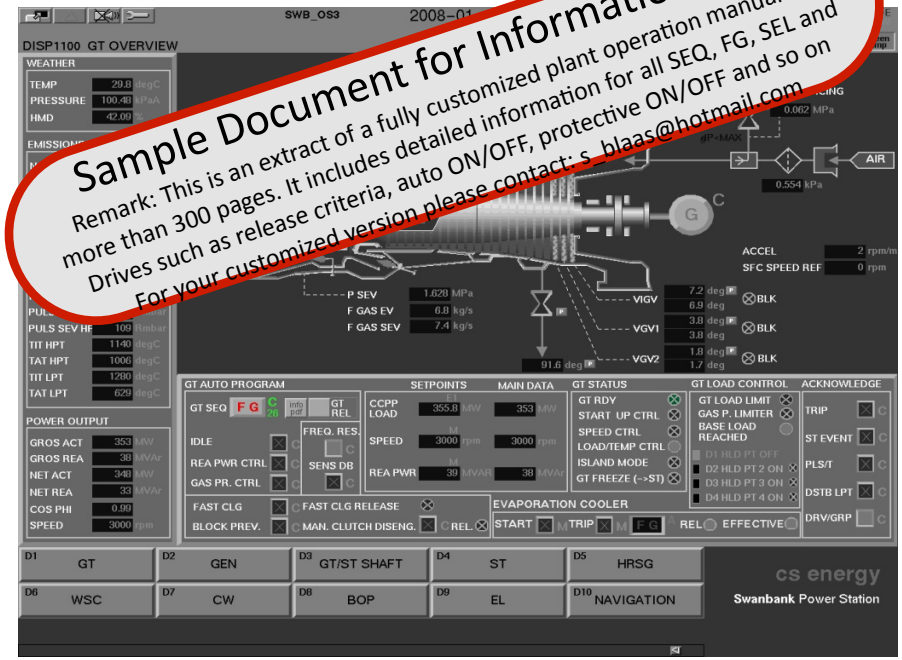
BOP Sequencer			ST/WSC Sequencer					GT Sequencer		
Standstill			Standstill							
20	FG Compressed Air	ON								
21	FG Demin Water Supply	ON								
	FG Demin Water Pumps	ON								
	FG Hot Waste CW	ON								
22	FG CCW Fill (Level Control)									
23	FG CCW Pumps									
								Op	FG Rotor Barring	ON
Turni						Turning Gear				
					ON	9	FG Cont Blowdown Pumps	ON		
				Control	ON					
				Level Control	ON					
				ADV Pumps	ON					
			31	Cond Level >600mm						
			32	FG Cond Pumps	ON					
				FW T Level >1510mm		10	FG OTC Drain Valves	ON		
			33	FG HP FW Pumps	ON		FG HRSG Drains and Vents	ON		
			34	FG HP WSC Drains	ON		FG HP Drum Level Control	ON		
				FG IP WSC Drains	ON		FG IP Drum Level Control	ON		
				FG LP WSC Drains	ON		FG LP Drum Level Control	ON		
					ON		FG HP OTC Air Cooler T Control	ON		
							FG LP OTC Air Cooler T Control	ON		
			35	FG WSC Dosing	ON	11	Drum Level HP > -618mm			
							Drum Level IP > -316mm			
							Drum Level LP > -390mm			
						12	FG HRSG Dosing	ON		
Ready to Runup			Ready to Runup			Ready to Runup				
40	FG MCW Pumps	ON				14	Not used			
	FG Sodium Hypoclorite Dosing	ON				15	FG HP Steam Temp Control	ON	1-26	FG GT Sequence	ON
	FG Cooling Tower Fans	ON	36	Wait for Flame ON			FG RH (IP) Steam Temp Control	ON		Subject to Release Criteria	
	FG Sulphur Acid Dosing	ON	40	Not used			FG Cont Blowdown ON	ON			
60	Finished		41	Vacuum Breaker	CLOSE		FG HP Bypass	ON			
				FG ST Drains	ON		FG IP Bypass	ON			
			42	FG Gland Steam	ON		FG LP Bypass	ON			
			43	FG Steam Air Ejectors	ON	16	Not used				
				FG FW Tank Temp Control	ON	17	Finished				
Bypass			Bypass			Bypass				
			50	Wait for Release Criteria ST						
			51	FG Safety System Reset	ON					
			52	Confirm Conde Vacuum						
				Wait for AUTO controler ON						
			53	Program Device	ON					
				Start Runup Program 0-3000rpm						
			54	Not used						
			55	Confirm positive loading gradient						
			56	Program Device	ON					
				Reset LP Stop VLV Protection	ON					
				Start Load Program 0-Full Load						
			Load Mode							

GT Sequencer ON		
1	FG Lube Oil	ON
	FG Safety System	OFF
	BOV Control (Open at 0rpm)	ENABLE
	Fuel Gas Trip SOV	CLOSE
	Gas Relief Valves	OPEN
	Manually Confirm Main SOV	Man OPEN
	N2 Pilot and Premix Fill Valves	Release
2	FG Power Oil	ON
	FG OTC Drains	ON
	FG HP OTC Coolers	ON
	FG LP OTC Coolers	ON
	Safety Sys (Staging Valve)	ON
	Enclosure Vent	ON
	Rotor Block Test	ON
3	FG Protection Test	ON
	VGV Control (Close at 0rpm)	ENABLE
	Rotor Block Test	ON
	FG SFC (purge speed 900rpm)	ON
	Ignition Purge	ON
	N2 Purge Test Pilot/Premix	ON
4	FG Seal Oil	ON
	EV Gas Relief Valve (MBP31AA002)	CLOSE
5	EV Gas Main SOV (MBP31AA001)	OPEN
6	Not used	
7	Not used	
8	Not used	
9	FG Exh End Bearing Vent	ON
	Relief Vlv EV Premix (MBP51AA001)	CLOSE
	Relief Vlv EV Pilot (MBP53AA001)	CLOSE
	Relief Vlv SEV (MBP51AA001)	CLOSE
	Wait for 5min purge time to end	
10	Wait for Ignition Purge Time 30sec	
11	SFC Start (accelerate further)	ON
	TAT1 Start Prot Settinga	ENABLE
12	**FG Ignition**	ON
	Wait for Temp Jump >10 DegC	
13	Gas Control Valve Stroke	ENABLE
14	Gas Control Valve Stroke	ENABLE
	Fuel Gas Trip SOV EV Pilot	OPEN
	FLAME ON	
15	Not used	
16	Not used	
17	FG Ignition	OFF
18	Accelerate to 2700 rpm	
19	FG SFC	OFF
20	Not used	
21	FG Excitation	ON
	Wait for Speed >3002.5rpm	
22	FG Synchronisation	ON
	Wait for Generator on Grid	
23	FG Synchronisation	OFF
	Wait for Active Power >4MW	
24	Relief Vlv SEV (MBP32AA002)	CLOSE
	SEV Gas Main SOV (MBP32AA001)	OPEN
25	Not used	
26	Finished (FG is ON)	

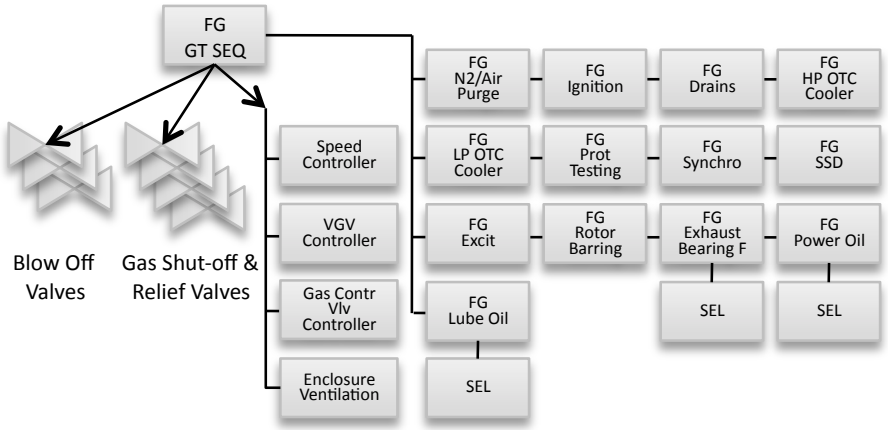
SEQUENCERS

- FG GT Sequencer: 11CJP00EA000
- FG ST&WSC Sequencer: 18MAY00EA100
- FG HRSG Sequencer: 11HAY00EA100
- FG BOP Sequencer: 19PAY00EA100

Process Graphic



Included Equipment



Functional Description

The function group gas turbine sequencer consists of a fully automatic start-up (step 1-26) and shut-down (step 51-63) program. It enables or disables all required systems and functions of the gas turbine in the correct order.

It is not possible to start or stop the turbine in a manual way without using the FG

- An ON command will initiate the start-up program of the turbine (subject to various process release criteria -> GT REL button)
- An OFF command will initiate the shut-down program

This FG is typically operated via the unit master and its relevant mode pre-selections:

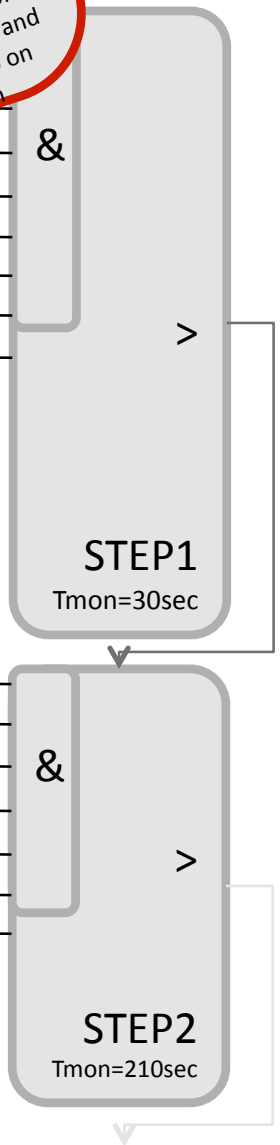
- Unit Master D1, D2, D3: FG GT Seq OFF
- Unit Mster D4, D5: FG GT Seq ON

To analyze the sequence steps: -> select SEQ -> analyze -> analyze seq
Or go to the feedback overview screen available from CCPP Seq screen

KKS Numbers

FG GT Sequencer:	11CJP00EA000

Feedback	Action



- FG lube oil ON
- Safety system OFF
- EV fuel gas tri
- EV
- air supply >6bar (600kPa)
- lation with screen button (Main manual gas vlv open)
- **Step Override: Flame ON**

⚠ Manual confirmation from operator required in order to complete step 1

- FG power oil ON
- FG OTC drains ON
- FG HP OTC cooler ON
- FG LP OTC cooler ON
- Safety system ON
- Rotor not blocked
- **Step Override: Flame ON**

- FG lube oil ON
- Enable blow off valve control (open at 0rpm, start closing the higher the speed)
- Safety sys OFF (MBX41…..)
- Close compressor washing valves (MBA83AA031/32/33)
- Close fuel gas trip SOV EV premix (MBP41AA001)
- Close fuel gas trip SOV EV pilot (MBP43AA003)
- Close fuel gas trip SOV SEV (MBP42AA001)
- Open relief valve EV premix (MBP51AA001)
- Open relief valve EV pilot (MPB53AA001)
- Open relief valve SEV (MBP52AA001)
- Release N2 pilot fill valve
- Release N2 premix fill valve

-> Put valves in defined position (even though they might already be in this position), start lube oil and CMAS

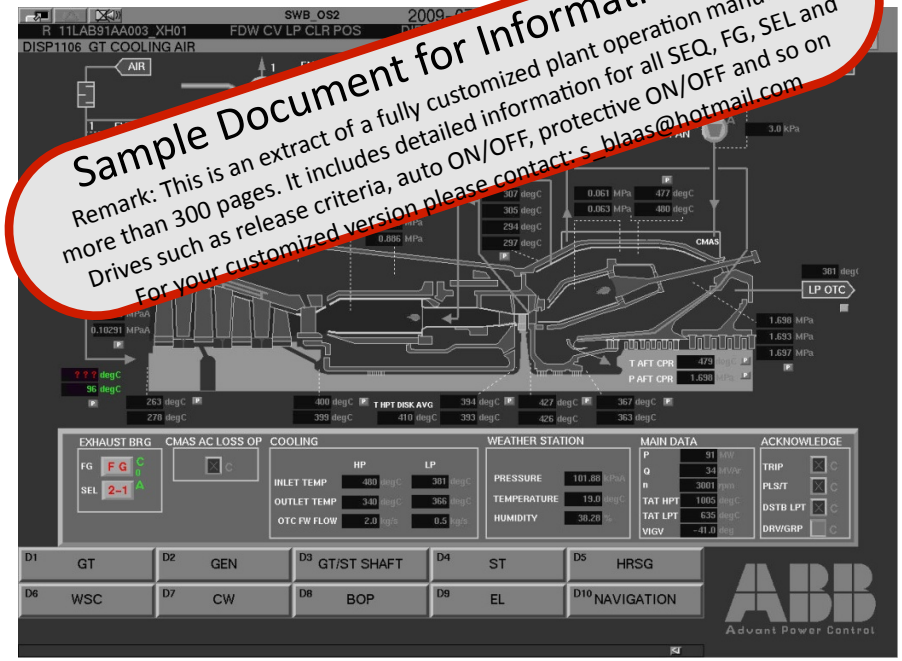
- FG power oil ON
- FG OTC drains ON
- FG HP OTC cooler ON
- FG LP OTC cooler ON
- Safety system ON
- Enclosure ventilation ON
- Rotor block test ON

-> Start power oil, OTC's, enlcosure vent close trip valves and staging valve

GT GAS TURBINE

- FG Premix N2/Air Purge: 11MBH74EA000
- FG Ignition Propane: 11MBP60EA000
- FG Drains: 11MBH40EA000
- FG Air Cooler LP: 11LAB91EA000
- FG Air Cooler HP: 11LAB92EA000
- FG Exhaust Bearing Fans: **11MBH50EA000**
- FG Protection Testing: 11MBX10EW000
- FG Compressor Washing Online: 11MBA83EA200
- FG Compressor Washing Offline: 11MBA83EA100
- FG Evaporation Cooler: 11MBL30EA100

Process Graphic



Functional Description

The exhaust bearing ventilation system cools the exhaust bearing structure during operation and during cool down. A fan blows ambient air into the bearing section.

During start-up of the GT, the sequencer automatically starts one fan. The selection of the fan is done by the operator. During normal operation, the pre-selected will run only.

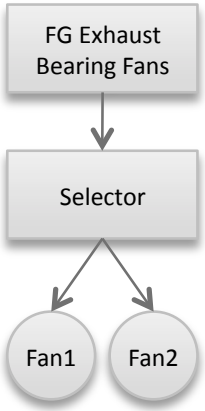
An automatic switch-over is carried out either if the dp over the fan is too low or the feedback “ON” from the running fan is missing.

If the temperature in the exhaust bearing tunnel will exceed a critical temperature, the second fan is started automatically.

After shut-down of the GT, the function group “EXHAUST BRG” is stopped automatically.

The inlet filters of the Exhaust Bearing fans MBH50AT001/002 have to be inspected and cleaned regularly

Included Equipment



Technical Specification

- Drive Model: ABB M2BA 200 LB2
- Power Rating Drive: 37kW, 415V
- Speed: 2950rpm

KKS Numbers

FG Exhaust Bearing Fans:	11MBH50EA000
SEL Exhaust Bearing Fans:	11MBH50EA111
Exhaust Bearing Fan1:	11MBH50AN001
Exhaust Bearing Fan2:	11MBH50AN002

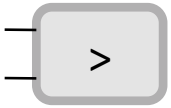
Release ON

Always

Release OFF

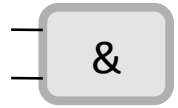
Always

Normal ON



Normal OFF

- Auto OFF: GT Startup Program NOT ACTIVE
  T HP Disk Average <70DegC



- Manual OFF: Not possible

Actions/Orders ON

- Selector ON -> Main Fan starts (depending on pre-selection)

Actions/Orders OFF

- Selector OFF -> Fans STOP

Feeback ON

- Exhaust Fan ON
- dP Exhaust Fan >15kPa (150mbar)

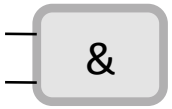
Feedback OFF

- Both Exhaust Fans OFF
- Both dP Exhaust Fan <14.9kPa (149mbar)

Selector

To change the fan Main/Standby selection : -> Click on Selector -> Change Preselection of Selector
The standby fan will start, both fans are running for 14 seconds and the the old master will switch off, if the new master is correctly running.

Standby Fan will START if: Air T Bearing Housing 1oo2 >150DegC
Standby Fan will STOP if: Air T Bearing Housing 2oo2 <148DegC for 1h
Both Fans are ON for 20sec
Auto Fan Changeover if: Fan Feedback is ON but dP<14.9kPa (149mbar)



Release ON

Always

N

of GT Sequence)

&

Release OFF

- Both Fans ON
- Cmd OFF from Selector (either FG OFF or additional Fan OFF)

>

Normal OFF

Auto:

- From FG -> SEL -GT Startup Program NOT ACTIVE
  -T HP Disk Average <70DegC)

&

Manual:

- by Operator with deactivate FG

Manual:

- by Operator with deactivate FG

Standby Drive ON

- Air T Bearing Housing 1oo2 >150DegC

Additional Drive OFF

- Air T Bearing Housing 2oo2 <148DegC for 1h
- Both Fans are ON for 20sec

&

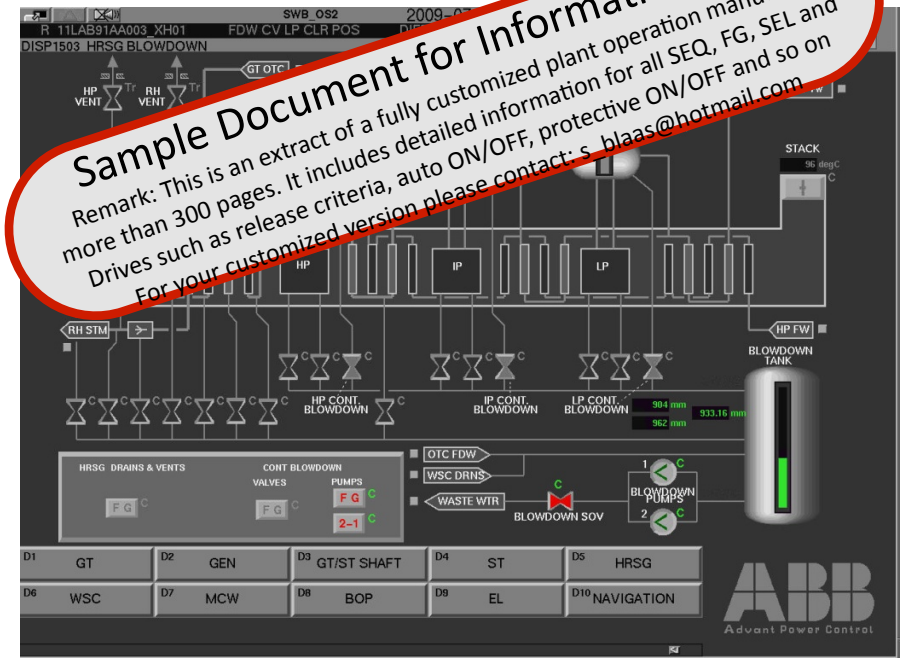
Protective OFF

- Fire Protection Exhaust End Bearing ACTIVE

HRSG HEAT RECOVERY STEAM GENERATOR

- FG HP Steam Temperature Control: 11LAE50EA100
- FG RH Steam Temperature Control: 11LAF40EA100
- FG HP Drum Level Control: 11HAD50EA100
- FG IP Drum Level Control: 11HAD30EA100
- FG LP Drum Level Control: 11HAD10EA100
- FG HRSG Drains and Vents 11LBA50EA101
- FG Continuous Blowdown Valves: 11LCQ10EA100
- FG Continuous Blowdown Pumps: **11LCQ00EA100**

Process Graphic



Functional Description

The clean drain system mainly acts during start-up of the water steam cycle. During these periods, large amounts of steam condense in the piping of the water steam cycle. The condensate is collected either in the ADV or in the blow down tank.

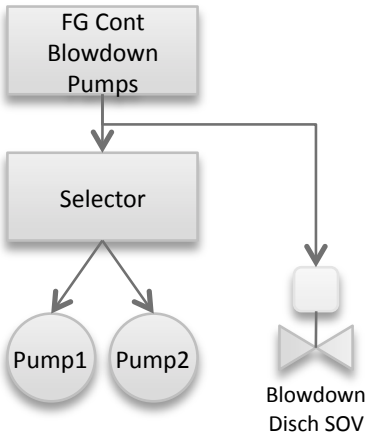
During normal operation, all drain shut-off valves and the warm-up shut-off valves close. During this period, the small accumulated amount of condensate is drained with the steam traps.

External drains are the drains of all lines where steam can flow while the steam turbine is not in operation and the condenser is not evacuated. The external drains are guided to the relevant collectors on the ADV respectively to the blow down tank.

The steam drains of the HRSG and the intermittent and continuous blow down drains are routed to the blow down tank. The connection of some drains of the main steam system and GT air cooling system to the blow down tank of the HRSG is done due to arrangement reasons.

The condensate/steam mixture expands and is separated in the ADV respectively in the blow down- / flash-tank. The flashed-out steam in the ADV is discharged via the exhaust lines to the atmosphere outside of the main hall building. The flashed out steam of the flash tank is recovered in the feed water tank and the steam from the blow down is routed to safe location in HRSG area. The condensate is transferred by the ADV pump respectively the 2x100% blow down tank pumps to the waste water system.

Included Equipment



Technical Specification

- Pump/Drive Model: KSB Ajax Pumps Mega M80-400 / Toshiba
- Power Rating Drive: 15kW, 415V
- Speed: 1450rpm

KKS Numbers

FG Continuous Blowdown Pumps:	11LCQ00EA100
SEL Blowdown Pumps:	11LCQ00EA111
Blowdown Tank Pump1:	11LCQ81AP001
Blowdown Tank Pump2:	11LCQ82AP001
Blowdown Discharge SOV:	11LCQ85AA001

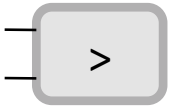
Release ON

Always

Release OFF

Always

Normal ON



Normal OFF

- Manual OFF: by Operator

Actions/Orders ON

- Enable Selector to ON/OFF if:
  ON: L Bdwn Tank 1oo2 >1200mm -> Pump ON
  OFF: L Bdwn Tank 1oo2 <700mm -> Pumps OFF
- Enable Selector Auxiliary Pump ON
  ON: L Bdwn Tank 1oo2 >1550mm -> Stby Pump ON

Actions/Orders OFF

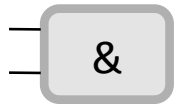
- Selector OFF -> Pumps are switched off

Feeback ON

- FG HRSG Cont Blowdown Pumps Command ON

Feedback OFF

- Pump 1 OFF
- Pump2 OFF

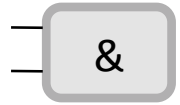


Selector

To change the pumps Main/Standby selection : -> Click on Selector -> Commands/Orders ->SWAP Objects

The standby pump will start, both pumps are running for 6 seconds and the the old master will switch off, if the new master is correctly running.

Standby Pump will START if: L Bdwn Tank 1oo2 >1550mm
FG HRSG Cont Blowdown Pumps Command ON



Release ON

- L Bdwn Tank 1oo2 >710mm

Release OFF

Always

Normal ON

- FG HRSG Cont Blowdown Pumps Command ON
- L Bdwn Tank 1oo2 >1200mm

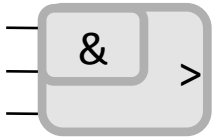
Manual:

- by Operator with deactivate FG

Normal OFF

Auto:

- FG HRSG Cont Blowdown Pumps Command ON
- L Bdwn Tank 1oo2 <700mm
- FG HRSG Cont Blowdown Pumps Command OFF



Manual:

- by Operator with deactivate FG

Standby Drive ON

- FG HRSG Cont Blowdown Pumps Command ON
- L Bdwn Tank 1oo2 >1550mm

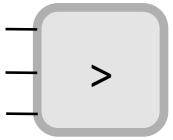
Protective OFF

- L Bdwn Tank 1oo2 <380mm

Release OPEN

Always

Normal OPEN



• L Bdwn Tank 1oo2 >710mm

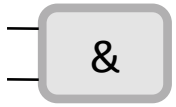
Manual:

• by Operator if no Auto/Prot command active

Safety OPEN

• L Bdwn Tank 1oo2 >1200mm for 1min

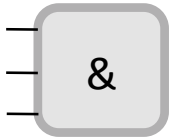
Release CLOSE



• Pump 1 OFF
• Pump2 OFF

Normal CLOSE

Auto:



• Pump1 OFF
• Pump2 OFF
• L Bdwn Tank 1oo2 <380mm

Manual:

• by Operator if no Auto/Prot command active and Release fulfilled

Protective CLOSE

Not applicable