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marking colors

	TODO
	To be checked by CRYO

Document History:

Version	Prepared by:	Checked, Date	Released, Date	Comment
	CMU		2022-01-18	• Refined regulation loops (see chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**) • added operation of He pump (see chapter 3.5)
0.1.4	WBach		20.02.2023	• Modified sequence • Modified option modes of FB PCO • Added Unit Alarms • Modified SCADA Panels

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Abbreviations**ABBREVIATION**	**DESCRIPTION**
AA	Analog Alarm
AI	Analog Input
AL	Alarm/Warning without reaction
AO	Analog Output
BB	Bus-bar
BPL	By-Pass Line
CB	Cold Box
CB_Dist	
CLB	Current Lead Box
CLBL	Current Lead Box Link
CV	Computed Variable or controlled valve (inside actuator names)
DA	Digital Alarm
DB_Dist	
DI	Digital Input
DO	Digital Output
EB_Dist	
FAT	Factory Acceptance Test
FB	Feed Box
FIL	Feed-In Line
FS	Full Stop Interlock
GHe	Gaseous helium
HP	High Pressure
HTS	High Temperature Superconductor
HX	Heat eXchanger
JT	Joule Thomson
LHe	Liquid helium
LP	Low Pressure
MCL	Main Current Lead
MLI	Multilayer insulation
MPL	Multi-Purpose Line
MV	Actual value
ONOFF	Actuators which are switched between on and off or open and clos solenoid valves
P&ID	Piping and Instrumentation Diagram
P&P	Pump and Purge
PS	Phase Separator
QIPP	Quality Inspection and Production Plan
SAT	Site Acceptance Test
SC	Superconducting
SEC	
SEC_Dist	
SI	Start Interlock
SP	Set point value
STF	Serial Test Facility

TL	Transfer Line
TL_Dist	
TLV	Total Loss of Vacuum
TS	Temporary Stop Interlock
VB	Vacuum Barrier
VCh	Vacuum Chamber

2. INTRODUCTION

An industrial plant, as far as the process control is concerned, can be defined as a hierarchy of **units**. The global requirements are then organised in requirements applicable to the plant-wide control and requirements applicable to the control of a particular plant unit. This decomposition is based on the approach defined in IEC 61512-1 or ANSI/ISA S88 [1].

The tags identifying sensors and actuators in this document must be the ones referenced on the P&I Diagrams of the controlled plant.

2.1 Terminology

Actuator: defined as *control module* in IEC 61512-1:

- A piece of equipment acting on the plant
- Acts as a single entity from a control standpoint
- Is the direct connection to the process and can embed sensors
- Cannot execute procedural sequences
- Examples: valves, motors, pumps, fans etc.

Unit: defined as unit and equipment module in IEC 61512-1:

- Collection of actuators and/or other units
- Can carry out a finite number of minor processing activities
- Contains all the necessary processing equipments to carry out these activities
- Can execute procedural sequences
- Examples:
    - Compression station : 3 compressors + 4 valves
    - Compressor : 1 motor + 1 valve

Controller: Regulation algorithm able to control a process variable (ex: PID controller)

Object: Unit or Actuator or Controller

Operational State: unit can be setup in different operational states (ex: Cooling, Heating).

Interlock: Asynchronous condition stopping an actuator or a unit or preventing from starting for security reasons. An interlock must not be used for normal operation but for abnormal behaviour. Software interlocks are not guarantying human security.

The possible interlocks for a complete unit or for an actuator are:

- **Full stop interlock (FS)**: Stop the unit/actuator (all dependent units/actuators are set to their fail-safe position) and wait manual acknowledgement before restarting.
- **Temporary Stop Interlock (TS)**: Stop the unit/actuator (all dependent units/actuators are set to their fail-safe position) and restart automatically when the interlock disappears.

- **Start Interlock (SI)**: Prevent the unit from starting (all dependent units/actuators stay in their fail-safe position).

Alarm (AL): It is an indication of a potential problem. In this case, there is no action.

User command: Specific operator order to specify a particular action.

Computed Variables: Values computed from a set of I/O signals or from parameters.

1. Purpose of the document

1.1 Description of the system

A short description of the process must be introduced here. A general Process and Instrumentation Diagram (P&ID) or a Block Flow Diagram (BFD) of the complete process can also be included.

Describe the main capabilities required and why they are needed. This section should describe the process to be supported by the control system, indicating those parts of the process where it is used.

You can briefly explain the different behaviours of the system here in subparagraphs if necessary.

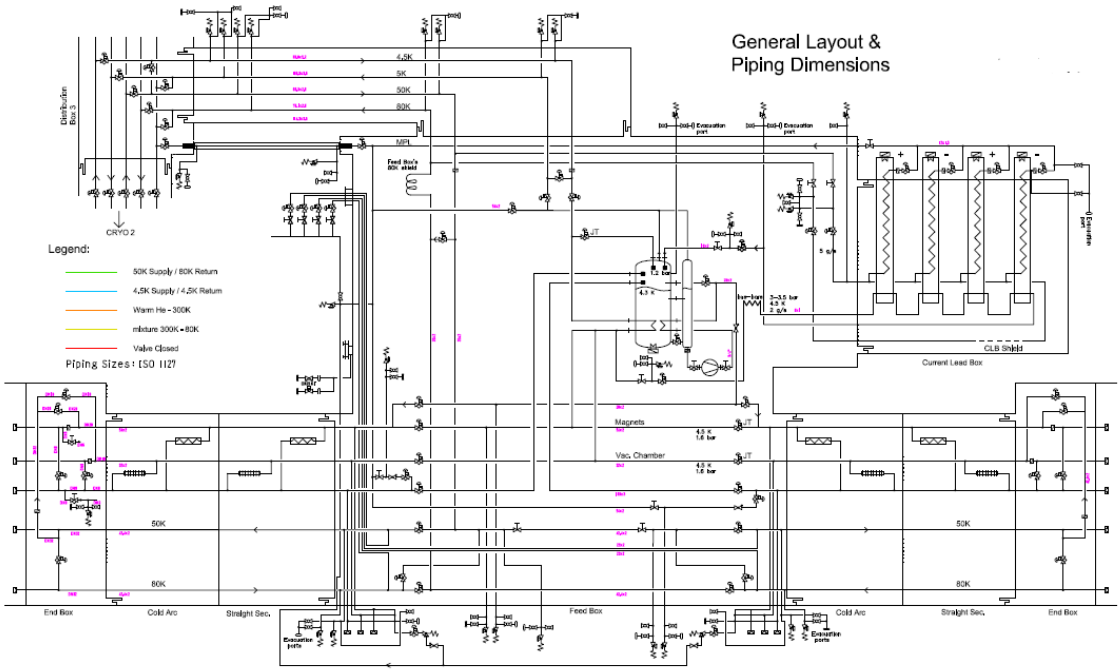


Figure 1: FB P&ID

There will be three FBs abbreviated 1,3 and 5 in corresponding niches supplying LHe as well as cold electrical connections to SIS100 (see schematics in Figure 2 as well as Appendix A: Quadrupole Electrical Circuits and Appendix B: Dipole Electrical Circuit). Each FB will supply via the FILs two sextants of the ring, each comprising of one straight section (see also [54]) and the arc section. The FB design foresees the possibility to warm up one sextant (for maintenance etc.) while keeping the other sextant at stand-by cold state (idling).
As common to all SIS100 components, the design strategy is to develop a unified design for all three FBs that can be used in all three niches. This can be achieved for the FBs 1 and 3 while FB 5 differs only in number of cold electrical connections. This has to be taken into account in the design, as described in [50], [51]. However, this shall present only a small difference in the design with no difference to the function and operation.

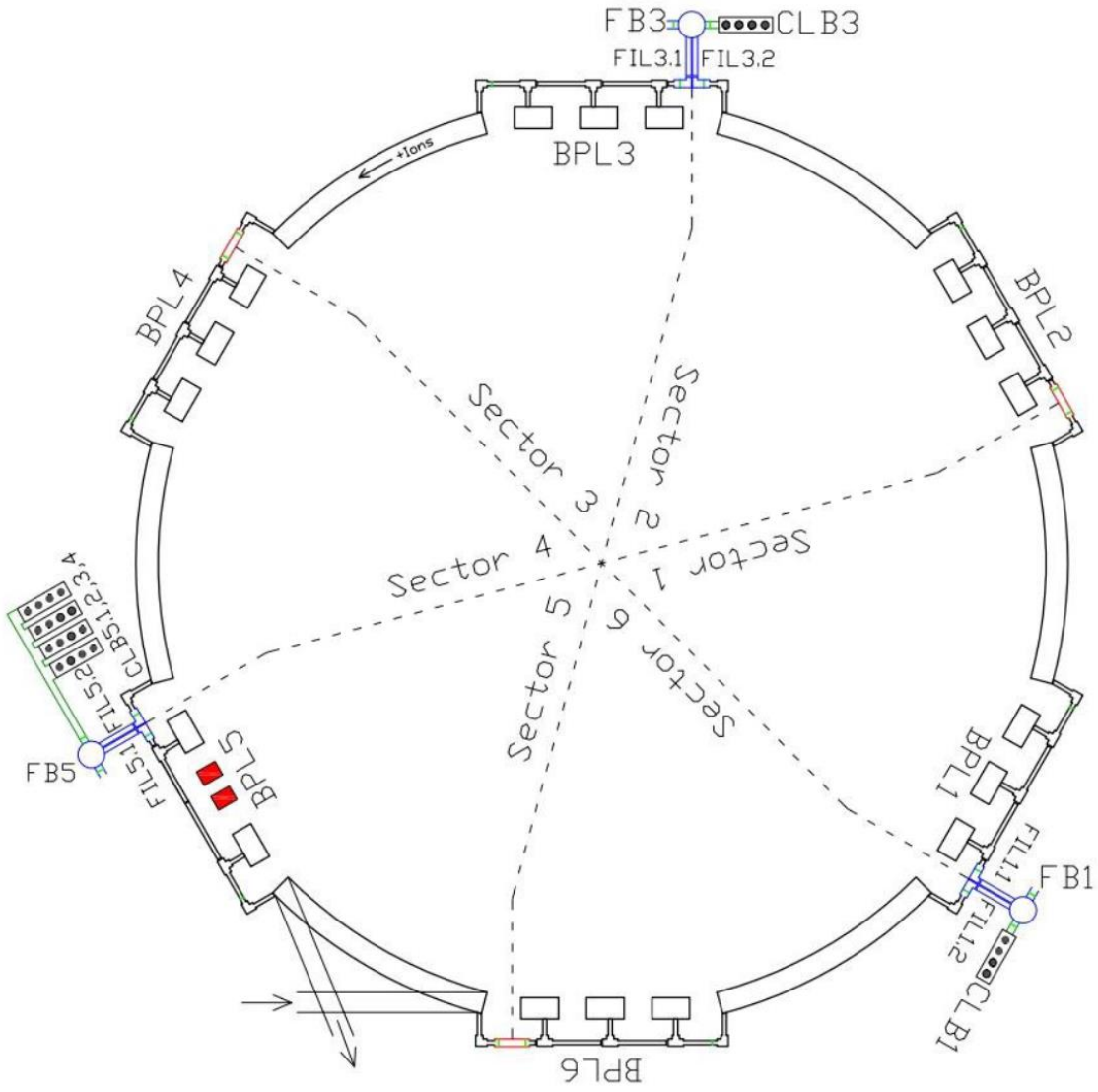


Figure 2: Schematic representation of the SIS100 accelerator ring

1.2 Process decomposition

Each FB is linked to a master PCO (Feed Box =XLSX). The master PCO control the slaves PCO endbox =QNE0 and =QNE1, sector = RSQX and RSQX+1 and the current lead box =WDLX. XLSX defines the conditions of the plant in the form of operational modes [2.1 Operational States].

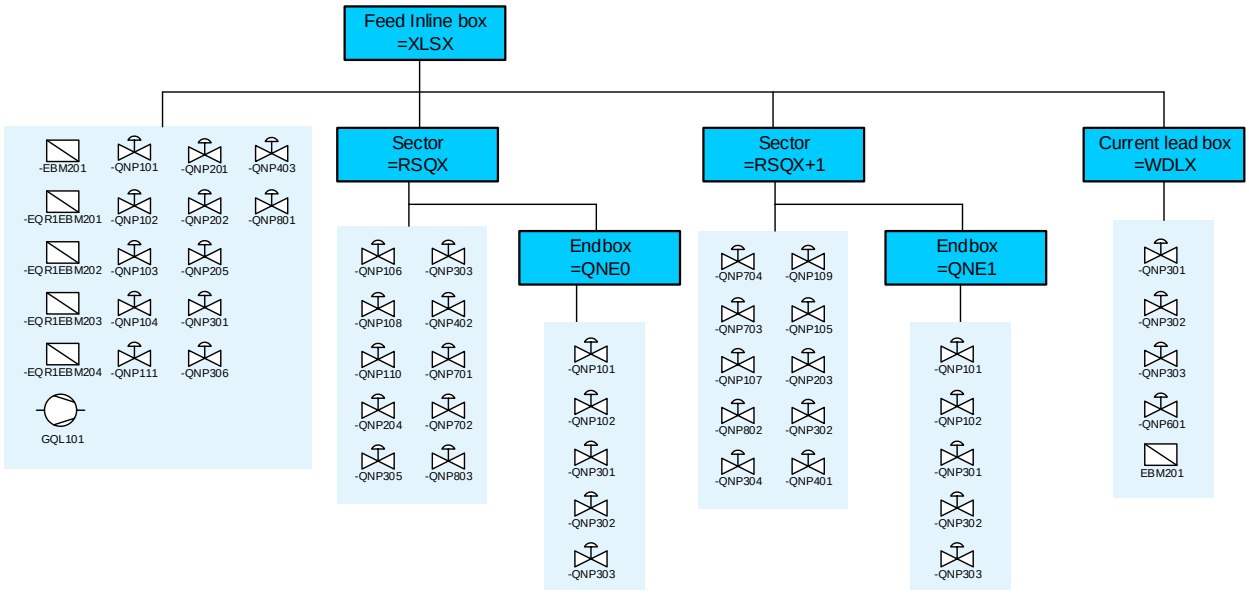


Figure 3: PCO structure

1.3 Emergency stop procedure

The cryogenic system is comprised of refrigerator, distribution system, SIS100 and SuperFRS. In case of a general electrical power or compressed air interruption, the cryogenic system shall not lose helium to the atmosphere. Therefor buffer tanks with sufficient buffer volume to take the complete helium inventory at a maximum pressure of about 20 bara will be installed.
In case of the mentioned interruption, most valves are normally opened in order to allow the equal pressurization of the entire cryogenic system. The helium gas of such combined volume is directed through dedicated valves in each section of the cryogenic system through the MPL to the buffer tanks

2. FB

2.1 Operational States

The operator can choose with the Figure 4: operational states of the FB the activity of the control system. The process starts from the mode *Standby* to the mode *Cooldown 80K*. This operation change is a condition for the Figure 5: GRAFCET of the FB to start the cool down to 80 K. From the *Cooldown 80K* it is possible to warm up the FB with the operation *Warm Up 300K*. The same logic is also valid for the operations *Cooldown 4K* and *Warm Up 80K*. The operation *Normal Operation* will hold the FB at 4K.

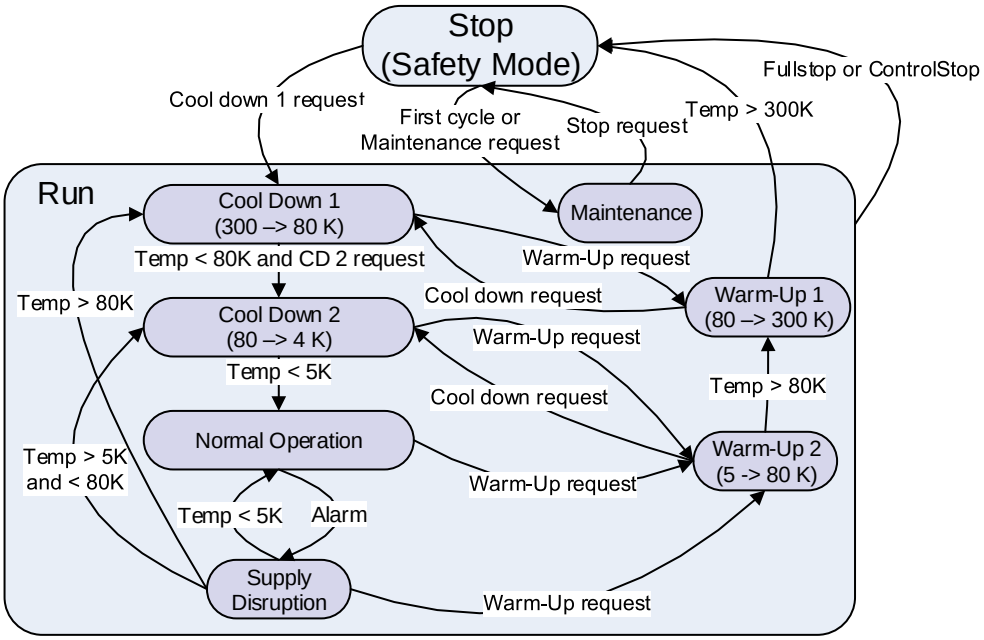


Figure 4: Operational States of the FB

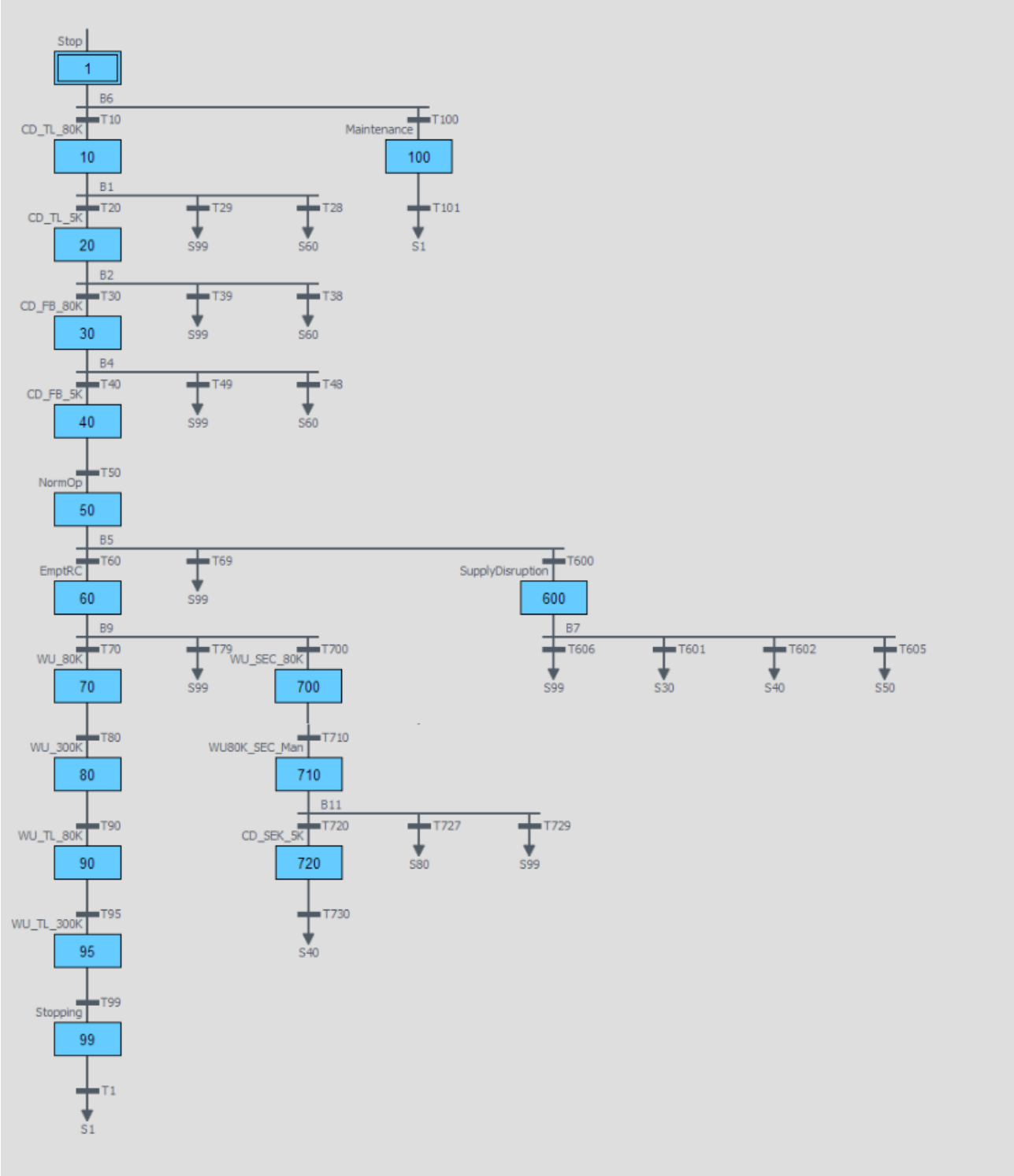


Figure 5: GRAFCET of the FB

2.1.1 Operational State definitions

Standby: The FB is at 300K and all valves are at their normal position.

Cooldown 80K: The process starts to cool down the FB to 80K.

Cooldown 4K: The process starts to cool down the FB to 4K.

Normal Operation: The process is running with 4K.

Warm Up 80K: The process starts to warm up the FB to 80K.

Warm Up 300K: The process starts to warm up the FB to 300K.

Supply Disruption: The plant is in an alarm step and waits for acknowledge.

Maintenance: The plant is in maintenance and operate only in force mode. All valves are in without current and in safe position.

2.1.2 Transition conditions

Cool-Down sequence:

T10: Cool-Down request

T20: TL + Shield: 80K

T28: Warm-Up request

T29: Control stop

T30: TL: 5K
Shield: 80K

T40: Cool down request
TL: 5K
Sextants: 80K
FB: 80K
CBL: 80K

T50: TL: 5K
Sextants: 5K
FB: 5K
CBL: 5K

Warm-Up 300K sequence:

T60: Warm-Up 1 request

T70: Sextants: 80K
FB: 80K
CBL: 80K

T80: Warm-Up 1 request

T90: TL: 80K
Sextants: 300K
FB: 300K
CBL: 300K

T99: TL: 300K
Sextants: 300K
FB: 300K
CBL: 300K

Warm-Up sextants:

T700: Warm-Up 2 request

T710: Warm-Up request
Sextants: 300K

Unusual sequences:

T29, T39, T49: Warm-Up request from Cool-down

T28, T38, T48, T69: Control stop

T81, T709: Cool-down request from Warm-Up

T91, T709: Cool down request
TL: 5K
Sextants: 80K
FB: 80K
CBL: 80K

Supply disruption sequence:

T600: Alarm from normal operation

T601: Cool-down request to feed box 80K

T602: Cool-down request to feed box 5K

T605: Normal operation request

T606: Warm-Up operation request

Maintenance sequence:

T100: Maintenance request or first cycle

T101: Stop request

2.1.3 Logical sequences

Operation	Cool down					NO	RC	Warm-Up Both Sec					WarmUp One Sec			Maint.
Drawing	R	B	C	D	E	F		K	L	M	N		G	H	I	
Step	1	10	20	30	40	50	60	70	80	90	95	99	700	710	720	100
QNP102	NC				O	O					O					
QNP306	NO				O	O					O			O	O	
QNP403	NO				O	O					O			O	O	
QNP101	NC	O	O	O	O			O	O	O	O		O	O	O	

QNP103	NO	O	O	O	O	O		O	O	O	O		O	O	O	
QNP104	NC	O	O	O	O	O		O	O		O		O	O	O	
QNP111	NO	O	O	O	O	O				O	O			O	O	
QNP201	NO					O				O			O			
QNP202	NC			O	O			O	O				O		O	
QNP205	NO	O	O	O	O					O	O			O	O	
QNP301	NC	O								O	O		O	O		
EQR1EBM201	0						O									
EQR1EBM202	0						O									
EQR1EBM203	0						O									
EQR1EBM204	0						O									
EBM201	0						O									
EBM202	0						O									
GQL101	NC															
QNP701	NC		O						O	O	O					
QNP702	NC		O						O	O	O					
QNP703	NC		O						O	O	O					
QNP704	NC		O						O	O	O					
QNP801	NO	O	O	O	O	O		O	O	O	O		O	O	O	
QNP105	NC			O	O	O		O	O	O	O					
QNP107	NC			O	O	O		O	O	O	O					
QNP109	NC					O										
QNP203	NO			O	O	O		O	O	O	O					
QNP302	NC		O	O	O	O		O	O				O		O	
QNP304	NC		O	O		O		O	O				O		O	
QNP401	NO		O	O	O	O		O	O							
QNP802	NC		O										O	O	O	
QNE0QNP101	NO	O			O	O										
QNE0QNP102	NO	O			O	O										
QNE0QNP301	NO	O	O	O		O		O	O	O	O		O	O	O	
QNE0QNP302	NC		O	O	O			O	O	O	O		O	O	O	
QNE0QNP303	NC		O	O	O			O	O	O	O		O	O	O	
QNP106	NC			O	O	O		O	O	O	O					
QNP108	NC			O	O	O		O	O	O	O					
QNP110	NC					O										
QNP204	NO			O	O	O		O	O	O	O					
QNP303	NC		O	O	O	O		O	O				O		O	
QNP305	NC		O	O		O		O	O				O		O	
QNP402	NO		O	O	O	O		O	O							
QNP803	NC		O										O	O	O	

QNE1QNP101	NO	O			O	O										
QNE1QNP102	NO	O			O	O										
QNE1QNP301	NO	O	O	O		O		O	O	O	O		O	O	O	
QNE1QNP302	NC		O	O	O			O	O	O	O		O	O	O	
QNE1QNP303	NC		O	O	O			O	O	O	O		O	O	O	
WDL1EBM201	0															
QNP601	NO	O	O	O	O	O		O	O							

Table 1: FB logical sequences

3. FB_Dist

3.1 Regulation Loops

Regulation loops of the Feedbox.

Example:

Controller 1

The controller is responsible for guaranteeing a stable pressure for the LP line to the compressor, but the setpoint depends on the operational states of Unit_A.

- Controlled variable: PT01 (bar)
- Controlled actuator: CV01 (0-100%)
- Set-Point limits: 1-5 bar
- Set-Point speed: 0.01 bar/s
- Set-point = 2 bar If Unit_A = State2 and PT01 < 2 bar, else setpoint=3 bar
- PID default parameters: Kc/Ti/Td = 2/1500 s/0
- Regulation mode: Unit_A <> State2 or PT01 >= 2 bar
- Output positioning mode: NOT regulation mode

QNP101:

4.5K - 5K bypass.

- Controlled actuator: XLSx=QNF0.QNP101
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP102:

4.5K inlet into FB.

- Controlled actuator: XLSx=QNF0.QNP102
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP103:

4.5K inlet into PS. (JT valve)

- Controlled actuator: XLSx=QNF0.QNP103
- Process value: XLSx=QNF0.BTV101 / .BPD201 / .BPA202
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
-
- Regulation mode: see above

QNP104:

Connection PS1-PS2. (for PS cooldown)

- Controlled actuator: XLSx=QNF0.QNP104
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP105:

He pump outlet into PS. (for PS cooldown)

- Controlled actuator: XLSx=QNF0.QNP105
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP106:

4.5 inlet (magnet) sector +. (JT valve)

- Controlled actuator: XLSx=QNF0.QNP106
- Process value: XLSx=QNF0.BFZ101 / .BPA103
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP107:

4.5 inlet (magnet) sector -. (JT valve)

- Controlled actuator: XLSx=QNF0.QNP107
- Process value: XLSx=QNF0.BFZ102 / .BPA104
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP108:

4.5 inlet (VCh.) sector +. (JT valve)

- Controlled actuator: XLSx=QNF0.QNP108
- Process value: XLSx=QNF0.BFZ103 / .BPA105
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP109:

4.5 inlet (VCh.) sector -. (JT valve)

- Controlled actuator: XLSx=QNF0.QNP109
- Process value: XLSx=QNF0.BFZ104 / .BPA106
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP110_1:

He pump into sector.

- Controlled actuator: XLSx=QNF0.QNP110 / .QNP111
- Process value: XLSx=QNF0.BTV105
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP112:

4.5K in BB circuit. (CLB circuit)

- Controlled actuator: XLSx=QNF0.QNP207
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP201:

5K FB out into TL.

- Controlled actuator: XLSx=QNF0.QNP201
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP201:

5K FB out into TL.

- Controlled actuator: XLSx=QNF0.QNP202
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP203:

5K return sector +.

- Controlled actuator: XLSx=QNF0.QNP203
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP204:

5K return sector -.

- Controlled actuator: XLSx=QNF0.QNP204
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP205:

5K out BB circuit. (CLB circuit)

- Controlled actuator: XLSx=QNF0.QNP205
- Process value: XLSx=WDL0.BTV101 / QNF0.BPD101 / .BPA101
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP301:

50K-80K bypass.

- Controlled actuator: XLSx=QNF0.QNP301
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP302:

50K in sector +.

- Controlled actuator: XLSx=QNF0.QNP302 / .QNP701
- Process value: XLSx=QNF0.BTV303 / QNE1.BTV301
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP303:

50K in sector -.

- Controlled actuator: XLSx=QNF0.QNP303 / .QNP702
- Process value: XLSx=QNF0.BTV305 / QNE0.BTV301
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP304:

50K in sector + (to 80K)

- Controlled actuator: XLSx=QNF0.QNP304
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP305:

50K in sector - (to 80K)

- Controlled actuator: XLSx=QNF0.QNP305
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP401:

80K out.

- Controlled actuator: XLSx=QNF0.QNP401
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP402:

80K out sector -.

- Controlled actuator: XLSx=QNF0.QNP402
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNPXXX:

80K in.

- Controlled actuator: XLSx=QNF0.QNP305
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP403:

50K in. (CLB circuit)

- Controlled actuator: XLSx=QNF0.QNP403
- Process value: XLSx= QNF0.BTV401
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =

- Regulation mode: see above

QNP701:

300K into 80K sector - (80K).

- Controlled actuator: XLSx=QNF0.QNP701
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP702:

300K into 80K sector + (80K).

- Controlled actuator: XLSx=QNF0.QNP702
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP703:

300K into 50K sector - (50K).

- Controlled actuator: XLSx=QNF0.QNP703
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP704:

300K into 50K sector - (50K).

- Controlled actuator: XLSx=QNF0.QNP704
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP801:

FB common out into MPL.

- Controlled actuator: XLSx=QNF0.QNP801
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP802:

Sector + 80K out into MPL.

- Controlled actuator: XLSx=QNF0.QNP802 / .QNP703
- Process value: XLSx=QNF0.BTV403 / QNE1.BTV401
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:

- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP803:

Sector - 80K out into MPL.

- Controlled actuator: XLSx=QNF0.QNP803 / .QNP704
- Process value: XLSx=QNF0.BTV405 / QNE0.BTV401
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP804:

Sector + 5K out into MPL.

- Controlled actuator: XLSx=QNF0.QNP804
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP805:

Sector - 5K out into MPL.

- Controlled actuator: XLSx=QNF0.QNP805
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

HEATER:

Heater ColdBox

- Controlled actuator:
- Process value:
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

PUMP:

Pump ColdBox

- Controlled actuator:
- Process value:
- Set-Point limits: 0 – 100%
- Set-Point speed: 20sec
- Set-point:
- PID default parameters: Kc/Ti/Td =

- Regulation mode:
  - Stat to regulate, when QNP103 is under 10%.
  - Consiquence is, that level is to high.
  - QNP015 should close, when pump start.
  - QNP110/111 start opening, because level should give away to sectors.

3.2 Manual valve

List of all manual valves in the Feedbox.

-QMH101	separation He pump
-QMH102	separation He pump
-QMH103	pump port to He pump outlet
-QMH104	pump port to 4.5K in FB
-QMH105	pump port to 4.5K sector # 6
-QMH106	pump port to 4.5K sector # 1
-QMH107	Block valve (cold) 4.5K inlet to BBs
-QMH108	pump port Block circuit 4.5K to BBs
-QMH201	pump port to PS
-QMH202	pump port 4.5K
-QMH203	Block valve (cold) 5K return to PS
-QMH204	pump port in Block circuit 5K
-QMH301	pump port to 50K sector # 6
-QMH302	pump port to 50K sector # 1
-QMH303	Block valve (cold) 50K
-QMH304	pump port Block circuit 50K
-QMH305	pump port Block circuit 50K sec#6
-QMH306	pump port Block circuit 50K sec#1
-QMH307	Block valve (cold) 50K to sec#6
-QMH308	Block valve (cold) 50K to sec#1
-QMH401	pump port to 80K sector # 6
-QMH402	pump port to 80K sector # 1
-QMH403	Block valve (cold) 80K
-QMH404	pump port Block circuit 80K
-QMH701	purge port to FB's MPL
-QMH702	purge port to He pump outlet
-QMH703	purge port to 4.5K
-QMH704	purge port to PS
-QMH705	purge port 4.5K
-QMH706	purge port 50K-80K
-QMH707	purge port 50K sector # 6
-QMH708	purge port 50K sector # 1
-QMH709	pump port FB vacuum vessel
-QMH710	vacuum gauge FB vacuum vessel
-QMH711	vacuum vessel GN2 purge
-QMH712	purge port block circuit 50K
-QMH713	purge port block circuit 80K

-QMH714	purge port block circuit 5K
-QMH715	purge port block circuit 4.5K
-QMH716	purge port block circuit MPL sec #6
-QMH717	purge port block circuit MPL sec #1
-QMH718	purge port block circuit 50K sec #6
-QMH719	purge port block circuit 50K sec #1
-QMH801	pump port Block circuit MPL sec#6
-QMH802	pump port Block circuit MPL sec#1
-QMH803	Block valve (cold) MPL from sec#6
-QMH804	Block valve (cold) MPL from sec#1

3.3 Safety Valves

List of all safety valves in the Feedbox.

-FLV101	He pump circuit
-FLV102	4.5K circuit
-FLV103	Double block 4.5K in
-FLV201	5K circuit in FB (through PS)
-FLV202	4.5K-5K circuit
-FLV203	Double block 5K out
-FLV301	50K-80K circuit
-FLV302	50K sector # 6
-FLV303	50K sector # 1
-FLV304	50K in (inside double block)
-FLV305	Double block to 50K sector # 6
-FLV306	Double block to 50K sector # 1
-FLV401	80K sector # 6
-FLV402	80K sector # 1
-FLV403	80K OUT (inside double block)
-FLZ701	FB vacuum vessel burst disc
-FLV801	MPL circuit of FB
-FLV802	Safety release to MPL sector # 6
-FLV803	Safety release to MPL sector # 1
-FLV804	Double block to MPL sector # 6
-FLV805	Double block to MPL sector # 1

3.4 Check Valves

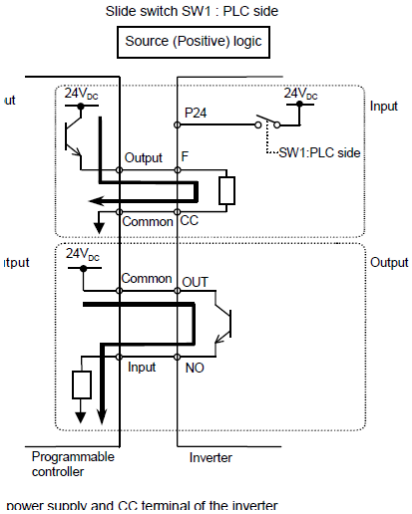
List of all check valves in the Feedbox.

-RMZ101	He pump outlet
-RMZ801	outlet MPL sector # 6
-RMZ802	outlet MPL sector # 1
-RMZ803	Safety out to MPL sector # 6
-RMZ804	Safety out to MPL sector # 1

3.5 Helium Pump

Parametrization of Toshiba inverter VF-S15

Set switch SW1 : PLC



power supply and CC terminal of the inverter

Parametrization:
press Mode, display shows AUd
turn knob until desired parameter is displayed

OpMode terminal block:	CNOd		0
set rpm via VIC 4..20mA:	FnOD		8
Forward:	Fr		0
acc. time	ACC		30
Braking Time	deC		30
max. Frequency	FH		100
upper limit frequency	UL		100
lower limit frequency	LL		0.5
uL Base frequency	uL		95
Base freq. Voltage	uLu		220
Carrier Frequency (kHz)		F300	3.0

Operation He Pump

IO-Signal	Input Inverter	Level	
DQ_RES	RES	TRUE	Reset controller
DQ_FWD	F	TRUE	Forward Run
AQ_FREQ	VIC	4..20 mA	Set rotation speed
DI_FC	-	TRUE	Feedback signal circuit breaker
DI_EMSTP	FLB	TRUE	Mains power for motor active
DI_SPD_OK	NO	TRUE	Speed reached
DI_RY	RY	TRUE	RY_signal (multi purpose signal)

3.6 List of fast reaction control loops, devices or interlock conditions

Describe here all different sensors, actuators and controllers which need fast control reaction (less than 500ms)*. Each PID controller function itself will be called within a 100ms cycle, but it's necessary to know whether the execution of the reaction to the related actuator needs to be guaranteed to be below 500ms, because it is necessary to check the whole control loop including the measured value, the controller, the actuator and the PLC cycle etc.*

3.7 User commands

Define eventual user specific operator commands (except start/stop of units or actuators).

In all cases, the action (or the sequence of actions,) the control system is expected to handle must be described. If issues can occur in the course of the sequence of actions, the expected exception sequences should also be described.

- **Unit_A Request:**
  User decision to switch to use the Unit_A for normal operation, Unit_B is then released for filling mode
- **Unit_B Request:**
  User decision to switch to use the Unit_B for normal operation, Unit_A is then released for filling mode
- **Unit_A Fill:**
  Operator order: start filling of Unit_A. The system shall start the pump, wait 10 s and open the input valve
- **Unit_B Fill:**
  Operator order: start filling Unit_B. The system shall start the pump, wait 10 s and open the input valve

3.8 Parameters

Define here all parameters for the process control which should be accessible to operators. Give a precisedefault value for each of them and define a unique name in order to use this name elsewhere in the document.

- **TempSp:** temperature regulation set-point: 15,7 °C by default
- **OpenTempo:** Delay to open the dampers: 25 s by default
- **CWaterFlow:** Min. value for cooling water flow: 80% by default

Remark: All threshold for calculating the logic for a digital alarm (DA) are parameters by default. In case common parameters are used for several alarms, explain it. Parametrization of analog alarm thresholds should be defined in the limit column of the AA lists.

3.9 Computed Variables

This section should contain all requirements concerning dedicated calculations on variables/parameters (e.g. engineering conversion, limit/status checking, etc.).

Remarks: These values can be displayed in the HMI.

Name, description	Type	Unit	Calculation
LT1 Level in percentage of the vessel 1	Real	%	LT1 = (M1 * 50)/100
LT400 Total mass of nitrogen	Real	kg	LT400 = 1LT400+2LT400
HP_LP_diff	Real	mbar	AI BP290 – AI BP068
QN61_acc	Real	%	|AI QN61 – SP QN61|

3.10 Unit feedback

Define the "on" and "off" state of the unit and if the unit has a dedicated controlled stop sequence the end condition for this sequence.

- **Feedback On =** Motor M1 is running and valve CV01 is opened
- **Feedback Off =** Motor M1 is stopped
- **Feedback Control Stop Fin =** Motor M1 is stopping and valve CV01 is closing

3.11 Events

Describe here occurrences of conditions which are relevant for the operation of several objects (Those significant for transitions or operation of a unique object should be defined in the above paragraphs).

Name	Condition
Overflow	Tank level >90% and valve CV01 is opened

3.12 Unit Alarms

Naming convention for alarms:

Description	Alarm name
Analog Alarms with a threshold on a sensor or computed-variable with relationship (reaction, alarm) to a Unit	Unitxxx_AA (Unit = name of Unit, xxx = type of AA)

Digital Alarm on DI or computed-variable with relationship to an Unit	Unitxxx_AA (Unit = name of Unit, xxx = type of AA)

AA List for Unit_A:

NAME	MESSAGE	LOGIC FOR ALARM	LIMITS [HH;H;L;LL]	ACTION	DT [s]
QNF0BC01_MGF_MEU_AA	Alarm of QNF0BC01	NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	,,,	AL(XLS1QNF0)	
QNF0BC02_MGF_MEU_AA	Alarm of QNF0BC02	NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	,,,	AL(XLS1QNF0)	
WDL0BTV201_AA	T - outlet from 4th MCL (4.5K) too high		5.5,5,,	AL(XLS1QNF0)	
BTV101_AA	T - 4.5K inlet from TL too high		5.5,5,,	AL(XLS1QNF0)	
BTV103_AA	T - 4.5K inlet after subcooler too high		5.5,5,,	AL(XLS1QNF0)	
BTV105_AA	T - outlet of the pump too high		5.5,5,,	AL(XLS1QNF0)	
BTV201_AA	T - 5K common return US too high		5.5,5,,	AL(XLS1QNF0)	
BTV203_AA	T - 5K common return DS too high		5.5,5,,	AL(XLS1QNF0)	
BTV209_AA	T - 5K return from BB-loop too high		5.5,5,,	AL(XLS1QNF0)	
BTV205_AA	T - PS too high		5.5,5,,	AL(XLS1QNF0)	
BTV207_AA	T- 5K siphon (after heater) too high		5.5,5,,	AL(XLS1QNF0)	
BTV301_AA	T - 50K supply too high		5.5,5,,	AL(XLS1QNF0)	

BTV303_AA	T - 50K supply US too high		5.5,5,,	AL(XLS1QNF0)	
BTV305_AA	T - 50K supply DS too high		5.5,5,,	AL(XLS1QNF0)	
BTV403_AA	T - 80K return US too high		5.5,5,,	AL(XLS1QNF0)	
BTV405_AA	T - 80K return DS too high		5.5,5,,	AL(XLS1QNF0)	
BTV407_AA	T - 80 Koutlet from CLB shield too high		5.5,5,,	AL(XLS1QNF0)	
BTV401_AA	T - 80 KFB's shield too high		5.5,5,,	AL(XLS1QNF0)	
BPA101_AA	P - 4.5K inlet too high		6,5,,	AL(XLS1QNF0)	
BPA103_AA	P - 4.5K supply after JT (magnet) US too high		6,5,,	AL(XLS1QNF0)	
BPD103_AA	DP - 4.5K supply after JT (magnet) US under low range		6,5,,	AL(XLS1QNF0)	
BPA104_AA	P - 4.5K supply after JT (magnet) DS too high		6,5,,	AL(XLS1QNF0)	
BPD104_AA	DP - 4.5K supply after JT (magnet) DS under low range		6,5,,	AL(XLS1QNF0)	
BPA105_AA	P - 4.5K supply after JT (VCh) US too high		6,5,,	AL(XLS1QNF0)	
BPD105_AA	DP - 4.5K supply after JT (VCh) US under low range		6,5,,	AL(XLS1QNF0)	
BPA106_AA	P - 4.5K supply after JT (VCh) DS too high		6,5,,	AL(XLS1QNF0)	
BPD106_AA	DP - 4.5K supply after JT (VCh) DS under low range		6,5,,	AL(XLS1QNF0)	
BPA102_AA	P - outlet of the pump too high		6,5,,	AL(XLS1QNF0)	
BPD102_AA	DP - outlet of the pump under low range		6,5,,	AL(XLS1QNF0)	

BPA201_AA	P - PS too high		6,5,,	AL(XLS1QNF0)	
BPD201_AA	DP - PS under low range		6,5,,	AL(XLS1QNF0)	
BPA301_AA	P - 50K supply too high		6,5,,	AL(XLS1QNF0)	
BPA303_AA	P - 50K supply behind inlet valve US too high		6,5,,	AL(XLS1QNF0)	
BPA305_AA	P - 50K supply behind inlet valve DS too high		6,5,,	AL(XLS1QNF0)	
BPA401_AA	P - 80K return too high		6,5,,	AL(XLS1QNF0)	
BPA403_AA	P - 80K return behind outlet valve US too high		6,5,,	AL(XLS1QNF0)	
BPA405_AA	P - 80K return behind outlet valve DS too high		6,5,,	AL(XLS1QNF0)	
BLZ201_AA1	Level - PS too low		,,5,0	AL(XLS1QNF0)	
BLZ201_AA2	Level - PS too high		90,80,,	AL(XLS1QNF0)	
BTP101_AA	4.5K supply (magnet) - sector US too high		60,,,	AL(XLS1QNF0)	
BTP103_AA	4.5K supply (magnet) - sector DS too high		60,,,	AL(XLS1QNF0)	
BTP102_AA	4.5K supply (VCh) - sector US too high		60,,,	AL(XLS1QNF0)	
BTP104_AA	4.5K supply (VCh) - sector DS too high		60,,,	AL(XLS1QNF0)	
BTP201_AA	5K outlet - sector US too high		60,,,	AL(XLS1QNF0)	
BTP202_AA	5K outlet - sector DS too high		60,,,	AL(XLS1QNF0)	
BTP301_AA	50K supply - sector US too high		60,,,	AL(XLS1QNF0)	

BTP302_AA	50K supply - sector DS too high		60,,,	AL(XLS1QNF0)	
BTP401_AA	80K return - sector US too high		60,,,	AL(XLS1QNF0)	
BTP402_AA	80K return - sector DS too high		60,,,	AL(XLS1QNF0)	
EQR1EBM201BTC_AA	H - heater PS too high		20,0,,	AL(EQR1EBM201_AnaDig)	
EQR1EBM202BTC_AA	H - heater PS too high		20,0,,	AL(EQR1EBM202_AnaDig)	
EQR1EBM203BTC_AA	H - heater PS too high		20,0,,	AL(EQR1EBM203_AnaDig)	
EQR1EBM204BTC_AA	H - heater PS too high		20,0,,	AL(EQR1EBM204_AnaDig)	
EBM201BTC_AA	H - heater siphon too high		20,0,,	AL(EBM201_AnaDig)	
EBM202BTC_AA	H - heater siphon too high		20,0,,	AL(EBM202_AnaDig)	
WD01BTP301_AA	temperature sensor BTP301 too high		60,55,,	AL(XLS1WDL1)	
WD01BTP303_AA	temperature sensor BTP303 too high		60,55,,	AL(XLS1WDL1)	
WD01BTP305_AA	temperature sensor BTP305 too high		60,55,,	AL(XLS1WDL1)	

**FS = Full Stop Interlock; TS = Temporary Stop Interlock; SI=Start Interlock; AL=Alarm*

DA List for Unit_A:

NAME	MESSAGE	LOGIC FOR ALARM	ACTION	DT [s]
QNF0BT01_ANoFail_DA	Air condition and temperature monitoring	NOT QNF0BT01_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	SI(XLS1QNF0)	1
QNF0BT02_ANoFail_DA	Air condition and temperature monitoring	NOT QNF0BT02_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	SI(XLS1QNF0)	1

QNF0BT03_ANoFail_DA	Air condition and temperature monitoring	NOT QNF0BT03_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	SI(XLS1QNF0)	1
QNF0BT04_ANoFail_DA	Air condition and temperature monitoring	NOT QNF0BT04_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	SI(XLS1QNF0)	1
QNF0FA01_ANoFail_DA	Over voltage protection 400VAC	NOT QNF0FA01_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0CA21_ANoFail_DA	Buffer module 24VDC / 24VDC	NOT QNF0CA21_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0TB21_AFail_DA	Power supply 400VAC / 24VDC	QNF0TB21_AFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC121_ANoFail_DA	Automatic cicuit breaker 400VAC	NOT QNF0FC121_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0CA22_ANoFail_DA	Buffer module 24VDC / 24VDC	NOT QNF0CA22_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0TB22_AFail_DA	Power supply 400VAC / 24VDC	QNF0TB22_AFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC122_ANoFail_DA	Automatic cicuit breaker 400VAC	NOT QNF0FC122_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC131_ANoFail_DA	Potential distribution terminals	NOT QNF0FC131_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC132_ANoFail_DA	Potential distribution terminals	NOT QNF0FC132_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC118_ANoFail_DA	Potential distribution terminals	NOT QNF0FC118_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC231_ANoFail_DA	Potential distribution terminals	NOT QNF0FC231_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC232_ANoFail_DA	Potential distribution terminals	NOT QNF0FC232_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1

QNF0KF01_ANoFail_DA	Safety relay	NOT QNF0KF01_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FB01_ANoFail_DA	Heater cicuit breaker	NOT QNF0FB01_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC331_ANoFail_DA	Potential distribution terminals	NOT QNF0FC331_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC332_ANoFail_DA	Potential distribution terminals	NOT QNF0FC332_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC314_ANoFail_DA	Potential distribution terminals	NOT QNF0FC314_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0QA31_ANoFail_DA	Potential distribution terminals	NOT QNF0QA31_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FB02_ANoFail_DA	Potential distribution terminals	NOT QNF0FB02_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC431_ANoFail_DA	Potential distribution terminals	NOT QNF0FC431_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
QNF0FC432_ANoFail_DA	Potential distribution terminals	NOT QNF0FC432_ANoFail AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
Maintenance_DA	Error in channel activation/deactivation	NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
AK011_IODiag_DA	(Bus:100|Adress: 11) has communication error	DB_IODiag.AK011.GET_DIAG.myDIAG.IOState.%X5	AL(XLS1QNF0)	1
AK021_IODiag_DA	(Bus:100|Adress: 12) has communication error	DB_IODiag.AK021.GET_DIAG.myDIAG.IOState.%X5	AL(XLS1QNF0)	1
AK051_IODiag_DA	(Bus:1|Adress: 3) has communication error	DB_IODiag.AK051.GET_DIAG.myDIAG.IOState.%X5	AL(XLS1QNF0)	1
AK061_IODiag_DA	(Bus:100|Adress: 16) has	DB_IODiag.AK061.GET_DIAG.myDIAG.IOState.%X5	AL(XLS1QNF0)	1

	communication error			
AK071_IODiag_DA	(Bus:100|Address: 17) has communication error	DB_IODiag.AK071.GET_DIAG.myDIAG.IOState.%X5	AL(XLS1QNF0)	1
BPS901_AFail_DA	Compressed air	BPS901_PressAir AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
BPS902_AFail_DA	Compressed air	BPS902_PressAir AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
BPS903_AFail_DA	Compressed air	BPS903_PressAir AND NOT CPC_GLOBAL_VARS.First_Cycle AND NOT (XLS1QNF0.OpMoSt = 5.0)	AL(XLS1QNF0)	1
WDL0BTV201_DA	T - outlet from 4th MCL (4.5K) too high	WDL0BTV201_AA.ISt OR (WDL0BTV201_DA.ISt AND WDL0BTV201_AA.WSt)	AL(XLS1QNF0)	1
BTV101_DA	T - 4.5K inlet from TL too high	BTV101_AA.ISt OR (BTV101_DA.ISt AND BTV101_AA.WSt)	AL(XLS1QNF0)	1
BTV103_DA	T - 4.5K inlet after subcooler too high	BTV103_AA.ISt OR (BTV103_DA.ISt AND BTV103_AA.WSt)	AL(XLS1QNF0)	1
BTV105_DA	T - outlet of the pump too high	BTV105_AA.ISt OR (BTV105_DA.ISt AND BTV105_AA.WSt)	AL(XLS1QNF0)	1
BTV201_DA	T - 5K common return US too high	BTV201_AA.ISt OR (BTV201_DA.ISt AND BTV201_AA.WSt)	AL(XLS1QNF0)	1
BTV203_DA	T - 5K common return DS too high	BTV203_AA.ISt OR (BTV203_DA.ISt AND BTV203_AA.WSt)	AL(XLS1QNF0)	1
BTV209_DA	T - 5K return from BB-loop too high	BTV209_AA.ISt OR (BTV209_DA.ISt AND BTV209_AA.WSt)	AL(XLS1QNF0)	1
BTV205_DA	T - PS too high	BTV205_AA.ISt OR (BTV205_DA.ISt AND BTV205_AA.WSt)	AL(XLS1QNF0)	1
BTV207_DA	T- 5K siphon (after heater) too high	BTV207_AA.ISt OR (BTV207_DA.ISt AND BTV207_AA.WSt)	AL(XLS1QNF0)	1
BTV301_DA	T - 50K supply too high	BTV301_AA.ISt OR (BTV301_DA.ISt AND BTV301_AA.WSt)	AL(XLS1QNF0)	1
BTV303_DA	T - 50K supply US too high	BTV303_AA.ISt OR (BTV303_DA.ISt AND BTV303_AA.WSt)	AL(XLS1QNF0)	1
BTV305_DA	T - 50K supply DS too high	BTV305_AA.ISt OR (BTV305_DA.ISt AND BTV305_AA.WSt)	AL(XLS1QNF0)	1

BTV403_DA	T - 80K return US too high	BTV403_AA.ISt OR (BTV403_DA.ISt AND BTV403_AA.WSt)	AL(XLS1QNF0)	1
BTV405_DA	T - 80K return DS too high	BTV405_AA.ISt OR (BTV405_DA.ISt AND BTV405_AA.WSt)	AL(XLS1QNF0)	1
BTV407_DA	T - 80 Koutlet from CLB shield too high	BTV407_AA.ISt OR (BTV407_DA.ISt AND BTV407_AA.WSt)	AL(XLS1QNF0)	1
BTV401_DA	T - 80 KFB's shield too high	BTV401_AA.ISt OR (BTV401_DA.ISt AND BTV401_AA.WSt)	AL(XLS1QNF0)	1
BPA101_DA	P - 4.5K inlet too high	BPA101_AA.ISt OR (BPA101_DA.ISt AND BPA101_AA.WSt)	AL(XLS1QNF0)	1
BPA103_DA	P - 4.5K supply after JT (magnet) US too high	BPA103_AA.ISt OR (BPA103_DA.ISt AND BPA103_AA.WSt)	AL(XLS1QNF0)	1
BPD103_DA	DP - 4.5K supply after JT (magnet) US under low range	BPD103_AA.ISt OR (BPD103_DA.ISt AND BPD103_AA.WSt)	AL(XLS1QNF0)	1
BPA104_DA	P - 4.5K supply after JT (magnet) DS too high	BPA104_AA.ISt OR (BPA104_DA.ISt AND BPA104_AA.WSt)	AL(XLS1QNF0)	1
BPD104_DA	DP - 4.5K supply after JT (magnet) DS under low range	BPD104_AA.ISt OR (BPD104_DA.ISt AND BPD104_AA.WSt)	AL(XLS1QNF0)	1
BPA105_DA	P - 4.5K supply after JT (VCh) US too high	BPA105_AA.ISt OR (BPA105_DA.ISt AND BPA105_AA.WSt)	AL(XLS1QNF0)	1
BPD105_DA	DP - 4.5K supply after JT (VCh) US under low range	BPD105_AA.ISt OR (BPD105_DA.ISt AND BPD105_AA.WSt)	AL(XLS1QNF0)	1
BPA106_DA	P - 4.5K supply after JT (VCh) DS too high	BPA106_AA.ISt OR (BPA106_DA.ISt AND BPA106_AA.WSt)	AL(XLS1QNF0)	1
BPD106_DA	DP - 4.5K supply after JT (VCh) DS under low range	BPD106_AA.ISt OR (BPD106_DA.ISt AND BPD106_AA.WSt)	AL(XLS1QNF0)	1
BPA102_DA	P - outlet of the pump too high	BPA102_AA.ISt OR (BPA102_DA.ISt AND BPA102_AA.WSt)	AL(XLS1QNF0)	1

BPD102_DA	DP - outlet of the pump under low range	BPD102_AA.ISt OR (BPD102_DA.ISt AND BPD102_AA.WSt)	AL(XLS1QNF0)	1
BPA201_DA	P - PS too high	BPA201_AA.ISt OR (BPA201_DA.ISt AND BPA201_AA.WSt)	AL(XLS1QNF0)	1
BPD201_DA	DP - PS under low range	BPD201_AA.ISt OR (BPD201_DA.ISt AND BPD201_AA.WSt)	AL(XLS1QNF0)	1
BPA301_DA	P - 50K supply too high	BPA301_AA.ISt OR (BPA301_DA.ISt AND BPA301_AA.WSt)	AL(XLS1QNF0)	1
BPA303_DA	P - 50K supply behind inlet valve US too high	BPA303_AA.ISt OR (BPA303_DA.ISt AND BPA303_AA.WSt)	AL(XLS1QNF0)	1
BPA305_DA	P - 50K supply behind inlet valve DS too high	BPA305_AA.ISt OR (BPA305_DA.ISt AND BPA305_AA.WSt)	AL(XLS1QNF0)	1
BPA401_DA	P - 80K return too high	BPA401_AA.ISt OR (BPA401_DA.ISt AND BPA401_AA.WSt)	AL(XLS1QNF0)	1
BPA403_DA	P - 80K return behind outlet valve US too high	BPA403_AA.ISt OR (BPA403_DA.ISt AND BPA403_AA.WSt)	AL(XLS1QNF0)	1
BPA405_DA	P - 80K return behind outlet valve DS too high	BPA405_AA.ISt OR (BPA405_DA.ISt AND BPA405_AA.WSt)	AL(XLS1QNF0)	1
BLZ201_DA1	Level - PS too high	BLZ201_AA1.ISt OR (BLZ201_DA1.ISt AND BLZ201_AA1.WSt)	AL(XLS1QNF0)	1
BLZ201_DA2	Level - PS too high	BLZ201_AA2.ISt OR (BLZ201_DA2.ISt AND BLZ201_AA2.WSt)	FS(XLS1QNF0)	1
BLZ201_Err	Error from DESY level card of BLZ201	GSI_DB_DESY_LVL.LVL[1].Error.CurrentDeviatesGreatly OR GSI_DB_DESY_LVL.LVL[1].Error.CurrentToSmall OR GSI_DB_DESY_LVL.LVL[1].Error.VoltageUToHigh OR GSI_DB_DESY_LVL.LVL[1].Error.InterrpConnIPlus OR GSI_DB_DESY_LVL.LVL[1].Error.InterrpConnIMinus OR GSI_DB_DESY_LVL.LVL[1].Error.InterrpConnUPlus OR GSI_DB_DESY_LVL.LVL[1].Error.InterrpConnUMinus OR	AL(BLZ201_OO)	1

		GSI_DB_DESY_LVL.LVL[1].Error.ADCError		
BTP101_DA	4.5K supply (magnet) - sector US too high	BTP101_AA.ISt OR (BTP101_DA.ISt AND BTP101_AA.WSt)	AL(XLS1QNF0)	1
BTP103_DA	4.5K supply (magnet) - sector DS too high	BTP103_AA.ISt OR (BTP103_DA.ISt AND BTP103_AA.WSt)	AL(XLS1QNF0)	1
BTP102_DA	4.5K supply (VCh) - sector US too high	BTP102_AA.ISt OR (BTP102_DA.ISt AND BTP102_AA.WSt)	AL(XLS1QNF0)	1
BTP104_DA	4.5K supply (VCh) - sector DS too high	BTP104_AA.ISt OR (BTP104_DA.ISt AND BTP104_AA.WSt)	AL(XLS1QNF0)	1
BTP201_DA	5K outlet - sector US too high	BTP201_AA.ISt OR (BTP201_DA.ISt AND BTP201_AA.WSt)	AL(XLS1QNF0)	1
BTP202_DA	5K outlet - sector DS too high	BTP202_AA.ISt OR (BTP202_DA.ISt AND BTP202_AA.WSt)	AL(XLS1QNF0)	1
BTP301_DA	50K supply - sector US too high	BTP301_AA.ISt OR (BTP301_DA.ISt AND BTP301_AA.WSt)	AL(XLS1QNF0)	1
BTP302_DA	50K supply - sector DS too high	BTP302_AA.ISt OR (BTP302_DA.ISt AND BTP302_AA.WSt)	AL(XLS1QNF0)	1
BTP401_DA	80K return - sector US too high	BTP401_AA.ISt OR (BTP401_DA.ISt AND BTP401_AA.WSt)	AL(XLS1QNF0)	1
BTP402_DA	80K return - sector DS too high	BTP402_AA.ISt OR (BTP402_DA.ISt AND BTP402_AA.WSt)	AL(XLS1QNF0)	1
QNP101_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP101	NOT QNP101_Maintenance_DP	AL(QNP101_Ana)	1
QNP102_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP102	NOT QNP102_Maintenance_DP	AL(QNP102_Ana)	1
QNP103_Maintenance_DA	Alarm to visualize the	NOT QNP103_Maintenance_DP	AL(QNP103_Ana)	1

	deactivate maintenance DP of QNP103			
QNP104_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP104	NOT QNP104_Maintenance_DP	AL(QNP104_Ana)	1
QNP105_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP105	NOT QNP105_Maintenance_DP	AL(QNP105_Ana)	1
QNP106_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP106	NOT QNP106_Maintenance_DP	AL(QNP106_Ana)	1
QNP107_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP107	NOT QNP107_Maintenance_DP	AL(QNP107_Ana)	1
QNP108_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP108	NOT QNP108_Maintenance_DP	AL(QNP108_Ana)	1
QNP109_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP109	NOT QNP109_Maintenance_DP	AL(QNP109_Ana)	1
QNP110_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP110	NOT QNP110_Maintenance_DP	AL(QNP110_Ana)	1
QNP111_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP111	NOT QNP111_Maintenance_DP	AL(QNP111_Ana)	1
QNP201_Maintenance_DA	Alarm to visualize the deactivate	NOT QNP201_Maintenance_DP	AL(QNP201_Ana)	1

	maintenance DP of QNP201			
QNP202_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP202	NOT QNP202_Maintenance_DP	AL(QNP202_Ana)	1
QNP203_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP203	NOT QNP203_Maintenance_DP	AL(QNP203_Ana)	1
QNP204_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP204	NOT QNP204_Maintenance_DP	AL(QNP204_Ana)	1
QNP205_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP205	NOT QNP205_Maintenance_DP	AL(QNP205_Ana)	1
QNP301_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP301	NOT QNP301_Maintenance_DP	AL(QNP301_Ana)	1
QNP302_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP302	NOT QNP302_Maintenance_DP	AL(QNP302_Ana)	1
QNP303_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP303	NOT QNP303_Maintenance_DP	AL(QNP303_Ana)	1
QNP304_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP304	NOT QNP304_Maintenance_DP	AL(QNP304_Ana)	1
QNP305_Maintenance_DA	Alarm to visualize the deactivate	NOT QNP305_Maintenance_DP	AL(QNP305_Ana)	1

	maintenance DP of QNP305			
QNP306_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP306	NOT QNP306_Maintenance_DP	AL(QNP306_Ana)	1
QNP401_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP401	NOT QNP401_Maintenance_DP	AL(QNP401_Ana)	1
QNP402_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP402	NOT QNP402_Maintenance_DP	AL(QNP402_Ana)	1
QNP403_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP403	NOT QNP403_Maintenance_DP	AL(QNP403_Ana)	1
QNP701_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP701	NOT QNP701_Maintenance_DP	AL(QNP701_Ana)	1
QNP702_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP702	NOT QNP702_Maintenance_DP	AL(QNP702_Ana)	1
QNP703_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP703	NOT QNP703_Maintenance_DP	AL(QNP703_Ana)	1
QNP704_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP704	NOT QNP704_Maintenance_DP	AL(QNP704_Ana)	1
QNP801_Maintenance_DA	Alarm to visualize the deactivate	NOT QNP801_Maintenance_DP	AL(QNP801_Ana)	1

	maintenance DP of QNP801			
QNP802_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP802	NOT QNP802_Maintenance_DP	AL(QNP802_Ana)	1
QNP803_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP803	NOT QNP803_Maintenance_DP	AL(QNP803_Ana)	1
EQR1EBM201BTC_DA	H - heater PS too high	EQR1EBM201BTC_AA.ISt OR (EQR1EBM201BTC_DA.ISt AND EQR1EBM201BTC_AA.WSt)	FS(EQR1EBM201_AnaDig)	1
EQR1EBM202BTC_DA	H - heater PS too high	EQR1EBM202BTC_AA.ISt OR (EQR1EBM202BTC_DA.ISt AND EQR1EBM202BTC_AA.WSt)	FS(EQR1EBM202_AnaDig)	1
EQR1EBM203BTC_DA	H - heater PS too high	EQR1EBM203BTC_AA.ISt OR (EQR1EBM203BTC_DA.ISt AND EQR1EBM203BTC_AA.WSt)	FS(EQR1EBM203_AnaDig)	1
EQR1EBM204BTC_DA	H - heater PS too high	EQR1EBM204BTC_AA.ISt OR (EQR1EBM204BTC_DA.ISt AND EQR1EBM204BTC_AA.WSt)	FS(EQR1EBM204_AnaDig)	1
EBM201BTC_DA	H - heater siphon too high	EBM201BTC_AA.ISt OR (EBM201BTC_DA.ISt AND EBM201BTC_AA.WSt)	FS(EBM201_AnaDig)	1
EBM202BTC_DA	H - heater siphon too high	EBM202BTC_AA.ISt OR (EBM202BTC_DA.ISt AND EBM202BTC_AA.WSt)	FS(EBM202_AnaDig)	1
XLS1WDL1_5K_ReDisr_DA	Matrix for the return disruption of 5K of XLS1WDL1	|	AL(XLS1WDL1)	1
XLS1WDL1_80K_ReDisr_DA	Matrix for the return disruption of 80K of XLS1WDL1	0	AL(XLS1WDL1)	1
XLS1WDL1_5K80K_ReDisr_DA	Matrix for the return disruption of 5K and 80K of XLS1WDL1	XLS1WDL1_5K_ReDisr_DA.ISt AND XLS1WDL1_80K_ReDisr_DA.ISt	AL(XLS1WDL1)	1

XLS1WDL1_Interface_DA	Interface alarm of XLS1WDL1		AL(XLS1WDL1)	1
WD01BTP301_DA	temperature sensor BTP301 too high	WD01BTP301_AA.ISt OR (WD01BTP301_DA.ISt AND WD01BTP301_AA.WSt)	AL(XLS1WDL1)	1
WD01BTP303_DA	temperature sensor BTP303 too high	WD01BTP303_AA.ISt OR (WD01BTP303_DA.ISt AND WD01BTP303_AA.WSt)	AL(XLS1WDL1)	1
WD01BTP305_DA	temperature sensor BTP305 too high	WD01BTP305_AA.ISt OR (WD01BTP305_DA.ISt AND WD01BTP305_AA.WSt)	AL(XLS1WDL1)	1
QNP601_Maintenance_DA	Alarm to visualize the deactivate maintenance DP of QNP601	NOT QNP601_Maintenance_DP	AL(QNP601_Ana)	1

**FS = Full Stop Interlock; TS = Temporary Stop Interlock; SI=Start Interlock; AL=Alarm*

4. EB_Dist

4.1 Regulation Loops

Regulation loops of the end box.

QNP101:

4.5K magnet 5K return bypass.

- Controlled actuator: XLSx=QNEx.QNP101
- Process value: XLSx= QNEx.BTV101 / .BPA101 / .BPD101
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP102:

4.5K VCh. 5K return bypass.

- Controlled actuator: XLSx=QNEx.QNP102
- Process value: XLSx= QNEx.BTV103 / .BPA103 / .BPD103
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Set-point:
- PID default parameters: Kc/Ti/Td =
- Regulation mode: see above

QNP301:

50K 80K bypass.

- Controlled actuator: XLSx=QNEx.QNP301
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP302:

50K - 4.5K magnet bypass.

- Controlled actuator: XLSx=QNEx.QNP302
- Set-Point limits: 0 – 100%
- Set-Point speed:
- Output positioning mode: see above

QNP303:

50K - 4.5K VCh. bypass.

- Controlled actuator: XLSx=QNEx.QNP303
- Set-Point limits: 0 – 100%

- Set-Point speed:
- Output positioning mode: see above

4.2 Manual valve

List of all manual valves in the end box in sec +.

-QMH701	pump port EB vacuum vessel
-QMH702	vacuum gauge
-QMH703	vacuum vessel GN2 purge
-QMH701	BB-loop vacuum port
-QMH501	BB-loop purge port
-QMH101	BB-loop insulation Inlet
-QMH201	BB-loop insulation outlet

List of all manual valves in the end box in sec -.

-QMH701	pump port EB vacuum vessel
-QMH702	vacuum gauge
-QMH703	vacuum vessel GN2 purge

4.3 Safety Valves

List of all safety valves in the end box in sec +.

-FLD101	4.5K magnet circuit
-FLD102	4.5K VCh. circuit
-FLD201	5K Return circuit
-FLD301	50K circuit
-FLD401	80K circuit
-FLZ201	BB-loop insulation circuit

List of all safety valves in the end box in sec -.

-FLD101	4.5K magnet circuit
-FLD102	4.5K VCh. circuit
-FLD201	5K Return circuit
-FLD301	50K circuit
-FLD401	80K circuit

4.4 List of fast reaction control loops, devices or interlock conditions

Describe here all different sensors, actuators and controllers which need fast control reaction (less than 500ms). *Each PID controller function itself will be called within a 100ms cycle, but it's necessary to know whether the execution of the reaction to the related actuator needs to be guaranteed to be below 500ms, because it is necessary to check the whole control loop including the measured value, the controller, the actuator and the PLC cycle etc.*

4.5 User commands

Define eventual user specific operator commands (except start/stop of units or actuators).

In all cases, the action (or the sequence of actions,) the control system is expected to handle must be described. If issues can occur in the course of the sequence of actions, the expected exception sequences should also be described.

- **Unit_A Request:**
  User decision to switch to use the Unit_A for normal operation, Unit_B is then released for filling mode
- **Unit_B Request:**
  User decision to switch to use the Unit_B for normal operation, Unit_A is then released for filling mode
- **Unit_A Fill:**
  Operator order: start filling of Unit_A. The system shall start the pump, wait 10 s and open the input valve
- **Unit_B Fill:**
  Operator order: start filling Unit_B. The system shall start the pump, wait 10 s and open the input valve

4.6 Parameters

Define here all parameters for the process control which should be accessible to operators. Give a precisedefault value for each of them and define a unique name in order to use this name elsewhere in the document.

- **TempSp:** temperature regulation set-point: 15,7 °C by default
- **OpenTempo:** Delay to open the dampers: 25 s by default
- **CWaterFlow:** Min. value for cooling water flow: 80% by default

Remark: All threshold for calculating the logic for a digital alarm (DA) are parameters by default. In case common parameters are used for several alarms, explain it. Parametrization of analog alarm thresholds should be defined in the limit column of the AA lists.

4.7 Computed Variables

This section should contain all requirements concerning dedicated calculations on variables/parameters (e.g. engineering conversion, limit/status checking, etc.).

Remarks: These values can be displayed in the HMI.

Name, description	Type	Unit	Calculation

LT1 Level in percentage of the vessel 1	Real	%	LT1 = (M1 * 50)/100
LT400 Total mass of nitrogen	Real	kg	LT400 = 1LT400+2LT400
HP_LP_diff	Real	mbar	AI BP290 – AI BP068
QN61_acc	Real	%	|AI QN61 – SP QN61|

4.8 Unit feedback

Define the "on" and "off" state of the unit and if the unit has a dedicated controlled stop sequence the end condition for this sequence.

- **Feedback On =** Motor M1 is running and valve CV01 is opened
- **Feedback Off =** Motor M1 is stopped
- **Feedback Control Stop Fin =** Motor M1 is stopping and valve CV01 is closing

4.9 Events

Describe here occurrences of conditions which are relevant for the operation of several objects (Those significant for transitions or operation of a unique object should be defined in the above paragraphs).

Name	Condition
Overflow	Tank level >90% and valve CV01 is opened

4.10 Unit Alarms

List here all interlocks acting on the unit.

Note that all hardware interlocks must be instrumented and readable by the control system (emergency stop chain, circuit breaker, etc.) in order to ensure the consistency between the control program and the real behaviour of the process. In addition to the hardwired actions, define here the desired software action if any.

Please differ between digital alarms and analog alarms for the naming and condition column. Alarms can be defined as multiple types, which are interesting for using a single alarm as well as SI as also as FS or TS.

In case a single event has to trigger reactions on different units, which don't have a mother child relationship it is necessary to define for each dedicated unit it's own alarm.

Please also define the delay time filter [s] for the alarm activation.

Do one table for DA and one for AA.

Naming convention for alarms:

Description	Alarm name
Analog Alarms with a threshold on a sensor or computed-variable with relationship (reaction, alarm) to a Unit	Unit_A_AA_1 (Unit_A = name of Unit, 1 = counter AA of Unit)
Digital Alarm on DI or computed-variable with relationship to an Unit	Unit_A_DA_1 (Unit_A = name of Unit, 1 = counter DA of Unit)

AA List for Unit_A:

NAME	MESSAGE	LOGIC FOR ALARM	LIMITS [HH;H;L;LL]	ACTION	DT [s]
Unit_A_AA_1	Unit_A: LP out of start range	AI BP290	2;;0.95;	SI	0
Unit_A_AA_2	Unit_A: Buffer pressure < APSLL	AI BP068	;;;1.2	SI	0
Unit_A_AA_3	Unit_A: LP < APSLL	AI BP290	;;1.02;1.02	FS	60
Unit_A_AA_4	Unit_A: press. diff. inlet/outlet out of range	CV HP_LP_diff	3;2;1;0.5	TS	2
Unit_A_AA_5	Unit_A: Comp. air < APLL	AI BP952	;;4.5;4	FS, SI	2

**FS = Full Stop Interlock; TS = Temporary Stop Interlock; SI=Start Interlock; AL=Alarm*

DA List for Unit_A:

NAME	MESSAGE	LOGIC FOR ALARM	ACTION	DT [s]
Unit_A_DA_1	Unit_A: Fuse 24V DC	DI FC27OK = false	SI, FS	0
Unit_A_DA_2	Unit_A: Flow cooling water < AFLL	Unit_A start release and BF751 >= CWaterFlow	FS	10
Unit_A_DA_3	Profinet Unit_A not avalilable	No communication to Unit_A	AL	2
Unit_A_DA_4	Unit_A: Group alarm	DI K20_AGroup = true	SI, FS	1
Unit_A_DA_5	Unit_A: No running feedback	DI K20_Run = false and DO K20_Start = true	FS	20
Unit_A_DA_6	Unit_A: Emergency Stop	DI K20_Estop = true	FS	0

**FS = Full Stop Interlock; TS = Temporary Stop Interlock; SI=Start Interlock; AL=Alarm*

4.11 Actuator Alarms

List here all interlocks acting on an individual actuator.

Note that all hardware interlocks must be instrumented and readable by the control system (emergency stop chain, circuit breaker, etc.) in order to ensure the consistency between the control program and the real behaviour of the process. In addition to the hardwired actions, define here the desired software action if any.

Do one table for DA and one for AA per actuator.

Naming convention for alarms:

Description	Alarm name
Analog Alarms with a threshold on a sensor or computed-variable with relationship (reaction, alarm) to an Actuator	QN61_AA_1 (QN61 = name of Actuator, 1 = counter AA of Actuator)
Digital Alarm on DI or computed-variable with relationship to an Actuator	QN61_DA_1 (QN61 = name of Actuator, 1 = counter DA of Actuator)

AA List for QN61:

NAME	MESSAGE	LOGIC FOR ALARM	LIMITS [HH;H;L;LL]	ACTION	DT [s]
QN61_AA_1	QN61: temperature positioner out of range	AI QN61_Temp	50;45;10;0	SI	0
QN61_AA_2	QN61: positioning accuracy > AGHH	CV QN61_acc	10;8;;	TS	0

**FS = Full Stop Interlock; TS = Temporary Stop Interlock; SI=Start Interlock; AL=Alarm*

DA List for QN61:

NAME	MESSAGE	LOGIC FOR ALARM	ACTION	DT [s]
QN61_DA_1	Profibus QN061 positioner not available	No communication to positioner QN61	SI, TS	2

**FS = Full Stop Interlock; TS = Temporary Stop Interlock; SI=Start Interlock; AL=Alarm*

AA List for QN72:

NAME	MESSAGE	LOGIC FOR ALARM	LIMITS [HH;H;L;LL]	ACTION	DT [s]
QN72_AA_2	QN72: positioning accuracy > AGHH	|AI QN72 – SP QN72|	10;8;;	TS	0

**FS = Full Stop Interlock; TS = Temporary Stop Interlock; SI=Start Interlock; AL=Alarm*

DA List for QN72:

NAME	MESSAGE	LOGIC FOR ALARM	ACTION	DT [s]
QN72_DA_1	Profibus QN72 positioner not available	No communication to positioner QN72	SI, TS	2

**FS = Full Stop Interlock; TS = Temporary Stop Interlock; SI=Start Interlock; AL=Alarm*

DA List for QN06:

NAME	MESSAGE	LOGIC FOR ALARM	ACTION	DT [s]
QN06_DA_1	Profibus QN06 positioner not available	No communication to positioner QN06	SI, TS	2
QN06_DA_2	QN06: valve is not closing in stopping step	Stopping step = true and valve position > 2%	FS	15

**FS = Full Stop Interlock; TS = Temporary Stop Interlock; SI=Start Interlock; AL=Alarm*

5. Supervision

How the control system should look like (Example from STF):

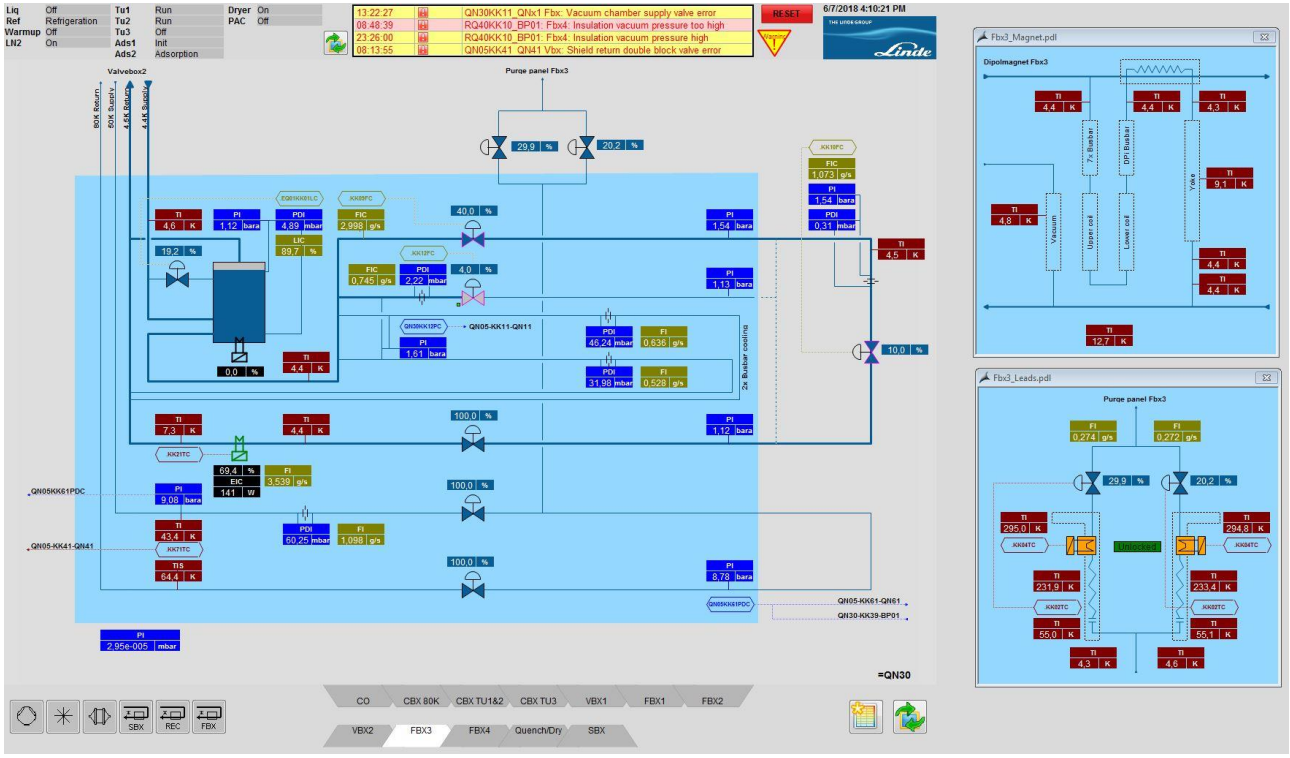


Figure 6: Example STF1

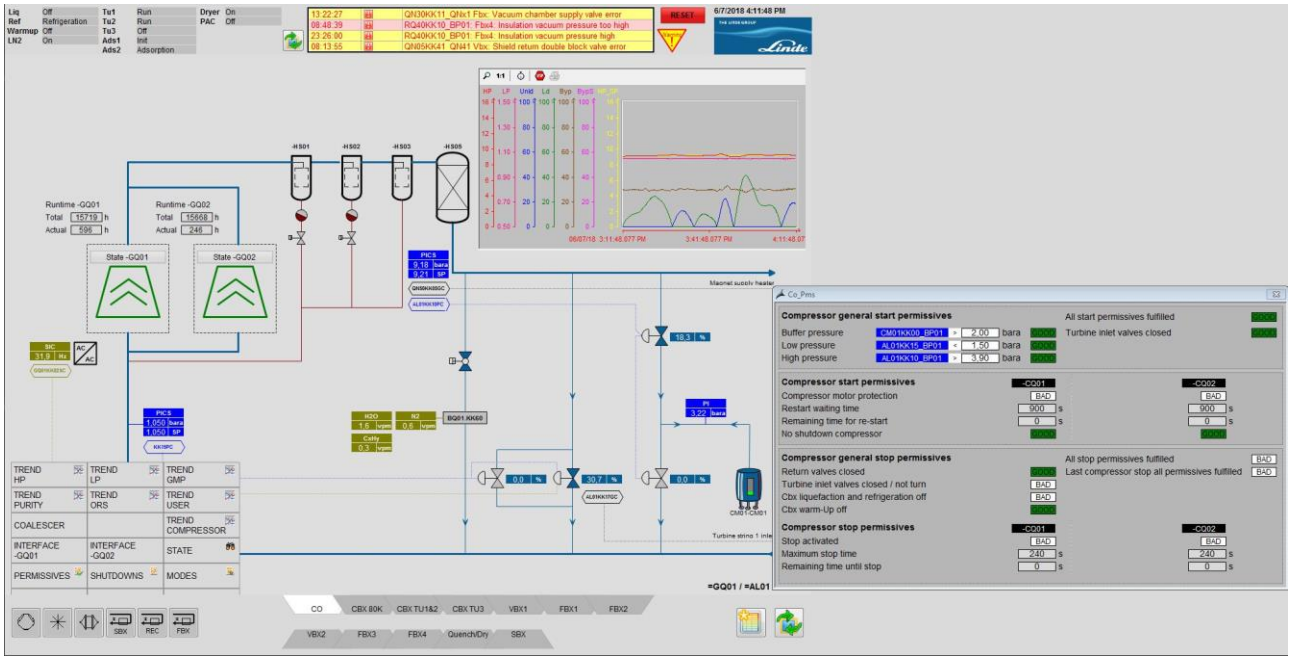


Figure 7: Example STF2

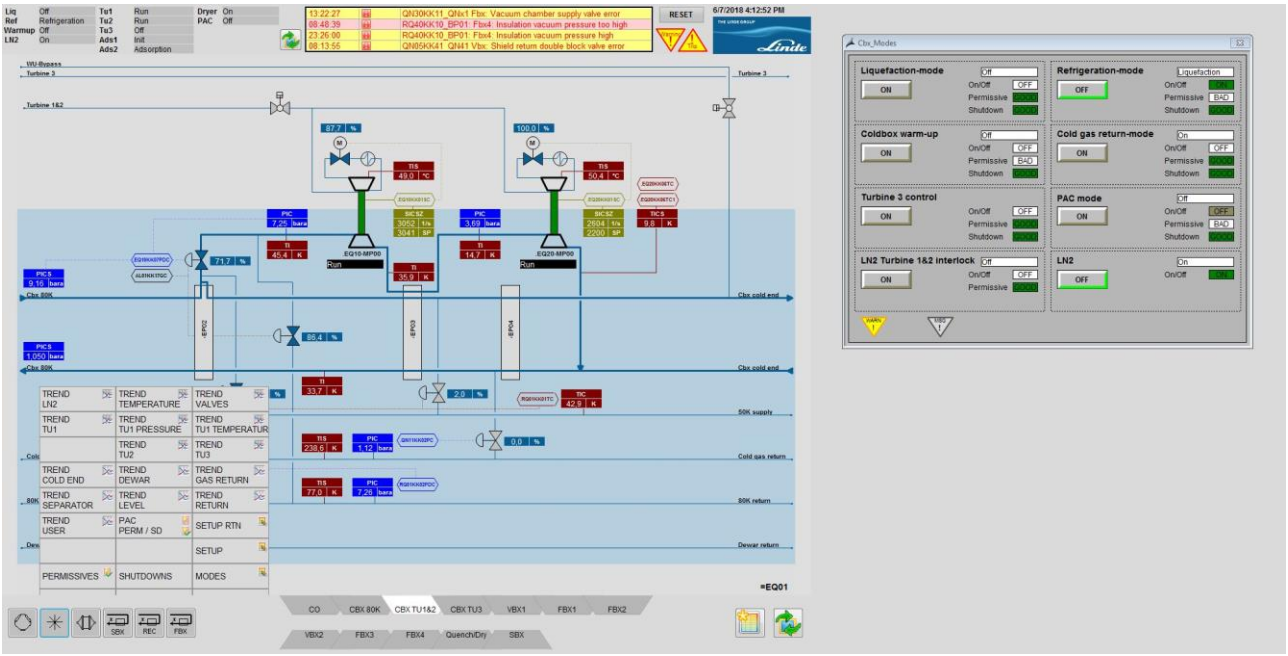


Figure 8: Example STF3

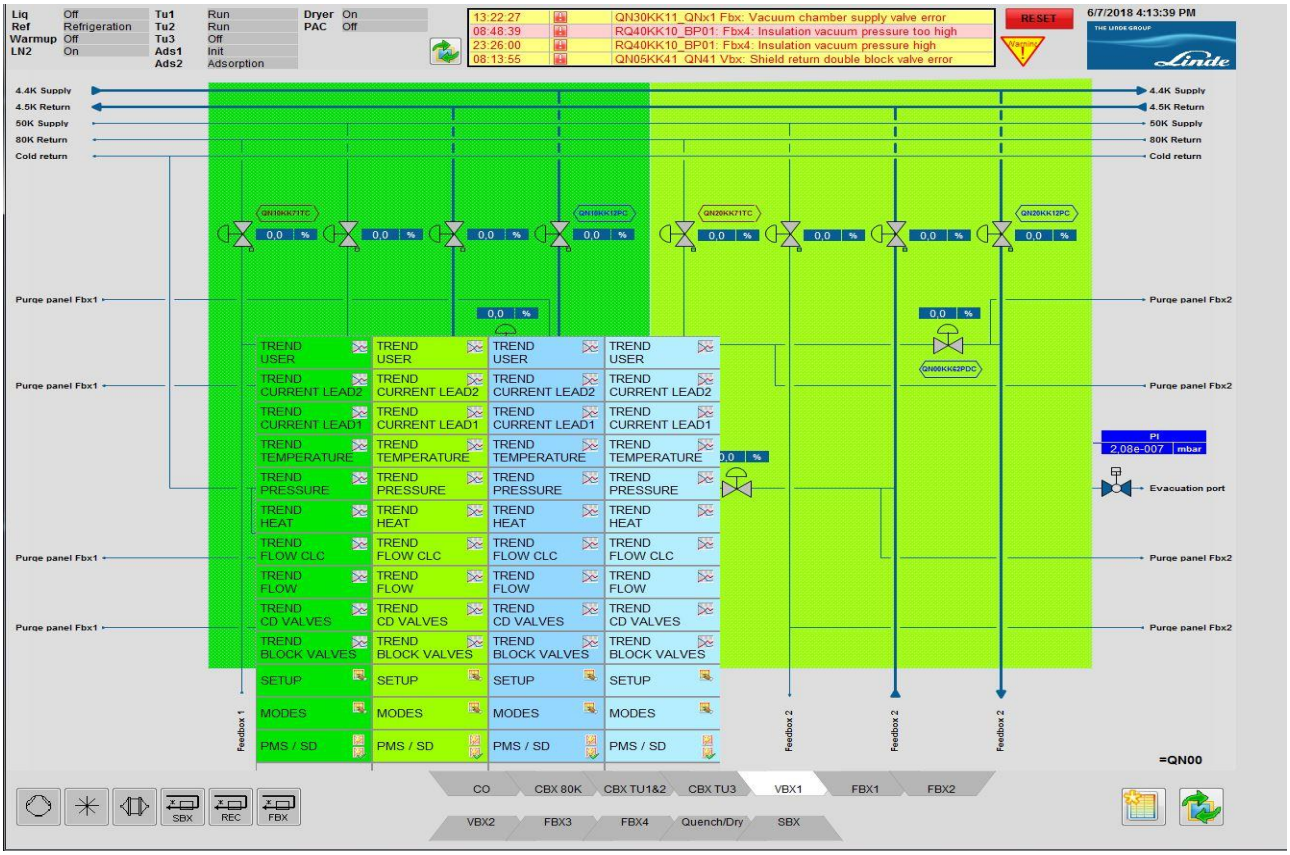


Figure 9: Example STF4

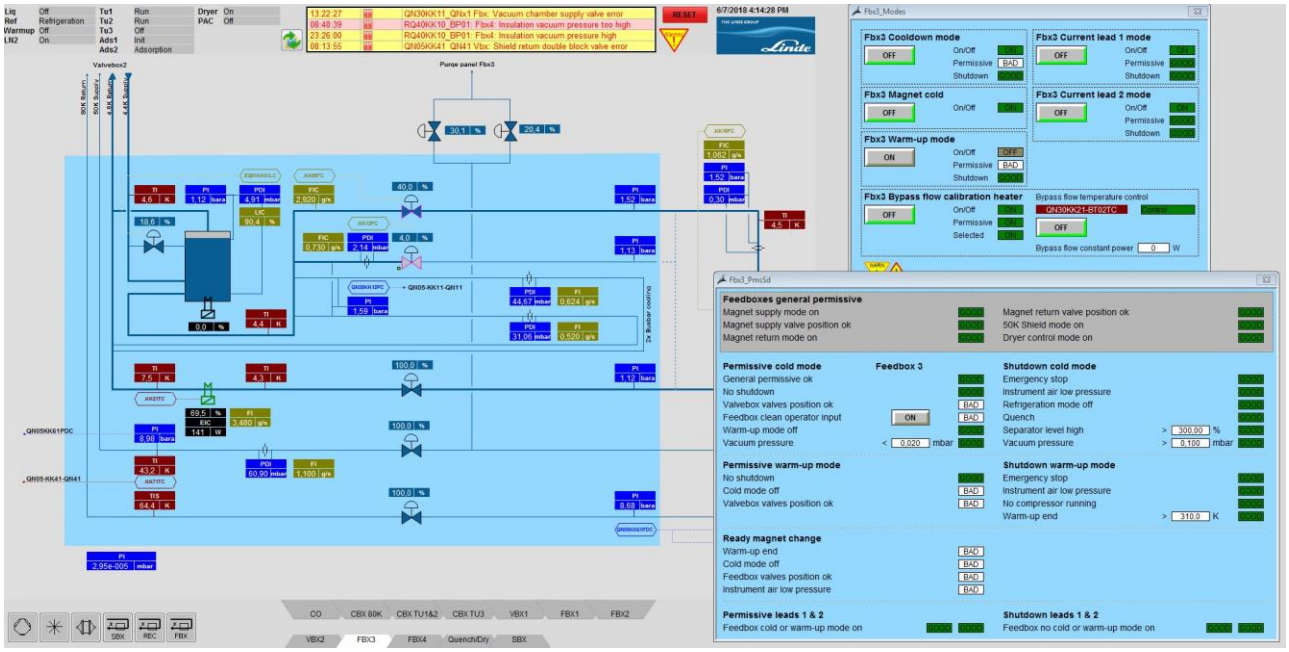


Figure 10: Example STF5

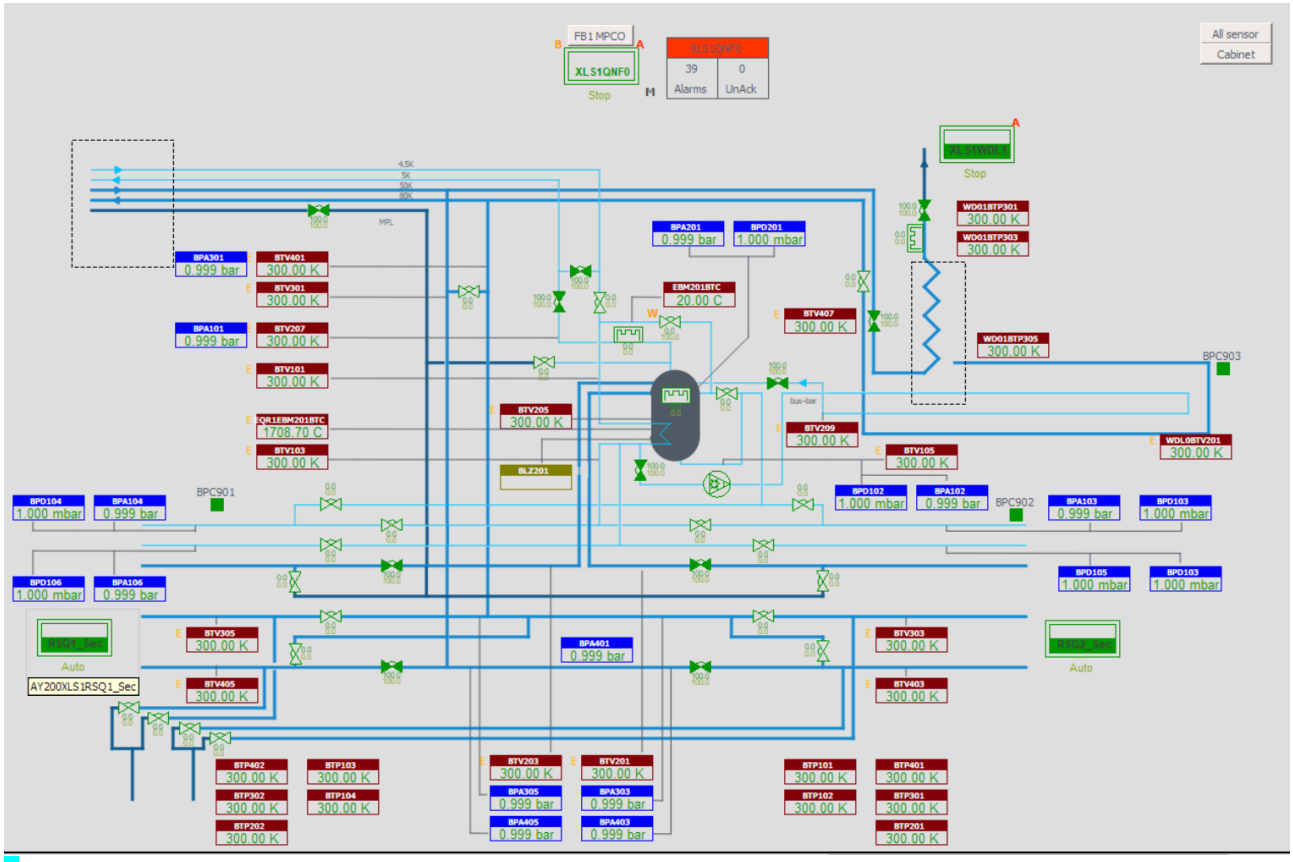


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Figure 15: Overview panel SIS100

5.1 Synoptic Panels

Describe here all needed synoptic panels with name, specific view and contents

- **Name:** Unit A

View:

- Needed synoptic e.g. detail of P&ID, drawing etc.

Content:

- List of equipment to be represented on the dedicated panel
- Needed buttons with label and function
- Needed diagnostic functions/panels
- Needed special information like:
  - Working hours of pumps
  - Remaining time until maintenance cycle

5.2 Trends

Describe here all needed trends/plots with name and configuration

- **Name:** Temperature Unit A

Elements:

- DP: TT100, Legend Text: “Temperature Turbine Inlet”, Y Axis: OFF
- DP: TT101, Legend Text: “Temperature T2 Inlet”, Y Axis: ON
- DP: TT105, Legend Text: “Temperature Turbine Outlet”, Y Axis: OFF

5.3 Panel organization

Describe here how the panels should be organized. Needed information is:

- *Window tree*
- *Trend tree*
- *Navigation between panels*

5.4 Access rights

Describe here if there are any special access rights needed.

6. REFERENCES

Add here any other documents which may be related to this functional analysis (e.g. user requirement, process functionalities, etc.).

[1] F-DS-K-30e_SIS100_Feed_Box