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TS-CV-DC

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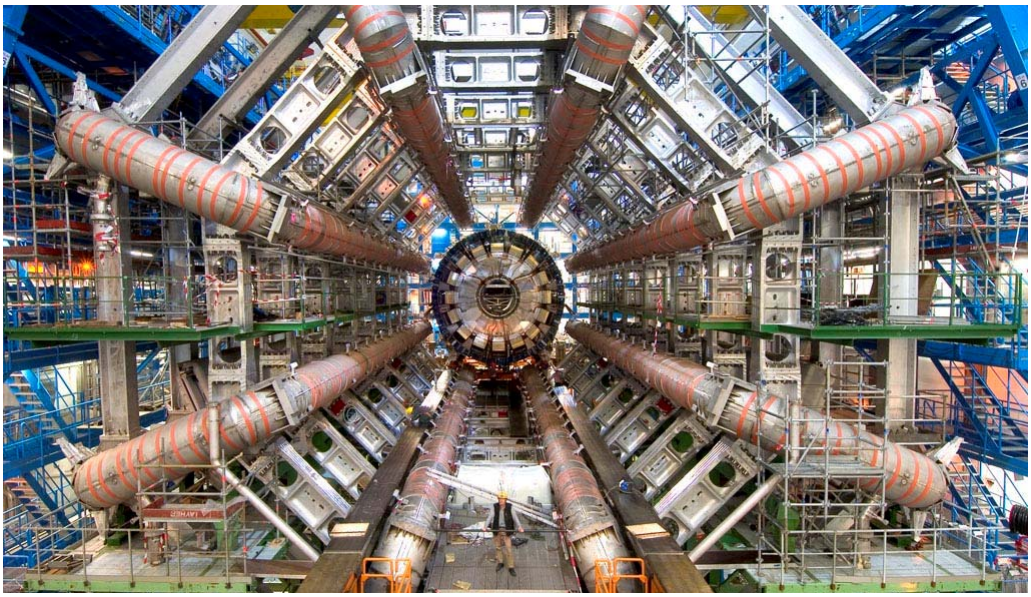
TS/CV Detector Cooling Project Document No.
186.15.80

EDMS Document No.
781377

HYDRAULIC DOSSIER

ATLAS DIFFUSION VACUUM PUMPS COOLING SYSTEM



General description and functionalities

This cooling unit is for the cooling of the diffusion vacuum pumps situated on the Toroid Barrels, the LAr Barrels, the End Caps as well as on the Valve Box and Solenoid Dewar of the ATLAS experiment, a total of 26 pumps. It uses demineralised water with an anti-corrosion additive and works according to the LCS.v2 leakless principle.
The maximum cooling power is 54 kW @ 15/25°C, corresponding to a total flow of 4.7 m^3/h, with a nominal head of 56 m.
Twelve distribution lines serve the user circuits.

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History of Changes

Rev. No.	*Date*	*Pages*	*Description of Changes*

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1. INTRODUCTION

Plant Name: FCUL-00016 (TS/CV/DC project number: 186.15.80)

Location: ATLAS Experimental Cavern, UX15.

Project responsible: Carsten Houd, TS/CV/DC, tel. 70679/165173

1.1 GENERAL DESCRIPTION

This cooling unit is for the cooling of the diffusion vacuum pumps situated on the Diffusion Pumps and Toroid Barrels, the Liquid Argon and Toroid End Caps as well as on the Valve Box and Solenoid Dewar of the ATLAS experiment, a total of 26 vacuum pumps. It uses demineralised water with an anti-corrosion additive added and works according to the LCS.v2 leakless principle that will be described in Chapter 3.1.

The maximum cooling power is 54 kW @ 15/25°C, corresponding to a total flow of 4.7 m^3/h, with a nominal head of 56 m.

Drawings 186.15.82 (Annex A1) and 186.15.83 (Annex A2) show the layout of the cooling system and their piping for the ATLAS Diffusion Vacuum Pumps in UX15. The cooling station, consisting of the tank, circulator, heat exchanger and pneumatic pressure regulators are located on the floor of the experimental cavern. The pipes can go up to ~ 15 m to distribute the liquid in the cooling circuit of each vacuum pump. Depending of their location inside the detector, the pumps are grouped by sector while respecting a maximum pressure head of 2 to 3m in each sector. Each sector has a pressure transmitter and corresponds to a channel (or line) on the cooling plant.

According to the LCS v.2 principle, the overpressure will be limited to the inlet pipes, from the pump at the cooling station to the arrival in the corresponding sector. The distribution lines in the sectors, the heat exchangers on the vacuum pump and the return pipes will run in sub-atmospheric mode (1 to 0.7 bar(a)).

Twelve distribution lines serve the user circuits. The cooling station is equipped with four spare lines for later use.

A line for the quality control runs from the station to Analysis Rack in USA15 where a valve for analysis sampling is available.

1.1.1 EVM WORK UNIT DESCRIPTION

The cooling plant for the Diffusion Pumps, including connections to the manifolds and to the heat exchangers on the vacuum pumps, will be assembled, tested, installed and later maintained by TS/CV. Cables and pneumatic pipes from the racks to neighbouring control equipment (PLC, etc.) in USA15 are included. Cables to other areas (i.e. control room) should be laid to our specifications by the experiment. Documentation (schematics, description, user instruction manuals) and the associated controls will be delivered for the cooling plant. The PLC hardware is included in the work package, as well as the software and the hardware for the TS/CV supervision.

1.1.2 ASSOCIATED DOCUMENTS

EDMS Id 781379: ATLAS Diffusion Pumps cooling system technical dossier. Electrical Part.

EDMS Id 786905: ATLAS Diffusion Pumps cooling system technical dossier. Pneumatic Part.

2. NAMING & SPARE PARTS

2.1 MAINTENANCE DATABASE NAMING

ATLAS Diffusion Pumps Cooling System. Project no. 186.15.80. Leakless cooling system, demineralised water.		FCUL-00016
TS-CV responsible: Carsten Houd		
Description	**Comment**	**MP5 name**
Power supply local, ATLAS Diffusion Pumps circ. pump		FCTIR-00028
Expansion Tank, 600 l. STT		FCEE-00013
Safety valve tank, REV1	100 mbar, NPT 1/2"M	FCKE-00025
Plate heat exchanger 54 kW, HPX	B12Mx40/1P-SN-S 4*1 1/4"	FCE-00017
Circulation pump 1, VCP1	CRN5-11, DN32	FCP-00039
Circulation pump 2, VCP2	CRN5-11, DN32	FCP-00075
Vacuum pump, VP	KNF N026, 220 V	FCP-00040
Ultra-sonic Level Transmitter, WLT	MSP400RH-B28. Gamme 0.3-12 m	FCLT-00004
Pressure switch, PZA1	Gamme-50/-600 art.625.64301121	FCPS-00020
Pressure transmitter, PT16	Type 680 CERN modif, 0-2.5 b.a	FCPT-00086
Pressure transmitter, PT17	Type 680 CERN modif 0-10 b.a	FCPT-00087
Pt100 Station out, TT1	Type SI 1119 F/L/3F/A	FCTT-00066
Pt100 Station in, TT2	Type SI 1119 F/L/3F/A	FCTT-00067
Pt100 chilled water in, TT3	Type SI 1119 F/L/3F/A	FCTT-00068
Pt100 chilled water out, TT4	Type SI 1119 F/L/3F/A	FCTT-00069
Manometer Station out, PG1	Ech. -1/+10 bar D100	FCPG-00020
Manometer Station in, PG2	Ech. -1/+1 bar D100	FCPG-00021
Strainer secondary circuit, STR1a	Tecofi F6240, stainless	FCF-00021
Strainer secondary circuit, STR1b	Tecofi F6240, stainless	FCF-00072
Strainer chilled water, STR2	Brass 0.8, DN32. F2140	FCF-00022
Diff. pressure regulator, DPR	SART type 5362 L4, DN25	FCPV-00011
Electro-valve for vac. Pump, EVB16	CERN store	FCV-00300
Control valve chilled water, PCVB	B6R 1", 10 m3/h w. pneu act	FCV-00301
Flowmeter, chilled water, FZA13	Art.No. 120428, DN30	FCFIC-00019
Pneum. Ball valve PVA1	Inox DN20 w. pneu. Act.	FCV-00302
Pneum. Ball valve PVA2	Inox DN15 w. pneu. Act.	FCV-00303
Pneum. Ball valve PVA3	Inox DN15 w. pneu. Act.	FCV-00304
Pneum. Ball valve PVA4	Inox DN25 w. pneu. Act.	FCV-00305
Pneum. Ball valve PVA5	Inox DN25 w. pneu. Act.	FCV-00306
Pneum. Ball valve PVA6	Inox DN25 w. pneu. Act.	FCV-00307
Pneum. Ball valve PVA7	Inox DN25 w. pneu. Act.	FCV-00308
Pneum. Ball valve PVA8	Inox DN15 w. pneu. Act.	FCV-00309
Pneum. Ball valve PVA9	Inox DN15 w. pneu. Act.	FCV-00310
Pneum. Ball valve PVA10	Inox DN20 w. pneu. Act.	FCV-00311
Pneum. Ball valve PVA11	Inox DN15 w. pneu. Act.	FCV-00312
Pneum. Ball valve PVA12	Inox DN15 w. pneu. Act.	FCV-00313
Pneum. Ball valve PVA16	Inox DN15 w. pneu. Act.	FCV-00314

Pneum. Ball valve PVA17	Inox DN15 w. pneu. Act.	FCV-00315
Pneum. Ball valve PVA18	Inox DN15 w. pneu. Act.	FCV-00316
Pneum. Ball valve PVA19	Inox DN15 w. pneu. Act.	FCV-00317
Pneum. Control valve PCVA1	Baumann 1/2" 24000S pneu act	FCV-00318
Pneum. Control valve PCVA2	Baumann 1/2" 24000S pneu act	FCV-00319
Pneum. Control valve PCVA3	Baumann 1/2" 24000S pneu act	FCV-00320
Pneum. Control valve PCVA4	Baumann 24000S, Cv=1 pneu act	FCV-00321
Pneum. Control valve PCVA5	Baumann 24000S, Cv=1 pneu act	FCV-00322
Pneum. Control valve PCVA6	Baumann 24000S, Cv=1 pneu act	FCV-00323
Pneum. Control valve PCVA7	Baumann 24000S, Cv=1 pneu act	FCV-00324
Pneum. Control valve PCVA8	Baumann 24000S Cv=0.5 pneu act	FCV-00325
Pneum. Control valve PCVA9	Baumann 24000S Cv=0.5 pneu act	FCV-00326
Pneum. Control valve PCVA10	Baumann 24000S Cv=0.5 pneu act	FCV-00327
Pneum. Control valve PCVA11	Baumann 24000S Cv=0.5 pneu act	FCV-00328
Pneum. Control valve PCVA12	Baumann 24000S Cv=0.5 pneu act	FCV-00329
Balancing valve BAV1	STADA 1/2"M, kvs 1.47	FCV-00330
Balancing valve BAV2	STADA 1/2"M, kvs 1.47	FCV-00331
Balancing valve BAV3	STADA 1/2"M, kvs 1.47	FCV-00332
Balancing valve BAV4	STADA 3/4"M kvs 2.52	FCV-00333
Balancing valve BAV5	STADA 3/4"M kvs 2.52	FCV-00334
Balancing valve BAV6	STADA 3/4"M kvs 2.52	FCV-00335
Balancing valve BAV7	STADA 3/4"M kvs 2.52	FCV-00336
Balancing valve BAV8	STADA 1/2"M, kvs 1.47	FCV-00337
Balancing valve BAV9	STADA 1/2"M, kvs 1.47	FCV-00338
Balancing valve BAV10	STADA 1/2"M, kvs 1.47	FCV-00339
Balancing valve BAV11	STADA 1/2"M, kvs 1.47	FCV-00340
Balancing valve BAV12	STADA 1/2"M, kvs 1.47	FCV-00341
Flowmeter line 1, FZA1	Art.No.: 120426, DN20	FCFIC-00007
Flowmeter line 2, FZA2	Art.No.: 120425, DN15	FCFIC-00008
Flowmeter line 3, FZA3	Art.No.: 120425, DN15	FCFIC-00009
Flowmeter line 4, FZA4	Art.No.: 120427, DN25	FCFIC-00010
Flowmeter line 5, FZA5	Art.No.: 120427, DN25	FCFIC-00011
Flowmeter line 6, FZA6	Art.No.: 120427, DN25	FCFIC-00012
Flowmeter line 7, FZA7	Art.No.: 120427, DN25	FCFIC-00013
Flowmeter line 8, FZA8	Art.No.: 120425, DN15	FCFIC-00014
Flowmeter line 9, FZA9	Art.No.: 120425, DN15	FCFIC-00015
Flowmeter line 10, FZA10	Art.No.: 120426, DN20	FCFIC-00016
Flowmeter line 11, FZA11	Art.No.: 120425, DN15	FCFIC-00017
Flowmeter line 12, FZA12	Art.No.: 120425, DN15	FCFIC-00018
Pressure transmitter PT1	Type 680 CERN modif 0-10 b.a	FCPT-00088
Pressure transmitter PT2	Type 680 CERN modif 0-10 b.a	FCPT-00089
Pressure transmitter PT3	Type 680 CERN modif 0-10 b.a	FCPT-00090
Pressure transmitter PT4	Type 680 CERN modif 0-10 b.a	FCPT-00091
Pressure transmitter PT5	Type 680 CERN modif 0-10 b.a	FCPT-00092
Pressure transmitter PT6	Type 680 CERN modif 0-10 b.a	FCPT-00093

Pressure transmitter PT7	Type 680 CERN modif 0-10 b.a	FCPT-00094
Pressure transmitter PT8	Type 680 CERN modif 0-10 b.a	FCPT-00095
Pressure transmitter PT9	Type 680 CERN modif 0-10 b.a	FCPT-00096
Pressure transmitter PT10	Type 680 CERN modif 0-10 b.a	FCPT-00097
Pressure transmitter PT11	Type 680 CERN modif 0-10 b.a	FCPT-00098
Pressure transmitter PT12	Type 680 CERN modif 0-10 b.a	FCPT-00099
Flow sight glass FSG1	VC4LTGNI 20	FCFG-00067
Flow sight glass FSG2	VC4LTGNI 15	FCFG-00068
Flow sight glass FSG3	VC4LTGNI 15	FCFG-00069
Flow sight glass FSG4	VC4LTGNI 25	FCFG-00070
Flow sight glass FSG5	VC4LTGNI 25	FCFG-00071
Flow sight glass FSG6	VC4LTGNI 25	FCFG-00072
Flow sight glass FSG7	VC4LTGNI 25	FCFG-00073
Flow sight glass FSG8	VC4LTGNI 15	FCFG-00074
Flow sight glass FSG9	VC4LTGNI 15	FCFG-00075
Flow sight glass FSG10	VC4LTGNI 20	FCFG-00076
Flow sight glass FSG11	VC4LTGNI 15	FCFG-00077
Flow sight glass FSG12	VC4LTGNI 15	FCFG-00078
Flow sight glass FSG18	VC4LTGNI 15	FCFG-00079
Pneumatic ball valve PVA13a	Type 80D DN32, PN40 GS full bore. Pneumatic drive: Air Torque AT 201 S21A	FCV-01340
Pneumatic ball valve PVA13b	Type 80D DN32, PN40 GS full bore. Pneumatic drive: Air Torque AT 201 S21A	FCV-01341

2.2 GENERAL NAMING

Components		Lines	
ACH	Air cooled water chiller	**AL**	Analog signal line
BAV	Balancing valve	**CWL**	Chilled water line
BOV	Booster	**DL**	Digital line
BPR	Back pressure regulator	**DGL**	Distribution gas/vapor line
BTV	Butterfly valve	**DLL**	Distribution liquid line
BUF	Buffer tank	**DWL**	Demineralized water line
CBV	Compact ball valve	**GL**	Gas line
CEP	Converter E->P	**IGL**	Intermediate gas/vapor line
CF	Chemical filter	**ILL**	Intermediate liquid line
CHV	Check valve	**LL**	Liquid line
CIR	Circulator	**MGL**	Main gas/vapor line
COP	Piston compresor	**MLL**	Main liquid line
CSC	Control scale	**MWL**	Mixed water line
DPR	Differential pressure regulator	**PL**	Pneumatic line
ECVA	Electrical control valve 2 ways	**PWL**	Power line
ECVB	Electrical control valve 3 ways	**VL**	Vacuum line
EI	Switch control (manual valve)		
EVA	Electrovalve 2 ways		
EVB	Electrovalve 3 ways		
FRA	Frame		
FSG	Flow sight glass		
FZA	Flow controller		
GFL	Gas flowmeter		
HCP	Horizontal centrifugal pump		
HEA	Resistance heater		
HPX	Heat plate exchanger		
LFL	Liquid flowmeter		
MCVA	Manual control valve 2 ways		
MCVB	Manual control valve 3 ways		
MDP	Magnetic drive centrifugal pump		
MF	Mechanical filter		
MVA	Manual valve 2 ways		
MVB	Manual valve 2 ways		
PCVA	Pneumatic control valve 2 ways		
PCVB	Pneumatic control valve 3 ways		
PG	Pressure gauge		
PR	Pressure regulator		
PT	Pressure transmitter		
PVA	Pneumatic valve 2 ways		
PVB	Pneumatic valve 3 ways		
PZA	Pressure switch		
QT	Conductivity transmitter		
REV	Relief valve		
RFB	Resin filter body		
RFC	Resin filter cartridge		
STR	Strainer		
STT	Storage tank		
TA	Temperature controller / alarm		
TT	Temperature transmitter		
TVA	Thermostatic valve 2 ways		
TVB	Thermostatic valve 3 ways		
VCP	Vertical centrifugal pump		
VP	Vacuum pump		
WLT	Water level transmitter		

2.3 SPARE PART LIST

The following spare parts are associated with the equipment installed:

Part No.	Description	Manufacturer	Preferred Supplier	Supplier reference	Price [chf]	Quantity installed
F05-08-020	Kobold level sensor AEV2-VK-L1350	Kobold	Kobold	Type: AEV2-VK-L1350-SV-TPS343A	1246	1
F05-10-012	Grundfos vertical centrifugal pump CRN5-11, DN32	Grundfos	Grundfos	product no.96517190	1800	1
F05-03-027	Garniture mécanique HQQE pour pompes Grundfos types CR 1 CR 3 CR 5	Grundfos	Grundfos	No. Art.: 96455086	213	1
F05-03-030	Jeux de joints EPDM (manteau)	Grundfos	Grundfos	No. Art.: 96455090	53	1
F31-03-031	Joints plats universel, DN32		CERN Magasin	36.12.60.178.1	2,6	6
F05-08-010	Huba Control pressure transmitter, 0-2.5 b(a)	Huba Control	Huba Control	Type 680 for CERN, 0-2.5 bar.a	270	1
F05-08-011	Huba Control pressure transmitter, 0-10 b(a)	Huba Control	Huba Control	Type 680 for CERN, 0-10 bar.a	270	13
F05-08-006	Thermo-Est Pt100 temperature transmitter	Thermo-Est	Thermo-Est	Sonde Pt100; Type SI 1119 F/L/3F/A	64	4
F05-08-023	Aquadis flow meter, DN15 Q=1 m3/h	Aquadis	Actaris SA	N° art.120425	210	6
F05-08-024	Aquadis flow meter, DN20 Q=2.5 m3/h	Aquadis	Actaris SA	N° art.120426	210	2
F05-08-025	Aquadis flow meter, DN25 Q=3.5 m3/h	Aquadis	Actaris SA	N° art.120427	260	4
F05-08-026	Aquadis flowmeter, DN32 Q=10 m3/h	Aquadis	Actaris SA	N° art.120428	755	1
F05-08-015	Actaris Cyble sensor	Actaris SA	Actaris SA	N° art. 120433	73	13
F05-10-005	KNF pompe a vide, N026 220v	KNF	KNF	PM16867-026-7.00	403	1
F05-03-009	Viton rubber diaphragm for SART 5362 L4	SART Von Rohr	Ribat			1
F25-06-006	El. valve 3/2.1/4G.NO.131K04		CERN Store	18.60.80.905.3	71,5	1
F05-03-020	Presse etoupe pour Sauter B6R	Sauter	Sauter			1
F05-03-038	Pneumatic actuator Tri-Matic for ball valve DN15	Tri-Matic	Tri-Matic			6
F05-03-039	Pneumatic actuator Tri-Matic for ball valve DN20	Tri-Matic	Tri-Matic			2
F05-03-040	Pneumatic actuator Tri-Matic for ball valve DN25	Tri-Matic	Tri-Matic			4

F05-03-013	Pneumatic actuator for Baumann 24000S regulation valve	Baumann	Ribat	Actionneur pneumatique pour vanne Baumann	515	12
F05-03-014	Diaphragm exchange kit for Baumann 2400S regulation valve actuator	Baumann	Ribat	Membrane de rechange pour vanne Baumann	225	12
F05-03-015	Spring exchange kit for Baumann 2400S regulation valve actuator	Baumann	Ribat	Jeu de ressort pour actionneur de vanne Baumann	18	12
F05-03-019	Replacement glass for Meca-Inox sight glass DN15 FB / DN20 RB	Meca-Inox	Ribat	Verre de rechange viseur Meca-Inox DN15 PI / DN20 PR		6
	Replacement glass for Meca-Inox sight glass DN20 FB / DN25 RB	Meca-Inox	Ribat	Verre de rechange viseur Meca-Inox DN20 PI / DN25 PR		2
	Replacement glass for Meca-Inox sight glass DN25 FB / DN32 RB	Meca-Inox	Ribat	Verre de rechange viseur Meca-Inox DN25 PI / DN32 PR		4
F05-03-041	Pneumatic actuator Air Torque for valve DN32/40	Air Torque	Zurcher Technik	AT 250 S012 A	215	2

3. HYDRAULIC DOSSIER

3.1 LCS.V2 OPERATING PRINCIPLE

The liquid is held in a storage tank (3) maintained below atmospheric pressure by a vacuum pump (2). A check valve discharges any excess air in the event of drainage and prevents the pressure in the storage tank from rising above atmospheric pressure. The liquid is moved into the exchangers (1) incorporated through the electronic system by a circulator (4).
The pressure at the various points of the circuit depends on the head losses and hydrostatic pressures.

At start-up, if the pressure in the storage tank is not low enough the vacuum pump is activated. While the later is in operation, in the event of an air intake for instance, the circulator cannot run. The pressure throughout the circuit still equal to the pressure in the storage tank.

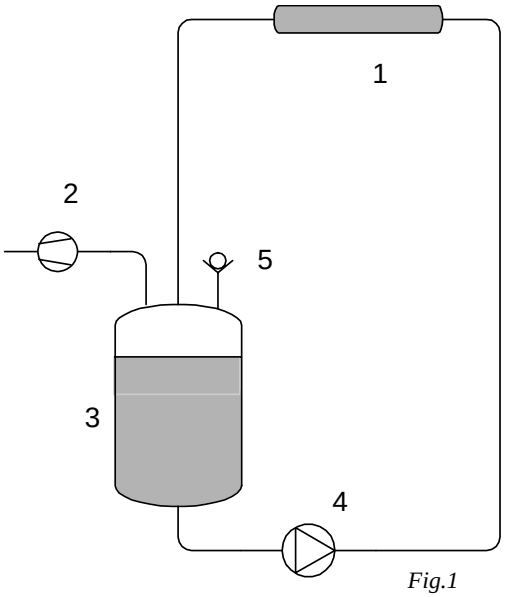

Fig.1

3.2 USER REQUIREMENTS

Cooling needs for each diffusion pump has been given in term of flow rate and with a ΔT=10°C across the pumps.

Sub-detector pump	Flow per pump [l/h]	Nbr. of pumps	Total flow per channel [l/h]	Equivalent power [W] Per pump / per line
Toroid End Cap – Side A	180	2	360	2100 / 4200
Diffusion Pumps End Cap – Side A	160	1	160	1860
Diffusion Pumps Barrel – Side A	160	1	160	1860
Toroid Barrel – USA Side A	180	4	720	2100 / 8400
Toroid Barrel – US Side A	180	4	720	2100 / 8400
Toroid Barrel – USA Side C	180	4	720	2100 / 8400
Toroid Barrel – US Side C	180	4	720	2100 / 8400
Diffusion Pumps Barrel – Side C	160	1	160	1860
Diffusion Pumps End Cap – Side C	160	1	160	1860
Toroid End Cap – Side C	180	2	360	2100 / 4200
Valve Box – Side C	180	1	180	2100
Solenoid Dewar	160	1	160	1860
Total		**26**	**4700**	**53400**

3.3 SYSTEM DESIGN SPECIFICATIONS

This cooling system is designed to evacuate 54 kW from the cooling circuit of the ATLAS diffusion vacuum pumps.
The unit is a closed liquid circuit working according to the LCS v.2 principle and connected to a primary circuit through a brazed plate heat exchanger. The supply and return manifolds are attached to the station. A Programmable Logical Controller controls the operation. See drawing 186.15.83 (Annex 3).

- The primary circuit is the ATLAS chilled water circuit:
  - Inlet 5°C
  - Return 11°C
  - Flow rate 7.7 m3/h
- The secondary circuit : Demineralised water w/ anti-corrosion additive
  - Inlet 15°C
  - Return 25°C
  - Flow rate 4.7 [m3/h]
  - Number of supply lines: 12 + 1 line for quality control in USA15 + 1 line for a filter cartridge (unused) and 4 spare lines.

A circulator pump moves the fluid from the pressurized storage tank to the exchangers through a brazed plate heat exchanger connected to the primary circuit via a pneumatic 3 ways valve. The temperature is controled by a PID module inside the PLC. The circuit inlet pressure is maintained by a back pressure valve on a by-pass.

- Pump specifications:
  - Vertical multistage centrifugal pump
  - Flow max: 4.7 [m3/h] at head max 56[m].
  - Power: 2.2 kW (comes directly from UX15)

(Head requirement: 1.5 bar in lines, 0.5 bar in station, 25 m in height difference, 0.8 bar inside pump heat exchanger + 20% => P=6.4 bar)

  - The station is equipped with a redundancy pump. A change of pump, in case of malfunction, can be done from the PLC interface (see Chapter 4 – User Manual)

- Heat exchanger specifications:
  - Construction: Nickel brazed plate heat exchanger
  - Max power dissipation: 54.55 [kW]
  - Heat exchange surface: 1.06 [m^2]
  - Pressure drop, primary side: 11.4 [kPa]
  - Pressure drop, second. Side: 15 [kPa]

- Back pressure regulator specifications:
  - Stainless steel self-operated regulator
  - Flow max : 5 [m3/h]
  - Working temperature: 20°C
  - Outlet pressure: 6 bar
  - Differential pressure range: 5 bar (depending of the pump's curve)

Each line is equipped at the manifold level with a pneumatic valve controlling the inlet pressure of the corresponding sector. The signal is controlled by a PID module inside the PLC.
The pressure of the storage tank is controlled by a membrane vacuum pump and a pressure transmitter.

- Tank specifications:
  - Capacity: 0.6 [m3]

The cooling station and the manifold are in stainless steel material and all the piping is realized with multi-layer PE/Alu/PE pipe and Geberit crimp fittings. The heat exchangers on the diffusion pumps consists of copper tube and the water has been added an additive to inhibit corrosion on these parts.

- Cooling water specifications:
  - Volume: 600 [l]
  - Anti-corrosion treated demineralised water
  - Additive: Aquadis K-20, dose 300 [ml] / [m^3]. Prescriptions and documentation on this product can be found in Annex C.
  - Sample valve available in the Analysis Rack (FCTIR-00021) in USA15.

Controls:

- 1 Pt100 temperature sensor on the outlet of the heat exchanger
- 1 pressure transmitter at the outlet of the pump.
- 1 manometer at the outlet of the pump.
- 1 pressure transmitter on the storage tank.
- 1 manometer on the return line.
- 1 flow sight glass on each return line before the main return manifold.
- Visual liquid level on the tank.
- Ultrasonic water float level in the storage tank
- Flow meters in each of the 12 return lines
- Pressure transmitters in each of the 12 supply lines

Alarms:

- Ultrasonic water float level in the storage tank
- High pressure switch on the tank.
- Auto-protection / thermal switch on the circulating pump.

Signals, warnings and alarms from the PLC and the control rack are part of the LCS v.2 process and described in the Electrical Dossier.

Security:

- Relief valve on the storage tank, Set Point at 100 [mbar(a)]

3.4 SCHEMATICS AND DRAWINGS

All drawings can be found in the Annex A to this document:

- Annex A1: 186.15.81 – Construction drawing for the cooling station
- Annex A2: 186.15.82 – Cavern layout and piping schematics
- Annex A3: 186.15.83 – Principle drawing for the cooling circuit

3.5 CIVIL ENGINEERING INTEGRATION

See drawings in CDD:

- **Civil Engineering - Package 1 - Underground**
  - o Civil Engineering – UX15

The services required by this cooling plant are:

- 7.7 m^3/h of chilled water
- 2.2kW, 400V from the TS-CV standard power distribution
- XXW, 220V from TS-CV Diesel power distribution
- Compressed air at 6bar (consumption is negligible).
- TCP/IP connection

4. USER MANUAL

4.1 INTRODUCTION

This user manual concerns the use of the PLC interface panel on the control rack FCTIR-00016. The normal operation of the Diffusion Pumps cooling plant is done via PVSS logistic situated in CERN Experimental Control Room (ECR). The XBT panel can be operated only when being authorized from the PVSS logistic.

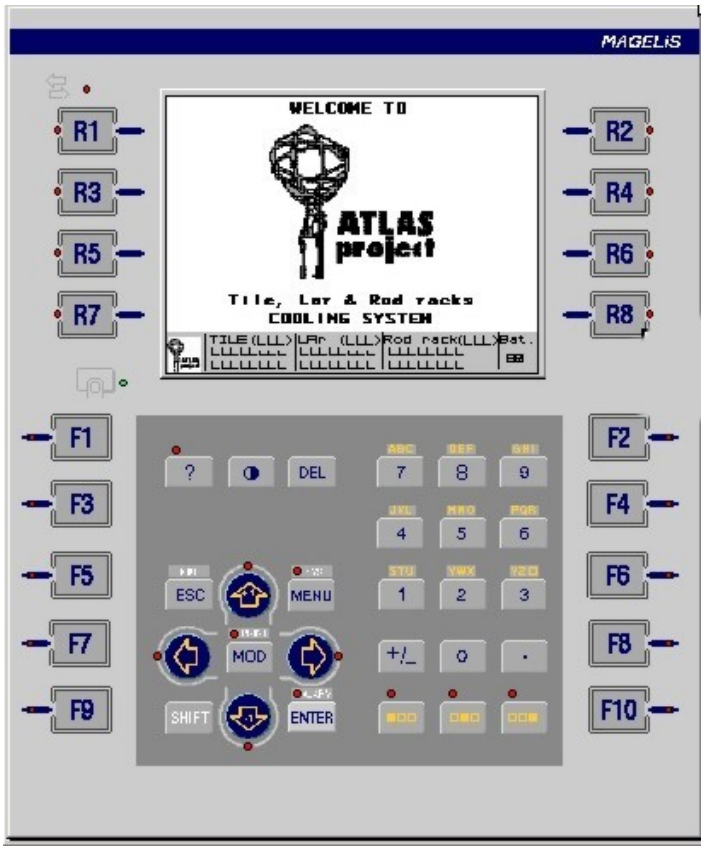

Figure 4.1.1 XBT-Magelis Interface Panel

The PLC handles the functions of three different cooling units in UX15 (Diffusion Pumps, TRT and ID Cables). The main page of the XBT is shown on the Figure 4.1.1.

The XBT panel functions with two different sets of buttons, on top the R1 to R8, which operates different functions seen on the display (functions change depending on the display). The buttons below, F1 to F10 operates the main functions that can be found below.

F1	Main page	**F2**	TRT cooling system front page
F3	System designed by	**F4**	Cables cooling system front page
F5	Faults and status (Chap.6.5)	**F6**	Diff. Pumps cooling system front page (Chap.4.2.)
F7	Sensors calibration (Chap.6.6)	**F8**	Empty
F9	Empty	**F10**	Reset

4.1.1 KEYBOARD

The keyboard of the XBT interface panel is according to the figure 4.1.1.1

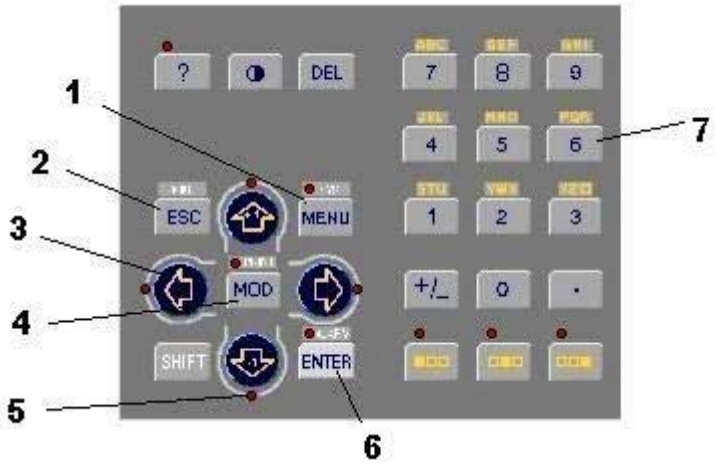

Figure 4.1.1.1 Keyboard

1: **Menu** – see chapter 4.3

2: **ESC** – move back to the previous page

3: **Arrow keys** that you can use to navigate in the menus

4: ***MOD*** to modify parameter

5: Small **led lights** indicate when the button next to it is operational

6: Validate your choice by hitting ***Enter***

7: **Number keys** 0 to 9 that you can use e.g. to insert the password or set points.

4.2 DIFFUSION PUMPS CONTROL/ F6

Access to the Diffusion Pumps cooling control system happens by pressing key "Diffusion Pumps" (F6). The display will show the view below (figure 4.2.1).

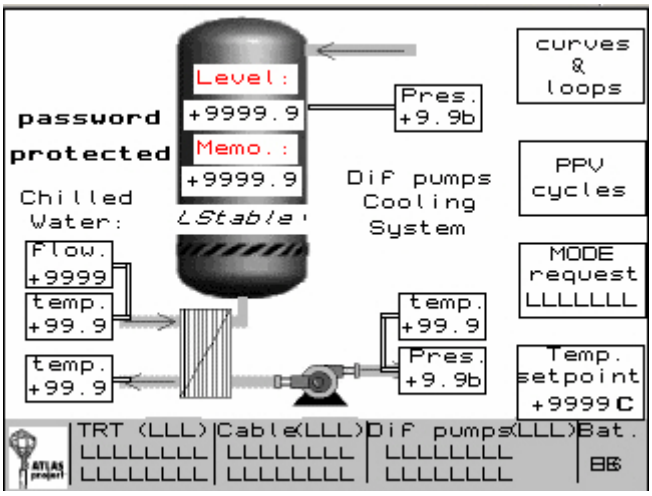

Figure 4.2.1 Diffusion Pumps front page

The Diffusion Pumps front page shows following values of the cooling system:

- Primary network (chilled water) flow [m^3/h]
- Primary network (chilled water) supply temperature (before the heat exchanger) [°C]
- Primary network (chilled water) return temperature (after the heat exchanger) [°C]
- Secondary network (demineralised water) return temperature (before the storage tank) [°C]
- Secondary network (demineralised water) tank level in the storage tank [l]
- Secondary network (demineralised water) memorized tank level in the storage tank [l]
- Secondary network (demineralised water) supply temperature (after the heat exchanger) [°C]
- Secondary network (demineralised water) supply pressure (after the circulation pump) [bar(a)]
- Secondary network (demineralised water) set-point temperature (after the heat exchanger) [°C]

The screen has on its right side following functions:

- loops and curves (operates by pressing button R2)
- PPV cycles (operates by pressing button R4)
- MODE request (operates by pressing button R6)
- Temp. set point (operates by pressing button R8)

All pages displayed on the screen after the main page bear information on the Cycle and the Status. The former can assume 3 different values: Stop, Stand-by, and Run. The latter can either display OK, Warning or Alarm.

The default Cycle when the plant is powered ON is STOP. In this cycle the circulator pump is idle; in all circuits supply valves are closed, return valves are open; the reservoir is at atmospheric pressure; the chilled water valve is closed.

When the plant is powered ON, the Status is likely to be indicating ALARM. The exact list of alarms can be obtained by pressing F5 – faults and status (see chapter 4.5).

4.2.1 LOOPS AND CURVES / R2

When button R2 – Diffusion Pumps loops and curves is pressed the following display (Figure 4.2.1.1.loops and curves) will appear on the screen.

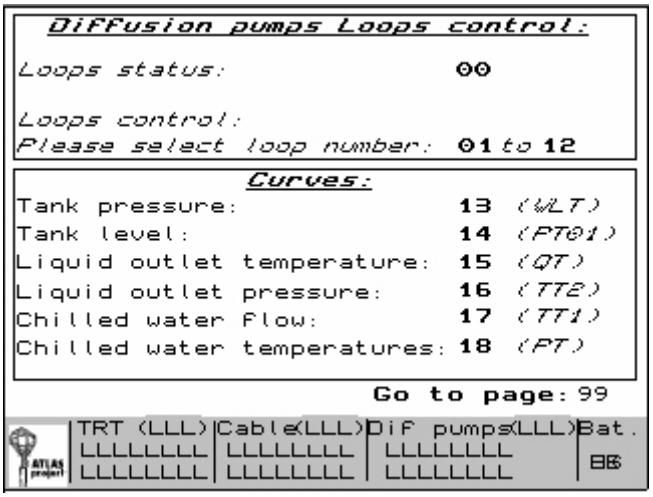

Figure 4.2.1.1 loops and curves

Press the button R8 to have the access on the screen. There will be a rectangular box appearing where the number of the wanted loop or curve is to be written (next to the text 'Go to page'). Insert the number using the number keys, and press enter.

The loops and curves display allows the access to the 12 different cooling loops of the cooling system (see chapter 3 and the drawings Annex A). From these pages (see Fig. 4.2.1.2 for example) the pressure during the last 24 hours, the actual flow and pressure can be seen and the pressure set point can be changed, provided the correct **USER** password has been entered (see Chapters 4.1.2.keyboard, 4.7 MENU and 4.7.7 MOT DE PASSE).

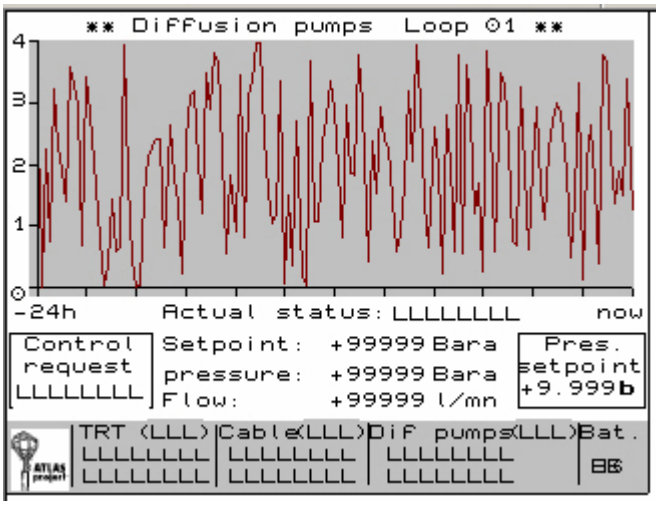

Figure 4.2.1.2 Diffusion Pumps Loop 01

For a quick overview, ask for the Loops Status page (Fig. 4.2.1.3 Loops Status) where you have actual pressure, set point and status of all the loops at the same time.

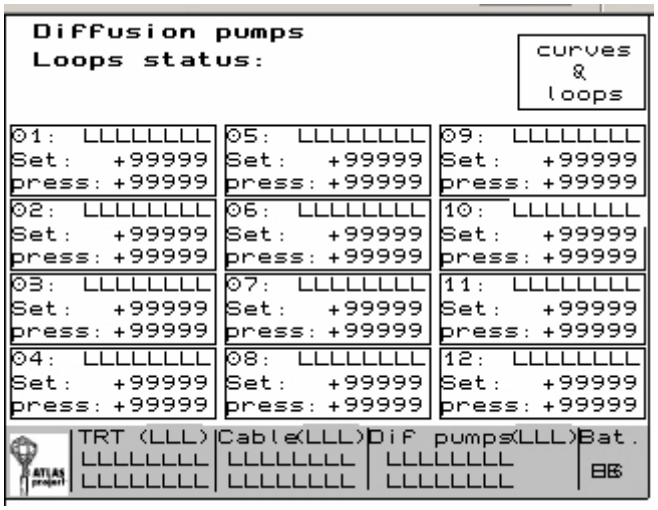

Figure 4.2.1.3 Loops status

There is also access to the different measuring points of the cooling station (curves 13 to 18 according the figure 4.2.1.1). Below is an example, 4.2.1.3 Diffusion Pumps – Tank Pressure.

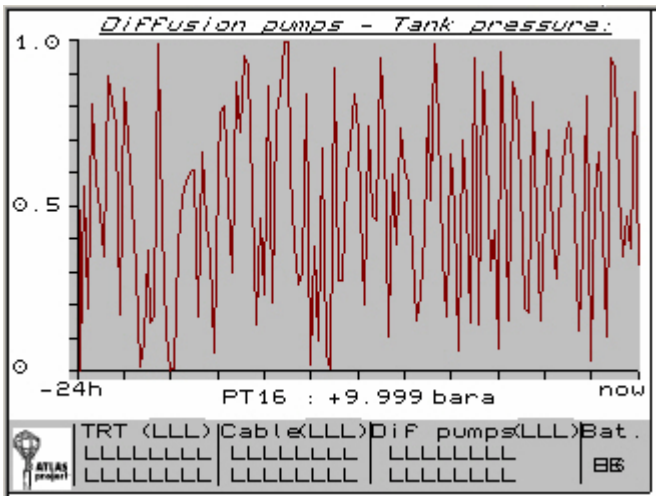

Figure 6.2.1.3 Diffusion Pumps – Tank Pressure

The curves and loops can be viewed without a password. In order to change the settings of the curves and loops you need to insert the **USER** password.

For more detail on the loops control see chapter 4.3.2 COOLING SETTINGS.

4.2.2 PPV CYCLES / R4

When button R4 – PPV cycles is pressed the following display (Figure 4.2.2.1 PPV cycles) will appear on the screen.

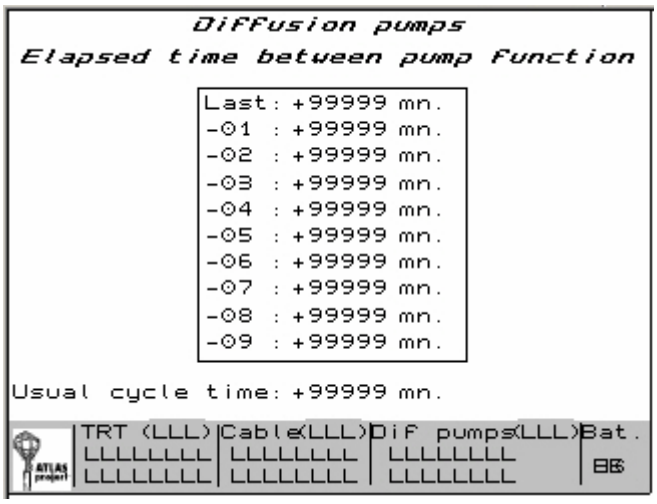

Figure 4.2.2.1 PVV cycles

The display shows the elapsed time between the vacuum pump cycles. Here some of the possible leaks (air infiltration) in the cooling system can be detected.

4.2.3 MODE REQUEST / R6

From here, using the **MAINTENANCE** password, you can manage the current function of the cooling station. There are three different functions.

1) Stop
2) Stand-by
3) Run

You need to insert the **MAINTENANCE** password before you can operate this function. The **MAINTENANCE** password can be inserted from the menu (see chapters 4.1.2.KEYBOARD, 4.7.MENU AND 4.7.7.MOT DE PASSE).

When button R6 – MODE REQUEST is pressed the display (Figure 4.2.1.Diffusion Pumps front page) will not change. A rectangular box below the text 'MODE request' will start plinking. The cooling station mode can now be changed using the arrow keys.

The cooling station operation is more precisely described in the chapter 4.3.Cooling Settings.

4.2.4 TEMPERATURE SET POINT / R8

From here you can control the supply cooling liquid temperature that is going to the detector. You need to insert the **USER** password before you can operate this function.

When button R8 – 'Temp. Set point' is pressed the display (Figure 4.2.1.Diffusion Pumps front page) will not change. A rectangular box below the text 'Temp. Set point' will start plinking. Now you can change the temperature set point using the number keys.

The temperatures can be set between ***14 and 20 degrees***. The cooling system operates with one uniform temperature. If you change the temperature of one of the cooling loops, you will change the temperature of all the cooling loops at the same time.

4.3 COOLING SYSTEM OPERATION

4.3.1 STARTING COOLING

The cooling mode can only be changed using **MAINTENANCE** password. The **MAINTENANCE** password can be inserted from the menu (see chapters 4.1.2.KEYBOARD, 4.7.MENU AND 4.7.7.MOT DE PASSE).

The cooling can only be started at the stand-by mode. If the system is stopped, you need first to go in the stand-by mode from the Diffusion Pumps front page – mode request (See chapter 4.2.3.). Before starting the system you have to wait that the pressure in the storage tank is at 400 mbar (a).

Upon selecting the **RUN** Cycle, the circulator pump starts working and the chilled water valve begins cooling the heat exchanger. This temperature regulation is piloted by a PID control algorithm. The set points for these closed-loop controls are operated according to the chapters 4.2.4 TEMPERATURE SET-POINT, and 4.2.1 LOOPS AND CURVES.

If all the cooling circuits are closed or locked when the circulator pump starts working (i.e. when the RUN Cycle is selected), the by-pass regulation valve shall divert the flow from the supply manifold to the return manifold. Starting pumping through the by-pass before opening any circuit is in fact the safest way to proceed, as it will prevent any initial pressure or temperature spike to propagate to the detector.

4.3.2 COOLING SETTINGS

Given the correlation between flow rate and pressure (loosely ΔP~FlowRate2), the user should turn his attention to the exact cooling circuits he plans to circulate water through. This is done by hitting the "Loops and curves" keys on the panel Chapter 4.2.1 LOOPS AND CURVES).

You need to insert the **USER** password before you can operate cooling settings.

The cooling loops have to be viewed separately. You can move from one loop to the next one by pressing the key F8, return to the previously viewed page by pressing ESC.

Any given cooling loop can display one of three states:

- **Locked**: supply and return valves are closed. This is the state you should select only in case of major leak on the loop.
- **Open**: supply valves regulate the inlet pressure and return valves is open.
- **Closed**: supply valve is closed but return valve is open. Select this state if the plant is in ***Stand-by*** and you intend to **open** the circuit once the plant is in ***Run***. This is also the state in which a circuit should remain if it is piped to the detector and contains water left inside. By letting the return valve open, the whole circuit will be kept below atmospheric pressure and thereby prevent any water spill out through possible leaks in the detector.

When a cooling circuit changes from locked to open, there is a 6 sec time delay between the opening of the return and the supply valve. Similarly, when an open circuit is to be locked, the return valve is shut 6 sec after the supply valve.

Note that when the cooling plant is in Stand-by, the pressure in the reservoir is kept sub-atmospheric by the vacuum pump. This pressure is controlled by switching ON the vacuum pump when the pressure surges 50mbar and OFF when it is back at its set point. Therefore, when the volume of a cooling circuit is for the first time put in contact with the reservoir volume, (example: locked ☐ closed or locked ☐ open), the vacuum pump will have to remove that additional air from the reservoir.

4.3.3 MONITORING OF PARAMETERS

Real time information on the main parameters of the cooling plant can be viewed on the Diffusion Pumps front page. The parameters of the 12 cooling loops to the detector can be viewed at the loops and curves, chapter 4.2.1.

4.3.4 STOP PROCEDURE

The **MAINTENANCE** operator can select Stop from any of the other cycles. When doing so, the circulator pump stops, the chilled water regulation valve and the supply valves shut, the return valves remain open. The below-atmospheric pressure in the reservoir is no longer maintained.

> The cooling plant can remain safely in ***Stand-by*** or ***Stop*** and it should not be powered off unless maintenance interventions are planned.

4.4 THE "LEAKLESS" PROTECTION

When the cooling plant is in Stand-by, the whole system (plant + piping + detector) is kept below atmospheric pressure whereas in Run, only the return pipes and eventually part of the detector is in sub-atmospheric pressure. Should a leak occur in these parts of the installation, it will lead to air infiltration.

Water leakage can happen only when the system is operated in Run mode and then only in the supply lines of the system.

4.4.1 WATER LEAKAGE

Leakage of water can be detected and stopped early in time. This is done by continuously measuring the water level in the reservoir and stopping the circulator pump when a significant drop is detected. As soon as the pump stops, the sub-

atmospheric pressure prevails throughout the whole system (system = cooling plant + piping + detector), thereby stopping any further water spillage.

The water level in the reservoir may drop without necessarily meaning that water is being spilled out somewhere. This the case when the plant goes from Stand-by to Run and/or when cooling(s) circuits are put into service (more water leaves the reservoir to fill-up new volumes outside the plant) or when the pumped flow varies (altering the pressure set point). It is quite often the case that air trapped inside the detector piping itself takes time to be flushed down to the reservoir, so new volumes of water are still being filled outside the plant, long after the pumping has started. These water level disturbances (opening circuits, pump start/stop and change of flow throughput) are acknowledged by the PLC and do not set off the Fast liquid level change ALARM. However, after one of these disturbances has occurred, the PLC needs to rememorize a new stable level. Level is considered suitable to be memorized if it remains within a +- 5L margin of a given level for the 15 minutes following the reading of that level. Once a new level is memorized, the surveillance is reactivated and any level drop of more than 100L will give rise to the Fast liquid level change ALARM and take the system to Stand-by.

The evolution of water level during all these events is shown below:

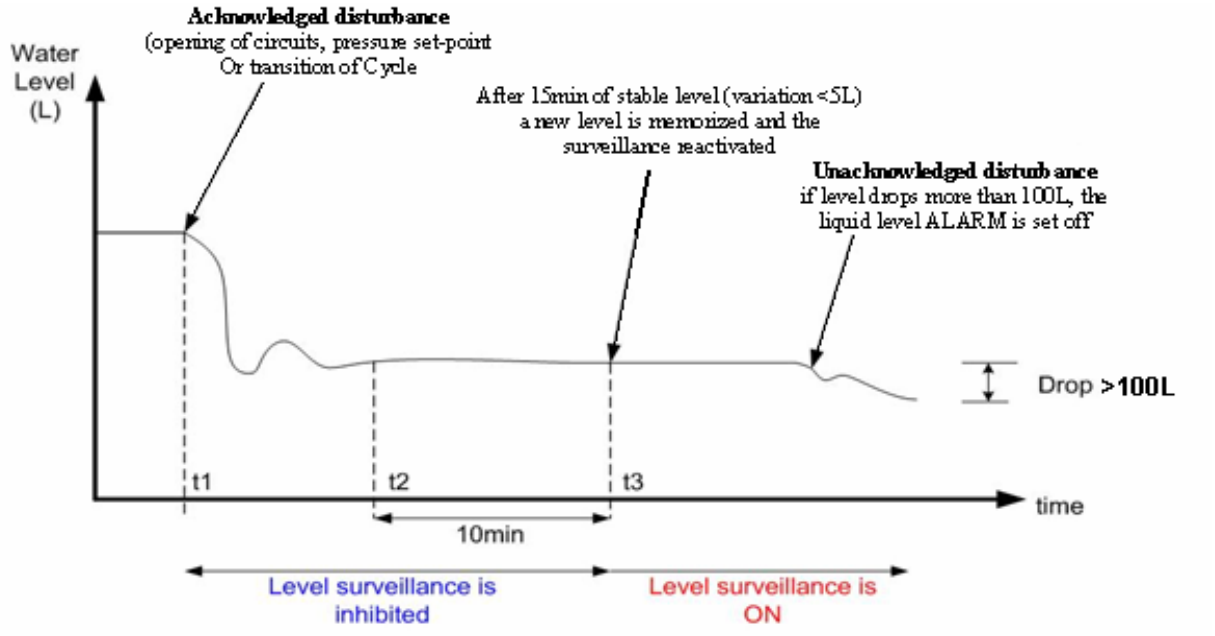

Figure 4.4.1.2 Normal and abnormal variations of the water level in the reservoir

During the surveillance inhibition period, the ***Level stability Fault*** will appear (Faults & Warnings page). Once the Level surveillance is back on, this fault will disappear.

4.4.2 AIR INFILTRATION

Air infiltration is not a problem but may become one if it is big enough. It may equalize the pressure to atmospheric and thereby allow water to spill out.

In case of a major air infiltration causing the air pressure to rise above 0.9bar, the Pressure Fault will appear in the Warnings page and the circulator pump stops (if the

plant happens to be in Run at that moment). When the pressure drops below 0.9bar the circulator pumps restarts.

However, after 20 minutes of continuous vacuum pump working, the Vacuum pump timing ALARM will make the system go to Stand-by (thus bringing the circulator pump to a definitive halt). Note however that in Stand-by mode the reservoir pressure regulation is still ON, so the vacuum pump carries on working to bring the pressure down to the set point if possible.

4.5 FAULTS AND ALARMS / F5

By pressing F5 on the main page you can manage the faults and alarms of all three the cooling systems. Alarms can be reset by pressing key F10.

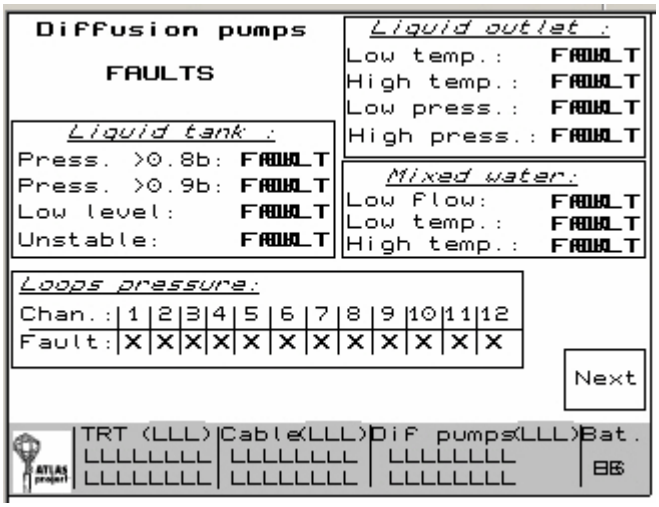

Figure 4.5.1 Faults

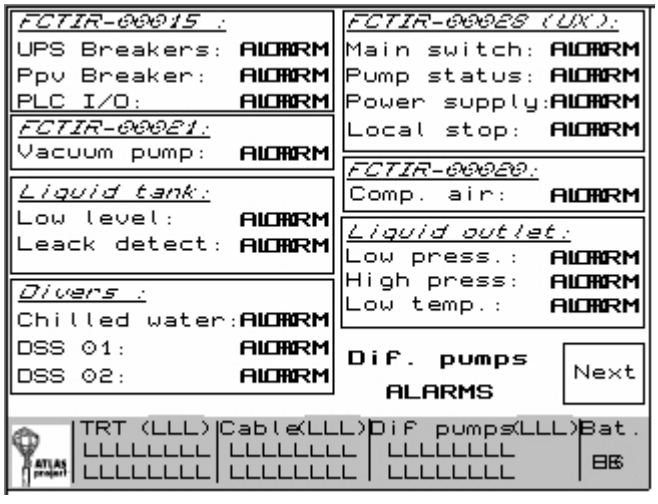

Figure 4.5.2 Alarms

The first two views that appear on the screen is TRT cooling system faults pages. By pressing the button R8 – 'Next', you move on the next page. The Diffusion Pumps cooling system has two pages like TRT, and ID Cables (the third system after Diffusion Pumps).

In general, a FAULT occurs when a continuous variable (pressure, temperature, flow) goes beyond a defined threshold. If the variable attains a second threshold, then the FAULT turns into an ALARM. For some continuous variables however, only ALARM or FAULT thresholds were defined. Obviously, this is also the case for binary (Boolean) variables (pressure switches, shut off valves, circuit breakers etc). Once the origin of a FAULT has been corrected (i.e. the variable is back within its normal range or to its normal logical value) the indication OK appears by itself.

Once the origin of an ALARM has been corrected, the user must push the Reset button on the panel and only then the indication OK appears. The system will then re-start with the parameters used before the shut-down.

IMPORTANT:

- **An Alarm should only be reset after its cause has been fully understood.**
- **If the Alarm persists after it has been reset, do not keep on pushing the Reset button repeatedly as this may damage the cooling plant.**
- **The system can be reset only three times consequently.**

4.5.1 LIST OF WARNINGS AND ALARMS

Warning	Cause	Outcome	Cycles in which it is active		
			Stand-by	Run	Stop
Liquid outlet: Temp. < 16°C	The temperature of the water at the supply manifold is below 10ºC	none		•	
Liquid outlet: Temp. > 24°C	The temperature of the water at the supply manifold is above 20ºC	none		•	
Liquid outlet: Low press.	The pressure at the supply manifold is below 1.2 bar(a).	none		•	
Liquid outlet: High press.	The pressure at the supply manifold is above 7.0 bar(a).	Halts circulator pump		•	
Chilled water: temp<8°C	The chilled water temperature is lower than 4ºC.	none	•	•	•
Chilled water: temp>15°C	The chilled water temperature is higher than 14ºC.	none	•	•	•
Chilled water: Flow<20L/h	The chilled water flow is less than 20L/h.	none	•	•	•
Liquid Tank: Pressure	Air pressure in the reservoir is above 0.8 bar(a).	Halts circulator pump (if in Run)	•	•	•

Liquid Tank: Level<100L	The volume of water in the reservoir is less than 100L.	none	•	•	•
Loop max. pressure	The pressure at the cooling loop rises above it's normal pressure	Closes the loop		•	
Liquid Tank: Level stability	Following an acknowledged disturbance, the level surveillance is inhibited while a new stable level is being memorized.	none	•	•	•

Alarm	**Cause**	**Outcome**	**Cycles in which it is active**		
			Stand-by	**Run**	**Stop**
Compress air fault	The pneumatic supply pressure is below limit.	Goes to Stand-by	•	•	
Breakers fault 1-3	The circuit breakers of the UPS power supply tripped	Goes to stand-by	•	•	
Breakers fault 4-6	The main circuit breakers tripped	Goes to Stand-by	•	•	
Liquid Pump power supply failure	The liquid pump power supply failure	Goes to Stand-by		•	
Liquid Pump Failure	The liquid pump failure	Goes to Stand-by		•	
Low outlet Pressure	Following the fault threshold at 1bar(a), the pressure has now dropped below 0.8bar(a)	Goes to Stand-by		•	
High outlet Pressure	Following the fault threshold at 6.0bar(a), the pressure has now surged above 8.0bar(a)	Goes to Stand-by		•	
Tank liquid level	Following the fault threshold at 100L, the level has further dropped below 50L.	Goes to Stand-by	•	•	
Fast Liquid level change	Following an unacknowledged disturbance, the level drops more than 100L	Goes to Stand-by	•	•	
Supply temperature > 25°C	If the supply temperature is higher than 25ºC	Goes to Stand-by		•	
Vacuum pump timing	Vacuum pump works continuously for more than 20min	Goes to Stand-by	•	•	

Alarm	Cause	Outcome	Cycles in which it is active		
			Stand-by	Run	Stop
PLC I/O failure	Processor watchdog out of range input signal	Goes to Stop	•	•	
Local equipment stop	System shut-down from red button on the cooling system in UX15	Goes to Stop	•	•	
DSS interlock	DSS connection requests	Goes to Stop	•	•	

4.6 SENSORS CALIBRATION / F7

From here you can manage the calibrations of the pressure and temperature sensors (only in the case of replacing a sensor). You need to insert the **MAINTENANCE** password before you can operate this function. The password can be inserted from the menu (see chapters 4.1.2.KEYBOARD, 4.7.MENU and 4.7.7.MOT DE PASSE).

When button R8 is pressed (Figure 4.6.1 Sensors calibration) a rectangular box next the text 'Go to page' will start plinking. Now you can choose which sensors you want to calibrate.

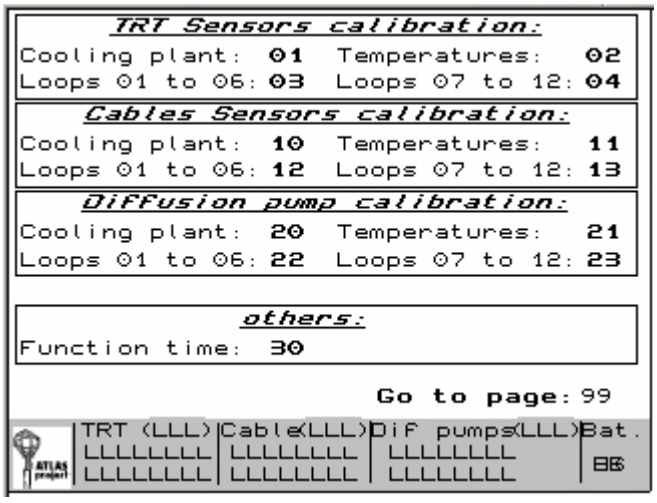

Figure 4.6.1 Sensors calibration

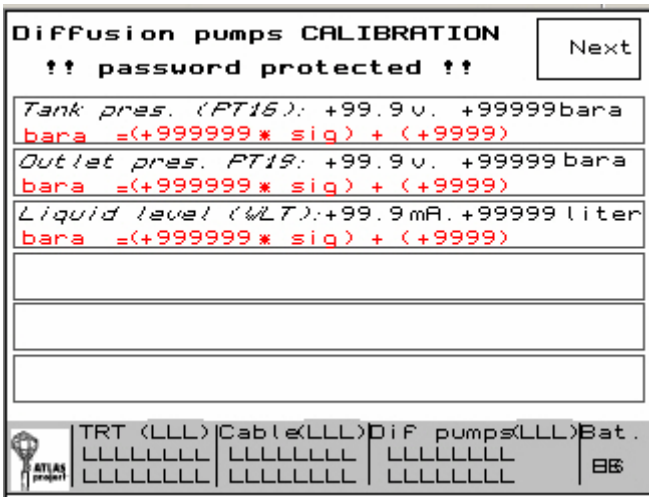

Figure 6.5.2 Sensors calibration / page 01

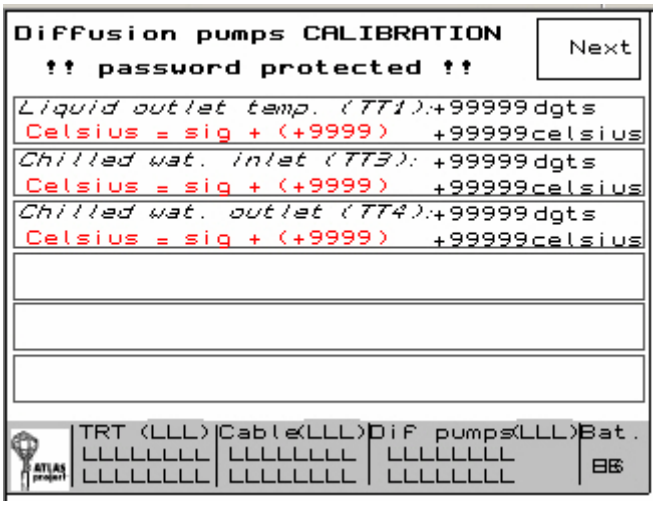

Figure 6.5.3 Sensors calibration / page 02

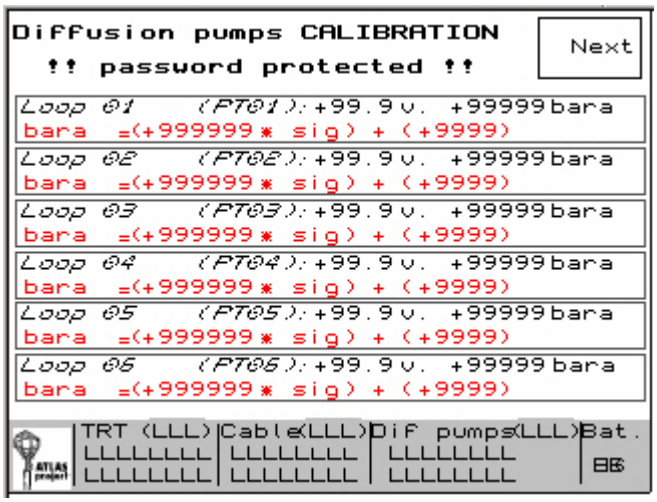

Figure 6.5.4 Sensors calibration / page 03

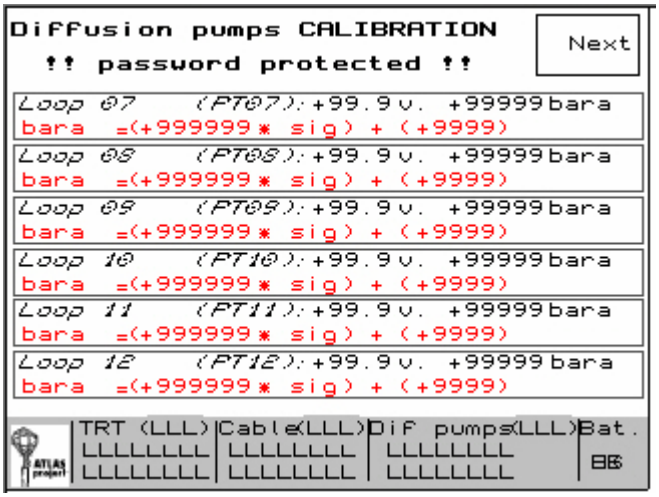

Figure 6.5.5 Sensors calibration / page 04

4.7 MENU

When pressing the button MENU on the keyboard the following display (Figure 4.7.1.MENU) will appear on the screen.

Figure 4.7.1 Menu display

Use the buttons R1 to R8 to enter to the different menus. The functions R3, R4 and R5 do not function.

4.7.1 LISTE DES PAGES / R1

This page contains all the pages on a number order.

4.7.2 LISTE DES ALARMES / R2

This page contains all the active alarms on a number order that they have appeared. You have also the time that each of the alarms have appeared. See chapter 4.5 Faults and Alarms.

Figure 4.7.2.1 List of alarms

You can access the different alarms using the arrow keys up and down on the keyboard (the red LED light is on when the button is in operation). Using the arrow key right, you can access the help display, where the cause of the alarm is more precisely explained (see the figure 4.7.2.2 below).

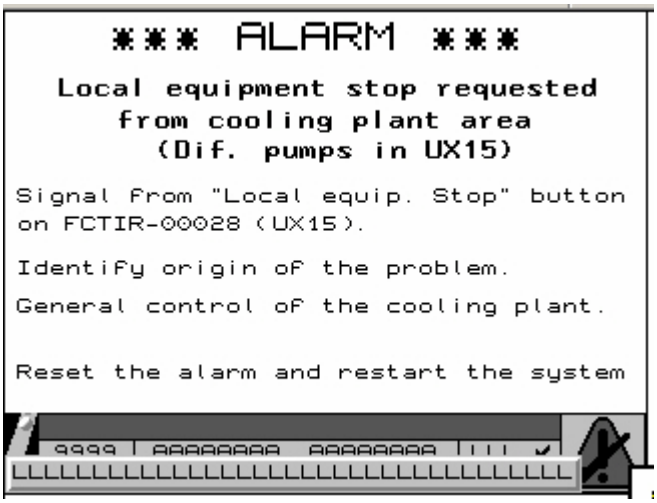

Figure 4.7.2.2Alarm help page

4.7.3 LISTE DES RECETTES / R3

This page does not function for the moment.

4.7.4 HISTORIQUE DES ALARMES / R4

This page contains the history of the alarms. You can see the times of the appearances and resets of the alarms at their proper order.

Figure 4.7.4.1 History of aLarms

4.7.5 LISTE DES FORMULAIRES / R5

This page does not function currently.

4.7.6 ARRET DE L'IMPRESSION / R6

This page does not function currently.

4.7.7 MOT DE PASSE / R7

On this page you can insert the user or maintenance password.

Figure 4.7.7.1 Password

4.7.8 ESC / R8

Use the button to go back on the previous page.

4.7.9 TIME AND DATE

In case of a power cut, the XPT looses the memory of the time and the date. In order to maintain a clear history of the alarms, the time and the date must be re-set.

When pressing the buttons SHIFT + MENU at the same time, the following display (Figure 4.8.1.SYSTEM) will appear on the screen. Pressing R1 – Parametres terminal gives access to change the time and the date on the XPT.

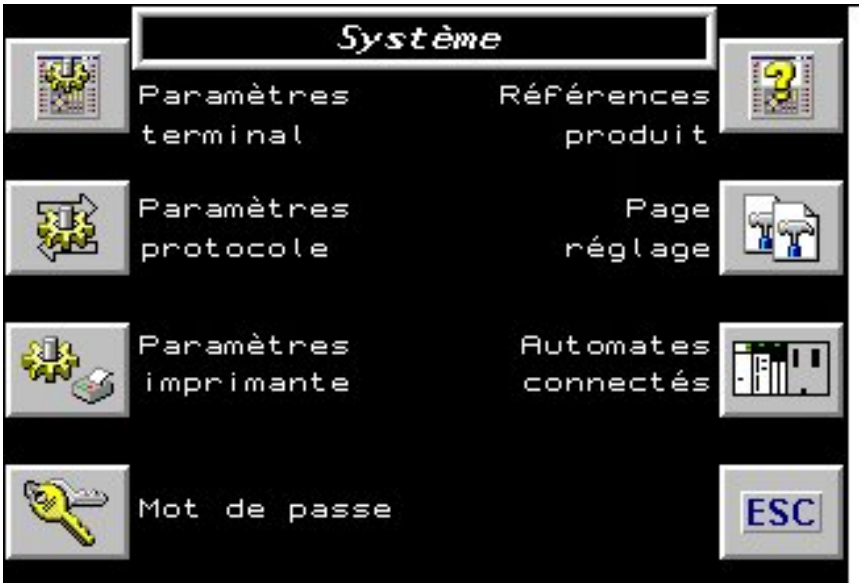

Figure 4.8.1 System

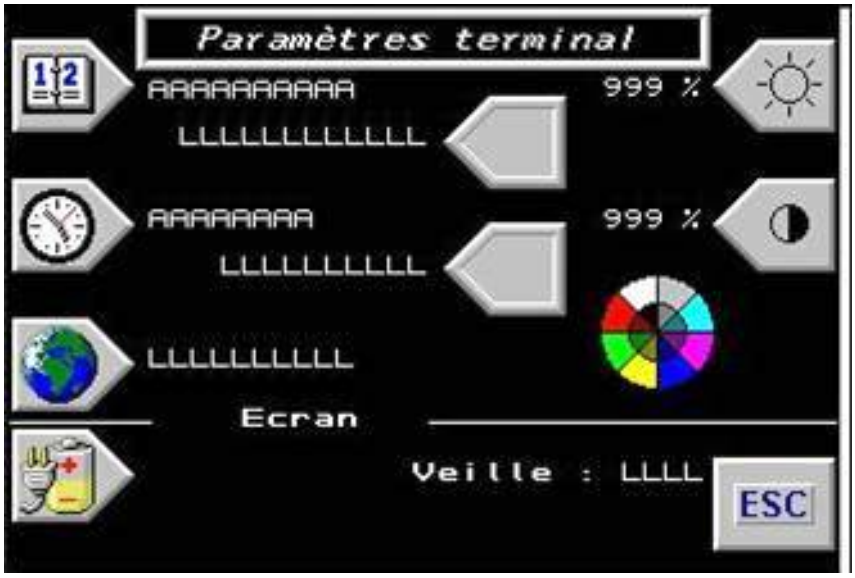

Figure 4.8.2 Terminal parameters

Go to the page "Terminal Parameters": Press R1 to set the date. Press R3 to set the time.

5. COMPONENT DOCUMENTATION

5.1 COMPONENT DOCUMENTATION

The list of components is done according to chapters:

- 2.2 General naming,
- 3.3 System design specifications / Annex A1 Principle drawing

See component manuals in Annex B, and DAI-documents in Annex C.

5.1.1 ADDITIVE, CORROSION INHIBITOR

The additive used in order to prevent corrosion on the copper parts of the circuit is Aquaris K-20, dosage 300 ml/ m^3. See DAI/2098833 and the user manual can be found in Annex B.

5.1.2 CONVERTER ELECTROPNEUMATIC (CEP)

The electro pneumatic converter (CEP1 to CEP13) is Samson regulation model 6111 with 4-20mA. See DAI/1731032 and the user manual in Annex B.

5.1.3 COMPACT BALL VALVE (CBV)

The compact ball valves (CBV1 to CBV4) are Zurcher Technik model 80D DN32 PN40-GS. See DAI/1750048 and DAI/2278448.

5.1.4 DIFFERENTIAL PRESSURE REGULATOR (DPR)

The differential pressure regulator (DPR) is SART Von Rohr type 5362 L4 – MS DN32 PN40 with servomotor C2-2419. The regulation pressure is between 5.2 ~ 7 bar. See DAI/1750378 and the user manual in Annex B.

5.1.5 ELECTROVALVE 2 WAYS (EVB)

The Electrovalves (EVB1 to EVB16) are Asco Joucomatic model Ilots Compact 8 profibus-DP. See DAI/1795807 and the user manual according Annex B.

5.1.6 SIGHT FLOW GLASS (FSG)

The sight flow glasses (FSG1 to FSG12) are Meca-Inox model PS4. See DAI/1750152, and the user manual in Annex B.

5.1.7 FLOW METER (FZA)

The flow meters (FZA1 to FZA13) are Actaris model Aquadis. See DAI/1822934 and the user manual in Annex B.

5.1.8 PLATE HEAT EXCHANGER / CHILLED WATER (HPX)

The heater HPX is a SWEP model B12Mx40/1P-SN-S 4*1 1/4". The heat exchanger total power is 54kW at 5/11°C (primary) and 25/15°C (secondary) with flow rate of 7.7m^3/h (primary) and 4.7m^3/h (secondary). See DAI/1786239 and the user manual in Annex B.

5.1.9 MECHANICAL FILTER (MF1)

The mechanical filter for compressed air is Tri-matic model 5000 Nl/min, 1st stage. See DAI/1913327 and the user manual in Annex B.

5.1.10 PNEUMATIC CONTROL VALVE 2 WAYS (PCVA)

The pneumatic control valves (PCVA1-12) are Emerson Process model Baumann 24000S. See DAI/1755448 and the user manual in Annex B.

5.1.11 PNEUMATIC CONTROL VALVE 3 WAYS / CHILLED WATER (PCVB1)

The pneumatic control valve (PCVB1) is Sauter Controls model B6R 25 type F300 with pneumatic actuator (Kvs 10m^3/h). See DAI/1751949 and the user manual in Annex B.

5.1.12 MANOMETER (PG)

See MAG/1756354.

5.1.12.1 PG1 -1 TO 10 BAR

The manometer -1 to 10 bars are model CERN, SCEM: 22.41.21.310.7 MANOMETER Ech.-1-10bar D100.

5.1.12.2 PG2 -1 TO 1 BAR

The manometers -1 to 1 bars are model CERN, SCEM: 22.41.21.350.9 MANOMETER Ech.-1-1bar D100.

5.1.13 PRESSURE REGULATOR (PR)

The pressure regulator for compressed air electro valves (PR1) is Tri-matic model One 8 bar. The pressure regulator for compressed air electro pneumatic converters (PR2) is CERN model 40.05.10.240.4. See DAI/1913327, and the user manual in Annex B.

5.1.14 PRESSURE SWITCH (PST2)

The pressure switch for compressed air (PST2) is Tri-matic model One 2 bar. See DAI/1913327 and the user manual in Annex B.

5.1.15 PRESSURE TRANSMITTER (PT)

The pressure transmitters (PT1 to PT12, and PT16) are Huba Control model 680 range 0-2.5 bar.a, 4-20mA. The pressure transmitter PT17 is Huba Control model 680 range 0-10 bar.a, 4-20mA. See MAG/1727519 and the user manual in Annex B.

5.1.16 PNEUMATIC BALL VALVE 2 WAYS (PVA)

The Pneumatic valves (PVA1 to PVA12) are the return valves on the manifolds. The pneumatic valves PVA16 and PVA18 are the valves on the water quality control line going to USA15 and PVA17 and PVA19 are spare.

The valves are Tri-Matic model stainless steel ball valve 316 with spring return actuator, normally open. See DAI/1817643.

5.1.17 PRESSURE SWITCH (PZA)

The pressure switch PST1 is Huba control model Huba-50/600, Article nr. 625.6430.1121. See DAI/1714295 and the user manual Annex B.

5.1.18 RELIEF VALVE (REV)

The relief valve REV1 100mbar, NPT ½"M is model CERN, SCEM: 40.10.44.508.8 Safety valve 6-13, 9PSI ½ NPT. See MAG/1756354.

5.1.19 STRAINER (STR)

The strainers STR1 and STR3 are a Tecofi model F6240 in stainless steel with tami-molecular filters. The strainer STR2 is a Tecofi model F2140 in bronze with tami-molecular filters. See DAI/1750096 and the user manual in Annex B.

5.1.20 STORAGE TANK (STT)

The storage tank is a 0.6m^3 stainless steel tank fabricated by Depositos Coballes. See DAI/1749931 and the Annex A / Drawing 186.15.25_SpecTank.

5.1.21 TEMPERATURE TRANSMITTER (TT)

The temperature transmitters PT100 (TT1 to TT4) are Thermo-Est model SI 1119F/L/3F/A Class A, range 0-100°C. See DAI/1786843 and the user manual in Annex B.

5.1.22 VERTICAL CENTRIFUGAL PUMP (VCP)

The cooling system pump (VCP1) is a Grundfos CRN 5-11. The flow rate of the pump is 5 m3/h@60m. See DAI/2216211 and the user manual in Annex B.

5.1.23 VACUUM PUMP (VP)

The vacuum pump VP is KNF model N026, type ANE. See DAI/1755797 and the user manual in Annex B.

5.1.24 WATER LEVEL TRANMITTER (WLT)

The Water level transmitter is Kobolt instruments model AEV2-VK-L1350-SV-TPS343A. See DAI/2351606 and the user manual in Annex B.

5.2 PHOTO GALLERY

Cooling station

Return line

Regulation valves

Chilled water supply

Differential pressure regulator

Level transmitter on tank

XBT

Electro valve for vacuum pump

Analysis rack

Vacuum pump

Tank manometer in USA15

Sample valve

6. REGULATION PARAMETERS

Parameters signalled with * require access to the PLC source code file and therefore can only be modified by TS/CV-DC.

6.1 REGULATION OF PRESSURE IN RESERVOIR:

Type: ON/OFF
Set-point=0.6 bar(a)
Regulation band = ±50mbar*
Maximum pumping time = 20min*

6.2 REGULATION OF TEMPERATURE

Type: PID
Set point=14 ºC at the range of 12~18ºC
Precision of ±1 ºC
P=see source PL7 code
I= see source PL7 code
D= see source PL7 code

6.3 REGULATION OF SECONDARY CIRCUIT WATER PRESSURE (STATION)

Type: Mechanic (see Annex B / 6.13 DPR)
Range=5.2~7.0 bar(a)
Set point=6 bar(a)

6.4 REGULATION OF SECONDARY CIRCUIT WATER PRESSURE (12 LOOPS)

Type: PID
Set point= 1 ~ 3 bar.a (modifiable by user)
P= see source PL7 code
I= see source PL7 code
D= see source PL7 code

7. TEST

7.1 HYDRAULIC PERFORMANCE

The hydraulic performance test has not been done.

7.2 COOLING PERFORMANCE

The cooling performance test has not been done.

7.3 LEAKTIGHTNESS TEST

The leak tightness test has been performed to the cooling station, pipe works between the station and the manifolds, and the manifolds itself. Please see Annex D.

7.4 PRESSURE TEST

The pressure test has been performed to the cooling station, pipe works between the station and the manifolds, and the manifolds itself. Please see Annex D.

8. MAINTENANCE

This chapter has to describe, where applicable, the maintenance procedures to be foreseen to operate the installation. Ex.: report the maintenance procedures and maintenance schedule for a compressor taking the information from the compressor's constructor manual.

Not standard maintenance and operation procedures have to be defined in detail (ex.: chemical analysis of fluid specimens after an amount of run to test fluid qualities degradations).

9. CONTACT PERSONS

Emergencies (outside working hours):..... TS/CV/DC Standby – 162400
TS/CV/DC Section Leader:..... Michele Battistin - 164251
Maintenance and operation (8.30 – 17.30 mon-fri): ... Carsten Houd – 165173

10. ANNEXES

ANNEX A – DRAWINGS

ANNEX B – COMPONENT MANUALS

ANNEX C – DEMANDE ACHAT INTERNE (DAI)

ANNEX D – PRESSURE TEST REPORT

ANNEX E – PRESSURE TRANSMITTER LIST

ANNEX F – COST SPREAD SHEET