Table of Contents

Cooling...............................................................................................................................................................1
  Common primary chiller.................................................................................................................................1
  VELO/UT CO2 cooling (MAUVE)..................................................................................................................1
    Cooling plants............................................................................................................................................1
    Transfer lines.........................................................................................................................................1
    Junction box............................................................................................................................................2
    Local boxes............................................................................................................................................2
    Infrastructure.........................................................................................................................................2
    Safety.....................................................................................................................................................3
    Cleaning...............................................................................................................................................3
  SciFi SiPMs..................................................................................................................................................3
    Novec fluid.......................................................................................................................................3
    Transfer lines......................................................................................................................................3
    Manifolds.............................................................................................................................................4
    Baby demo..........................................................................................................................................4
    Vacuum system.................................................................................................................................4
    Dry gas system.................................................................................................................................4
  RICH.......................................................................................................................................................4
  SciFi and UT electronics..............................................................................................................................4
  UT service bays (mixed water)....................................................................................................................5
  VELO OPBs................................................................................................................................................5
  Dry gas....................................................................................................................................................5
    Drier....................................................................................................................................................5
      SXL8..............................................................................................................................................5
      UX85..............................................................................................................................................6
    Oil residue measurements....................................................................................................................6
    Nitrogen................................................................................................................................................6
  Infrastructure..........................................................................................................................................6
    Power distribution...............................................................................................................................6
  Dismantling and installation......................................................................................................................7
    Handling equipment............................................................................................................................7
    Dismantling..........................................................................................................................................7
    Installation...........................................................................................................................................7
  Useful links.............................................................................................................................................7
Cooling

Common primary chiller

- SciFi requirements (April 2016)
- Meeting (28 June 2016)
- Comparison of refrigeration options (M. Doubek)
- CO2 cooling meeting (13 October 2016)
- SciFi requirements, October 2016 (EDMS 1726874)
- VELO/UT requirements (EDMS 1851634)
- Review (11 October 2017)
- Work package (EDMS 1870688)
- Tender documents
- The chiller uses R449 as refrigerant.
- Weight estimate (February 2019, March 2019).
  ♦ Excel sheet
- Pipes through floor
- Layout of the chiller module frames
- Control cabinet
- Electrical cabinet
- Layout of the "bacs de retention"
- Top view of the chiller layout on the platform (including weights)

VELO/UT CO₂ cooling (MAUVE)

- EP-DT SharePoint
- UT requirements (EDMS 1487284)
- VELO requirements (EDMS 1556963)
- Welding guidelines

Cooling plants

- Engineering Design Review (3 December 2015)
- Work package (EDMS 1575817)
- Review (1 November 2017)
- P&ID (EDMS 1556956)
- Filtering scheme (EDMS 2003471)
- Process description (EDMS 2022099)

Transfer lines

- The vacuum-insulated concentric transfer lines between cooling plants and junction box were installed during the EYETS 2016/17.
  ♦ The inner pipe (liquid line) has a diameter of 10 mm.
  ♦ The two-phase return line has a diameter of 26.7 mm.
  ♦ The vacuum jacket has an outer diameter of 80 mm.
- Work package (EDMS 1609585)
- Meeting (28 April 2016)
- Meeting (4 May 2016)
- Meeting (18 May 2016)
- Proposed routing
  ♦ STP file
• Test with mockup pipes
• Tender documents (EDMS 1688007)
  ♦ Tender form
  ♦ Technical questionnaire
• Production drawings
• Mechanical and thermal analysis (EDMS 1739413)
  ♦ Report
  ♦ Presentation by Kriosystem
• Drawings
  ♦ STP file line A
  ♦ STP file line B
• CO₂ cooling meeting (10 November 2016)
• Pictures from the shielding wall dismantling
• Pressure tests
  ♦ EDMS 1751827, EDMS 1751828, EDMS 1751829, EDMS 1751830
• Cold tests
  ♦ Presentation by O. Crespo (27 March 2017)
  ◊ Reply from Kriosystem
  ♦ Pictures from cold test during TS1 (July 2017), Slides
  ♦ Cold test during TS2 (September 2017)
• Vacuum pump DAI

### Junction box

• Meeting (21 September 2016)
• Meeting (19 October 2016)
• RICH1 mechanics meeting (26 October 2016)
• CO₂ cooling meeting (23 March 2017)
• List of cables
• Electrical patch panel (Slides by L. Roy)
• Meeting (31 August 2017) to discuss the installation
• Insulation material
• Pipes between transfer lines and junction box (E. Pilorz, July 2019), Geometric survey
• Safety volumes

### Local boxes

• Meeting (16 January 2018)
• Meeting (26 March 2018)
• Components (Slides by D. Giakoumi)
• Meeting (17 September 2019)
• Drawings of the VELO local boxes (EDMS 2382854)
• Drawings of the UT local boxes (EDMS 2398341)
• Sensors: DAI 8109686, DAI 8123532, DAI 8109462, DAI 8107868

### Infrastructure

• Cost estimate for brine circuit to the alcove
• Cost estimate for mixed water circuit to the alcove
• Cost estimate for power distribution, April 2015
• Cost estimate for compressed air circuit
• Rail for lifting plant components (pump motors)
Safety

- Radiological risk assessment (CMS, EDMS 1321932)
- Risk assessment for CO2 release (EDMS 2025971)

Cleaning

- MAUVE meeting (12 February 2020)
- Presentation at the Technical Board (P. Tropea, 25 February 2020)
- MAUVE meeting (4 March 2020)
- Opteon SF79 safety data sheet, technical data

SciFi SiPMs

- Requirements (input for common chiller study, April 2016)
- Meeting (28 June 2016)
- Coldbox EDR (4 August 2016)
- Comparison of refrigeration options (M. Doubek)
- LHCb SciFi Requirements on SiPM Cooling in a Common Chiller Scheme (EDMS 1726874)

- Cooling system EDR (11 May 2017)
  - Reviewers' report
- Work package (EDMS 1806622)
- Draft P&ID (EDMS 1806629)
- Meeting (7 June 2016)
- Meeting (29 June 2016)
- Cooling system PRR (8 December 2017)
  - Reviewers' report

- Estimated weight of the SciFi Novec plant
- Weight distribution of the SciFi Novec plant

- Meeting (18 October 2019)
- Tests (O. Crespo, August 2020)

Novec fluid

- Novec validation studies, Project report (P. Gorbounov, 2015)
- Novec fluid validation (P. Gorbounov, December 2016)
- NOVEC Fluid Qualification Report (EDMS 1751219)
- Novec material compatibility (EDMS 1849552)
- (Non-)compatibility with Festo PUN tubes
- Novec 649 Safety Data Sheet
- Purchase order
- Meeting with 3M (25 February 2020)
  - Report (EDMS 2338086), Slides (O. Crespo)

Transfer lines

- Price enquiry transfer lines (EDMS 2014888)
- Routing of foam-glass insulated lines
- Routing of vacuum-insulated lines
  - Screenshot
Purchase order (vacuum-insulated lines)
- Supports of DN50 valves

**Manifolds**
- Report from visit by EN-CV at AEV
  - Annex 1, Annex 2, Annex 3, Annex 4

**Baby demo**
- Dimensions
- Weight: 1250 kg.

**Vacuum system**
- SCROLLVAC 10 plus 1ph Scroll vacuum pump (STP)
- TURBOVAC 50 Vacuum Turbo Molecular Pump (3D model)

**Dry gas system**
- Work package EP-DT (EDMS 2052204)
- Meeting (25 January 2019)

**RICH**
- Existing cooling system (EDMS 1327542)
- Cooling meeting (18 March 2016)
- Requirements and considerations for the upgrade (EDMS 1627009)
- Work package (EDMS 1747707)
- Cooling system EDR (24 May 2017)
  - Reviewer's report
- Existing transfer lines
  - RICH1, TT (STP file)
  - RICH2, IT (STP file)
- Proposed rerouting (O. Jamet, 12 October 2017)
- Price enquiry transfer lines (EDMS 2014888)
- Requirements for routing and termination of the transfer lines (EDMS 2086089)
- Modified transfer lines (M. Doubek, 17 January 2019)
- Meeting (17 October 2019)

**SciFi and UT electronics**
- Corrosion phenomena in demineralized water cooling circuits (EDMS 718814)
- UT thermal load estimates
- Meeting (23 August 2016)
- UT infrastructure meeting (17 November 2016)
- Meeting (25 July 2017)
- Specifications for the UT PEPI cooling (EDMS 1845196)
- SciFi water cooling requirements (EDMS 1887449)
- Meeting (21 February 2018)
- Work package (EDMS 1909489)
- Meeting (7 November 2018) to discuss the manifold layout
• Routing of existing OT (and VELO) transfer lines (STP file)
• Price enquiry transfer lines (EDMS 2014888)
• P&ID of the upgraded cooling plant
• Manifold
• UT manifold June 2019, December 2019
• EN-CV uses Loctite 55 cord for sealing the pipe threads in the manifolds.
• The SciFi uses stainless-steel flexible lines inside the detector (data sheet). The initial plan was to use kevlar-reinforced EPDM hoses (data sheet) but this was abandoned because of space constraints (diameter of pipes and bending radii). The UT uses Festo PUN-H polyurethane tubes.
• Temperature sensors for DSS (data sheet, quote).

**UT service bays (mixed water)**

• UT Service Bay cooling requirements (EDMS 1845195)

**VELO OPBs**

• Fan tray magnetic field tests (CMS)
• Field measurements around the VELO (June 2016)
• Proposal for cooling the OPBs (R. Dumps, April 2017)
• OPB specifications

**Dry gas**

• Dry gas requirements (EDMS 2046586)
• Work package (EDMS 2114223)
• UT dry gas overview (EDMS 2360648)

**Drier**

**SXL8**

- The drier in the assembly hall is an ULTRAPAC MSD 0035 (order).
- Quote MSD 0150
- Quote MSD 0100
- Data sheet (drier)
- Data sheet (hygrometer)
- Data sheet (Ultrair filter)
- Data sheet (Ultra-filter DF)
UX85

- Purchase order

**Oil residue measurements**

- ISO 8573-1 limits.

![Extrait des valeurs limites ISO 8573-1](image1)

- Measurements in SXL8, June 2018 (EDMS 2004139)

**Nitrogen**

- N2 in TT (information from J. van Tilburg)

![Infrastructure](image2)

**Infrastructure**

- UXA-C platforms
- Verification of UXA-C platforms
- Replacement of UXA-C2 caillebottis, pdf
- Assessment by SMB of core drilling in the PZ slab
- Drawing of the concrete slabs in the PZ gable

**Power distribution**

- Meeting (29 June 2017)
- Meeting (4 May 2018)
Dismantling and installation

- Installation workshop (16 May 2018)
- Meeting (27 June 2017)
- Meeting (3 November 2017)

Handling equipment

- PA01084 hoist
- Canne à pêche CMU 1.2 t
  - CRR-02810
  - Canne à pêche (Meeting, 27 February 2018)
  - Canne à pêche (Meeting, 5 July 2018)

Dismantling

- Meeting (28 February 2017)
- Work package procedure document (EDMS 1763853)
- Work package procedure document (EDMS 1968334)

Installation

- MAUVE installation procedure (23 November 2017)
- Transport test of the MAUVE plants
- Lifting of the primary chiller frames

Useful links

- Pressure drop calculator
- Pipe sizing calculator