Water Cooling for the LHC

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Content:

CERN- The Large Hadron Collider

THE Recovery/transformation of LEP

LHC-Users for water cooling

Water cooling systems for the LHC
  - Raw- and primary water systems
  - Demineralised water systems
  - Chilled- and mixed water systems

Reject water

Controls
From LEP to LHC
The LEP Tunnel

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The LEP Tunnel
Recovery of LEP Magnets
The LEP tunnel

P1

P2

P3

P4

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P8
The LHC tunnel

Système d'accélération haute fréquence

Nettoyage de faisceau Point 3

Point 4

CMS Point 5

Point 6

Extraction et absorption des faisceaux

Point 7

Nettoyage de faisceau

Point 8 LHC-B

TL 2 Injection

Point 2 ALICE

Tunnel du LEP/LHC

TL 8 Injection

Point 1 ATLAS

Tunnel du SPS

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Vue d'ensemble des ouvrages souterrains du LHC
LHC Experimental site (point 8)
Consumers of water cooling
Cooling the LHC
Main consumers

Cryogenic installations
Cooling the LHC: Cryogenic installations
Cooling at LHC
Main consumers

Electric power supplies (power converters)

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Warm magnets
Cooling at LHC consumers

Air treatment

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Cooling at LHC
Main consumers

The LHC Detectors

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LHC Raw water cycle

Raw water

Heat recovery

Water chillers

Cooling towers

Surface

Underground

Rejects
Raw water pumps point 4
The LHC cooling chain

- Heat sink
- Production
- Distribution
- Compressed air
- Heat recovery
- Water chillers
- Cooling towers

Surface

Underground

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The LHC Cooling system
Primary water circuit

MAIN CHARACTERISTICS

Temperature at the cooling tower
- Outlet 24°C
- Inlet 34°C
- Set point 23°C
- Tolerance ± 1°C

Available pressure difference for each user 3 bar

Fig. 1
Primary Circuit Point 1
LHC Cooling towers

Caracteristics

Water T 24/34°C

Wet bulb T 20°C
Cooling tower at LHC point 4
Heat exchanger primary system point 4
Demineralised water circuits

Primary water production
SF Building
13.95 MW / 24-34°C - 1196 m³/h

Surface

Underground

Demineralised Water
Magnet cooling for L3
4 MW / 27-45°C / 190 m³/h

Demineralised Water
circuit T1 2
2.2 MW / 27-42°C / 129 m³/h

Demin. Water
ALICE muon magnet
3.75 MW / 47-20°C
120 m³/h

Chilled Water

Demineralised Water for
"Machine" cooling sector 2.1
2.15 MW / 27-37°C / 185 m³/h

Demineralised Water for
"Machine" cooling sector 2.3
2.8 MW / 27-37°C / 242 m³/h

Demineralised Water for L3
cooling jacket
0.18 MW / 19-29°C / 14 m³/h

Mixed Water
LHC Cooling

Demineralised water

Water resistivity

1) Production resistivity = 10-20 MΩ·cm
   (Corresponding to conductivity 0.1 -0.05 µS/cm)
2) Operational resistivity = between 3 and 1 MΩ·cm
3) Alarm resistivity lower than 0.8 MΩ·cm
Heat exchanger/primary & demineralised circuit
Machine circuit – demineralised water

Point 1

Point 2

Point 3

Point 4

Point 5

Point 6

Point 7

Point 8

SECTOR 1-2 SECTOR 2-3 SECTOR 3-4 SECTOR 4-5 SECTOR 5-6 SECTOR 6-7 SECTOR 7-8

Machine circuit – demineralised water

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Tunnel pipes
Chilled and Mixed water
Point 5
Chilled / Mixed water

Temperatures:

Chilled water: 5/11 °C
Mixed water: 13/18 °C
Clean and waste water
Clear water reject
## Cooling equipment

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Layer 3: TCR remote monitoring

Layer 2: Inter-point communication and local process supervision

Layer 1: Process control

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Local supervision
Level 3
Central supervision - TCR (Meyrin)

24/24h - 365 days per year
2 teams, 14 operators
30 000 alarms
100 000 variables
LHC recovery & environment