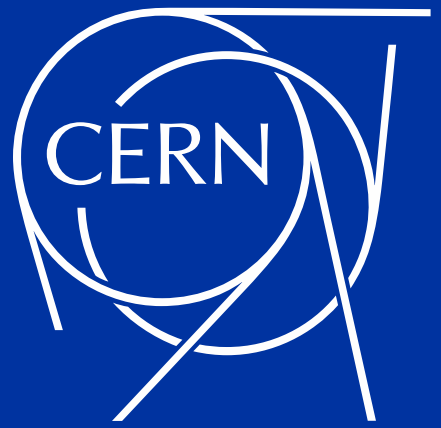

Water, reduction in consumption and treatment of effluents from cooling towers

6th Workshop Energy for Sustainable Science – S. Deleval - CERN

2022-29-09

Reference (https://indico.esrf.fr/event/2/contributions/112/)

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Introduction (1/2)

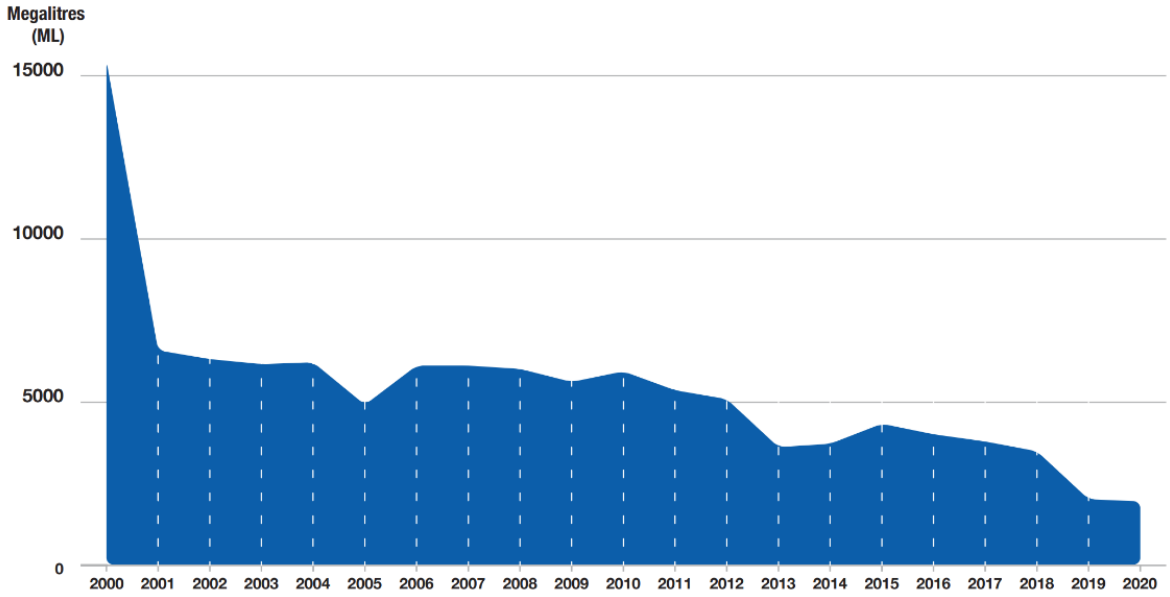
- **CERN Accelerators and Experimental areas are cooled by means of open wet cooling towers**
- **24 sets of cooling towers (with cumulated cooling capacity of 450 MW)**
- **For a run year CERN cooling towers consume ~1 500 000 m3/year (=45% of overall CERN consumption)**
- **Cooling need is increasing gradually over the years:**
  - 2 additional cooling towers to put in operation during the 2 coming years.
  - 1 additional cooling towers to build in 3 years
  - Upgrade of other system (additional cell)

Introduction (2/2)

- **CERN follow French law in matter of Legionella risk**
- **For the prevention against Legionella growth, water treatment is regulated in the circuit according to the guidelines (bests practices) provided by the French ministry of the Environment**
- **Water concentrated in salts and containing residuals of the products used to prevent bacteria is released as effluent**

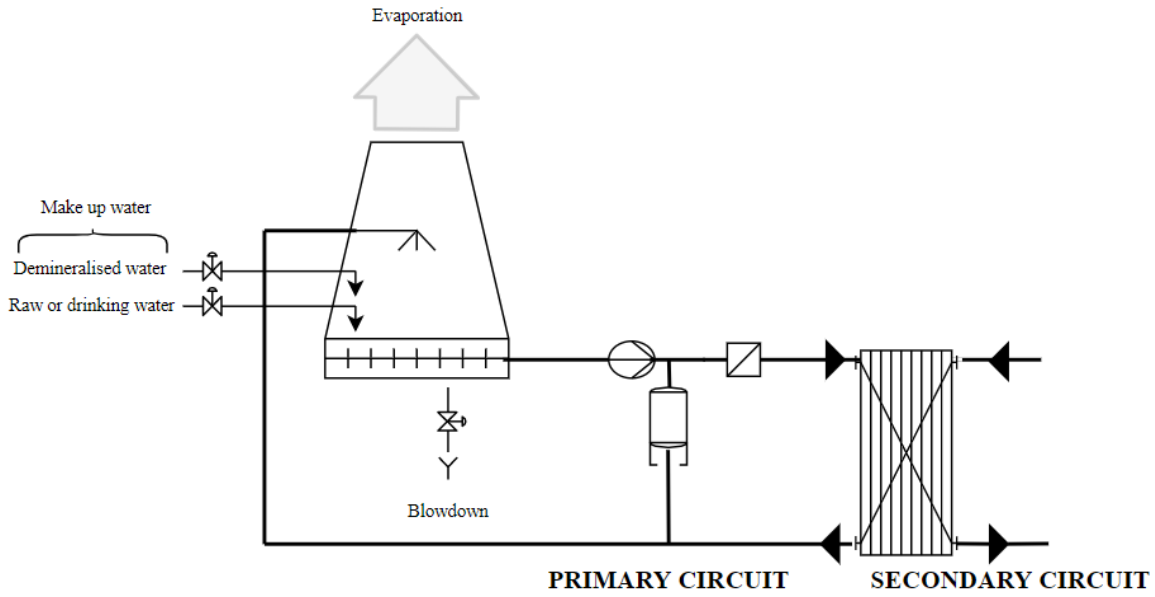
Objectives of the project

- **Avoid strong increase of the CERN water consumption (see CERN environmental report) despite the constant increase of cooling needs**
- **Re-use and recycle water**
- **Reduce the impact of cooling tower water treatment in the environment**



Solution 1

- **Make-up water with raw and demineralised water**
- **Reduction of blowdown and water consumption**
- **Solution applied when limited space**
- **Water treatment specific to this process**



Integration of environmental aspects in the design

Risk
- Avoid corrosion to limit Legionella growth

Water treatment
- Use a corrosion inhibitor
- For the copper no other solution than Benzotriazole (BTA) or Tolytriazole (TTA)

Wastewater
- Benzotriazole (BTA) or Tolytriazole (TTA) are micro-pollutants very difficult to eliminate even in wastewater treatment plant

Design
- For refurbishment avoid the use of copper
- Reduce as much as possible the contact of primary water with copper
- Suppress the use of copper inhibitor

Cooling tower of the Booster accelerator (1/2)

- **Complete refurbishment in 2019 and 2020**
- **Implementation of solution 1**
- **Cooling capacity (strongly increased) = 9,1 MW**
- **Water flow = 710 m3/h**

Cooling tower of the Booster accelerator (2/2)

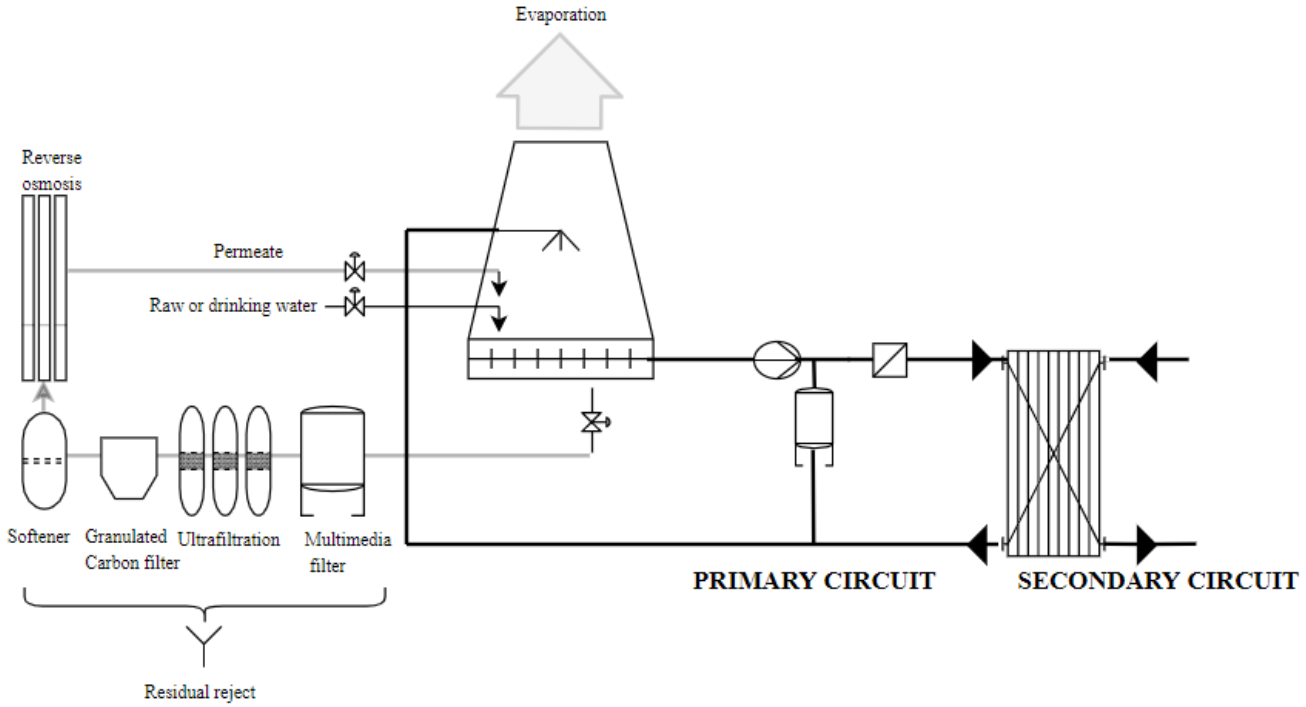
- **Reduction of blowdown despite the increase in the thermal load**
- **Reduction of water treatment consumption and impact in the environment**

	2018	2021	Difference
Make-up water	35 079 m3	25 624 m3	- 27%
Blowdown	7 677 m3	3 001 m3	- 39%
Average power during summer	Estimated ~3 MW	3,2 MW	+ 6%

	2018 (<Sept.)	2022 (<Sept.)	Difference
Make-up water	23 532 m3	23 424 m3	0%
Blowdown	5 201 m3	4 048 m3	- 23%
Average power during summer	Estimated ~ 3 MW	3,8 MW	+ 21%

Solution 2

- Add a water treatment plant
- Re-use of water
- Strong reduction of reject
- Residual reject to the wastewater network
- Solution applied for bigger circuit with enough space
- Water treatment specific to this process



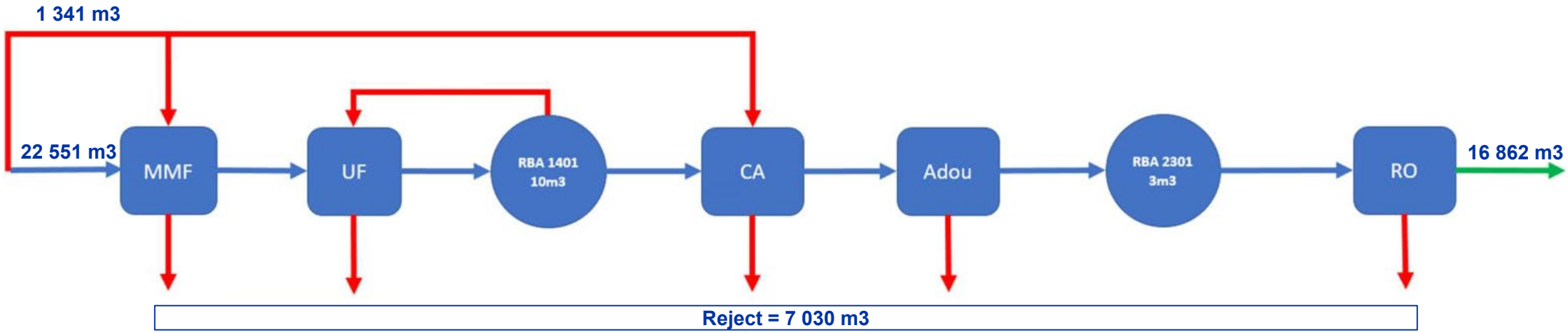
Cooling tower of the North area (1/2)

- **Implementation of solution 2**
- **Cooling capacity = 57 MW**
- **Water flow = 2400 m3/h**

Cooling tower of the North area (2/2)

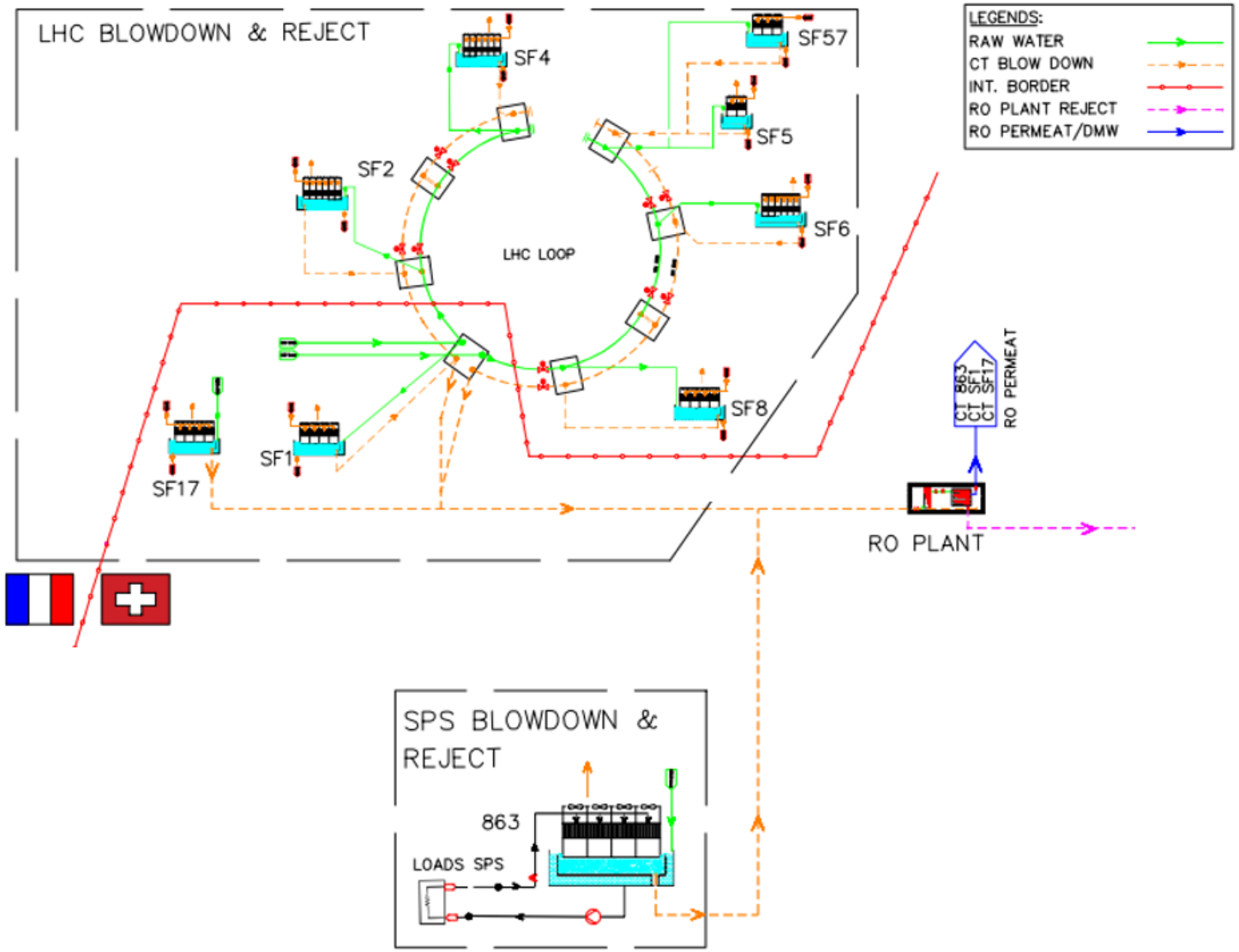
- **16 862 m3 recycled => sent back to the cooling tower**
- **Reduction of wastewater despite the increase in the thermal load**
- **Reduction of water treatment consumption and impact in the environment**

	2018 (<Sept.)	2022 (<Sept.)	Difference
Make-up water	103 793 m3	86 931 m3	-16%
Blowdown	27 939 m3	7 030 m3	- 75%
Average power during summer	ND	21 MW	Increased compared to 2018



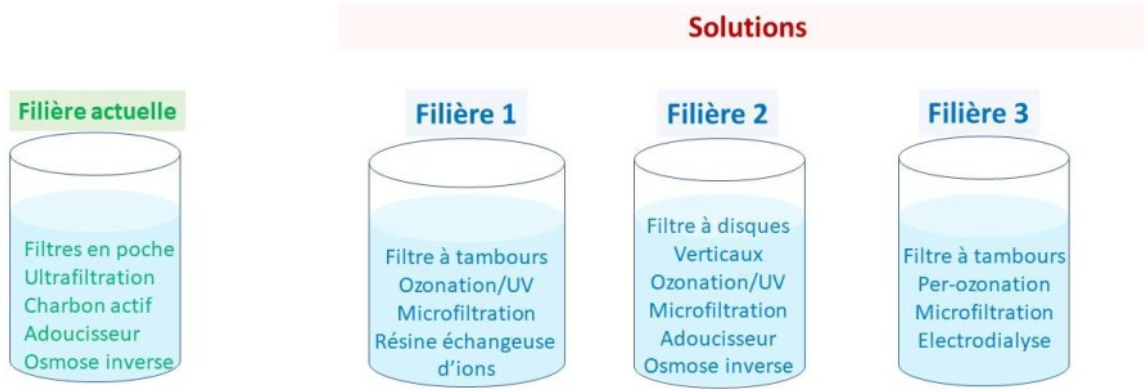
Water treatment plant for LHC and SPS (1/2)

- **One treatment plant for all LHC and SPS circuits**
- **Recycled water will be used in the cooling towers close to the treatment plant (SF1, SF17 and 863)**



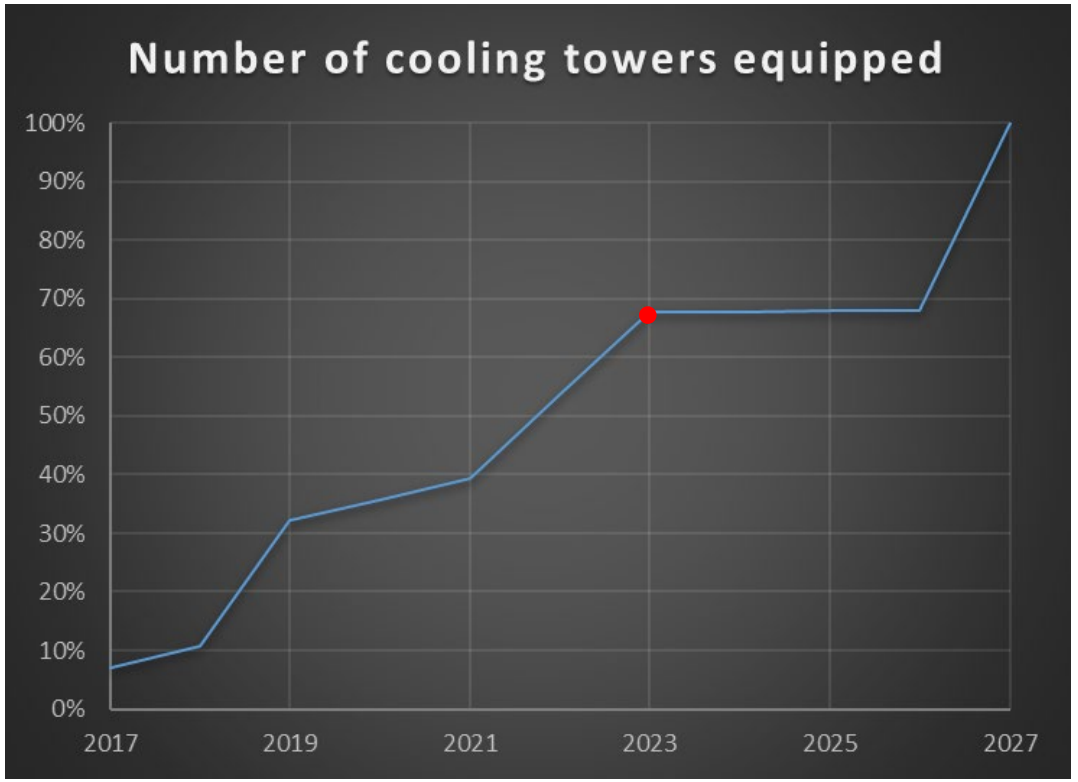
Water treatment plant for LHC and SPS (2/2)

- **Study of potential alternative solutions or optimizations of the water treatment plant with their**
  - Budget
  - Consumption (electricity, water, product,..)
  - Maintenance costs



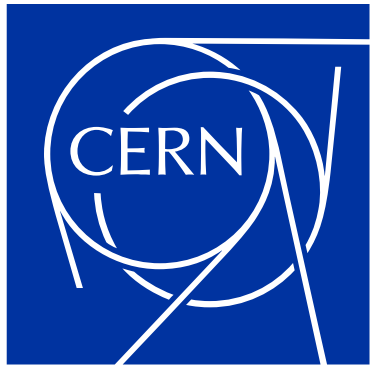
Status of the project

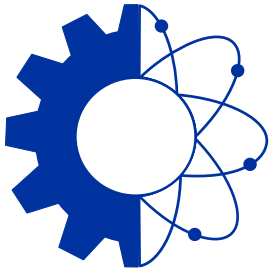
- **Plan of deployment over 10 years with a budget of 9,2 MCHF**
- **Most of the circuits treated => representing 34% of total flow of wastewater**
- **Ahead of schedule**
- **The last 9 circuits will be treated during the Long Shutdown 3 (plan in 2026-2027)**



Conclusion

- With the new projects, CERN cooling need has increased and will rise even more in the coming years
- To contain increase of water consumption and improve the quality of the water rejected CERN has set a project in 2016
- Circuits equipped with the defined solutions have shown the expected results
- The biggest water treatment plant for the reject of LHC and SPS will be installed in 2026 – 2027
- Major investment for CERN





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