CV ACTIVITIES ON LHC COMPLEX DURING THE LONG SHUTDOWN

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Abstract

The presentation gives an overview of the major projects and work foreseen to be performed during next long shutdown on cooling and ventilation plants. Several projects are needed following the experience of the last years when LHC was running, in particular the modifications in the water cooling circuits presently in overflow. Some other projects are linked to the CV consolidation plan. Finally, most of the work shall be done to respond to additional requests: SR buildings air conditioning, the need to be able to clean and maintain the LHC cooling towers without a complete stop of cooling circuits, the upgrade of the air conditioning of the CCC rack room cooling etc. For all these activities, the author will detail constraints and the impact on the schedule and on the operation of the plants that will however need to run for most of the shutdown duration. The consequence of postponing the long shutdown from 2012 to 2013 will be also covered. .

MAINTENANCE

During the long shutdown, one of the main activities will be the maintenance of the CV equipment. An important part of the maintenance has not been done for the last years because of the non abilities to stop the cooling plant.

. Table 1: Status of the maintenance for the CV equipment

Equipment	**Maintenance done**	**Maintenance not done**	**1/1/2012** Missing since
Cooling	Cleaning of the cooling tower Mechanical maintenance	Safety test Instrumentation Electrical maintenance. Test alarm transmission	3 years
Ventilation underground units	Filters and belts replacement	Instrumentation Mechanical maintenance Electrical maintenance. Test alarm transmission	2 years
Ventilation on the surface, sump, and compressed air.	Complete maintenance	-	1 year

For example for the primary circuit only 3 days stop have been allowed to respect the legal requirement [4] to avoid legionella growth in the cooling towers. This allows CV to stop the plant, drain it down, clean it and refill it but not to maintain it properly. In table 1 there is a status of the maintenance which has or hasn't been done for the last years.

To be able to restore a normal situation a stop of the cooling circuits for about 4 weeks per point during the long shutdown is needed. For the underground ventilation units an access for 2 weeks per points is mandatory.

PROJECT

During the long shutdown, several projects are to be completed. In the table 2 the number of project for CV, between 2011 and 2017 is detailed. The important list of project represent 87 projects for 6 years, 37 of which are presently foreseen in 2011 and 2012 in case if the long shutdown is in 2012. In case the long shutdown is in 2013 the distribution will be changed but the achievement of those projects is not affected. It is worth to remind that each project might include work activities in several LHC (or SPS) Points

Table 2: Number of project for CV between 2011 and 2017

Type	**Example**	**Number of project**
Upgrade	UW, CCR, Chilled water point 2	18
New installation	Linac 4, critical power 513, CMS clean room, Isolde, bldg 107	21
Original CV Consolidation plan [1]	PM32, PS and Booster ventilation	36
Consolidation (25 years)	Cooling of the PS magnet and Central bldg	12

In the next paragraphs several of those projects will be detailed.

UW upgrade

One important upgrade issue is related to the LHC cooling sector which is cooling most of the underground equipment (power converter, cooled cable, collimator, alcoves, etc.) During the LHC installation phase it's been decided not to buy the redundant pump for budgetary reasons. Those pumps have been bought in 2009 but there has been no opportunity to install them. In addition, a too high consumption from users with respect to design values is noted. In the table 3 the percentage of overflow measured by sector is given; some of these circuits are

presently at the limit of their working conditions and major breaks might appear.

Table3: Measured overflow in the cooling secondary circuits in the underground

Cooling sector	Present overflow
Sector 1-2	30 %
Sector 2-3	18%
Sector 3-4	38%
Sector 4-5	9%
Sector 5-6	18%
Sector 6-7	0%
Sector 7-8	25%
Sector 8-1	17%

To restore good working condition of the installation, four motor pumps have to be replaced. The integration of the future need for collimators is included. The onsite work should take 8 months with 6 weeks of stop per circuit. It's been estimated to 850 kCHF.

Backup for the primary cooling of the LHC cryo

The aim of this project is to provide backup cooling water for the LHC cryo systems during the cooling towers maintenance at Point 4, 6, 8. The solution proposed will allow to keep in operation critical cryo equipment housed in the SHs buildings (like compressors, cold boxes etc.), resulting in highly reduced thermal cycling, improved durability of the whole cryogenic systems and faster restart of the LHC operations. For the point 2 there is no need to create a backup system as the two cryo plants are already cooled by two separate primary circuits connected to SF2 and to the SPS loop. The proposed solution for Point 6 and 8 foresees the installation of a backup system with its own open cooling towers and pumping system in the proximity of each of the SF's buildings and the connection to the existing main primary water system. Isolation valves will allow switching from the original system to the backup system when needed.

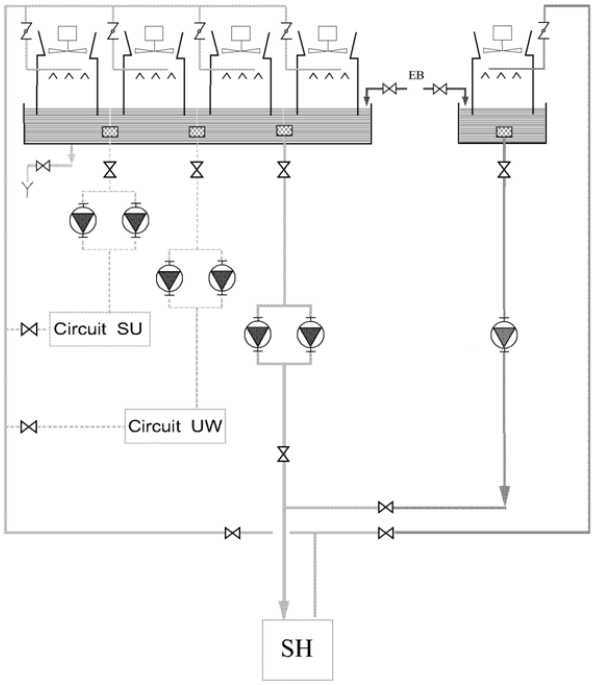

Figure 1: Layout of backup primary cooling for point 6 and 8

The backup system shares with the main system only the piping that goes to the SHs, while filters, heaters, pumps, piping accessories, electricity and controls are completely independent. This solution will allow, in addition, to carry out all the functional and safety tests of the main primary water system components (mainly the pumps) after the cooling towers have been cleaned. For the primary cooling in point 4 the present installation is different (closed circuit) and the use of an open cooling tower is therefore forbidden. The duration of the work will be 3 months per point with 2 weeks stop of the cryo. The project has been estimated to 3.6 MCHF.

Backup for the primary cooling of ATLAS

The aim of the project is to provide a primary water cooling backup for Point 1 during the SF1 cooling towers maintenance for cryogenic plants and part of the ATLAS detector. The proposed solution foresees to use the SPS primary water cooling loop as backup. In order to connect the SPS and SF1 system, it is planned to connect to the SPS loop close to BA6 building using the tappings originally used for BA6 and ensure therefore a backup

solution for SH, USA and SUX buildings.

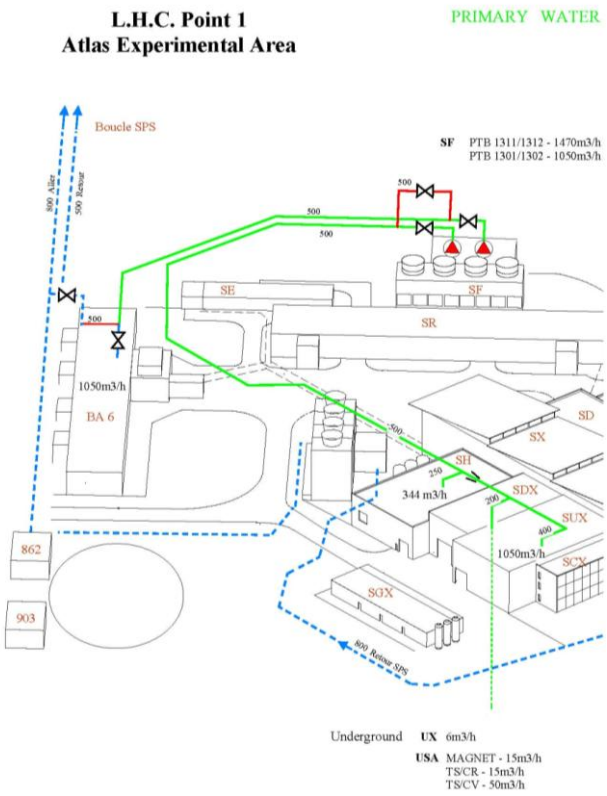

Figure 2: Layout of backup primary cooling for ATLAS connexion with the SPS ring

The duration of the work will be 4 months with 4 weeks complete stop of ATLAS cooling.

CCC upgrade

The aim of the project is to remove the dependency from the BA3 chilled water which is always a problem for example to perform the AUG test. Another objective of this project is to increase the cooling capacity of the rack room. In addition, the objective is to improve the reliability by having a redundant system to resist to possible power cuts. The project consists of adding a redundant chilled water production dedicated to the rack room. The modification of the electrical supply with new UPS and diesel, the installation of new air handling units and mixed water cooling the rack in the CCR is also foreseen. For CV the work should take 6 months with one month of total cooling stop in the rack room. For the CV work it has been estimated to 2 MCHF without civil engineering costs. The objective is to perform as much work as possible in advance of the long shutdown in order to minimize the workload during the shutdown.

Upgrade of the primary cooling in point 4

The primary circuit in Pt 4 for RF and cryogenic equipment consist of three distribution pumps but no spare pump is available. In case of failure on one of those pumps, motor or flow switches will affect the cryo and the RF and therefore stop the LHC. The risk is estimated as high. To reduce the risk a standby pump has to be added; in addition, frequency speed drive will be implemented and allowing a reduction of the energy consumption; this part shall be partly financed by EDF.

Upgrade of the chilled water production in point 2

The chilled water production is overloaded and can provide the required temperature in summer without any redundant chillers. The aim of the project is to increase to capacity of chilled water production by adding new chillers. The connexion has already been done but for the test of the new installation a stop of the whole production will be needed anyway.

Overpressure in point 8 tunnel vs LHCb

This project which has already been detailed in the Chamonix workshop 2010 [2] is foreseen during the long shutdown. The project consists of creating ventilated sas in RB84 and RB86 to avoid having the tunnel in overpressure with respect to the UX85.

Monitoring of the air in the LHC tunnel

The project has already been detailed in the Chamonix workshop 2010 [2] is also foreseen for the long shutdown and consists of adding air speed, differential pressure and temperature sensors in the tunnel.

PM32: Evacuation of the underground water

This project which is in the original CV consolidation plan [1] since several years has to take place during the long shutdown. There are no available spare parts for the old control system and with the new access constraint the manual intervention to remove the sand can't be done while the LHC is running. At the present 6 submerged vertical pumps are installed. Water collected in the pit is lightly charged with very fine sand. Furthermore the geometry of the pit and the pumps location inside it, allow the sand to separate from the water and to pile up on the bottom of the pit. After a while the sand cannot be evacuated anymore and clogs the pumps. In order to recover to correct working conditions, about 4 m^3 of sand have to be removed by hand every 3 months. The proposed solution foresees to modify the geometry of the pit by adding a 3D (diamond point shaped) inclination of the pit bottom in order to continuously direct the

incoming water towards a pipe that is connected to a manifold feeding three dry pumps that will lift the water to the surface using the original piping. This way, the sand doesn't have the time to separate from the water and the stagnation points are eliminated. If one dry pump fails, the water overflows towards the side where the original backup pumps are.

SR building ventilation refurbishment

This project is foreseen in the original CV consolidation plan [1] with a lower priority since, during the LHC design phase, the SR building was considered not critical and therefore no cooling was foreseen for that building [3].During 2010 run, it has been remarked that any temperature variation in the building affects the BLM and then the LHC beam. The refurbishment of the SR ventilation system has therefore to be done in next long shutdown. The project includes the replacement of the control cubicle and the electrical parts but also the instrumentation and several mechanical parts of the existing units.

REFERENCES

[1] Mid-term consolidation plan for the cooling and ventilation facilities. 2007.

[2] M. Nonis Modification of the LHC underground ventilation system. LHC performance workshop 2010.

[3] LHC engineering specification: LHC chilled an mixed water circuits. L. Annila, B. Pirollet, M. Wilhelmsson, 2002.

[4] Arrêté du 13 décembre 2004 relatif aux installations de refroidissement par dispersion d'eau dans un flux d'air soumises à autorisation au titre de la rubrique n°2921