A NEW CONCEPT FOR THE WATER SUPPLY AT CERN

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Abstract

The present state of the station Le Vengeron (the main pumping station supplying CERN with drinking water), and also to comply with the new Swiss standards impose a thorough consolidation and upgrade of this station which is shared with the *Services Industriels de Genève* (SIG). The total cost of the works (around 62 MCHF) would be shared proportionally to the nominal flow-rate demand which, at present, is of 2/3 for CERN and 1/3 for SIG. An alternative to the above is a complete review of CERN's water consumption, reducing our needs by half, thus allowing savings in both investment and operation. This reduction in investment cost would be diverted towards much needed consolidation works for the existing facilities within CERN. This paper also reviews the planning and possible ways for the execution of the works and the future responsibilities of operation of the water distribution systems (drinking and machine) inside CERN's sites.

1. INTRODUCTION

After 23 years of service, Le Vengeron, CERN's main drinking water supply station, needs a thorough make-up. In addition to the works for the upgrade and consolidation of Le Vengeron, one should consider the matter of the present drinking water and machine facilities, and the possible ways to improve the situation.

This paper summarizes a series of studies on the consolidation and upgrade of machine cooling stations at CERN. Throughout this document, the reader will find the choices that were available to CERN and the details of the proposal made by the Cooling and Ventilation Group (CV) for this project.

2. HISTORICAL BACKGROUND

The first stages of the construction of CERN's water supply system date back to the early 1950s, with the erection of the Peney pumping station. Together with the main supply at Peney, appeared a number of stations for distribution into Meyrin site. Station 1 was built in 1955, and stations 2, 3 and 4 in 1968, to supply the ISR machine and the West area.

The Peney station pumps up to 850 m^3/h of water from the underground table which, over the years, has become almost exhausted, decreasing greatly in quality. The high content in manganese of this water makes it inadequate both for drinking and cooling, and its use has largely decreased over the last years.

With the construction of the SPS accelerator in the 70s, the consumption demands skyrocketed as the new machine was to be cooled at a very low temperature (9 ºC). The solution could only come from a new water supply. The chosen source was the Lake of Geneva via a new pumping station at Le Vengeron.

This station, with a nominal capacity of 5400 m^3/h, was built for CERN and SIG. The investment cost was shared between the two users proportionally to the nominal flow-rate demand (2/3 for CERN, 1/3 for SIG). A similar proportion applies for the share of the operation cost every year.

In addition to the construction of this new water supply, a number of new stations were necessary inside CERN for the distribution of water. These were station 5 (SPS primary and drinking water supply to Prévessin - 1975) and station 6 (LEP make-up and primary water - 1986). All this added two more "layers" of projects to the existing layout, resulting in the fairly complex picture we can see today.

In all, CERN consumes around 19.1 Mm^3 of water (1996), of which 15.1 Mm^3 came from Le Vengeron only. The lumped maintenance and operation cost (which sets the price of the cubic meter of water to be paid) was some 2.8 MCHF that year.

3. REASON FOR A NEW WATER SUPPLY

The problem with the present water supply, Le Vengeron, is simply its age. After 23 years of service, a number of problems have arisen. Firstly, the concrete structure of the building housing the pumping station has been badly corroded over the years due to the presence of chlorine, needed for the water treatment. Secondly, the electric and control boards are no longer in compliance with Swiss standards (one must not forget that this station is operated and maintained by SIG, as it is outside CERN's limits). Last, new drinking water quality standards came into force in the canton after 1996, demanding a more extensive treatment (filtration, chlorination, ozonation and ultraviolet radiation and activated carbon filtering) for which the present station is not equipped.

All these elements have led SIG and the "*Fondation des Immeubles pour les Organisations Internationales*"(FIPOI), the owner of the station, to study the renewal of the existing treatment and pumping station. As mentioned above, CERN cannot own property outside its limits.

4. CHOICES

After a number of studies, two possible scenaris were suggested. The first one is to keep the present amount and share of flow rates for SIG and CERN unchanged. In this case, the total investment required for the consolidation and upgrade of Le Vengeron (base project) would come up to 62 MCHF.

Alternatively, CERN could reduce its present consumption in order to decrease its share in the costs. The advantages of this possibility, provided it is feasible, are the following:

1- Reduction of the investment cost required for CERN;

2- Reduction of the operation costs in the future.

To add to the appeal of this alternative, there is another factor to consider. It was agreed (1996) that the FIPOI would lend the total amount foreseen for the base project (62 MCHF) and, on the same conditions, to finance the necessary modifications of CERN's facilities in order to reduce the water consumption.

The final agreement for the second option consists of reducing CERN's consumption to half the present value of 3600 m^3/h. This demands an investment of some 18 MCHF for the upgrade of machine cooling plants, around 16 MCHF for the drinking water distribution network, and some 20 MCHF for the share of the new pumping station (Le Vengeron – Les Tuileries).

All these 55 MCHF would be financed by the FIPOI on the special conditions mentioned above, that is, 0 % interest rate and 50 years for refunding.

5. FUTURE LAYOUT

A very interesting result of the discussions carried out with SIG is the possibility of entrusting them with all the works which concern drinking water systems (pumping stations and distribution networks) at CERN.

The advantage of this situation is that a great deal of works will be completely outsourced allowing a much better follow-up of those which will remain for CERN to do (machine stations). The exploitation of all drinking water systems will also be given to SIG, whose competence and experience in the distribution of drinking water need no proof. It is very difficult to know at this moment all the details of the layout of these networks. Though, the important thing is that the distribution will be carried out by SIG in the same way as it is done in any Swiss town. Meters will be fitted at every consumption point (be that an office building or a machine station). The property of the network (up to some limits to be defined later) will be SIG's once the works are done. Also, the maintenance and repairs will be their responsibility and no longer at CERN's expense. The same quality of supply will be available for the Prévessin and Meyrin sites.

5.1 Upgrade of the PS complex facilities

Most of the cooling stations of the PS complex have been recently modified to reduce the consumption from an estimated 1200 m^3/h in 1993 to less than 500 m^3/h in 1997. Additional works (chillers in bldgs. 355 and 361, LINAC 2, East and South areas) will be carried out in the coming three years to a further 220 m^3/h by the year 2001.

5.2 Upgrade of the SPS complex facilities

Although the SPS was conceived to be cooled at a very low primary temperature (9ºC), it was clear from a series of facts that it could be readily run at higher temperature. To dissipate all possible doubts, a series of tests were carried out during the summer of 1996. These tests included a complete month of operation of the SPS at a set point of 25ºC on the secondary circuits, without any major incidence on the physics or the accelerator. In November 1996, the Technical Committee of the SL Division (SLTC), accepting CV's proposal, recommended that the works for the closure of the SPS primary circuit go ahead.

The modifications involved are extensive. The most relevant works could be enumerated as follows:

1. The SPS primary pumping station (St. 6) and cooling towers in the auxiliary building BA6;
2. The primary of all circuits in the auxiliary surface buildings of the SPS (BAs) cooling stations, including heat exchangers, regulation valves and piping;
3. The control systems of the BAs cooling stations;
4. The air conditioning of the BAs;
5. The air conditioning of the SPS main ring;
6. A new drinking water supply for the Prévessin site, as the SPS primary circuit will no longer carry drinking water.

5.3 Upgrade of the LEP-LHC complex facilities

As mentioned above, the existing LEP primary installations also consume drinking water (make-up water for the cooling towers in even points, direct cooling of chillers and alcoves). The aim here is to convert all the open circuits into closed ones, thus reducing the consumption from the present 750 m^3/h to an estimated 300 m^3/h

5.4 Rationalization of existing pumping stations

It has also been said that this project allows the rationalization of the present very complicated distribution network. This situation, inherited from the successive superposition of projects as CERN grew during the 1960s and 70s, was becoming a major concern for ST/CV due to the aging of the equipment and the increase in operation costs.

With the proposed layout, stations 1, 2, 3 and 4 will disappear, reducing the remaining stations to just one complex, situated in Point 1 of LEP. In addition, one of these stations will very likely be operated and maintained by SIG.

6. PLANNING OF THE WORKS

The preparation of the planning for the procurement and works is a difficult task due to the number of completely different jobs involved, more than 20 in all. Most of the works for the PS are already under way or scheduled for the two or three coming winter shut-downs.

Perhaps the most demanding part is the works for the SPS which, to be performed, require a complete stop of the machine. For this reason, they have been scheduled in parallel (in all eight BAs) during the so-called long SPS shut-down – Winter and Spring 2001. This shall allow the restart of the SPS in May 2001 already running on a closed primary circuit.

The works for the LHC will start during 2002, as soon as the buildings and caverns concerned have been commissioned.

7. CONCLUSIONS - BENEFITS FOR CERN

In spite of the very large investments involved in the projects (which could be the only disadvantage), one can say that there are only benefits to CERN. There would be only one drawback, that is the very tight schedule for the works, since they all must be carried out between January 2000 (when the loan will be made available) and May 2001 (when the SPS must restart for physics).

The other positive side is that plenty of benefits can be derived from this project. Just to give a few of them here, one could enumerate the following:

1- Reduction of the total capital investment needed for the works at Le Vengeron;

2- Availability of funding for much needed consolidation of all the stations which will undergo modification works anyway;

3- Rationalization of the water distribution layout, suppressing old stations in bad condition;

4- Significant reduction of the future maintenance and operation costs;

5- Reduction in manpower needs;

6- Reduction in CERN's water bill due to the 50% decrease in consumption (around 1 MCHF per year) after the year 2001.

In order to understand better the motivation for the proposal presented here, one must remember the two main boundary conditions of this project. First, the financing proposed by FIPOI, which could be considered as a donation of the Swiss Confederation. Second, the compulsory nature of the works foreseen by SIG at Le Vengeron.

Given these two conditions, the reasons above show that CERN's interest will be best served by choosing CV's proposal instead of the basic upgrade and consolidation alternative.

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