The EN/EL activities during the next long shutdown

F. Duval, CERN, Geneva, Switzerland.

Abstract

The EL group will participate in many activities during the next long shutdown. They are divided in four categories:

- Projects which require an extension or modification of the distribution network.
- Consolidation work of the electrical distribution infrastructure led by EN/EL.
- Scheduled maintenance activities and, in addition, the maintenance activities postponed since the start of the LHC.
- Many upgrades of EN/EL infrastructure following an evolution of the power request (from EN/EL or other groups).

It should be noticed that so far, we know only a small part of the work for which we will be involved. Indeed, projects must be sufficiently defined by our colleagues before submitting us their request.

Furthermore, it should be noted that the decision to delay from 2012 to 2013 the long shutdown will lead to a schedule change of some projects and will increase the risk of failure of EN/EL equipment due to a lack of maintenance. This postponement of the long shutdown will be preceded by an additional Christmas break; we hope it will be longer than the past two. The work program is too tight and leaves us no time to repair any defects found during the various tests and increases our rate of human mistakes.

INTRODUCTION

The EN/EL group activity volume will be multiplied by about 4 during the next long shutdown as seen by the past. This increase is made possible through the group's experience to handle such situations by converting part of its capacity to run studies into capacity to lead worksites and also with our subcontractors who know how to increase their manpower in such a ratio keeping a good level of professionalism.

The group's activities during the next shutdown are shared between maintenance activities and projects. Some projects are carried out by our colleagues who “subcontract” to EN/EL the cabling, optical fibre installation or even a modification in our distribution network required by the project. EN/EL also conducts its own projects to consolidate its infrastructure mainly because of the obsolescence of some equipment. Moreover, the evolution of the needs for the organization led us to reorganize our network, to upgrade it in order to meet these new requests.

Finally, many requests have not been received by EN/EL yet; except the last-minute requests that might be anticipated, it is a bit early for most of our users. Their projects have not yet reached the point that they can define precisely their needs in term of cabling and in terms of necessary additional power.

PROJECTS

Under the project R2E, EN/EL will be responsible for moving approximately 80 racks (re-cabling operations included) outside areas where the radiation level might affect the operation of equipment. LHC points 1, 5, 7 and 8 are involved. Most of equipment installed in the safe room is concerned; because of the lack of available space, the concept of "safe room" (resistance to fire for 2 hours minimum) will be redefined. Besides the lack of space to relocate equipment, we also face the problem of finding space for the new cables and their trays. An important part of the work will be to run the functional tests after relocation. The estimated budget for this project is about 5MCHF.

Just after installation in 2008, the water cooled cables in the LHC started showing signs of unexpected deterioration. These cables are made of a small section of conductor located inside a hose made of reinforced rubber similar to the technology used for car tires. The circulation of a cooling fluid in the hose provides an acceptable temperature of the conductor. After various tests we realized that the hoses show evident manufacturing defects. Negotiations are underway with the manufacturer. Without waiting the outcome of the discussions, EN/EL foresees to replace more than 3 km of these hoses in the sector whose signs of deterioration (cracks) are worse than others; we identify those located in points 4, 6 and 8 of the LHC. The replacement work will be followed by a complete campaign of tests (hydraulic, mechanical and electrical) before re-commissioning operations.

The UPSs are used to eliminate glitches and to provide power supply during mains losses for a limited time (depending on the size of the batteries). In the LHC tunnel, 74 UPS Silcon have been installed in 2004. At this time they were about to be withdrawn from the market, replaced by newer models. In addition, Silcon was taken over by APC and recently, APC was acquired by its competitor MGE UPS of Schneider Electric. This information seems to be trivial but has generated a complete loss of competence from our supplier. Furthermore, the availability of spare parts is now uncertain. Our statistics show that these machines present worrying signs of decline: the unavailability rate is two times higher than for competitors UPSs which are even on average more than 10 years old. Each incident on these UPSs requires human intervention in the tunnel for inspection and, possibly for the replacement of the faulty component. We have a plan to replace these machines. This plan will include the modification of the downstream

circuit meeting new model requirements and meeting users requirement (e.g. QPS distribution). It includes the implementation of the supervision of the equipment and the commissioning tests as well. A quick estimate shows that the cost of such an operation would be around 6MCHF.

The above three projects are mainly held in the tunnel and must be programmed during a shutdown.

The following projects do not require intervention in the tunnel but have an impact on the LHC operation. Part of the work can be carried out outside the shutdown period, but the connections and most of the final tests should be performed when the accelerators are stopped.

In the Computer Center (bldg 513), IT has to face problems of autonomy during power losses of normal network. IT has to also face a lack of redundancy of the infrastructure and they have to face a sharp increase of power needs up to 3,5MW (mainly for critical loads). The critical loads are supplied via the safety network (powered by diesel generators) through a UPS, which ensures an uninterruptible power supply unlimited (except by the size of diesel generator's fuel tank). The other loads called "physical" are supplied by the normal network through UPS to ensure uninterrupted power with battery autonomy of 10 minutes in case of loss of the normal network. The project consists mainly of significant changes in civil engineering and cooling systems in bldg 513, of the addition of two cubicles on the dedicated 18kV substation, of two 18kV power transformers and of two UPS systems (for a total of 9 modules 400KVA) with their 4 low voltage switchboards. This project is running from December 2010 until June 2012. The project Budget is 10.5MCHF.

The CERN Control Center (CCC) is powered from a dedicated electrical substation called SE0. This supply is guaranteeing uninterrupted power from the safety network through an UPS system. But the required redundancies for maintenance operation to avoid a potential failure are not sufficient. Furthermore, the EN/CV infrastructure have insufficient autonomy, they depend for part of the building 870 distribution infrastructure. The cooling power is no longer sufficient and the ventilation in the CCR must be modernized. For this, a project of consolidation and modernization is being finalized. This project will include:

- The redundancy of electrical installations since the safety network which supplies the CCR machine room and EN/CV facilities via diesel generators. This redundancy includes the UPSs and control distribution 48Vdc. This redundancy will allow the annual maintenance operation during the CCC operation.
- A new cooling and ventilation infrastructure taking advantage of the new distribution scheme.
- A new building for EN/CV and EN/EL infrastructure.

The project will start before the long shutdown but will require a stop of the CCC and therefore the LHC and its injectors. The project will be led by EN/EL, EN/CV and GS/SEM, the budget is estimation is around 5MCHF excluding the civil engineering costs (study ongoing).

CONSOLIDATION OF EL INFRASTRUCTURE

The consolidation of electric power distribution facilities for the next 15 years will be described in a document to be published soon. The first phase will be run until the next long shutdown and consists of 4 main activities:

- The 66kV protection system is about 25 years old and shows more and more its decline especially due to aging electronic components. It will be replaced by a modern system that will, in addition, implement modern features such as digital interlock and block for a better selectivity. The studies and manufacturing of components for this project will take place during operation of the machines. But the installation and the final testing will require the substation stop and will take place during the next long shutdown.
- The required power (especially from the safety network) for the installation of the CCC upgraded (see above) leads us to design and build a new substation for normal power distribution and a power generation system in order to increase the safety available power.
- The first step in the renovation of obsolete equipment in Meyrin site will start by replacing the substation SW (ME59) (commissioned in 1968) located in the basement of bldg 112. This new substation will be powered by a new power supply via a 66/18kV transformer located just outside the existing substation. This transformer will be powered by the main 66kV substation in Prévessin site, using a new cable link which will be installed together with the consolidation works of SPS cable (see below).
- After the installation of buried cables to replace the stable and pulsed loops and the SMB power supplies cables in 2011, the consolidation of the SPS infrastructure will continue in 2013 with the installation of complete modern substations (including their protection system, power supplies 48Vdc for the control circuits, etc.). 4 substations will be renewed, located in points 1, 2, 4 and 5 of the SPS.

The budget for the long shutdown activities on this project will be around 10MCHF.

MAINTENANCE

Since the start of the LHC, many maintenance operations were delayed: the RTE requests for the Bois-Tollot substation and the OHL 400kV line Génissiat/Bois-Tollot which is the only to supply full power to CERN. The scheduled maintenance of the main power plant 400kV and 66 kV including the power transformers have also been postponed twice. All these activities, in addition

to the scheduled operations, will be run during the next long shutdown.

More than 10 faulty circuit breakers were identified during AUG tests last December. After a tripping signal, the trip was delayed; 150mS for some, 1 minute for other and even worse for some others. The tripping mechanism was clogged by old dried lubricant.

UPGRADE PROJECTS

Many small or medium CERN projects lead to a need for upgrading EN/EL infrastructure such as changing the capacity of switchboards, of a cable or of a circuit breaker.

The main upgrade project concerns the PLCs used for an automatic reconfiguration of LHC network. They are mostly used on the auto-transfert, the connection of the diesel generator to the network or for UPS load shedding. Most of the PLCs have been installed in the 90s for LEP and are aged of twenty years of service and must be replaced. Furthermore, these PLCs must be reprogrammed to take in account network changes since their installation and to address the need of a homogeneous solution for the LHC.

SHUTDOWN POSTPONED TO 2013: IMPACT ON EN/EL

The failure rate will increase.

- At the SPS there has been no irradiated cables replacement campaign (formerly 1/7 of total per year) since 2009.
- Due to a lack of tests and maintenance (400kV substation, UPS for QPS, etc.). A failure of this type could lead to a major event.

Several projects will have to be rescheduled.

- IT bldg 513 upgrade.
- CCC powering upgrade.
- EL infrastructure consolidation (new substations commissioning).

A new Christmas break will be held by the end of 2011.

EN/EL is requesting to have a longer break because we have learned from the previous breaks that:

- The time schedule is too tight.
- The workload during tests led to an increased rate of human mistakes.
- No time available for repairs (even small) on fault detected during tests.
- The program is jeopardized by many "urgent" last minute requests.