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OPERATION AND MAINTENANCE IN THE COOLING AND VENTILATION GROUP

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Abstract

A core team of CERN staff is running the daily operations of the cooling and ventilation equipment at CERN, thus assuring multiple interfaces such as constant contact with the users of existing installations, the project leaders for new installations and intern-divisional communication. As support of this team, re-tendered contracts with external companies for the maintenance and operational tasks have been put into place multiple years ago. Higher-level maintenance continues to be entrusted to the equipments' constructor. The new task- and result-oriented contract E071/ST for maintenance and operation started on January 1st 2003 is briefly described. Tools for running the contract and responsibility limits on both sides of the contract are displayed. Training needs of personnel and knowledge transfer to maintain the mastering of the functioning of the machine park are briefly analyzed.

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1 INTRODUCTION

The operation and maintenance of installations related to cooling and ventilation for the machine and experimental areas is a vast field. More than 3000 installations in the fluid sector, that can be broken down into 70 classes and 250 categories are to be maintained and operated all over CERN for the accelerator sector. Most of the operation and maintenance work are being subcontracted to different companies and CERN staff has mostly a supervisor and organizer task, rather than carrying out the technical work in itself.

2 THE MACHINE PARK

The machine park consists of all cooling and ventilation equipment directly or indirectly related to the operation of accelerators or physics' experiments. This includes all LHC and SPS points as well as about half of the buildings in Prevessin and Meyrin sites.

The machine park is broken down into 70 classes and those again into 250 categories. An example for a class is "filter" or "pump", whereas a category would be "centrifugal pump 0-20 kW" or "sump pump". This categorization is necessary for the correct planning of the maintenance.

2.1 Hydraulics

The most visible hydraulic installations under ST-CV responsibility are the 24 cooling towers and the connected secondary circuits, such as demineralised or chilled water (113 secondary circuits in total), which cool the main components of the experiments and machine.

Less known are various infrastructural equipment such as fresh water supply, fire fighting water and evacuation of all underground water in the tunnels form and integral part of our machine park. This equipment is situated in technical galleries or underground areas, where accessibility is often restricted and interventions need to be well planned.

2.2 Ventilation, Compressed Air

The ventilation and air conditioning system includes the complete systems for all underground areas. Air from the surface is dehumidified and brought to the right temperature before being blown into the underground system. The ventilation system is also a part of the fire protection system with integrated smoke alarm system (ST-MA) and special modes in case of fire detection. Certain underground areas are always pressurized so as to keep them free of smoke in case of fire.

Other important buildings such as the computer centre, clean rooms, control rooms and power supply are being air conditioned as well.

Compressed air for pneumatic instrumentation, workshops etc is distributed centrally in three zones for Meyrin, Prevessin and the SPS ring, whereas the LHC points have each a local air distribution system.

3 CONTRACTS

The contractual activities within the operation and maintenance can be divided into three main parts: General Operation and Maintenance contractor (E071), Water treatment contractor (E061) and small orders directly to the constructors of specific material.

3.1 General Operation and Maintenance Contractor E 071

The largest activity for ST-CV is the maintenance of the equipment in order to ensure continuous running of the installation.

A new operation and maintenance contract has been put into place on January 1st 2003. With this new contract, a new structure for planning and following up all detailed tasks has been set up. The setup has been done so as to assure a flexible budgetary adaptation to the changing workload during the years of LHC installation.

3.1.1 Preventive maintenance

All preventive measures are introduced into a Computer Aided Maintenance Management System (CAMMS). In the year 2002, about 400 preventive instruction lists (IL) have been established. These consist of information about a specific task (e.g. "control: general state, bearings by manual rotation, logged vibration measurements, couplings, rotation gasket, change if necessary, oil or grease change) that can be done on a specific object like a pump.

In addition to the instruction lists, the inventory of equipment (about 18 000 entries) needed to be verified and completed. The combination of equipment with IL, that needs to be done manually by the CERN technical responsible, forms the Preventive Maintenance Plan (PMP). Regular checks of the installations, for example weekly patrols, are also part of the preventive measures and integrated in the same management structure.

With this new contract, CERN has taken responsibility about the tasks to be performed back into his hands.

3.1.2 Corrective maintenance

Interventions due to breakdowns obviously can not be put into a long term planning. They are considered corrective maintenance and can range from a simple acknowledgement of an alarm to a stop of installation due to equipment failure. Also repair of equipment that is close to breakdown is taken into account. An intervention is usually asked via a TCR phone call or directly from a CERN technical responsible and always comes along with a written work order (ODM Ordre De Maintenance) in the CAMM System.

The interventions considered as corrective maintenance constitute about 30% of the total workload of the general operation and maintenance contractor.

3.1.3 Operation

Some operational tasks are directed via work orders (ODMs) to the contractor. These comprise simple maneuvers of installations, such as start or stop, the surveillance of the process parameters, tests and inspections.

3.1.4 Follow up of works

Both maintenance and operation is followed up in the CAMM System. For each individual ODM, the contractor is required to give a feedback in written form and attributes a price depending on the instruction lists used. Unit prices for all tasks are fixed as an integral part of the contract structure. CERN staff then controls all written feedback and carries out some verification on site. The quantity of ODM done in three month amounts to about 850. Important problems are also being reported in the weekly operation meeting.

This system allows follow-up of works on a detailed level and creation of a history which will allow breakdown analysis later on. Unfortunately, this system is also manpower intensive in a time, where CERN attributes priorities more and more to the construction of the LHC and human resources are spare.

3.1.5 Minor works

In the global operation and maintenance contract, minor works are foreseen and done on a regular basis. There are constantly demands of minor modifications of existing systems, consolidation of old installations and connection of new users.

3.2 Water Treatment Contract E 061

3.2.1 Chemical Treatment

Certain activities within the scope of ST-CV are related to chemical treatment of water. The water in cooling towers is subject to biological pollution and - in natural state - corrosive to the pipes' and equipment surfaces that are not rust proof. Due to the evaporation of some of the water in the cooling tower, a natural enrichment of minerals occurs that might lead to scaling on the surfaces of heat exchangers and thus degenerate the cooling capacity. In order to prevent fouling, corrosion or scaling, chemical treatment with a close follow-up need to be in place.

The current contract provides chemicals, related equipment and services to ensure running of the cooling towers in good condition without degeneration of material or performances.

3.2.2 Demineralised water production

Demineralised water is necessary in all circuits that are partly situated in a magnetic field or radioactive environment. This water is produced in three buildings (378, 141, 358) on the Meyrin site and supplies the whole CERN including SPS and LHC. About 14000m3 are being produced every year at CERN. The process of demineralised water production is closely followed by the contractors' team.

The contractor also takes care of the regeneration of about 100 mixed bed cartridges per year. These cartridges are built in the demineralised water circuits all around CERN and their function is to filter minerals and other components that might slowly dissolve into the water so as to always guarantee a high quality of demineralised water. In case of failure, magnets might not work or the water might be charged radioactively.

3.3 Other Contracts

Interventions on specific equipment might be out of the competences of the above mentioned contractors or simply a question of guarantee for the material installed. Various small contracts are being ordered on a case by case basis. Regrouping is done wherever possible.

The drinking water supply at CERN is assured via the Geneva Water Services (SIG-SO – Services Industriels de Genève – Service d'eau). They are also responsible for the water distribution network on the Meyrin and Prevessin sites. These works can however not be done completely independent of CERN personnel. Certain actions can only be done by CERN staff, such as establishment of AOC (avis d'ouverture de chantier) and coordination with the users in case of water cuts. Constant information exchange with SIG personnel is necessary to ensure proper running.

4 PROJECTS

New installations are being developed by the design section according to clients' demands and the implementation is supervised by the works section. At the end of a construction phase, the material is handed over to the operation section and various steps need to be undertaken in order to integrate the new installation in the existing maintenance scheme. The process and functioning of the installation need to be fully understood as well. A detailed inventory of all equipment needs to be introduced into the CAMM System, type of maintenance and frequency need to be defined depending on the equipment and the running schedule. This can partly be subcontracted but a non negligible in-house effort is necessary as to become master of the new installations.

For strategic equipment, spare parts must be defined and put into the store to be immediately available in case of breakdown. Actually this is done on a case by case basis and largely relying on the technical competences of CERN staff. An appropriate automatic spare parts policy in the CAMMS still needs to be developed.

5 CLIENTS CONTACT

The activities of the operation and maintenance section are not limited to the follow up of the above mentioned contracts. Operation is in contact with the clients that need cooling and is adjusting process parameters according to their needs. This includes the optimization of the process, global tests and planning of running time with the clients.

Often, older installations have been recycled for a different use from which they originally were designed, and the equipment is not fully adapted to its new purpose.. Budgetary limitations ask for technical compromises that sometimes find their repercussions in the performance of the installation. For example, pumps have specific working parameters in their characteristic that need to be respected.

Advice about cooling possibilities on a lower scale is being done directly by the operation section. In case of smaller modifications, which require small or no additional design effort, the operation section takes care of the works. Otherwise transfer to the design and works section is being done.

6 MAINTENANCE WORKLOAD

The operation and maintenance tasks gradually have been reduced since LEP stopped partly due to the smaller amount of equipment running but also because of budgetary reasons. Routinely checks have been spaced out, certain preventive activities have been abandoned. The degeneration of the condition of the installations came gradually, showing only after some time.

With the reduction of maintenance, operational personnel have been transferred to the LHC construction and general consolidation projects. In this way, the projects can directly profit from the personnel's knowledge.

7 STORES

The strategic center of any maintenance is the stores in which the spare parts are kept. For the maintenance, spare parts supply need to be guaranteed in order to keep breakdown times low. Two stores situated in Prevessin and Meyrin hold the large stock of spare parts. Distances and customs' considerations make it necessary to have separated stores in France and Switzerland. The inventory and follow-up of parts' movements is done by a single person. The storekeeper does a regrouping of orders and price enquiries as well as taking care of reception and control of material.

Orders are being done following a preventive maintenance planning. This is a relatively straight forward task, where the planned interventions are being scanned for needs of spare parts.

More difficult considerations are necessary in case of unplanned breakdowns. A minimum store should be kept to ensure spare parts replacement in this case. Storage space limitations as well as budgetary considerations have limited the efforts in that area. Until now, the minimum storage is a fully manual task. Reliability has been relatively high in the past due to long experience of CERN staff. With the departure into retirement of some of these people with highly specific knowledge and the overall reduction of personnel this reliability will go down and make it necessary to invest into a proper and more automatic spare parts policy and an optimized stock keeping. This will consist of a full inventory of all spare parts, relating them to equipment installed.

Today, the same spare part that is necessary for two completely different installations might be purchased and stored twice since all the cross link verifications are done manually. At a first estimate, about 20 000 spare parts need to be dealt with, not taking into account the new material being installed for the LHC. Old installations don't always have their proper technical documentation, so for the proper information we largely rely on personnel that are more and more approaching retirement.

8 CONCLUSION AND OUTLOOK

A new maintenance has been put into place at the beginning of the year. A close follow up by CERN is put into place, which demands more effort but brings some of the mastering of the tasks back into CERNs hands. First results are promising but still a lot of things have to be implemented.

More efforts need to be done in order to finish the maintenance plan and the inventory of all installations. A spare parts policy needs to be properly defined and put into place. The maintenance plan should be finished before end of 2003. The spare parts policy will need an intensive effort. In order to be ready for the LHC start, we need to start this preparation now.