SAFETY SYTEMS (AL3) AND SYSTEMS RELEVANT TO SAFETY

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Abstract

The Level 3 alarm systems (AL3) are basic life protection, especially important during the shutdown; there should be no point in the LHC underground areas in which a person is not or cannot be informed of the dangers around him when they exist and so take the correct action. The implantation of the different systems will be reviewed in the light of our experience and their performance and reliability examined. The need for fire doors to control released Helium will also be examined, which may have an impact on the ventilation systems.

ALARMS OF LEVEL 3

The following report is only a superficial view of the detection, transmission and response to emergency alarms, with the inclusion of some remarks on safety items that could be implemented in the LHC. The AL3 alarms require an immediate intervention from the rescue team, the systems concerned are automatic fire detection, oxygen deficiency monitoring, flood alarms, flammable gas alarms, emergency phones ("red phones") and lift alerts, evacuation alarms and emergency stops, as specified in IS37 [1]. Safety systems are those that are relevant to prevent or reduce risks; the CERN fire service, ventilation control and the dissemination of safety information are considered, there are clearly many others that are being studied by the task force on underground safety.

DETECTORS

The Pompiers react to all alarms although these are mostly unexplained smoke detector alarms (over 300/year). Since more occur in shutdown time than operation, they are probably linked to human activities and some have been identified with dust from work activities in an area. The high sensitivity of these detectors reassures us that they are effective, and at the same time keeps the fire service in peak condition.

There is no automatic trigger of an evacuation in the case of a fire alarm in the tunnel; this is manually activated by the fire service after on site investigation or by any person present on site who should raise the alarm in such an event. Triggering an evacuation from the Safety Control Room (SCR) has been planned, but the connection is not yet installed.

The smoke detectors used are vulnerable to radiation, which could cause their sensitivity to change, those in the LHC tunnel have therefore been located in alcoves to minimize radiation damage, although they sampling air from the tunnel through piping. All Fire detectors are tested every year and their annual test results are recorded. Although the testing conditions are realistic and performed to standards, it would be instructive for the fire service to perform simulated electrical fires in the LHC, under normal ventilation conditions to observe the sensitivity and response times of a fire. This could also be made into a training exercise.

Oxygen Deficiency Hazard (ODH) detection is installed throughout the LHC tunnel, if the oxygen level falls below 19% a level 2 warning alarm is sent to the CCC, if the level falls below 18% a level 3 alarm is sent and flashing lights are activated locally. The audible evacuation alarm is triggered by two adjacent heads at below 18% and also extends the area affected to some adjacent zones in a pre-defined matrix. The evacuation trigger matrix is not completely finalised, and so remains to be fully implemented.

A recent review [2] identifies some limited underground areas where ODH risk exists but there are no ODH detectors installed: mostly linked to the Helium ring line in service areas and experiments. These represent a very small percentage increase over the installed system and will be installed immediately.

CERN SAFETY ALARM MANAGMENT

The old LEP era alarms system did not meet INB regulations as the transmission paths were not completely redundant and it was becoming difficult to operate reliably. Several thousand "false" alarms were generated each year, causing difficulties for the emergency service. Given the extra detection systems that were needed for the LHC, the CERN Safety Alarm Management system was specified and calls for tender were invited in 2000 [3], [4]. It is designed to handle emergency alarms and also the lower level alarms generated when important equipment requires repair or servicing.

The LHC AL3 systems comprise 8 of the 33 geographical CSAM zones, covering surface buildings and underground areas in all the CERN access points as well as the entire Meyrin and Prevessin sites. Each alarm is wired to a local copper system on the secure PLCs of the zone and from there to the CERN Control Center (CCC) and SCR: this is the core of the system; the pompiers will always receive an AL3 alarm indicating the location and type of alarm and will go onsite to identify the source locally. In addition to the copper link, the alarms are transmitted over two ethernet networks, as it is an important part of the safety philosophy that the communications lines be independent: no common nodes should exist which would render both channels inoperative. The CSAM system also provides detailed alarm information via a serial communications server.

The CSAM system monitors the status of every alarm and communicates the information using two separate communications networks to the CCC and SCR [5]. The information is also redistributed to local display terminals for use in an intervention, replacing the local hardwired synoptic panels that the fire service had relied on for years. Without the detailed alarm information, in an emergency the pompiers must locally identify which alarms are active. The reliability and operability of the CSAM system is therefore essential, the system as it is today manages these tasks well but like any electronic network, requires regular and thorough maintenance and consolidation as technology evolves.

CURRENT STATUS

Following operational experience of the system, the GS-ASE group has identified several areas to increase the operational reliability of the system and is actively pursuing a consolidation and improvement program. Among the items they are addressing are the unique nodes of the system, such as the serial communications server whose failure would stop the collection and distribution of the detailed alarm information, therefore a backup server will be prepared ready to be quickly switched into service.

Data transmission delays over a loaded network may cause data to arrive out of sequence, possibly creating errors. To remedy this, the controls software will be migrated to newer versions, which will improve the performance of the system, and a dedicated communications network will be installed, to be operational in 2010. This dedicated safety network was originally requested for the CSAM system, but was not implemented for cost reasons.

The CSAM system was conceived and constructed with some useful features, but as resources have been limited they are not currently used, needing some procedures and manpower in order to be implemented. One such feature is that individual alarms can be put into maintenance, hors service or test modes, which would be useful during tests and maintenance, avoiding erroneous alarms.

Another advanced feature requiring some extra resources is the alarm detail display. The system identifies specific alarms, the exact location of which can be shown on the "floor plan" in the system display, information that would speed the emergency team to the location of any alarm. The LHC point 18 has been completed but the task remains to be done for other areas. The system is also capable of storing specific information on a room or building (specific risk or consigne), which the fire service would appreciate, but no resources are available for this either. The type of information that would be of use here covers not only the materials stored in the room but also specific electrical or other hazards that they may encounter, and in the case of broken lifts, the location of the machinery room could be indicated too.

HELIUM CONFINEMENT

The experience of the sector 3-4 incident showed that the ventilation sectorisation of the LHC is critical in the case of helium loss. At present, when powering tests are performed in a sector during shutdown, adjacent areas have to be kept evacuated also, leading to the loss of many days of access. This is the result of the risk analysis evaluating the effect of a large helium loss in the arcs, where the resulting pressure wave quickly spread in both directions along the tunnel in the ventilation paths. The onset of oxygen loss would be extremely fast in the UA and UJ areas and accompanied with the pressure wave that could cause other hazards, limiting the ability of anyone in the area to equip themselves and evacuate the area.

Having a ventilation blast wall in each arc could reduce part of the danger; these would be constructed to allow normal ventilation flow, but when triggered by a reverse flow would block in the fashion of a butterfly valve or venetian blind. The wall itself would not be helium tight but would resist the pressure wave driving the gas forwards for a few minutes, hence giving personnel in the protected area enough time to react normally to the ODH alarms, for which they are trained and equipped. This question and others are being reviewed by the taskforce on accessibility of the LHC following the sector 3-4 incident.

SAFETY INFORMATION DISPLAYS

In shutdown mode the LHC is sectorised and different hazards will exist in different sectors and change on daily basis. This information is coordinated and transmitted electronically, but not displayed at the access points or underground.

Safety Information panels were proposed and specified many years ago, and could provide a means of informing people before going underground of the risks around their foreseen workplace, they would make it possible to inform users of any local alarms, the status of adjoining sectors, planned work that could impact users etc. (cryogenic status, transport restrictions, power testing plans, the need to evacuate an area at a certain time, x-ray tests…) Such panels would complement the access control system which only interlocks for beam safety; access is automatically granted even in when alarms are active in an area. Safety information panels would also be of use to the fire service when responding to an alarm in a closed sector: to quickly inform themselves of the type of extra hazards they could find on the other side of the door, e.g. tirs radiologiques, cryogenic status or powering tests that may be unrelated to the alarm they are responding to.

CONCLUSIONS

It has not been possible in the short time available to study all of the LHC alarm system and processes associated with it. Overall, the required LHC safety systems are in place and perform well 24/7 and the response teams are always ready to react. Consolidation and improvements to the systems are being implemented which will ensure a high level of operability of the systems. Extra resources are needed to provide some of the useful functions that are not yet operational.

Dissemination of safety information at the access points should be pursued and some links between the safety and access system could reduce the possibility of people finding themselves in hazardous situations: either by warnings of the conditions underground or by automatic access restrictions in the event of hazards.

The very few missing ODH detectors are to be installed.

The detector maintenance/test status, alarm locations and local information that can be transmitted by the system should be implemented, as they offer a faster response by the emergency team and safer interventions.

The findings of the taskforce on underground safety might entail more actions on safety related systems.

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