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SAFETY ALARMS AND EUROPEAN STANDARDS

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Abstract

This paper describes the current status and future of the safety-alarm (*Alarm-of-Level-3*) equipment at CERN. The emphasis is on the classification of these systems in the European standards framework as well as in other relevant international standards. Fire and gas detection systems and evacuation alarms represent the majority (approximately 90%) of the safety-alarm equipment at CERN. We will mainly address issues concerning the functioning of the fire-detection equipment and how it communicates with the Safety Control Room and Technical Control Room. The technological evolution of the equipment will be discussed. We shall also refer to the international and national standards applicable at CERN in the fire-equipment domain.

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1 INTRODUCTION

In order to assure that incidents on-site are handled by a correct rescue intervention, CERN has a safety-alarm system that permits the transmission of Alarms of Level 3 (AL3) to the Safety Control Room (SCR) and the Technical Control Room (TCR). The generation of an AL3 implies that people's lives are or may be in danger and requires immediate intervention by the Fire Brigade. The types of existing AL3 and their detector numbers are presented below.

Fire detection	6250
Flammable gas detection	361
Red telephones	514
Emergency stops	3500
Oxygen concentration detection	13
Flooding detection	155
Evacuation (glass plates)	305
Blocked lift detection	99
'Dead man' detection	5

2 EQUIPMENT

Most of the existing equipment on-site is reaching, or has already surpassed its age limit (10–15 years), especially the LEP and parts of the Meyrin site. The LEP sites will soon be entirely renovated with the start-up of LHC, but the Meyrin site equipment will gradually be replaced.

In doing this, CERN must take into consideration the continuously evolving regulations concerning safety equipment. These regulations impose constraints on the detection and transmission of the alarms to the SCR/TCR.

One of these constraints is redundancy. This means that the same alarm must arrive through two different systems that work in parallel, so as to guarantee that a malfunction of one system does not compromise the transmission of the alarm or the subsequent intervention by the Fire Brigade.

To cope with the growing population of detectors and with the redundancy principle, the CERN sites have been divided into safety zones such as the ones shown in Fig. 1.

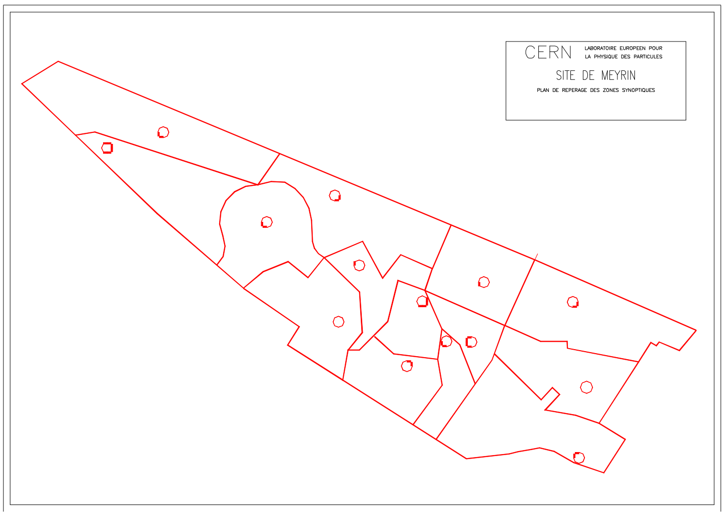

Figure 1: Illustration of the division of the Meyrin site into safety zones.

In each safety zone there is a Synoptic Panel or Local Display Panel that concentrates the various alarms and relays them to the SCR/TCR through a hardwired system. The fire-detection control panels communicate their alarms directly through a fieldbus. This doubling of information allows us to consider the system redundant. Indeed the redundancy is restricted to the indication of an AL3 in a particular safety zone.

However many of these control panels are not able to communicate via fieldbus and/or are non-addressable. This means that no specific information on the location and nature of the fire is transmitted other than the indication that there is an alarm in the particular building. This information is important as it provides an indication of the possible type of fire (or other danger) and adequate means to fight it.

In spite of this, there is the possibility of assigning a relay contact to an Equipment Control Assembly (ECA), where the indication is considered as critical. The ECA recognizes each particular alarm and generates a computer signal that provides all the information needed. This solution has at least one major disadvantage: the large number of cables may become impractical to handle.

There are four main formats of information that can be relayed to the SCR/TCR. This means that the following types of signal can be monitored:

- on/off contact,
- analogue signal,
- Profibus,
- TCP/IP.

3 FUTURE

Some of the most recent AL3 control panels have the capability to communicate via a fieldbus (Profibus).

In the near future they will be able to communicate directly in the TCP/IP protocol and thus eliminate any problems that may arise in the Profibus - TCP/IP conversion. This has the advantage of being the direct communication protocol with the Technical Data Server (TDS), which means that the communication will be simplified and thus relieved of conversion problems.

The goal is to have available as much information on each incident as possible to pass on to the Fire and Rescue Group. The information should cover the type of alarm, precise location, exact time of occurrence, and a comment on typical cause and intervention type.

In order to produce this data, new and up-to-date equipment is needed, and so control panels with enhanced capabilities will replace the old equipment. In addition, this should all be redundant information, i.e. we must have two systems working in parallel and they should both convey the same information through independent channels.

For this reason, the replacement or upgrading of the hardwired system with a computer network so as to provide more information has also been foreseen. The goal is also to have redundancy at the detailed information level, but a final solution is still not defined.

The LHC recommendations [1] indicate a possible architecture of such a system for the alarms of the LHC. The technological aspects for LHC alarm transmission are currently being discussed in Options for LHC safety alarm transmission [2].

4 STANDARDS

First and foremost CERN staff and equipment must comply with its internal regulations, produced by the Technical Inspection and Safety (TIS) Commission. The most important internal document on basic safety matters is the SAPOCO/42 [3] drawn up by the Safety Policy Committee.

Another commitment from CERN is to follow the regulations of the *Installations Nucléaires de Base* (INB). The main constraint in this field is on the traceability and maintainability of the security equipment. For this reason the *Instruction de Sécurité 37* (IS 37 Rev. 2) was drawn up by TIS to maintain a record and to allow the tracing of the equipment that is placed out of commission.

On the other hand, CERN’s installations must also comply with the most advanced of the Host States’ safety regulations as defined in [3]. In addition CERN gives priority to European standards and Member States standards.

4.1 International standards

The panorama of the international standards on Automatic Fire Detection (AFD) is somewhat confusing because the available standards do not cover exactly the same aspects, some are incomplete and others still waiting to be published.

Clearly the most important and relevant standard for CERN in this field is the European Standard 54 (EN 54 [4]) published by the European Committee for Standardization (CEN). This standard however is very recent and is not yet fully published. It is nevertheless the most advanced standard on this subject and the one to be used as a reference for all new equipment at CERN.

Covering some but not all of the matters of EN 54 are the standards from the International Organization for Standardization (ISO 7240 [5] and ISO 8421 [6]) and the International Electrotechnical Commission (IEC 839-1 [7]).

ISO 7240 and ISO 8421 are so general as to be hardly worth considering. They refer only to the definition of technical terms.

The IEC 839-1 covers generalities and a Code of Practice concerning installation, operation and maintenance. It provides an excellent source of experience to draw on when defining procedures.

With regard to transmission equipment there is the IEC 839-5 [8] and a relevant draft of standard from CEN: prEN 50 136.

IEC 839-5 (1991) focuses on the transmission systems and equipment, but is completely substituted by the draft prEN 50 136 (1996/1997), which covers all issues in IEC 839-5 and complements it by adding new requirements.

4.2 National standards

The Host States themselves have national regulations on AFD such as the French *Association Française de Normalisation*'s (AFNOR) NF S 61-950 [9] and the installation procedures R7 [10] from the *Assemblée Plénière des Sociétés d'Assurances Dommages* (APSAD).

The Swiss regulations are less specific regarding the equipment itself and limit themselves to the very general guidelines for fire protection [11] from the *Association des Établissements cantonaux d'Assurance Incendie* (VKF/AEAI).

5 CONCLUSION

For the construction of LHC and in order to comply with the most advanced regulations, the following are some of the topics and related standards to consider for the future.

Concerning fire detection, both France and Switzerland belong to CEN and all members states will implement EN 54 and remove all national conflicting standards. Consequently only European reference point concerning the manufacturing of equipment will be EN 54.

The most advanced set of rules for the installation is, for the moment, the APSAD R7 and the Code of Practice should the IEC 839-1, to be used as a source of information for defining procedures.

The transmission equipment is covered by prEN 50 136, but this is still not a valid standard; at present the most advanced is IEC 839-5, soon to be replaced by the final EN.
Table 1 presents a summary of this discussion.

Table 1
Summary of standards and related topics

Topic	Standards
Fire-detection equipment	EN 54
Installation and Code of Practice	APSAD R7 IEC 839-1
Transmission equipment	prEN 50 136

References

[1] CERN, WG-AL3S/hl, *Recommendations for LHC safety alarm system*, 20/11/98.

[2] P.Ninin, *Options for LHC safety alarm transmission*, Proc. ST Workshop, Chamonix, 1999.

[3] *Safety Policy at CERN*: SAPOCO 42 - Revision: Set 1994.

[4] EN 54, *Fire detection and fire alarms systems*, 1996-98.

[5] ISO 7240-1, *Fire detection and alarm systems - Part 1: General and definitions*, 1988.

[6] ISO 8421-1/3, *General terms and phenomena of fire/Fire detection and alarm*, 1987/1988.

[7] IEC 839-1, *Alarm systems - Part 1: General requirements*, 1987-89.

[8] IEC 839-5, *Alarm systems - Part 5: Requirements for alarm transmission systems*, 1991.

[9] NF S 61-950, *Matériel détection d'incendie*, 1985.

[10] APSAD R7, *Détection automatique d'incendie*, 1997.

[11] VKF/AEAI, *Norme de protection d’incendie*,1993.