Safety systems (AL3) and systems relevant to Safety

AL3 are those system which require immediate intervention from rescue team,

Safety systems are those that are relevant to prevent or reduce risks.

LHC AL3 systems: Automatic fire detection, oxygen deficiency monitoring, flood alarms, flammable gas alarms, emergency phones (“red phones”) and lift alerts, evacuation alarms and emergency stops…

Steve Hutchins with thanks to: Karl Gunnar Lindell, Rui Nunes, Silvia Grau, Henrik Nissen, Patrice Bossus, Hill Bont, Gerard Antoinet, Dimcho Indzhov, Alain Dumur

The old LEP era alarms system lacked detailed information transmission, the transmission paths were not completely redundant and it was becoming difficult to operate reliably.

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 (CERN-ST-2000-016 and EDMS 292663).

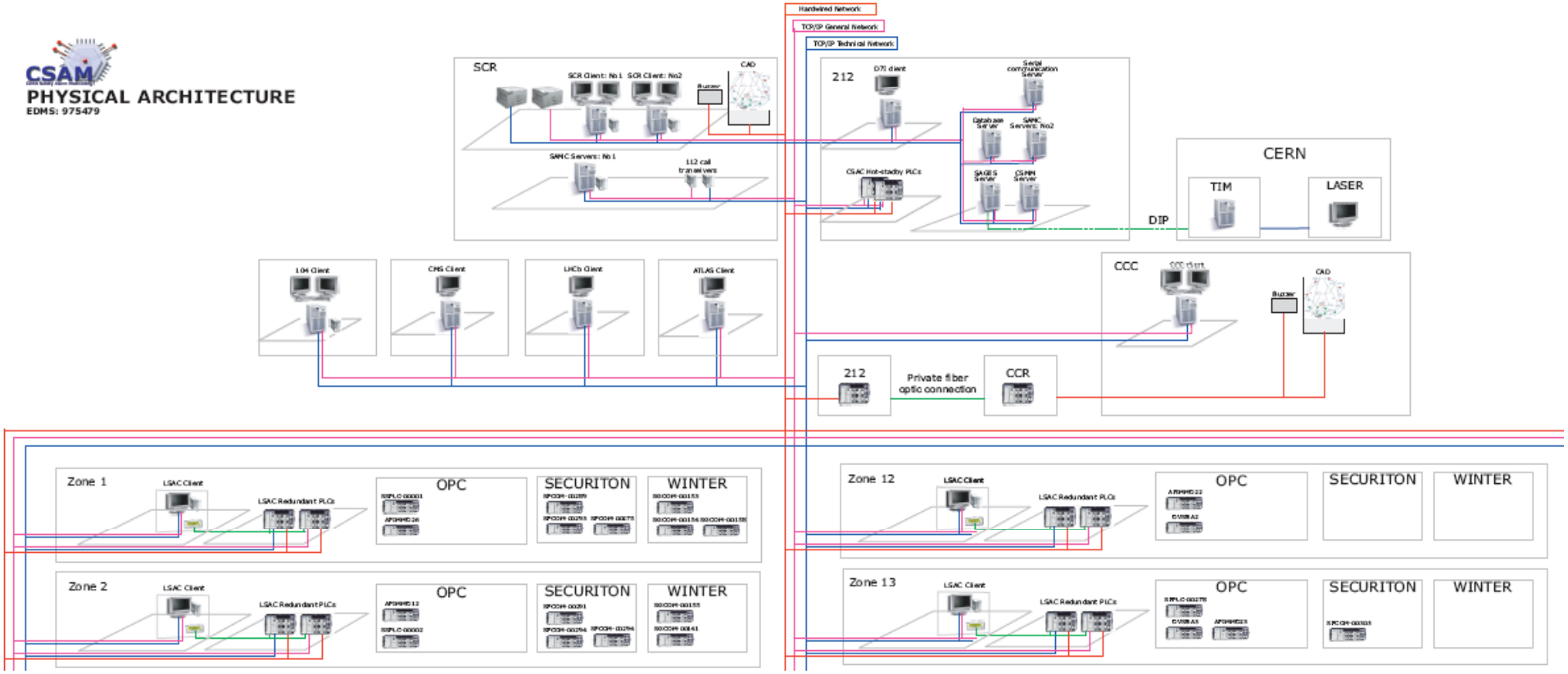
LHC AL3 systems are spread over 8 of the 33 geographical CSAM zones.

20000 detectors at CERN, covering surface building and underground areas.

The CSAM system monitors the status of every alarm and communicates the information over two separate communications systems to the CCC and SCR. The information is also redistributed to local display terminals for use in an intervention, replacing the local hardwired synoptic panels that the pompiers had relied on for years.

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.

Without the detailed alarm information, in an emergency the pompiers must locally interrogate the PLC controlling the zone, which would be time-consuming, making their task harder than it was in the days of LEP.



Part of the CSAM architecture as implemented, Detectors- PLCs- separate Communications channels (tnet and gen services net)- servers-information distributed to CCC and SCR (pompiers). The alarms are grouped in 33 different geographical zones.

CSAM System

Following operational experience of the system the GS-ASE group have identified several improvements to increase the operational reliability of the system:

1. The central server is a unique node; its failure would stop the collection and distribution of the alarm details, therefore a backup server will be installed as a “hot spare”.

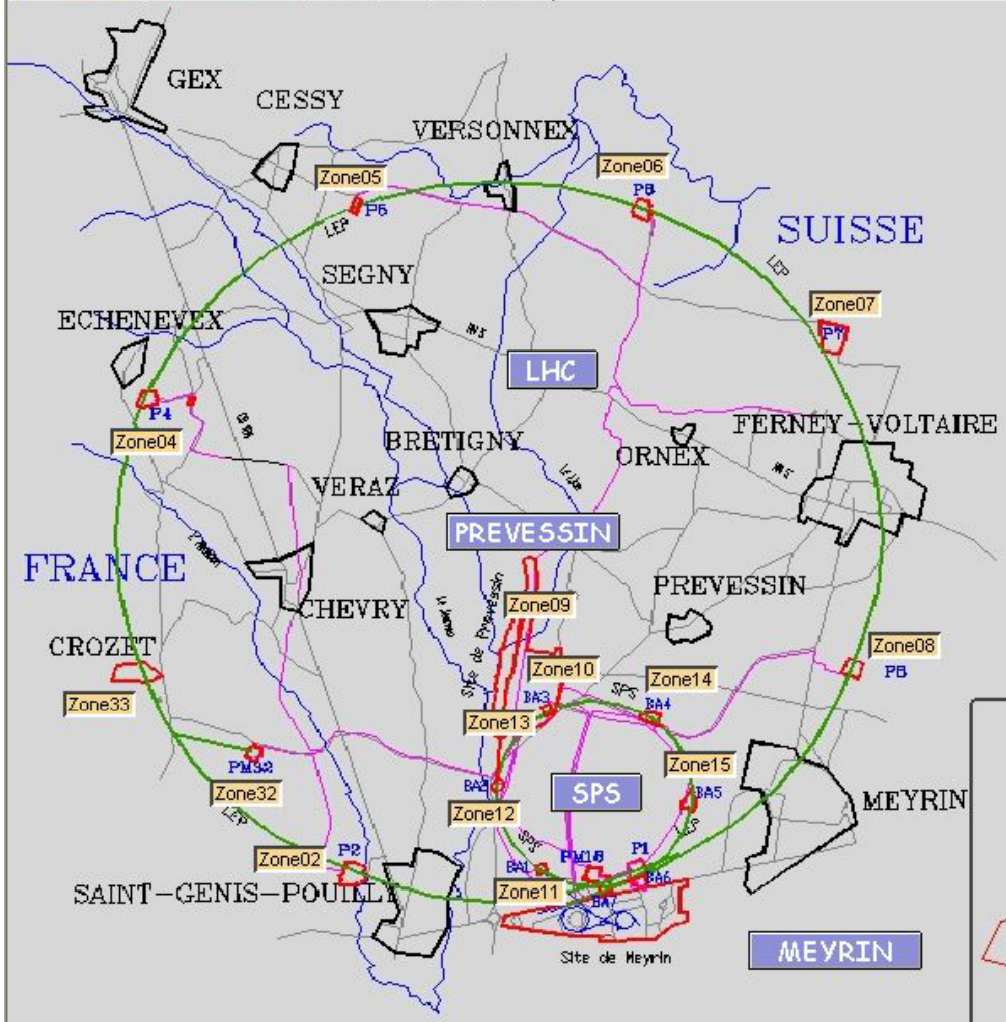
2. Data transmission delays over a loaded network may cause data to arrive out of sequence, possibly creating errors in the controls program.
To remedy this the controls software will be migrated to newer versions which will improve the performance of the system and the communication between machines, 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 dismissed for cost reasons.

Each alarm is wired to a local copper system on the secure PLCs of the zone:
This is the core of the system, the pompiers will always receive an AL3 alarm indication for the area and will go onsite to identify the source locally.

	MEY	PRE	SPS	LHC
Alarme niveau 3	2	0	0	0
Hors service	0	0	0	0
En test	0	0	0	0
En maintenance	0	0	0	0

CERN

OPERATEUR : admin | 26/01/09
POSTE : STCSAM D7i | 17:29:35

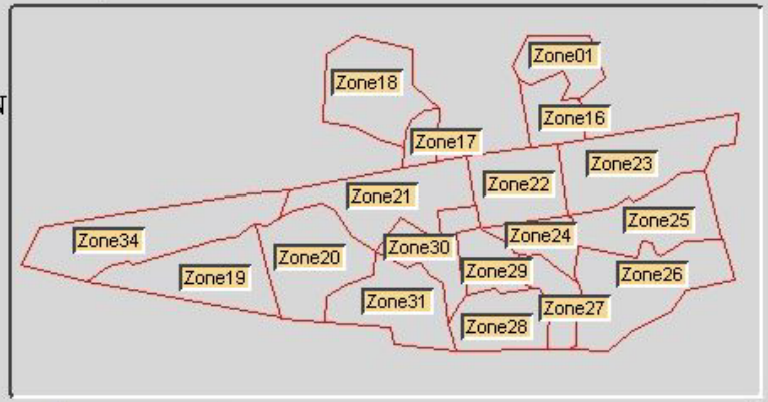


MEYRIN	
Zone19	0
Zone20	0
Zone21	0
Zone22	0
Zone23	0
Zone24	0
Zone25	0
Zone26	0
Zone27	0
Zone28	2
Zone29	0
Zone30	0
Zone31	0
Zone34	0

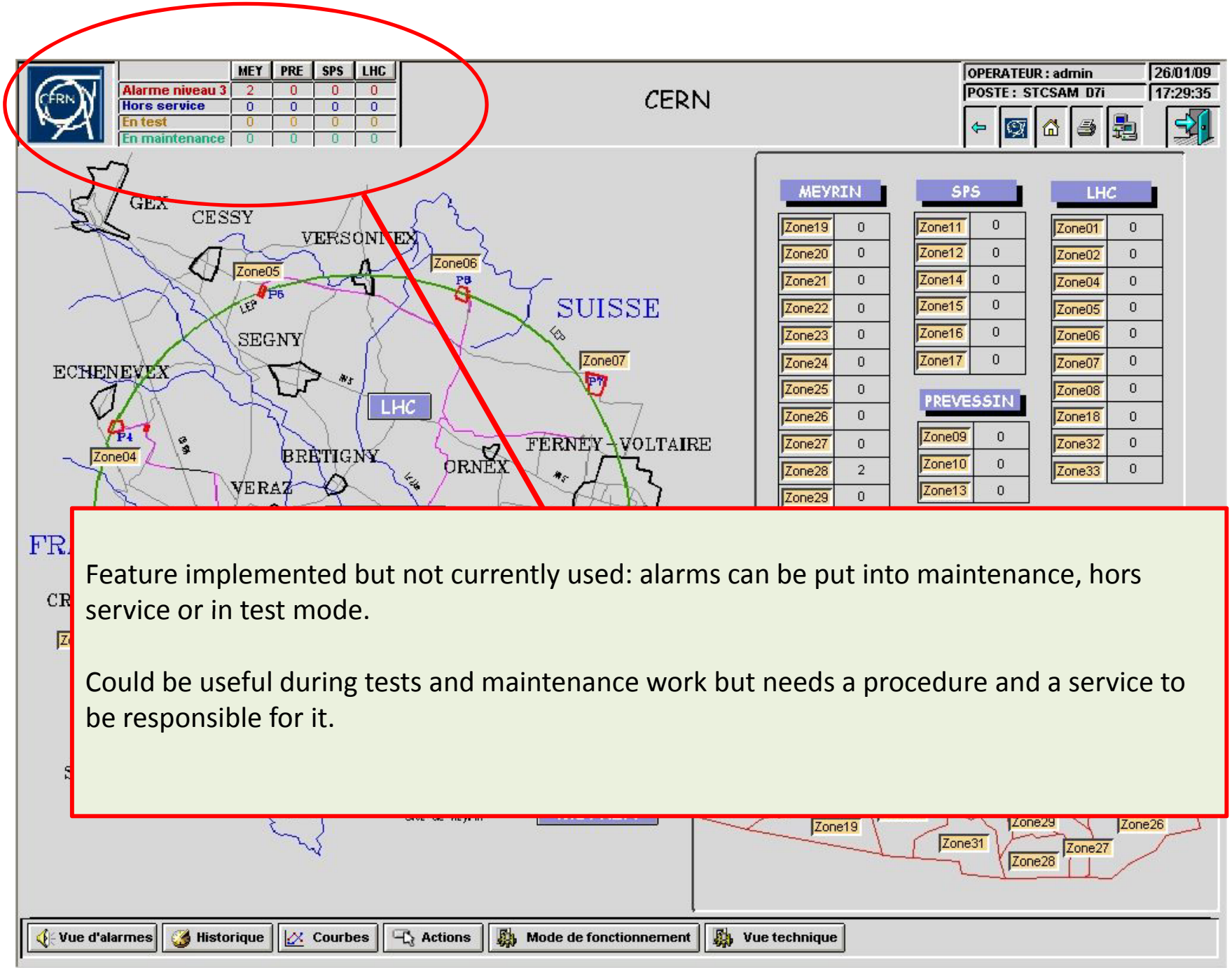
SPS	
Zone11	0
Zone12	0
Zone14	0
Zone15	0
Zone16	0
Zone17	0

PREVESSIN	
Zone09	0
Zone10	0
Zone13	0

LHC	
Zone01	0
Zone02	0
Zone04	0
Zone05	0
Zone06	0
Zone07	0
Zone08	0
Zone18	0
Zone32	0
Zone33	0



Vue d'alarmes | Historique | Courbes | Actions | Mode de fonctionnement | Vue technique



Feature implemented but not currently used: alarms can be put into maintenance, hors service or in test mode.

Could be useful during tests and maintenance work but needs a procedure and a service to be responsible for it.

	MEY	PRE	SPS	LHC
Alarme niveau 3	2	0	0	0
Hors service	0	0	0	0
En test	0	0	0	0
En maintenance	0	0	0	0

Zone 18

Surface

OPERATEUR : admin 26/01/09

POSTE : STCSAM D7i 17:31:34

Alarme generale

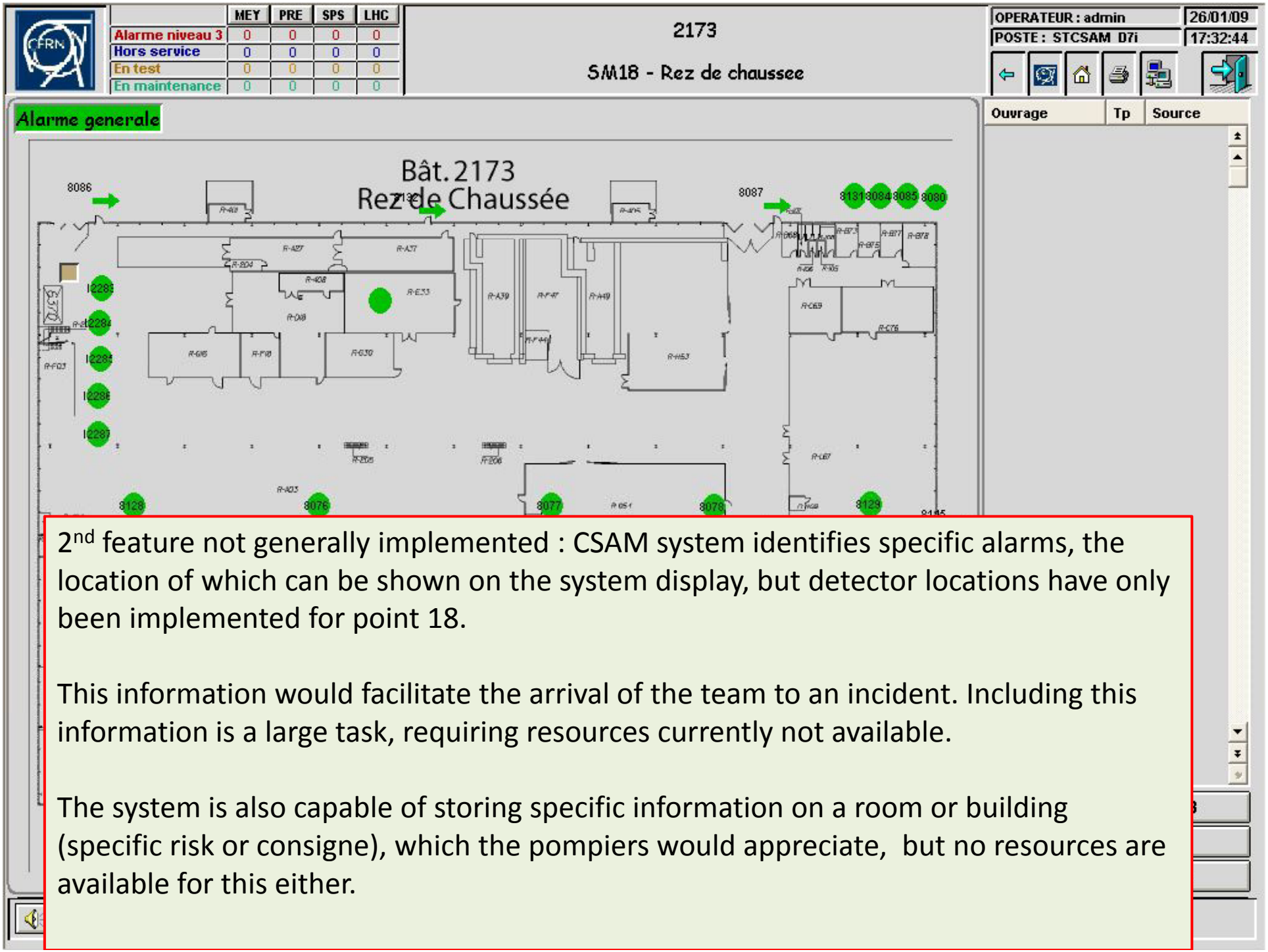
LHC 1.8
ZONE 18

SHB 2151
SH 2184
2173 SM18
3183 SW
3152
918
3153
SF 2165
SE
917
ACCES
Synoptique de zone
SMA18
3173
PM18 2145
987
373
SD 3156
3174 SHC
3177 SHM18
876
3187 SHE18
916
371

Ouvrage	Tp	Source

3183 SW18
3177 SHM18
3173 SMA18
3172 SL18
3156 SD181
2184 SH18
2173 SM18
2165 STP18
Zone18 - Tunnel
Zone18 - Galerie

Vue d'alarmes | Historique | Courbes | Actions | Mode de fonctionnement | Vue technique



2nd feature not generally implemented : CSAM system identifies specific alarms, the location of which can be shown on the system display, but detector locations have only been implemented for point 18.

This information would facilitate the arrival of the team to an incident. Including this information is a large task, requiring resources currently not available.

The system is also capable of storing specific information on a room or building (specific risk or consigne), which the pompiers would appreciate, but no resources are available for this either.

Automatic Fire Detection

Installed fire detectors are sensitive to radiation. The detector heads for the tunnel are located in REs to avoid damage, but they are sampling air from the tunnel through piping. The annual test results are recorded.

The Pompiers react to all Fire alarms although these are mostly unexplained fire alarms (over 300/year). Since more occur in shutdown time than operation, they are probably linked to human activities.

There is no automatic trigger of an evacuation in the case of a fire alarm in the tunnel; this is manually activated by the pompiers after on site investigation or by any person present on site.

All Fire detectors are tested every year.

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.

ODH detection

ODH detection is installed throughout the LHC tunnel.
A single ODH detection raises a level 3 alarm, two adjacent heads in alarm will also trigger an evacuation in the zone and some adjacent zones (matrix)

The evacuation trigger matrix is not completely finalised, and so remains to be fully implemented.

A recent review by Gunnar Lindell (EDMS 778170) identifies some limited underground areas where ODH risk exists but there are no ODH detectors installed: some are 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.

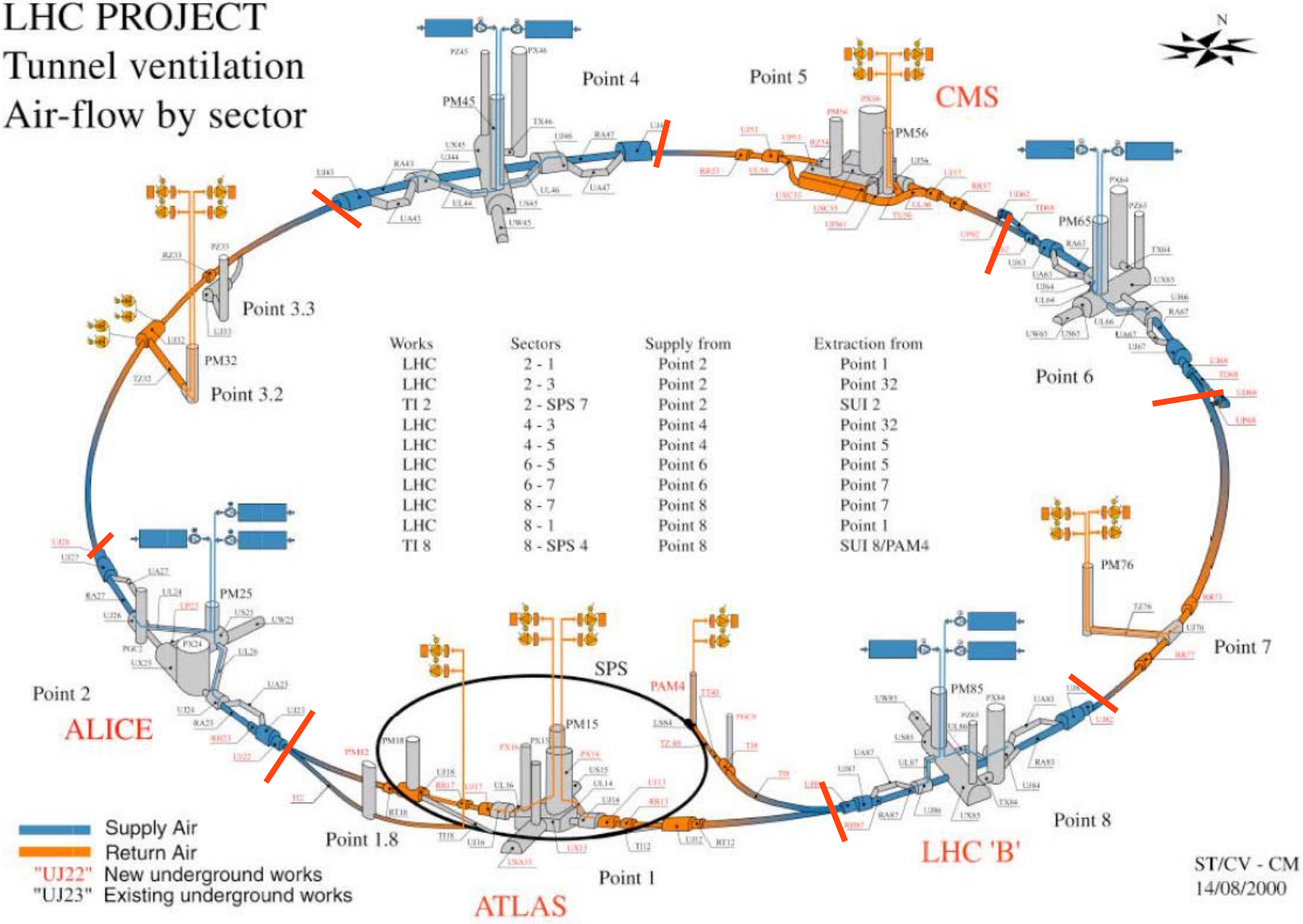
Helium loss

The experience of the sector 3-4 incident showed that the ventilation sectorisation of the LHC is critical in the case of helium loss.
In the worst of cases it would need to contain pressure waves in defined channels allowing work in areas close to powering tests.
This could be implemented by a containment wall that will allow the ventilation in one direction but stop the helium wave in the other, forcing the helium to be flushed out by the ventilation.

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.

This question and others are being reviewed by the taskforce on accessibility of the LHC following the sector 3-4 incident…

LHC PROJECT
Tunnel ventilation
Air-flow by sector



Works	Sectors	Supply from	Extraction from
LHC	2 - 1	Point 2	Point 1
LHC	2 - 3	Point 2	Point 32
TI 2	2 - SPS 7	Point 2	SUI 2
LHC	4 - 3	Point 4	Point 32
LHC	4 - 5	Point 4	Point 5
LHC	6 - 5	Point 6	Point 5
LHC	6 - 7	Point 6	Point 7
LHC	8 - 7	Point 8	Point 7
LHC	8 - 1	Point 8	Point 1
TI 8	8 - SPS 4	Point 8	SUI 8/PAM4

Safety Information Panels

Shutdown mode: machine is sectorised and different hazards will exist in different sectors and change on daily basis. This information is coordinated and transmitted by e-mail, but not displayed at the pit-heads 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; but they were never delivered.

Safety information panels would make it possible to inform users of any local alarms, the status of adjoining sectors etc. (cryo conditions, transport restrictions, power testing plans, the need to evacuate an area at a certain time, x-ray tests…) These panels would complement the access control system which only interlocks for beam safety.

Conclusions:

Overall, the required LHC safety systems are in place and perform well, despite some shortcomings.

The very few missing ODH detectors are to be installed.

CSAM single failure points will be eliminated with the introduction of the new network.

The “CSAM - test mode” should be used as soon as possible.

The taskforce results might entail more actions on safety and safety related systems.