Safety Detection Systems inside the LHC Experiments

Rui Nunes
ST-AA-AS
Presentation Organization

– Overall ST Picture
– Detection Systems
  • Overview
  • Fire, Gas & Evacuation in LEP
  • Projects for LHC
– Detection, CSAM & Safety Actions
– Time
  – 25~30 min presentation
  – Questions at the end please
Overall ST Picture (1/2)

- **ST-AA-AS Mandate**
  - Design, procure, install & maintain all Evacuation systems, Fire, Flammable Gas and Oxygen deficiency detection systems in all CERN Sites

- **ST-AA Responsibility**
  - Includes Transmission of Safety Alarms (AL3) to the Fire Brigade

- **What about ST-MO and CSAM ??**
Overall ST Picture (2/2)

- ST Division strategy
  - CSAM is a close collaboration between ST-AA & ST-MO
    - ST-MO was "contracted", due to their expertise to specify, design, install and commission a Safety Alarm Monitoring system
    - ST-MO provides the "tool" for ST-AA
    - CSAM will be integrated in ST-AA in the future
Detection Systems

What are they?

- WGAL3S defined them as the AL3S

- Listed in TIS IS37
  - smoke (fire) detectors
  - flammable gas detectors
  - oxygen concentration detectors
  - local evacuation signals
  - general emergency stop
  - flooding detectors
  - blocked lift
  - red telephones (will disappear?)
  - "deadman" devices

ST-AA
ST-AA
ST-AA
ST-AA
ST-EL
ST-CV
ST-HM
IT/CS
users
Detection Systems

– Detectors
– May be of many types and technologies
  • Fire detectors
    • Point smoke detectors (optical, ionisation)
    • Flame detectors (IR, UV)
    • Thermal detectors
    • Multi-point detectors (air sampling, sensitive cable, Optical, Laser, diffraction, etc..)
    • Linear detectors (IR, optical fibre, etc.)
  • Gas detectors
    • Flammable Gas (catalytic, IR, electrochemical, etc..)
    • Oxygen detectors (semiconductor, electrochemical, paramagnetic, etc..)
Detection Systems

Example of a Point Gas Detector
Detection Systems

- Detectors are connected to Control and Indicating Equipment (CIE)
  - The CIE is responsible for
    - Analysis of the signals
    - Interface with Alarm transmission network
    - Simple safety/warning actions
    - Maintenance interface
    - Etc...
Fire, Gas & Evacuation in LEP

Surface & Underground
- Generalised Fire Detection
- Flammable Gas detection in BGs and Gas mixing areas
- No Oxygen Deficiency detection
- Evacuation system
  - General Evacuation
  - BIW - Beam Imminent Warning
  - Alarm Transmission via GSS and hardwired
Safety Actions in LEP

- Not Always Homogeneous
  - Some direct safety actions (only on surface)
  - Some Actions via GSS (always via GSS in underground, sometimes on the surface)

- What kind of actions were performed?
  - Flashing panels and sirens
  - Ventilation (Cut or High Speed)
  - Electrical Cuts
  - Gas Valve Cuts
Projects for LHC Experiments

- Detection in the surface buildings
- Detection in the Underground
  - Experimental Caverns
  - Technical Caverns
- Evacuation for the Underground
- The SNIFFER Project
  - Inside the experimental apparatus
Projects for LHC Experiments

- Projects under the guidance of TIS
  - Respecting Relevant Codes and Instructions
- In close collaboration with the users (GLIMOS / DSO / FGSO / CSO / TSO)
- To determine User Requirements
  - LHC Safety Co-ordination (TIS)
  - ATLAS - FAGIA
  - CMS AL3 Task Force
LHC Surface Sites Strategy

- CERN Sites Divided into Safety Zones
  - 1 Fire Control Panel / Zone
  - 1 Gas Control Panel / Zone
LHC Surface Sites

– Systematic Re-evaluation due to:
  • Possible change of use of buildings
  • New buildings
– Gradual Replacement of Fire & Gas Detection
– New O$_2$ deficiency detection
– Summary of TIS & User Requirements published
  • CERN-TIS-GS/TM/2000-04
Generalised Detection systems

- User Requirements Gathering phase
  - ATLAS
    - the most advanced (FAGIA, GLIMOS)
    - but incomplete
  - CMS
    - Some information available,
    - very incomplete
  - ALICE, LHCb
    - No info available
Evacuation system

– Separate Safety Equipment from detection
  • Consisting of
    – Manual Call Points (break glass type)
    – Sirens or Public Address (to be defined by Experiments)
    – Control and Indicating Equipment (CIE)
  • Functions (to be confirmed by Experiments)
    – General Evacuation
    – Beam Imminent Warning
The SNIFFER Project

- For the protection of
  - People
  - Property

- Early Detection of
  - Fire
  - Flammable Gas Leak
  - Oxygen Deficiency

- INSIDE Experimental Apparatus
The SNIFFER Project

- Prototyping needed
  - to validate physical principle
  - to assure performances
  - to define best architecture

- Status report
  - Prototyping phase started
  - Expected Completion early next year
  - Invitation to Tender will go out during 2002
CSAM Functional Diagram

(Already Presented by L. Scibile)

Central Alarm Display

Supervision

Local Alarm Display

Safety Actions

Safety Alarm Detection Interface

Redundant Transmission System

Safety Alarm Transmission

Safety & Technical Alarm Transmission

Human Computer Interface

Event Logging System

Data Exchange Protocol

Reference Database (Configuration)

Technical Data Interface
Detection Safety Actions

- What are the capabilities for Safety Actions?
  - Few Hardwired contacts only (one per zone)

- Simple safety actions
  - General Electrical cuts, ventilation, and gas valves
  - Only a few simple actions are reasonably possible

- Complex Shutdown Operations
  - Impossible
Safety Actions

- Functional point of view
  - Three different functions can be identified:
    - Detection
    - Transmission
    - Safety Actions “Mise en sécurité”
      - Requires specific knowledge of the Experiment
  - There should be one “entity” for each of these functions
Summary (1/2)

- Overall ST Picture
  - ST-AA responsible for the whole chain
  - ST-MO provides the “tool” CSAM

- Detection Systems
  - User Requirements needed for
    - generalised detection in the LHC Experiments
    - evacuation system
    - SNIFFER Project
  - ST-AA-AS shall provide the equipment according to user requirements and approved by TIS, CSAM shall transmit to the Fire Brigade and XCR
– Safety Actions

• Technically
  – Only very simple safety actions can be performed by the detection equipment

• Practically
  – For reasons such as:
    • simplicity (the simpler the better)
    • shutdown operations
    • treatment of other signals than AL3

⇒ Safety Actions should be done by an entity with overall view and control of the experiment
Thank You for your Attention

For more info
Rui.Nunes@cern.ch