Safety aspects of the underground structures of the ILC Project

Legal framework, procedures and fire safety aspects of ILC

Fabio Corsanego
CERN Safety Commission

Fabio.Corsanego@cern.ch

ILC layout can be strongly influenced by evacuation and fire safety aspects.

This presentation is therefore mainly aimed to this specific issue.

Summary

- Existing Guidance at European Level
- French and Swiss Legislation
- Notes on few aspects for fire safety
- Design Guidance documents

Existing Guidance at European Level

European Community position on fire safety:

(Reference: Answer to Written Question No. 854/98 by Lyndon HARRISON to the Commission. Responsibility for fire- *Official Journal C 013, 18/01/1999 P. 0010*

“Fire prevention falls primarily within the competence of Member States. However, fire prevention and mitigation constitute a horizontal concern which is taken into account, wherever possible, in the different **Community policies and measures in order to complement and assist the efforts undertaken at the level of Member States**.”

“Fire prevention in the productive sphere is ensured from both the perspective of **protection of workers in the work place** and from the perspective of safety of **fixed installations** and of **particularly risky activities** or substances.

Example: Council Directive 82/501/EEC of 24 June 1982 on the major-accident hazards of certain industrial activities(6) (the Seveso Directive)

“The Community’s competence concerning the regulatory aspects in construction is limited to the **Internal Market** aspects of construction products, while the **building regulations, including safety levels, remain a national matter. “**

Example: Council Directive 89/106 on Construction Products

Existing Guidance at European Level

In the absence of a common European Regulation on safety in case of fire, the reference documents are the European Directives, their juridical translation at national level, and the National Legislation of the potential Host State(s).

European Directives on:

- workplaces and safety of workers
- infrastructures, as transportation tunnels
- major industrial accidents hazard
- construction products (CE marking)
- others..

National Legislation in France and Switzerland

Complex regulation made of many different texts, so it would be impossible to mention it all.

Safety of workplaces and workers (internal consequences):

- Fire Safety Norms and Directives of the Swiss Insurance Agencies Association (Association des Etablissements cantonaux d'assurance incendie)
- French Labor Code

Legislation on major industrial hazards (with potential external consequences):

- Installations classées pour la Protection de l'Environnement (F)
- Installations Nucléaires de Base (F)
- Ordonnance sur la protection contre les accidents majeurs OPAM (CH)

Legal Framework for CERN

Safety Policy document (SAPCO 42):

..CERN was founded as an Intergovernmental Organization.

(CERN is granted) authority and control over the whole of its site, with competence to issue rules as necessary for the exercise of its functions....

...Hence **CERN establishes its own safety policy and where necessary issues Safety regulations for its own staff and property,** independently of the Host States. However, only CERN personnel have international legal status and others on the site, such as contractors, are under the jurisdiction and control of the relevant Host State.

For its operation, the Organization bases its Safety regulations as far as possible on:

i) European and other international rules and standards,

ii) the rules in force in the Host States.

Safety authorization framework

If built in the French–Swiss area, a large project like ILC would probably be object of several different studies, plans and authorizations involving ILC Representatives, CERN and the Host States.

Design guidance for underground spaces

Documents dealing with evacuation and fire safety underground in different contexts can offer a valuable guidance to assess fire safety for ILC.

- *Directive 2004/54/EC of the European Parliament and of the Council on minimum safety requirements for tunnels in the Trans-European Road Network*
- *Comparative National Legislation in Europe on tunnels: Fire in Tunnel Association: (Report WP3 on Road Tunnels) at http://www.etnfit.net/*
- *NFPA 520-Subterranean spaces*
- *Règles fondamentales des sûreté relatifs aux INB autre que les réacteurs:RFS-I.4.a Protection contre l'incendie (28 février 1985*)

Notes on few aspects of fire safety

- Combustible Materials
- Evacuation
- Smoke control
- Emergency Intervention

Control of origin and initial spread of fire:

- Limit combustibles underground:
  - Solid (keep equipment on surface)
  - Liquid (combustible dielectric fluids, etc)
  - Gases (store and mix below explosion point on surface)
- Reduce Ignition probability:
  - Certified Equipment
  - Good reserve of cooling power to have low temperature equipment working pt. (reduce fault incidence)
  - Ampacity for massive cable runs
  - Fire retardant cables, printed circuit boards, shielding polymers
  - Seal cables and equipment in closed trays

Escape Means

- At east two independent exit paths from all points:
  - blind corridors shorter than 10m
  - Attention to radioprotection issues vetoing one of the two ways at a later stages!

- Tunnel: access to a different fire compartment (isolated from heat and smoke) within 500m
  - Pressurized bypass for twin tunnel straight sections
  - Fire doors every 500m normally open for the Damping Ring (proposal)- smoke extraction issue still to define

Escape means

- Underground Halls: exit to pressurized smoke free path in 30m
  - attention to length increase due to additional paths on steel superstructures and to parts inside the detector, not defined at this stage
  - Internal part of detectors : allow reasonable means of access (means of access should cope with machinery standards)
- Stair, lifts, part of the corridors pressurized and free from smoke (once inside, as safe as already outside)
- Closed circuit Oxygen self rescue masks
  - Attention, this is a personal protection device
  - It comes third, after risk control at source and after collective means

Smoke Hazard Reduction

Reduce Smoke toxicity:

- Reduction of corrosive smoke by use of no-halogen materials

Smoke removal – In general:

- Remotely controlled dampers and doors for immediate closure of a sector on fire
- Consider problem of emission of activated smoke: smoke extraction from internal fire, and a fire attacking the outlet filter

Smoke Removal- Tunnels

- Prevent air/smoke diffusion velocity from being higher than walking speed
- Prevent firefight thermal accidents like flashover or backdraft
- Increase of air/speed on demand to allow access of fire team from at least one fresh side

Smoke Removal - Underground Halls

- Should be powerful enough to keep smoke layer well above the heads of the occupants for a time sufficient to self rescue
- Should endure to heat and be powerful enough to remove most of the heat, to allow tenability for equipped fire fighters

Fire Control Measures

- Compartments small enough to be managed by a reasonable number of firefighters
- Tunnel cross section large enough to allow circulation of electric rescue vehicles
- Firefight water line with flanges every 100-200m
- Hose reels and handheld extinguishers
- Fire detection linked to automatic switch off of equipment,
- Adequate means of fire suppression (water, gas, aerosol , foam, etc)
- Fire Brigade with deep knowledge of the site and of Radioprotection procedures
- Camera video systems for fire confirmation
- Emergency systems and communication network (telephone, fire brigade radio) protected from fire

Design tools for the fire safety project

- Guideline on fire safety project
- Performance based approach

Guidance for the fire safety project

How to collect and organize in a systematic way the relevant information and plans needed for plan approval?.

CFPA (Confederation of Fire Protection Association) “Guideline N.13-2006: Fire protection documentation” http://www.cfpa-e.org

Authorities having jurisdiction may require further documents, but the core set of documents needed to define or present a project is relatively constant across different countries.

Guidance for the fire safety project

How can we treat possible non conformities to specific prescriptive measures in National Regulations?

An option is: demonstrating through a an engineering analysis that a proposed design will meet specific safety goals.

Performance Based Design:

It is based on:

(1) establishing fire safety goals and objectives;

(2) deterministic and probabilistic analysis of fire scenarios and

(3) quantitative assessment of design alternatives against the fire safety goals and objectives. using accepted engineering tools, methodologies, and performance criteria.

Performance based design

It allows to solve problems like:

- How much time is available before the smoke of a fire in a large hall does not allow anymore to see the exits?
- Will this time be sufficient to evacuate n people?
- What could happen if the fire is just in front of one exit?

Guidance for the fire safety project

Many Standards already exist for Performance Based Design. Examples:

- ISO/TS 16732:2005Fire Safety Engineering -- Guidance on fire risk assessment
- ISO/TS 16733:2006Fire safety engineering -- Selection of design fire scenarios and design fires
- ISO/TR 13387 Part 1 to Part 8: Fire safety engineering.

- ISO 13571:2007Life-threatening components of fire -- Guidelines for the estimation of time available for escape using fire data
- ISO 16734:2006Fire safety engineering -- Requirements governing algebraic equations -- Fire plumes

- NFPA 101A Guide on Alternative Approaches to Life Safety
- NFPA 550 Guide to the Fire Safety Concepts Tree
- NFPA 551 Guide for the Evaluation of Fire Risk Assessments
- NFPA 555 Guide on Methods for Evaluating Potential for Room Flashover
- SFPE Engineering Guide to Performance Based Fire Protection
- ICC Performance Code™ for Buildings and Facilities

Fire Performance Based Evaluation requires:

- higher than usual integration of information on layout, ventilation scheme, operations, nature and quantities of combustibles
- low level of uncertainty in these initial data
- qualified professionals (chartered fire engineers or equivalent), as, for being a powerful tool, it is potentially misleading if misused
- a relevant amount of manpower, in order to set many different case scenarios, and follow the constant modification of the design

Fire Performance Based Evaluation offers:

- Groups working on different issues are led to share information earlier
- Conflicts between functions emerge earlier, at a time when solutions are still possible
- A certain, measurable, freedom of design
- Cost savings
- Negotiation with Authorities Having Jurisdiction becomes easier, as backed by universally accepted engineering methods