Until 2018, the limited firefighting means in the SPS complex left it vulnerable to the consequences of self-ignition or accidental fire. In 2015 the SPS Fire Safety project was launched with the aim of improving personal safety and protecting property by deploying a whole set of automatic actions in the SPS in case of fire outbreak. Had nothing been done, an unmanaged fire could have threatened the lives of those working underground and could have meant losing a large part of the SPS machine and its equipment. In 2020, CERN completed the consolidation of its SPS fire safety systems. Among these, a water-based sprinkler system, following principles of standard industrial design but customized and tailor-made for SPS and its irradiated areas, is ready to operate. The system needed to take into account limitations related to the presence of fragile accelerator equipment, radioactive zones, integration constraints and comply with European norms, in particular EN12845. This paper presents the risk assessment, the selected technical solution, our experience from the planning and installation phase while discussing the custom-chosen and radiation tested equipment to conclude with the lessons learned and outlook for the future.
SPS Complex

Super Proton Synchrotron (SPS)

Second largest accelerator at CERN
Operational since 1976
Located in average 40m below the ground
Composed of the main ring tunnel, the transfer tunnels to PS and the LHC machines as well as several experimental areas.
### Risk Assessment

**Existing fire safety systems**
- Extinguishing system (sprinklers) in the shafts
- Fire detection system
- Push-button and alarm system
- Evacuation sirens

**Potentially combustible material**
- Cable insulation dating to 70’s
- Magnet coil insulation
- Electric trolleys batteries
- Material introduced during intervention or construction works

**Potential source of fire**
- Faulty electrical equipment including faulty connections
- Hot works such as welding, grinding, brazing (in access mode)
- Bake out equipment
- Electric trolleys, batteries and associated charging equipment
- Intentional malicious action
High fuel load
Lack of compartmentalization
Evacuation routes exposed to smoke
Very long evacuation routes
Aging fire detection and sprinkler systems
Limited coverage of the sprinkler system
Activated smoke
Limited firefighting means
Extremely long engagement distance for firefighters
SPS Fire Safety Work Packages

WP1 Fire Compartmentalization
- Fire doors in the shafts, TAs and SPS ring

WP2 Integrated Fire Safety Action System
- Fire detection, alarms, evacuation messages, fire doors

WP3 Dry Risers and dedicated fire service vehicles
- Dry riser system

WP4 Fire Sprinkler Protection System
- Sprinkler system in the Shafts extended to both level TAs and LSSs
- Rise pumps interlock
Design Challenges

**Materials and equipment constraints**
- **Radiation resistant** material, PTEF not authorized
- Black steel pipe; welded or threaded couplings
- System equipment (sprinklers, valves) irradiated from 50kGy up to 3MGy and tested according to ISO 6182-01:2014
  - Leak resistance and hydrostatic strength
  - Thirty-day leakage resistance
  - Dynamic heating
  - Operating temperature test

**Technical constraints**
- Study of **various extinguishing technologies**
- Design and installation according to EN12845
- Reversed configuration
- Quick response, high pressure sprinkler heads
- Customized maintenance procedures (radiation constraint)

**Integration constraints**
- Minimal 400mm distance from the machine and its equipment
- Minimal 200mm distance from cable trays
- Very limited space and lack of routing options
- Non obstructed sprinkler discharge path to be preserved
- Other system integration
Installation

ALARA Level 3 works and **optimization methods** for “hot zones”
- Dedicated tools
- Enlarged teams for workers replacement
- Special assembling methods and transport means
- Workshop in a safe place

Reduced accessibility & work at height
Machine protection for the pressure tests
Machine protection during welding
Tight LS2 schedule and co-activities
Protection during works: additional hose line, fire curtains
Next projects

**BA7 Consolidation**
- Shaft
- Transport tunnel
- TT60 Transport Area towards BA6

**North Area Consolidation**
- Underground
- Strategic technical buildings