CERN SPS SPRINKLER SYSTEM: A CUSTOMIZED INDUSTRIAL SOLUTION FOR A NON-CONVENTIONAL SITE

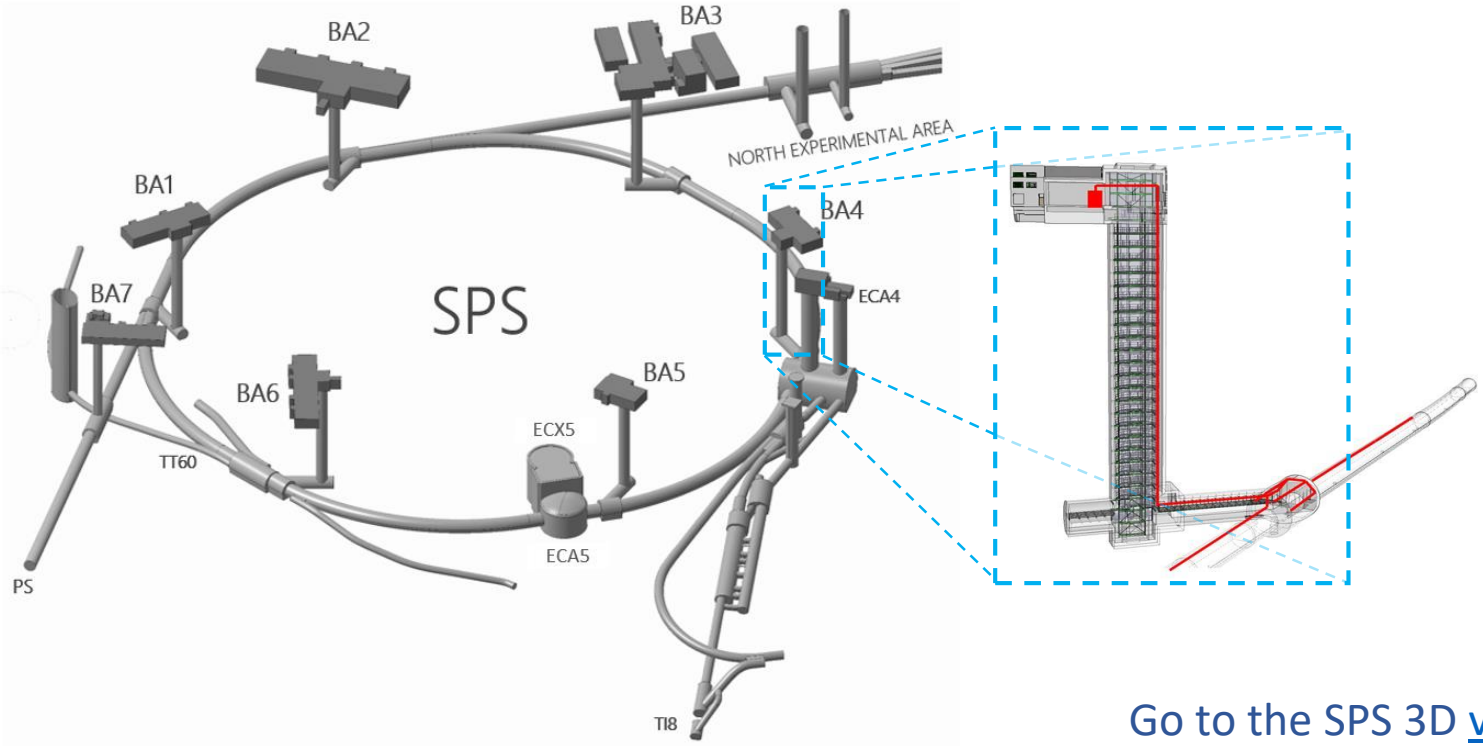
Until 2018, the limited firefighting means in the SPS complex left it vulnerable to the consequences of self-ignition or accidental fire. In 2015 the SPS Fire Safety project was launched with the aim of **improving personal safety** and **protecting property** by deploying a whole set of automatic actions 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.

A.Suwalska, A. Arnalich, F. Deperraz, M. Munoz Codoceo, P. Ninin CERN, Geneva, Switzerland

WEPAB283

SPS Complex

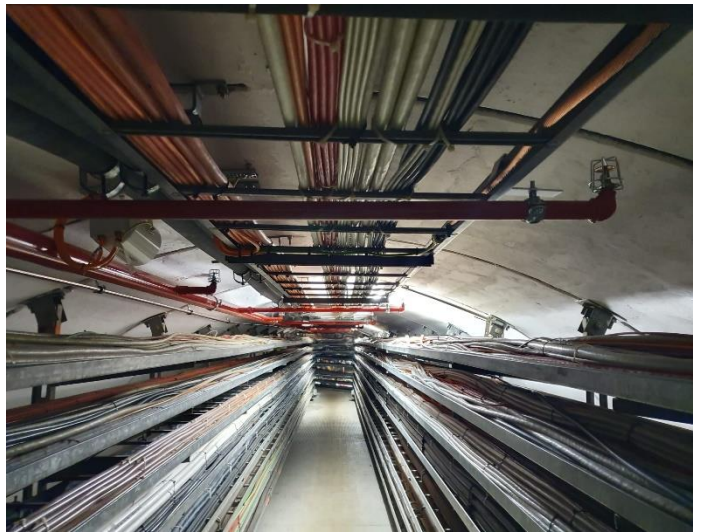
Super Proton Synchrotron (SPS)	Second largest accelerator at CERN Operational since 1976 Located in average 40m below the ground Composed of the main ring tunnel, the transfer tunnels to PS and the LHC machines as well as several experimental areas.



Go to the SPS 3D video

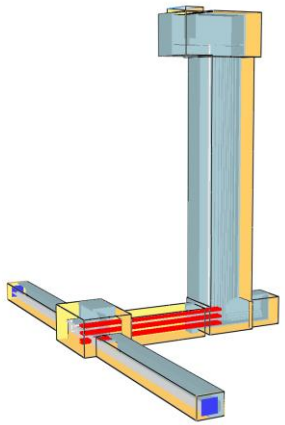
Risk Assessment

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 us welding, grinding, brazing (in access mode) Bake out equipment Electric trolleys, batteries and associated charging equipment Intentional malicious action



Highlighted safety issues

Safety constraints highlighted by the study	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



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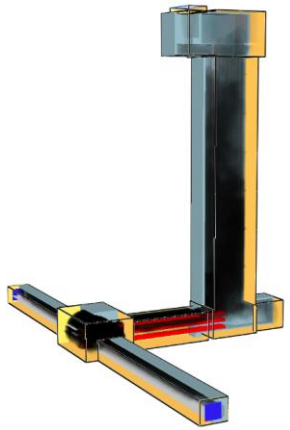

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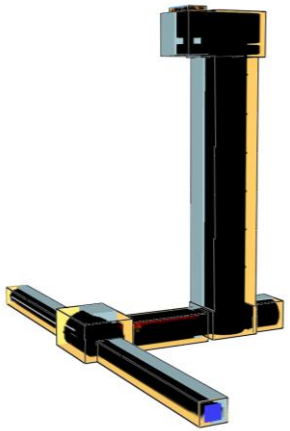

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SPS Fire Safety response

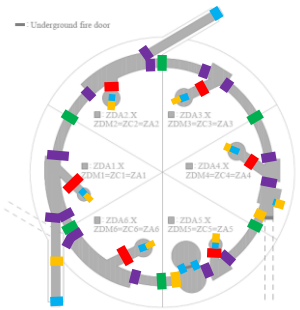
SPS Fire Safety Work Packages

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

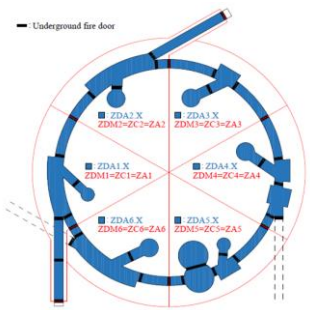
WP2 Integrated Fire Safety Action System
- Fire detection, alarms, evacuation messages, fire doors

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

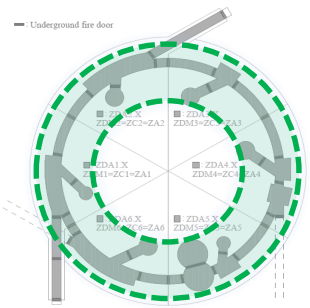
WP4 Fire Sprinkler Protection System
- Sprinkler system in the Shafts extended to both level TAs and LSSs
- Rise pumps interlock



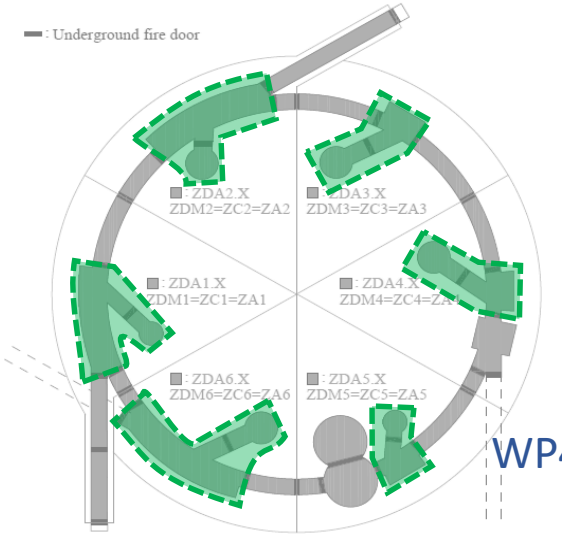
WP1



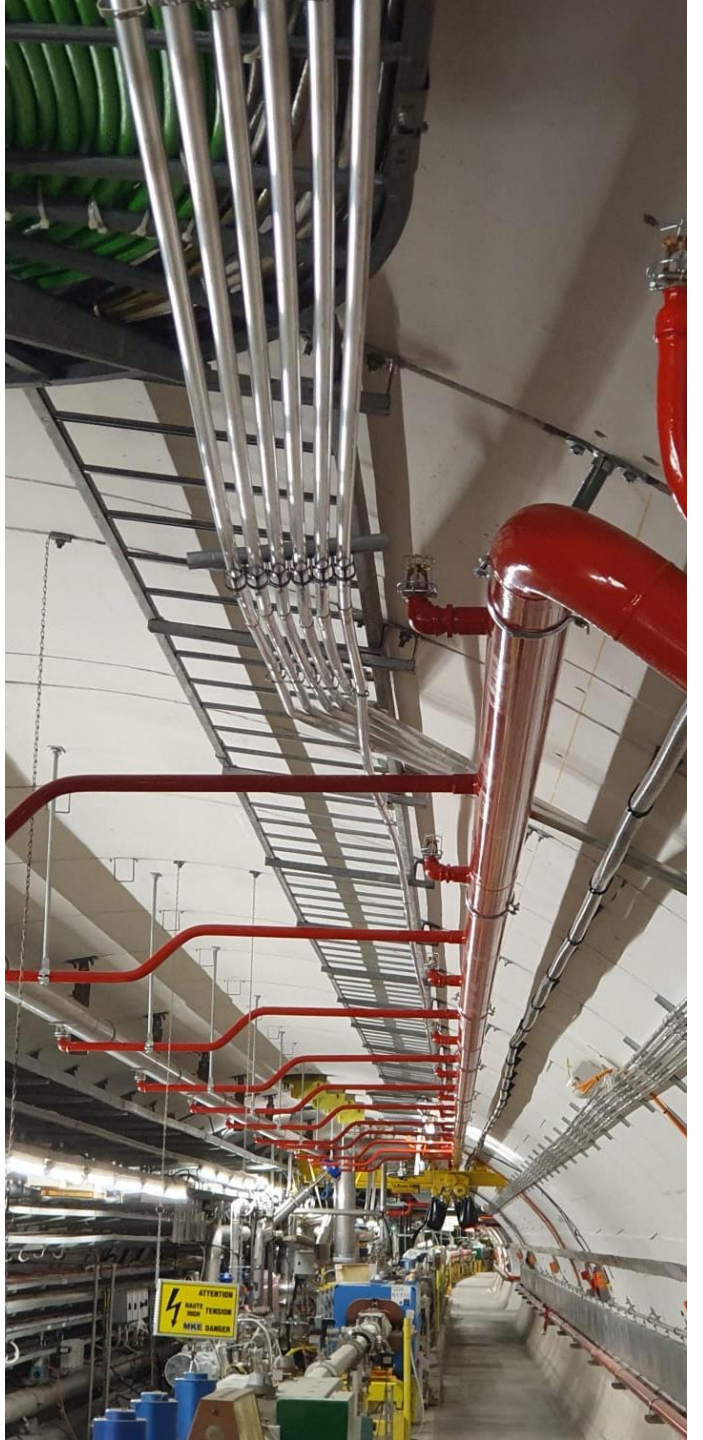
WP2



WP3

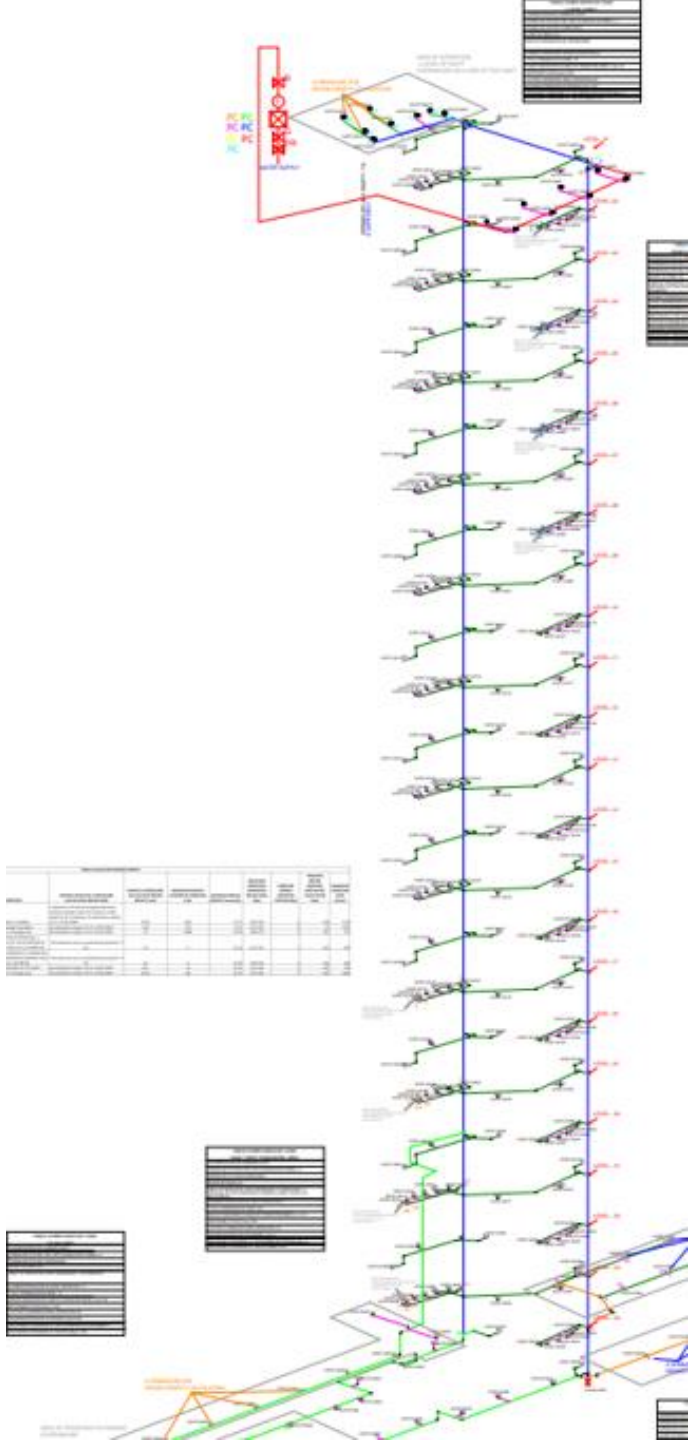


WP4



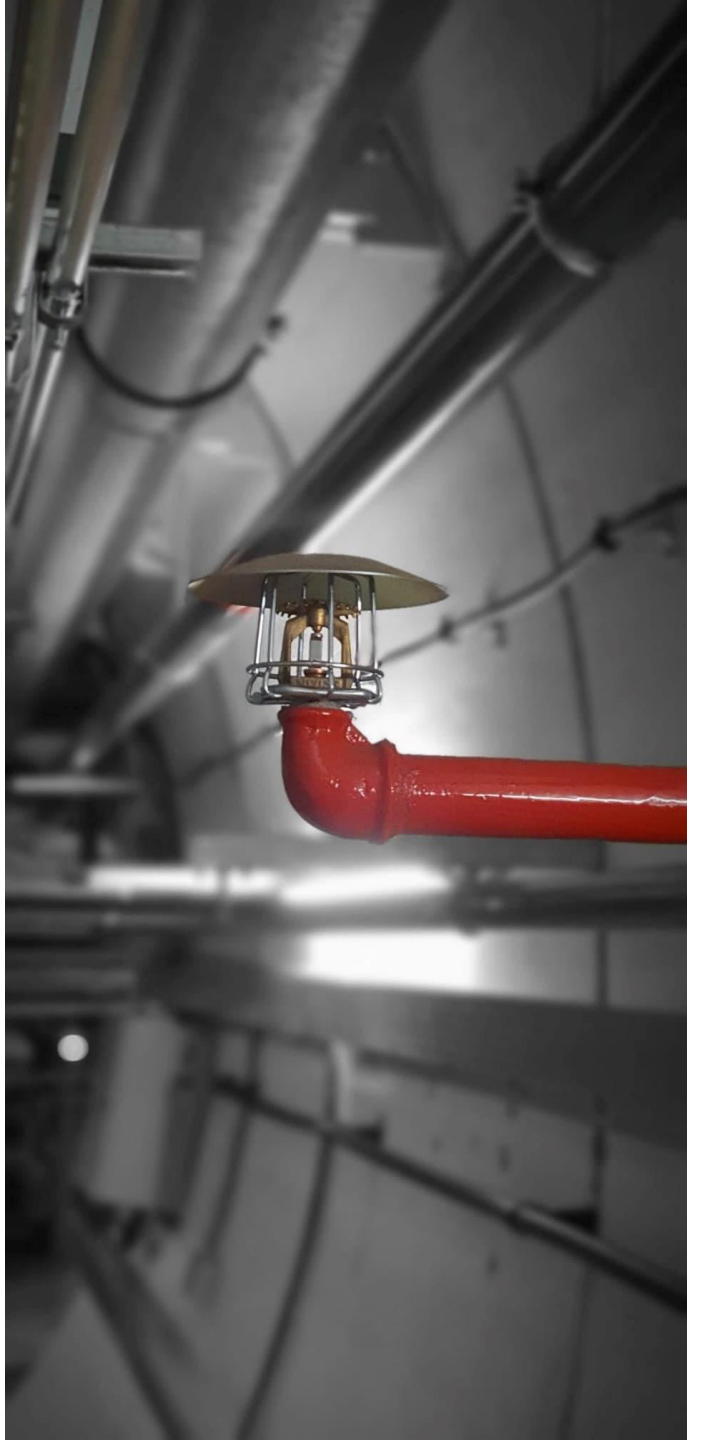
Design Challenges

Materials and equipment constraints	**Radiation resistant** material, PTEF not authorized Black steel pipe; welded or threated 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

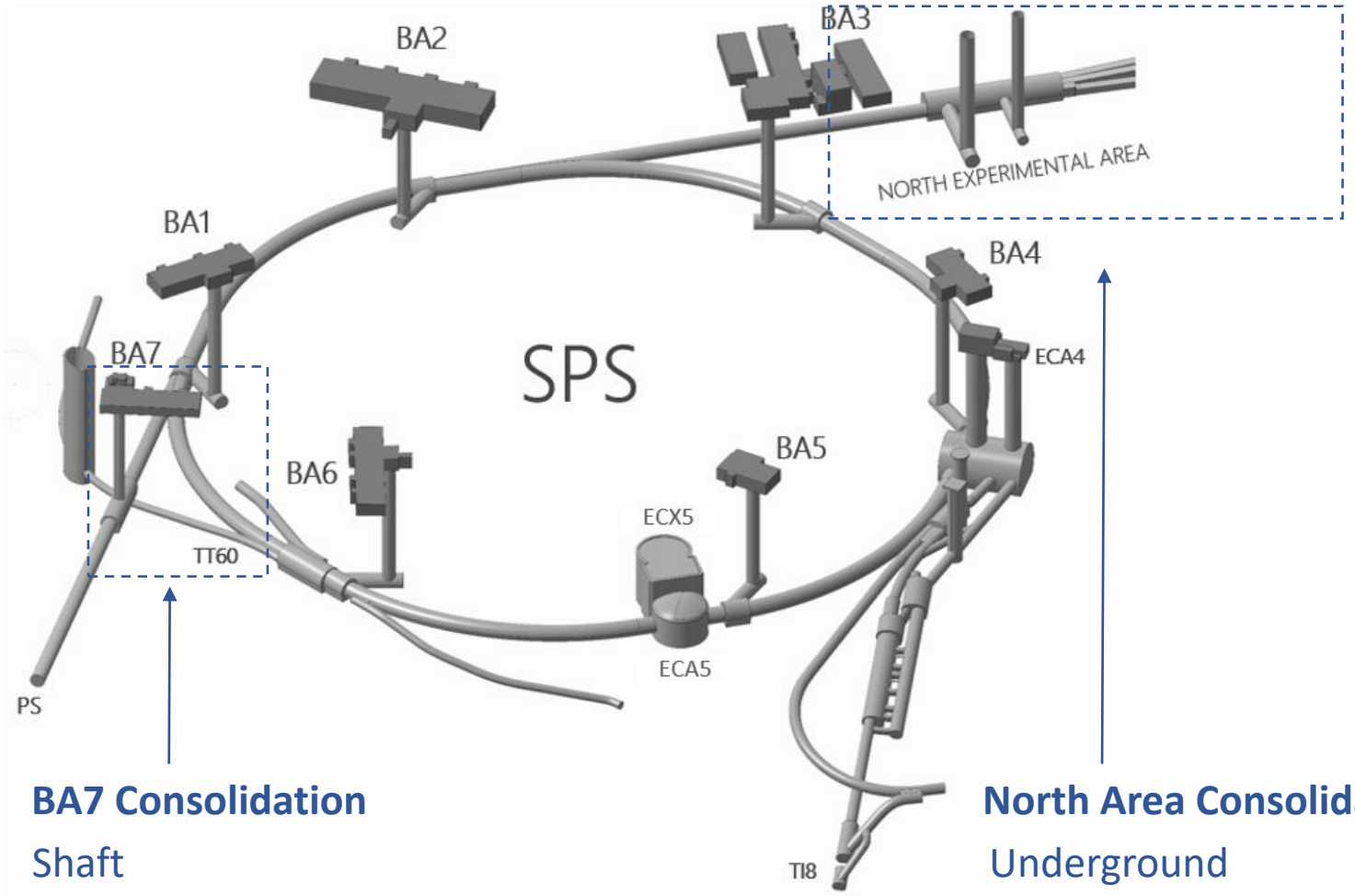


Installation

Installation challenges	
	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