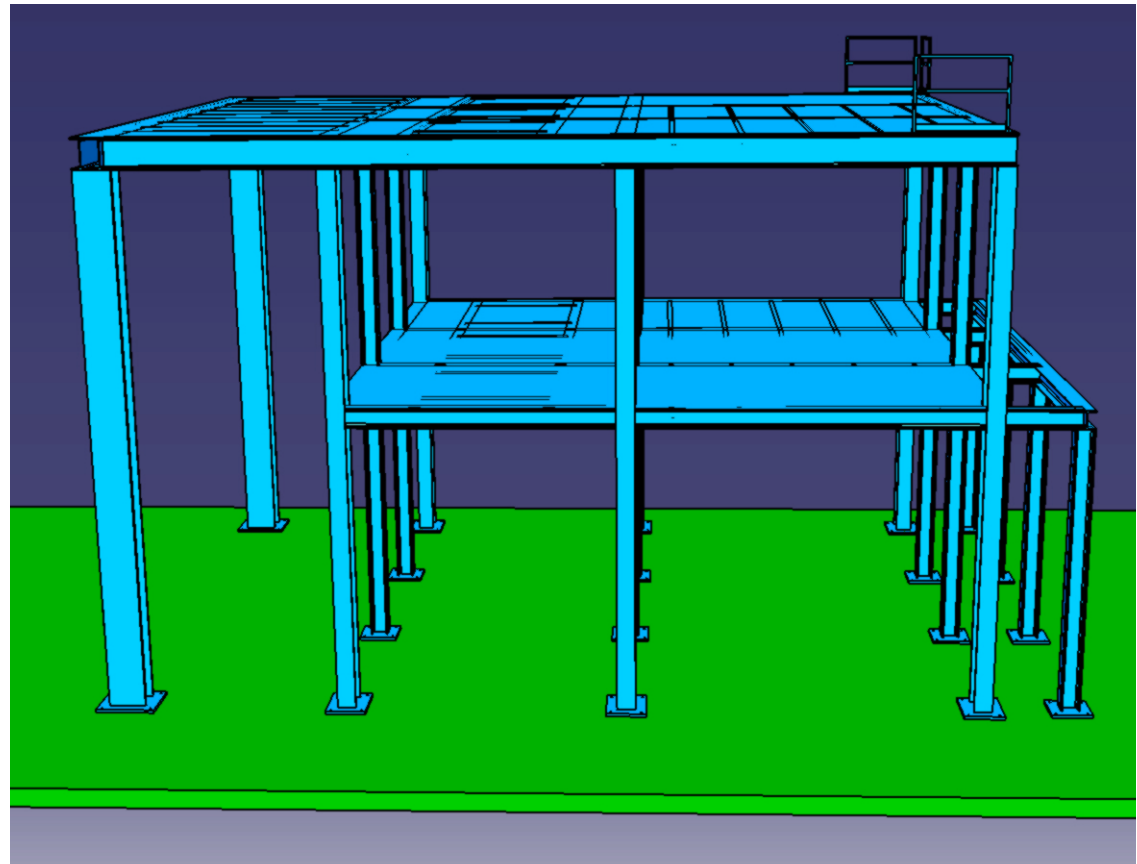
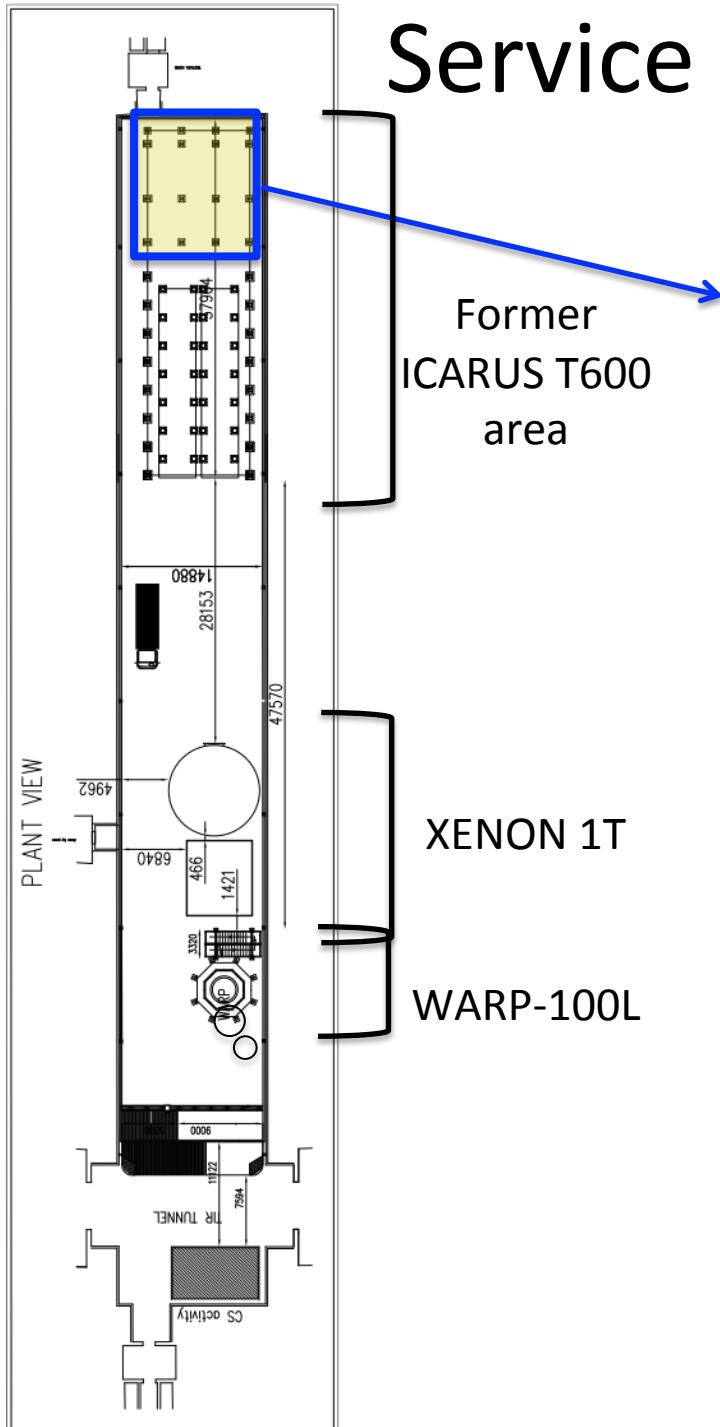


SABRE

Roma

Decemeber 10, 2015

Service Structure in Hall B



Part of the former "ICARUS service structure"

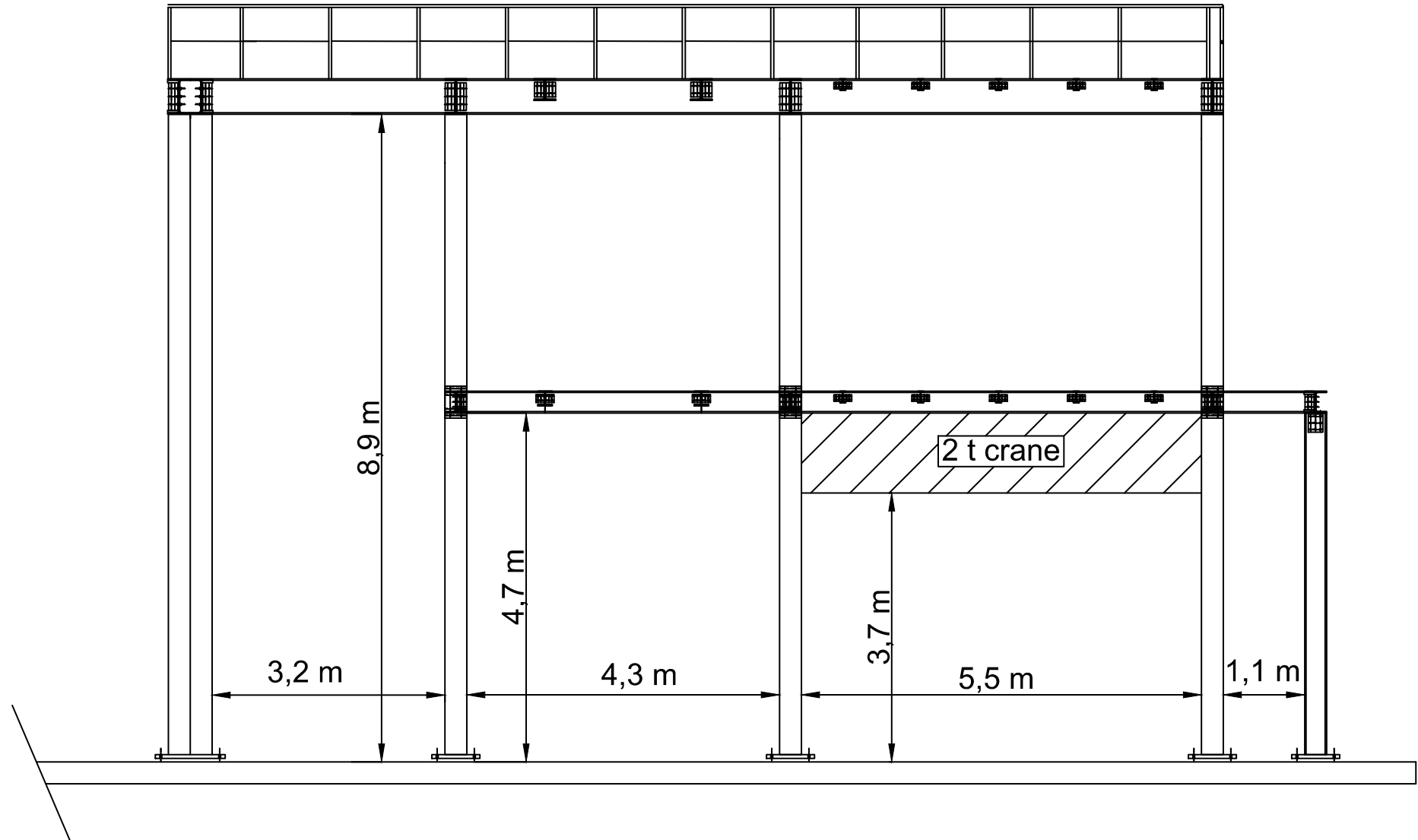
- 3 levels: floor, ≈ 5 m, ≈ 10 m + spiral stair
- Dedicated 2 t service crane

Exploiting the ICARUS utilities (to be maintained/ turned back into operation):

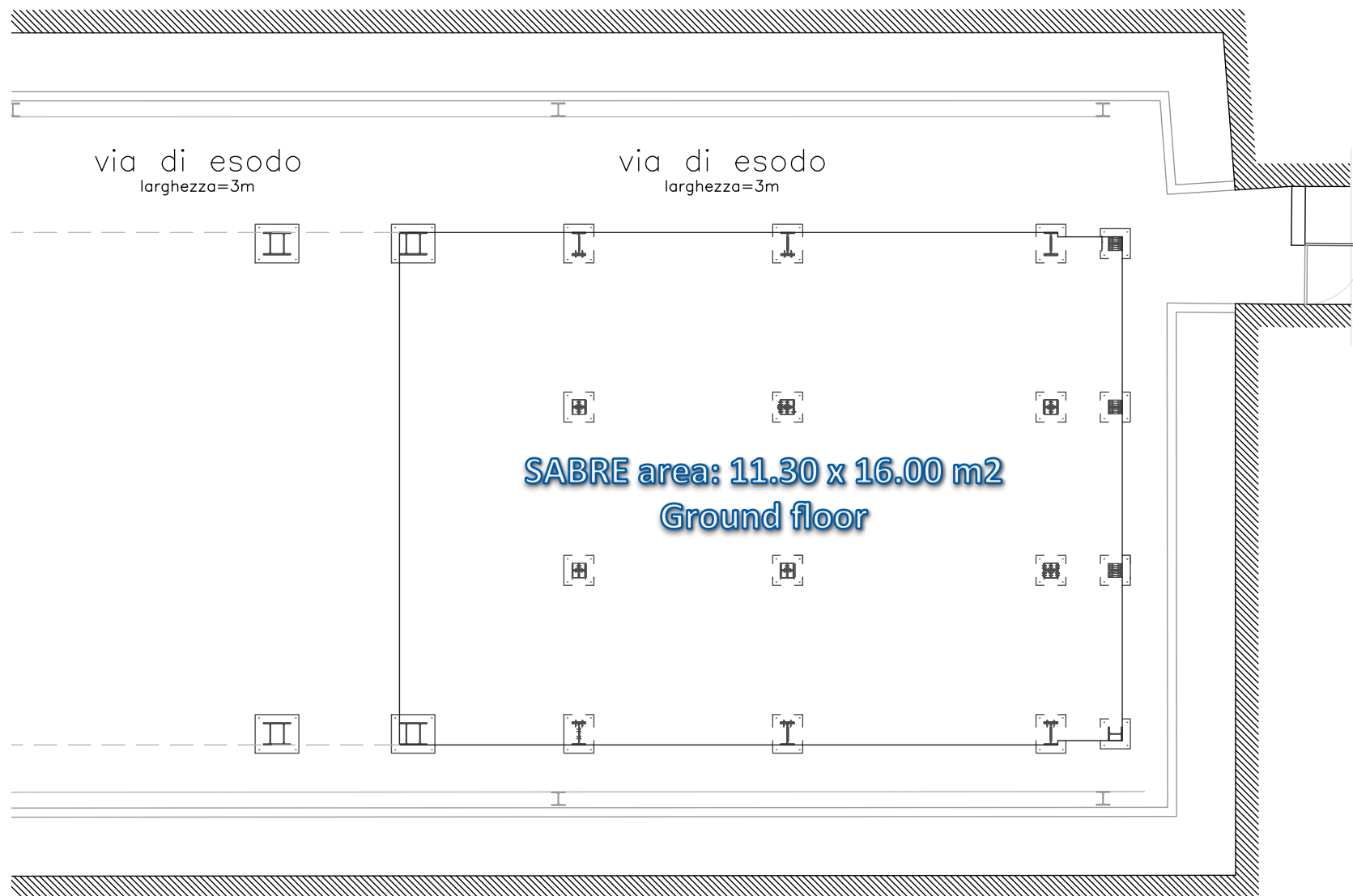
- electrical cabinets, power distribution lines, UPS lines
- Lights, water, compressed air, emergency air extraction system



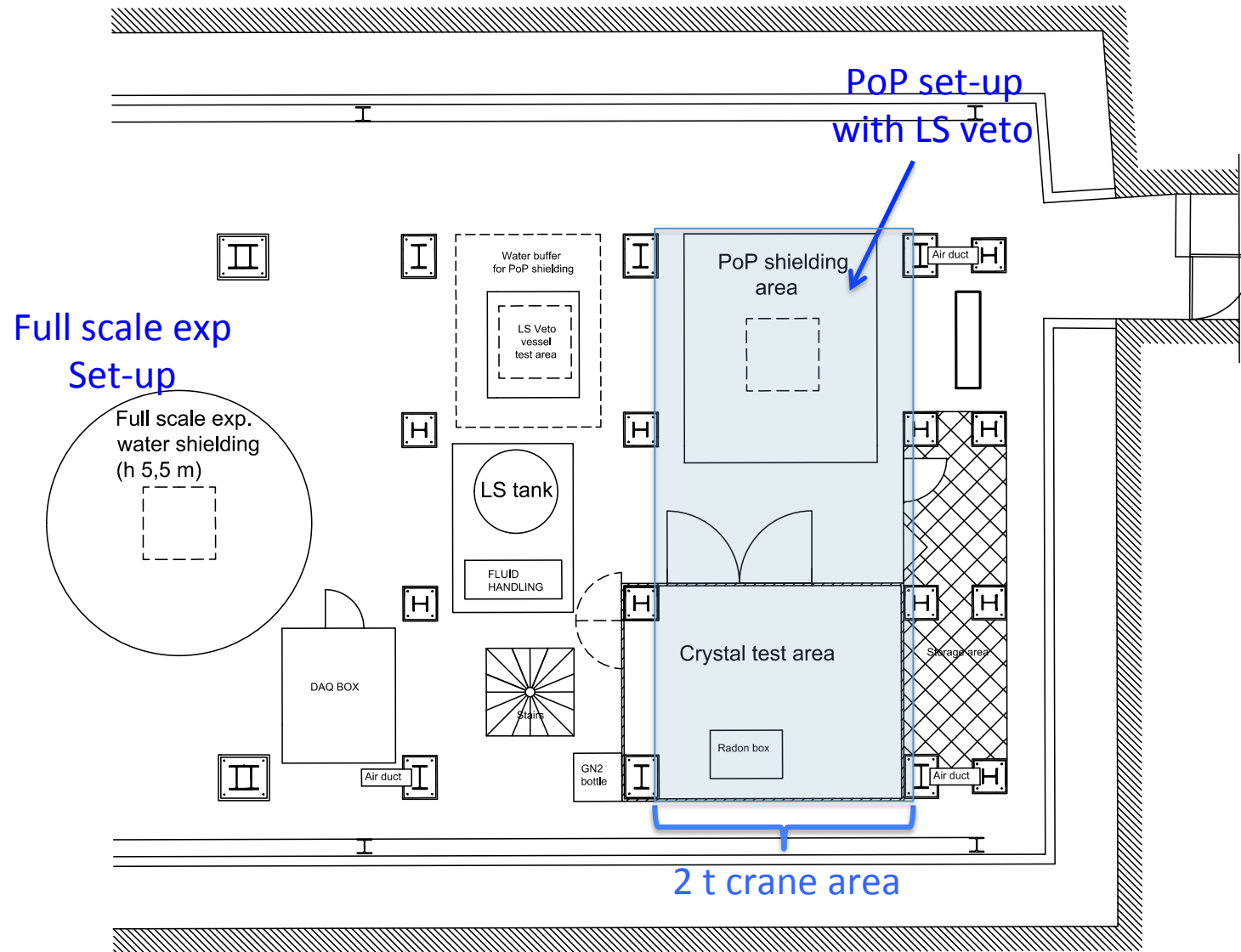
SABRE approved area: ground floor



SABRE approved area: ground floor



SABRE approved area



SABRE area: 11.30 x 16.00 m²

SABRE Active Veto



Vessel already delivered in Princeton:
1.3 m diameter 1.5 m length
Made out of low radioactivity steel

Liquid scintillator quantity:

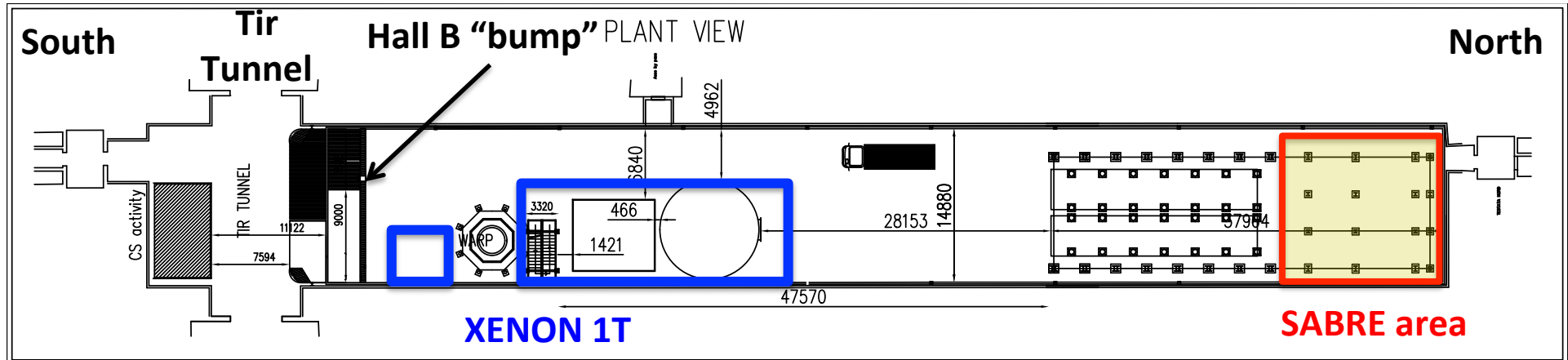
- Volume $\approx 2.25 \text{ m}^3$
- Weight $\approx 2 \text{ ton}$

Scintillator options (PPO to be added):

- 1,2,4 –Trimethylbenzene (PC)
 - Good scintillator performance
 - Known and high radio-purity level achievable
 - **Infrastructures/competences available @ LNGS**
- Linear Alkyl Benzene (LAB)
 - Interesting alternative to PC
 - Share JUNO Collaboration experience
- Different safety approaches for safety and environmental hazards (flammability, toxicity and disposal problems)
- **At the moment the choice is PC+PPO to exploit the present Borexino facilities and expertise**

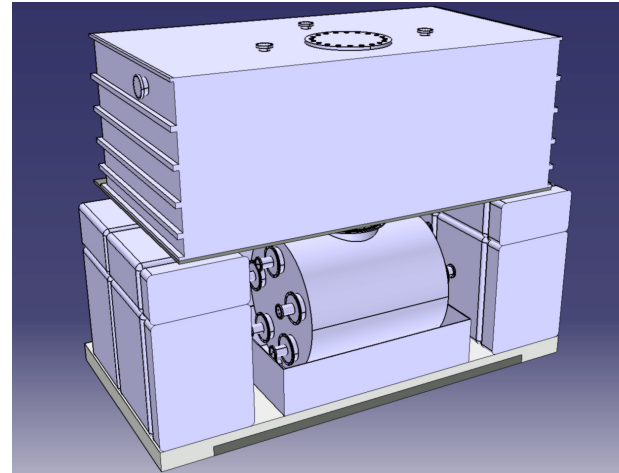
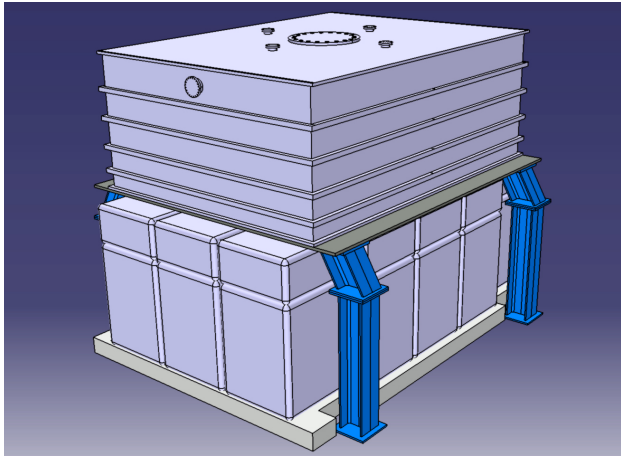
Preliminary Risk Assessment

Hall B: 125 m length x 15 m width x 18 m height (hemispherical)

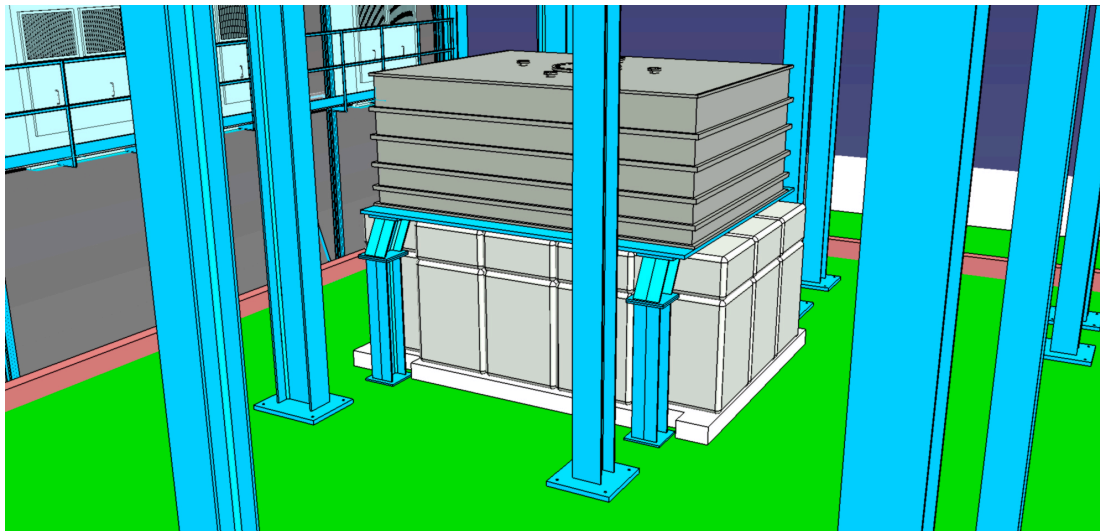


- Hall B protected with safety containment and liquid collection grid
 - Further collecting pool around and under SABRE installation + optional double containment will be installed
- Hall B air inlet from Southern side + aspiration from Northern Side
 - SABRE can be decoupled from the rest of the Hall B
 - ICARUS capillary emergency air extraction for heavy vapors and gas
- Fire extinguishing system can be specifically developed: Red Devil?
- No major interferences with other Hall B activities
 - ≈ 50 m distance from Xenon 1T (already assembled, cryogenic experiment)
 - WARP decommissioning

SABRE PoP hybrid shielding



Bottom: PE (10 cm) + Pb (15 cm)
Lateral walls + top: H₂O tanks (\approx 90 cm H₂O thickness)



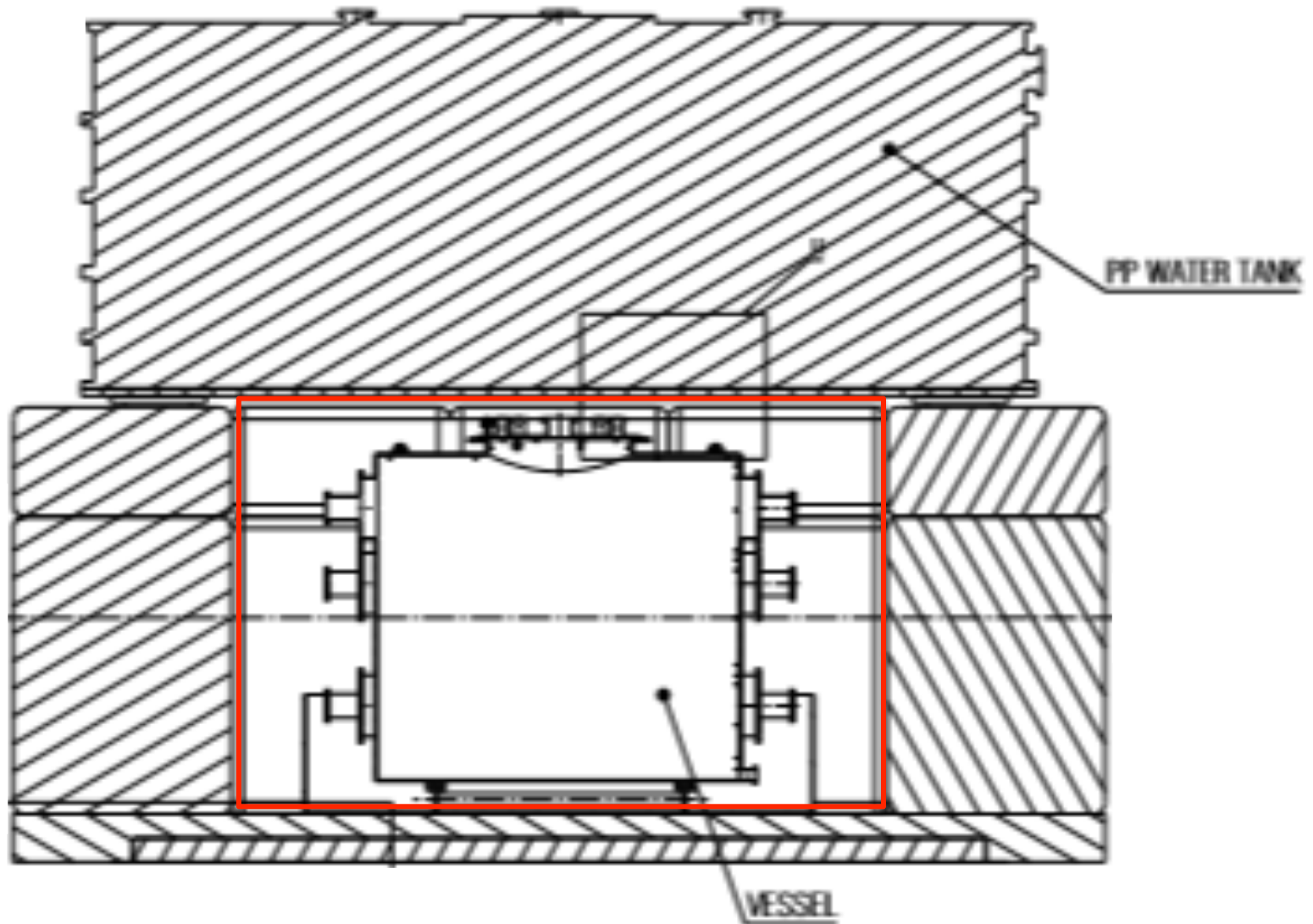
Shielding set-up
4571 mm x 2743 mm
H = 3520 mm

Lead
3571 mm x 2353 mm
H = 100 mm

Upper Steel plate
4000 mm x 3500 mm
H = 40 mm

Radon box
2742 mm x 1386 mm
H = 1702 mm

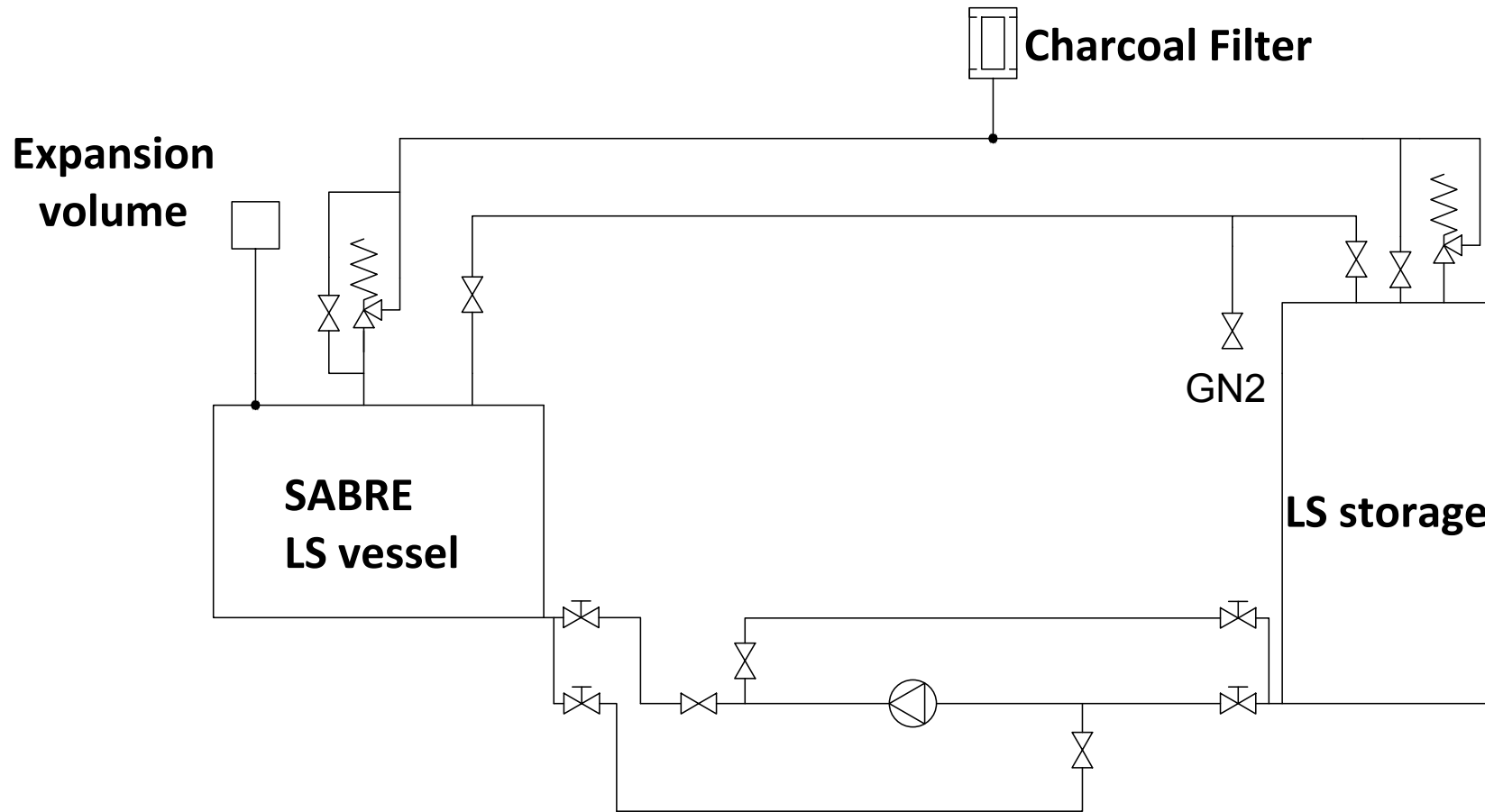
Radon box



Rn box

- GN2 fluxed
- “double containment for safety” (PC sensors, purge through a charcoal filter, ...)
- Catch basin (1/3 vessel volume is required)
- Sealing to access on the sides to PMTs and on top to the vessel upper flange

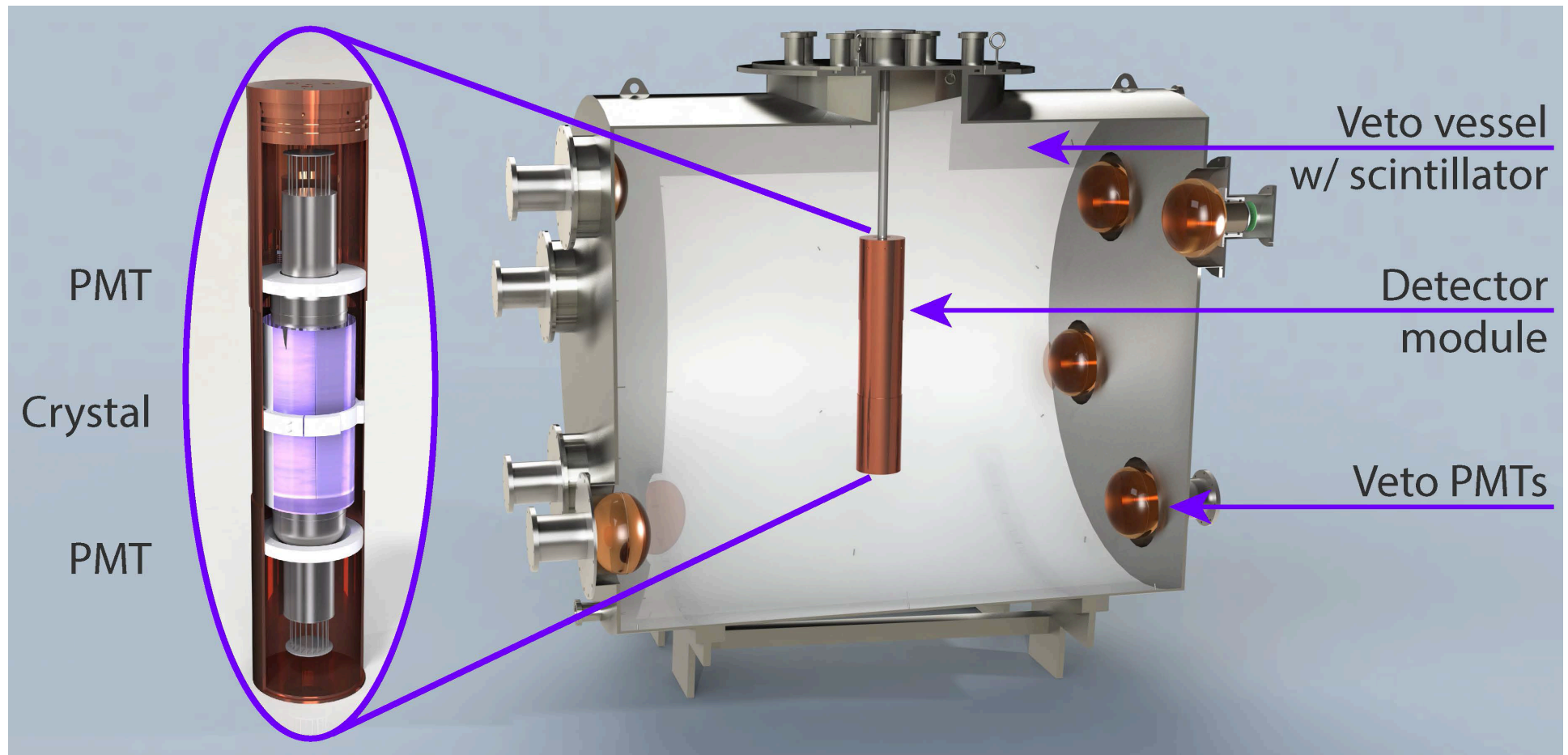
Fluid handling scheme



Aspetti tecnici per il sito

- Revisione/rimessa in servizio impianti ICARUS
- Sensoristica di sicurezza, controlli, allarmi, supervisione
- Prevenzione incendi
- Impianto acqua (riempimento/ svuotamento)
- Rifusione piombo
- Camera pulita ed impianti dedicati
- Revisione struttura servizi
- Circuito GN2
- Fluid handling (storage, purificazione, sicurezza)
- SRA, Hazop, procedure, coordinamento Sala B
- Aspetti ambientali
- Progettazione meccanica set-up completo
- Logistica, site management
- GLIMOS, RAE
- Infrastrutture di calcolo e rete

SABRE Detector

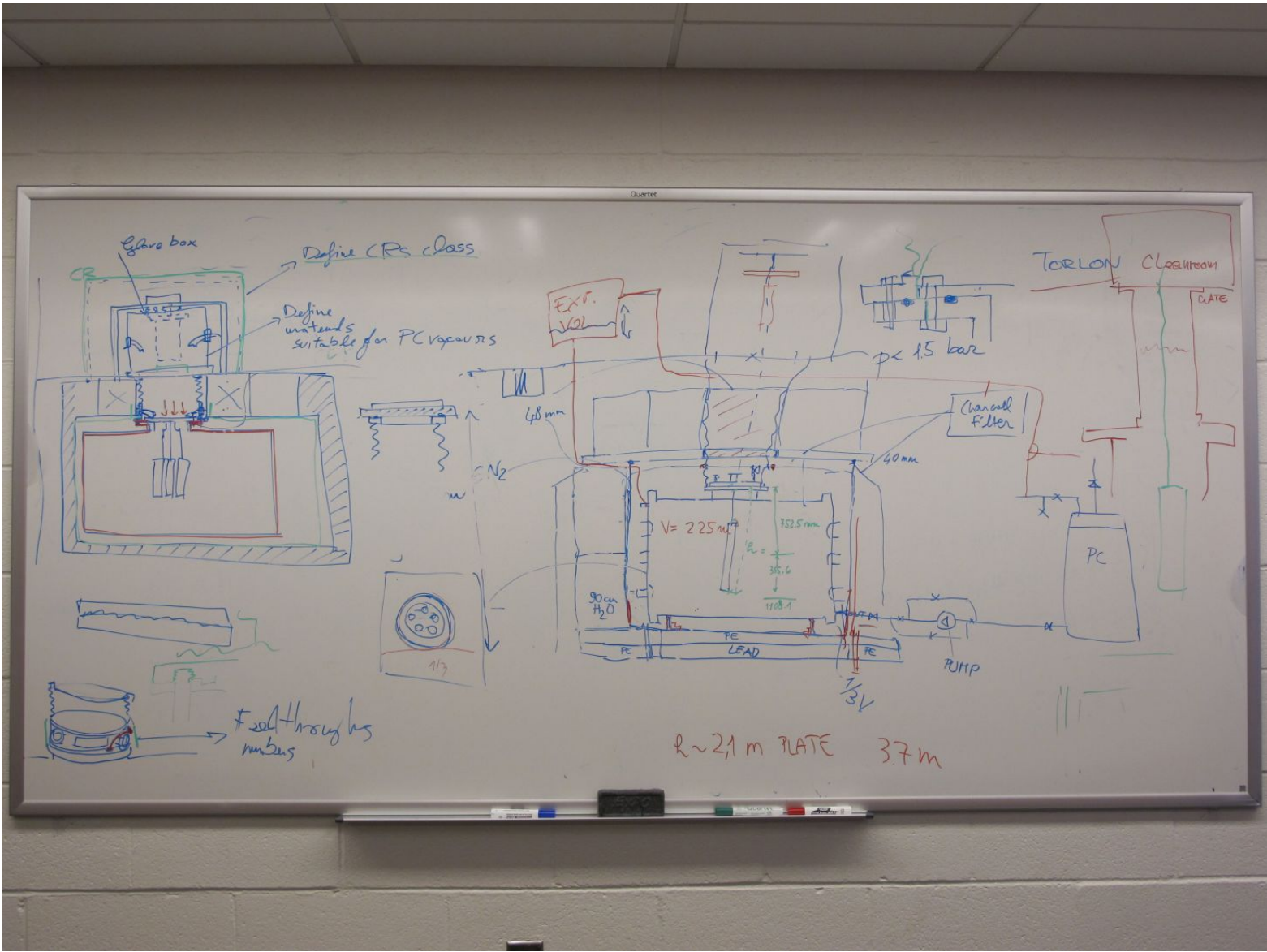


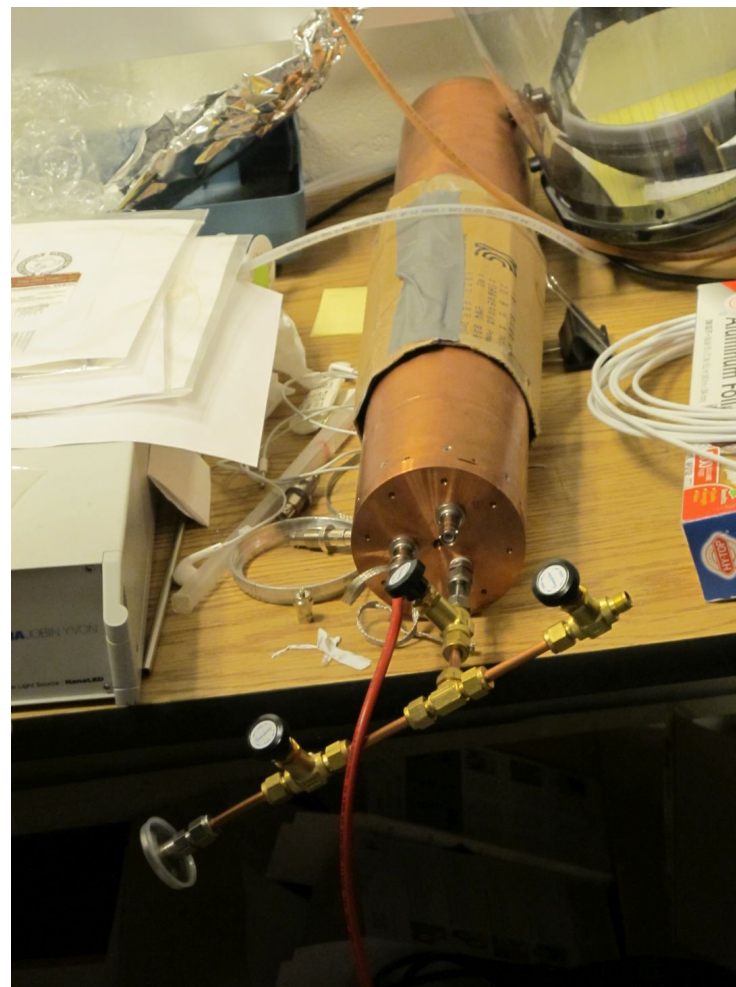
Crystal dimensions: 3" diameter, 4" length
Crystal shape and surface: to be discussed!
Crystal PMTs : 3" flat Hamamatsu R11065
LS veto PMTs: 8" semispherical Hamamatsu R5912

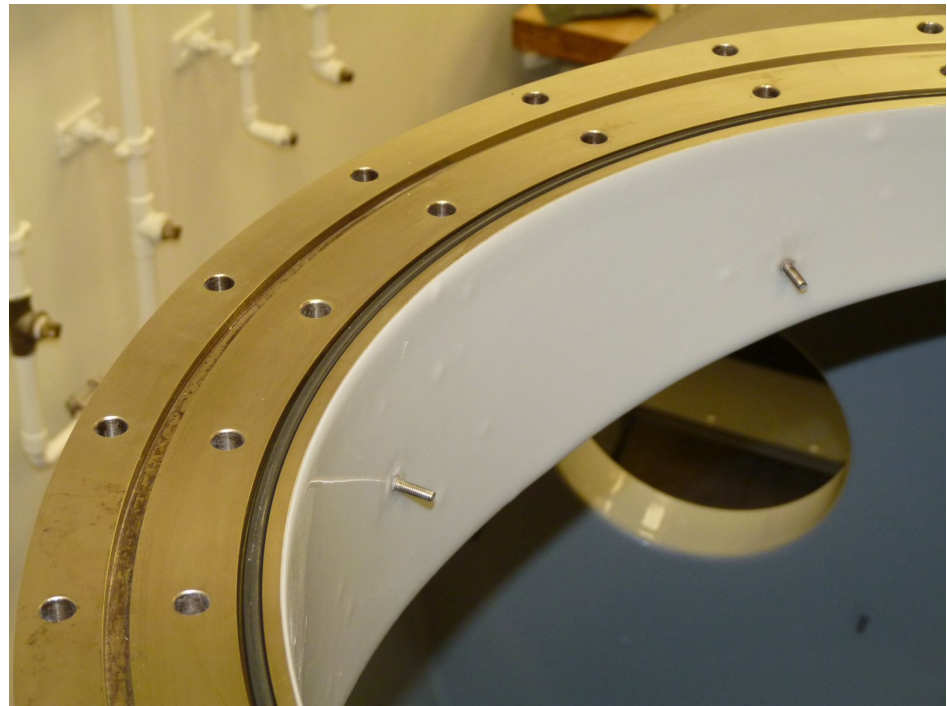
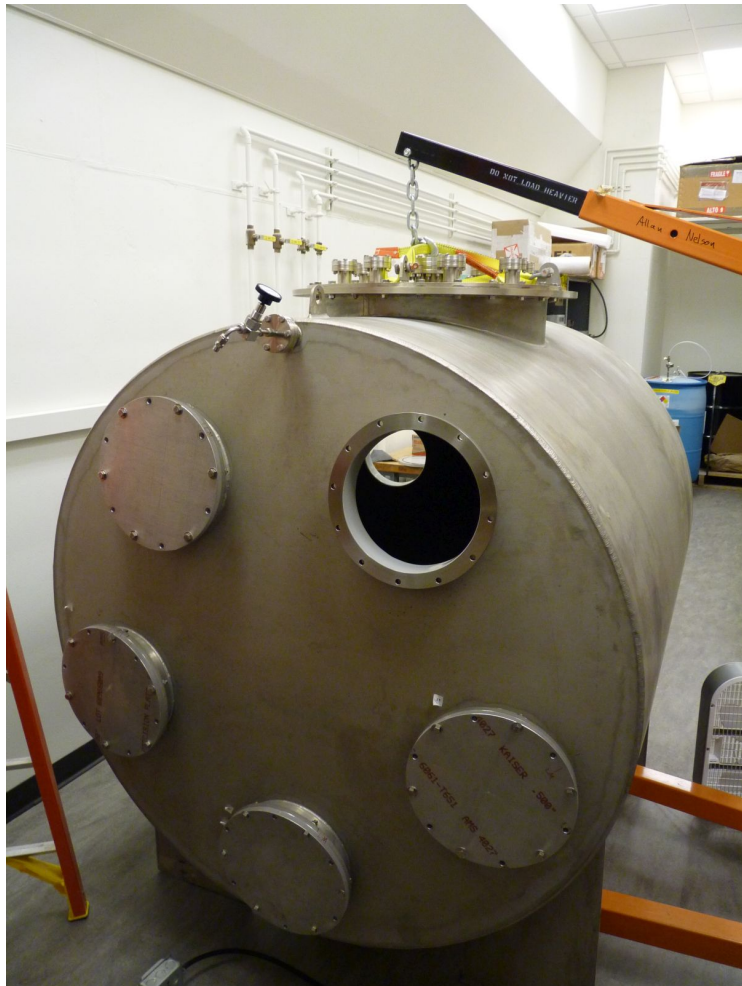
Vessel: 1.3 m diameter 1.5 m length
Liquid scintillator quantity:
Volume $\approx 2.25 \text{ m}^3$
Weight $\approx 2 \text{ ton}$

SABRE DETECTOR TECHNICAL ASPECTS

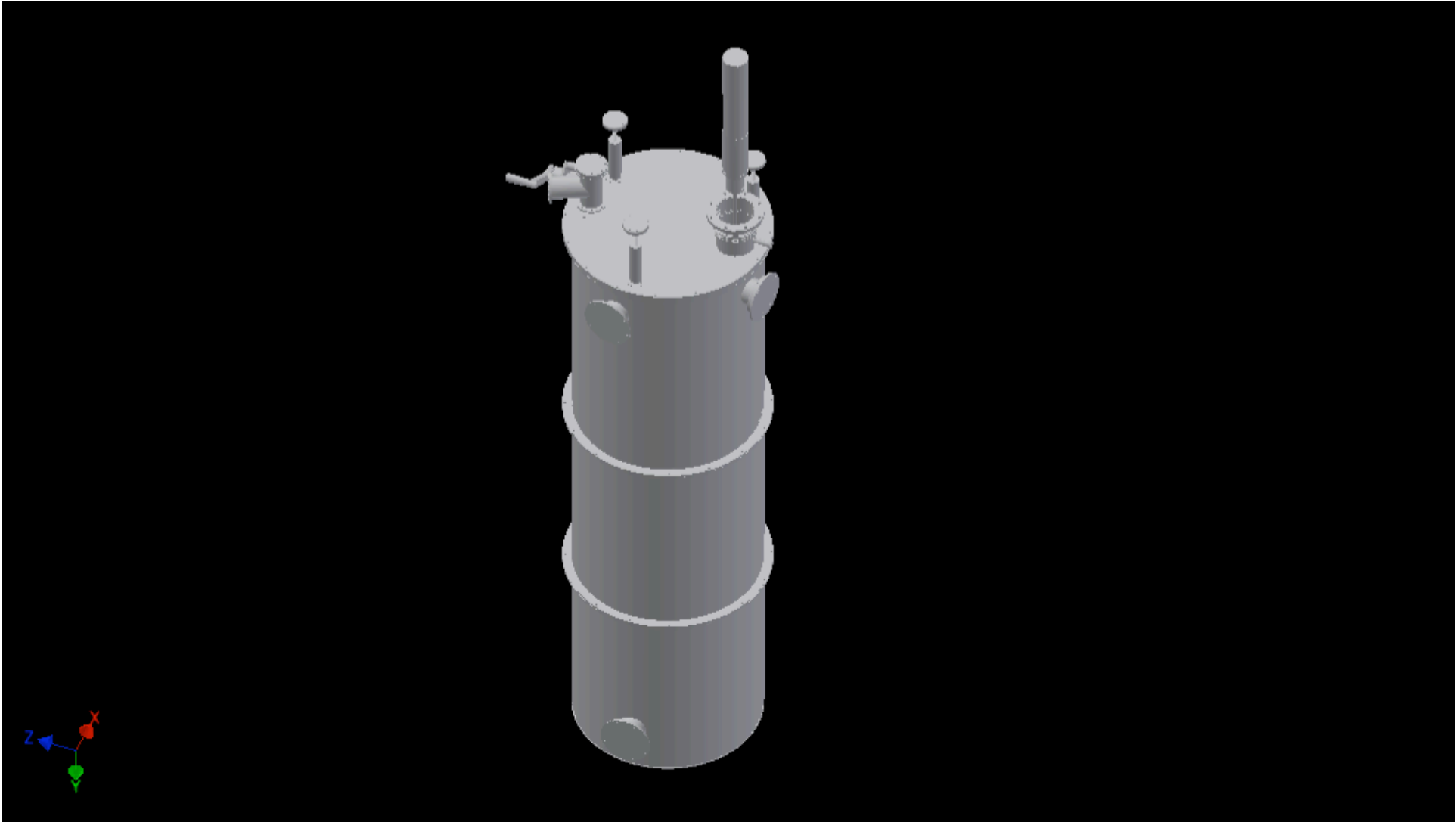
- Crystal enclosures
- Crystal holders
- Crystal handling
- Veto PMT housing
- LS vessel connections
- Calibration source insertion system
- LS vessel internal sensors
- PC+PPO preparation, purification and handling
- LS vessel inner Rn extraction during operation
- PoP shielding set-up (included LS catching basin, Rn box, safety sensors, pipe/cable passthrough, water circuit)
- PoP shielding installation/opening/upgrade options
- Top flange removal, crystal removal
- Clean room connection to vessel option
- LS fluid handling (including vessel/pipes/storage) and safety
- PoP infrastructures and services
- Crystal PMT preamp
- PoP check-list and schedules
- Single crystal shielding set-up











SABRE PoP check-list

Crystal enclosure set-up

- Crystal shape and surface?
- Enclosure design
- Sealing selection
- Feedthrough selection
- Reflective foil selection
- PMT-crystal optical coupling
- PMT bias and signal options, Bases & Preamp development
- Connectors and cables
- Drying system?
- Glove box and handling

LS vessel

- Top flanges definition
- Crystal holders
- Valves, safety valves, pipes for fluid handling, expansion volume
- Crystal extraction/insertion system
- Lumirror foil
- Calibration system
- PMT housing
- PMT metal shielding, bases, feedthroughs, cables, connectors
- Sensors (level, pressure, temperature ...)
- Thermal insulation or temperature regulation system?
- Internal Rn stripping?

SABRE PoP check-list

PoP hybrid shielding

MC simulations

Design and integration

PMT housing and connections

Top supporting structure and plate

Vessel fixing to ground

Vessel translation system?

Crystal insertion/ extraction system?

Source insertion system

Catch basin

Rn box (access to side and top flanges) and safety equipment

Fluid handling pipes and cables pass-through

Water tanks

Lead bottom layer (Pb melting)

Integration

SABRE PoP check-list

Preparation of the Hall B Site

Clean room construction (glove box?, ..)

Material storage and workshop area preparation (“dirty area”)

Infrastructures, utilities

- Water circuit

- Electrical plant

- UPS

- Lights

- GN2 circuit

- Network

LS fluid handling skid and LS storage

- PC+PPO preparation and handling

- Safety

Safety equipment, sensors and alarms, SCADA system

Fire prevention system

Single crystal passive shielding preparation

Cu, Pb

GN2 fluxed Radon box

Documentazione richiesta da LNGS e CSN2

- Obiettivi, programma temporale attività PoP, finanziamenti, milestones
 - Proposal PoP
 - TDR PoP (inclusi funzionamento, manutenzione, decommissioning)
 - Quantitative Risk Analysis (QRA)
 - MoU
-
- Progetto Full Scale exp (TDR, finanziamenti, programma temporale)