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# CNGS dismantling

ABSTRACT:

[Abstract of the document]

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# HISTORY OF CHANGES

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|---|---|---|---|
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# EXECUTIVE SUMMARY

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Short guidelines to authors:

Chapter 4: refer to more detailed study documents (EDMS, preferably approved or under approval) where possible. Also reference presentations where relevant.

Chapter 4-Summary: only give the total cost here and a few lines (max. 2 pages) on the main findings/message from the study for this part.

Chapter 4-Detailed study: max. 5 pages, refer to other documents. Do not put detailed costs, they are collected at the end of the document. Mention technical assumptions, main challenges, etc.

# 1. Scope of the document

The Advanced WAKefield Experiment (AWAKE) has been validated as a CERN project in 2013 and has been running since 2015.

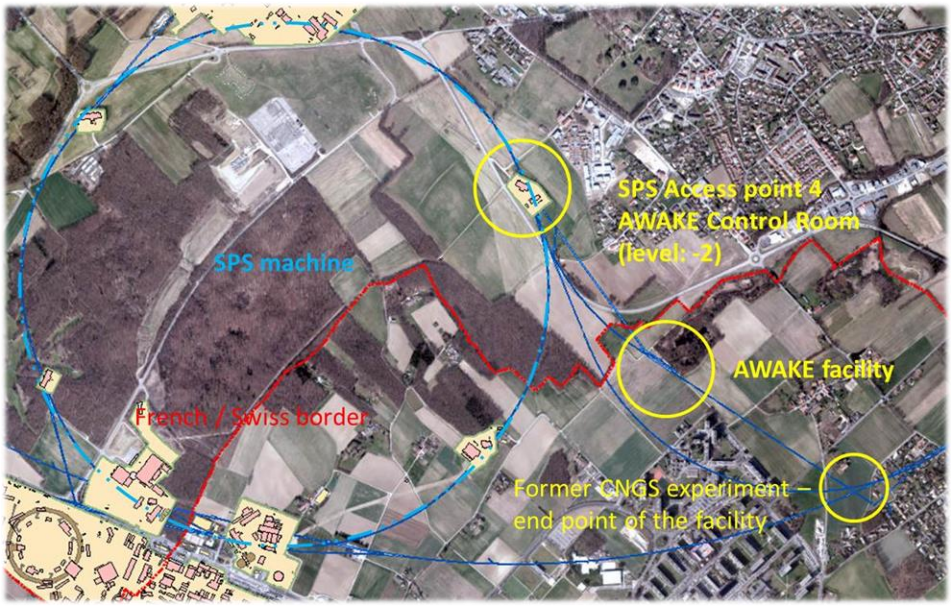



Figure 1 Satellite view of AWAKE location

The purpose of this document is to compile all relevant results from the CNGS dismantling pre-study. It describes the general process to follow for the dismantling and gives a first estimation of the cost of this project.

In order to best describe the project, the document has been structured as follows:

- A first part (chapter 3) with general information on the location and the schedule
- A second part (chapter 4) describing all essential aspects of the dismantling:
  - Dismantling contract
  - Radiation protection
  - Handling and Transport
  - Target and horn
  - Surface building

## 2. Goal and motivation for the CNGS dismantling

In 2018 AWAKE successfully achieved its goal to accelerate electron using proton driven plasma wake fields. Following this first success, the experiment aims to go further by proving that this technology can be enhanced, scaled, and used physics research purpose.

Following the SPSC committee of **October 2020 (SPSC-SR-279)**, AWAKE Run 2 has been divided into 4 phases (see global schedule in section 3.2): Run 2a and b (2021-2024) will use the same layout as run 1, Run 2c (2025-2027) is the dismantling of CNGS and installation of the new layout, and Run 2d (2027 and beyond) is for the first physics application. The physics plan for AWAKE Run 2 was approved during the SPSC committee of January 2021 (SPSC-SR-285).

In this scope, AWAKE will need twice more equipment than the run 1 (2 plasma cells, 2 electron line, 4 Klystrons). To accommodate all this new hardware, it was proposed to dismantle the 100 meters long TCC4 tunnel which was used for the CNGS facility until 2012. The two figures below present the current layout (run 1/run 2a/b) (2015 to 2024) and the future layout of the run 2c/d (~2025 and beyond).

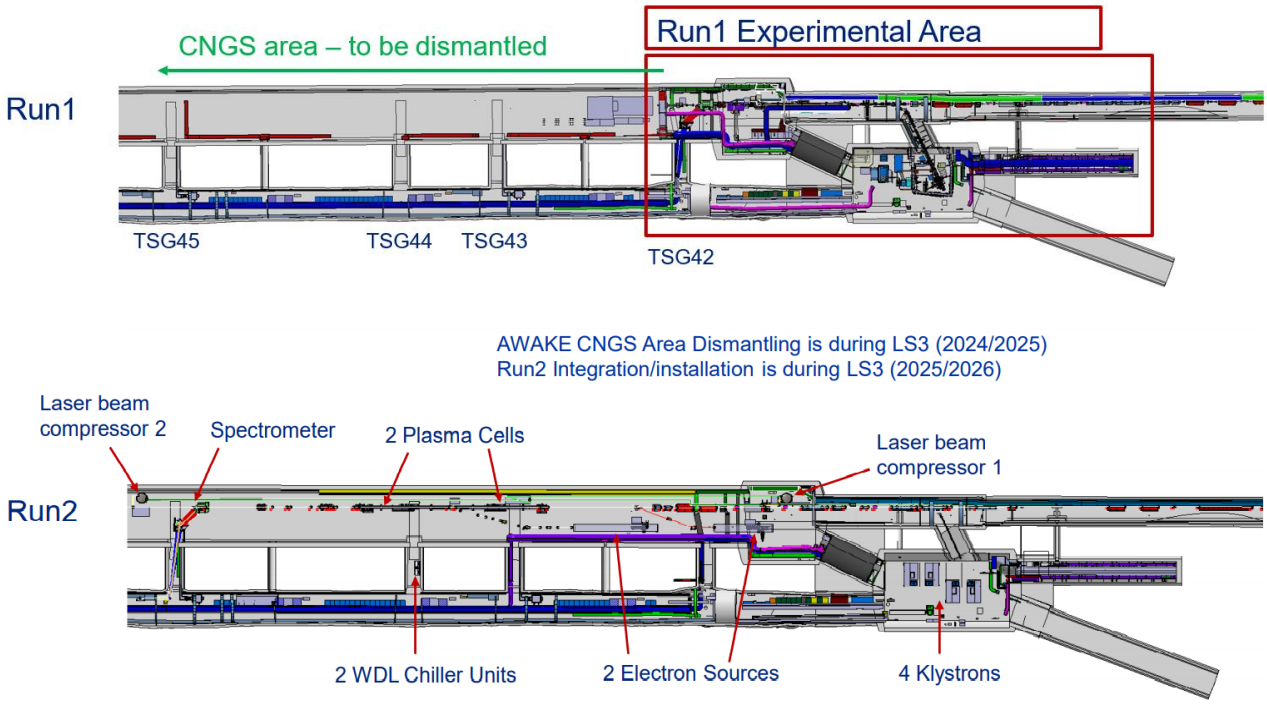



Figure 2 On top AWAKE run 1 layout, on bottom AWAKE Run 2 layout

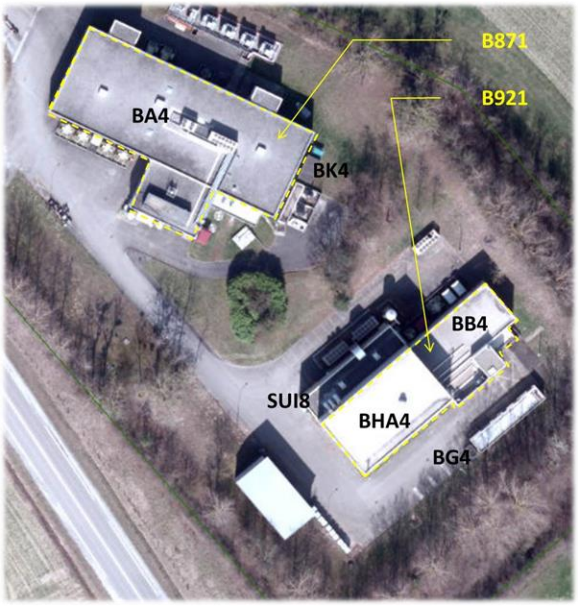
CNGS dismantling is *tentatively* foreseen to take place during LS3 in 2025. To anticipate on the resources that will be needed, a pre-study has been

done (October 2020 – March 2021) to obtain a first solid estimation of cost and schedule for this project.

# 3. General information

## 3.1 Localisation and environment

The AWAKE facility and CNGS tunnel are accessible by the SPS point 4. This point is fenced, and entry is controlled via badge reader.




It hosts the following surface building and facilities:

- Building 871 (BA4) which houses the main access shaft to the SPS machine.
- Building 921 (BHA4, BB4) which houses the hardware access shaft PAM4 and serves the caverns ECA4 and ECX4
- Building 3880. Also known as SUI8 (ventilation systems)
- Building 930, known as BG4
- Building 984, known as BK4 (electrical station)

Figure 3 Top view of SPS point 4 (GIS Portal)

The pit depth in BB4 is around 60 meters and it leads to the cavern ECA4 where the access point is situated. The access tunnel leading to the experimental area is 800 meters long and leads to the TCV4 cavern. After the junction tunnel TSG41, the TCC4 cavern is accessible and is about 115 meters long.

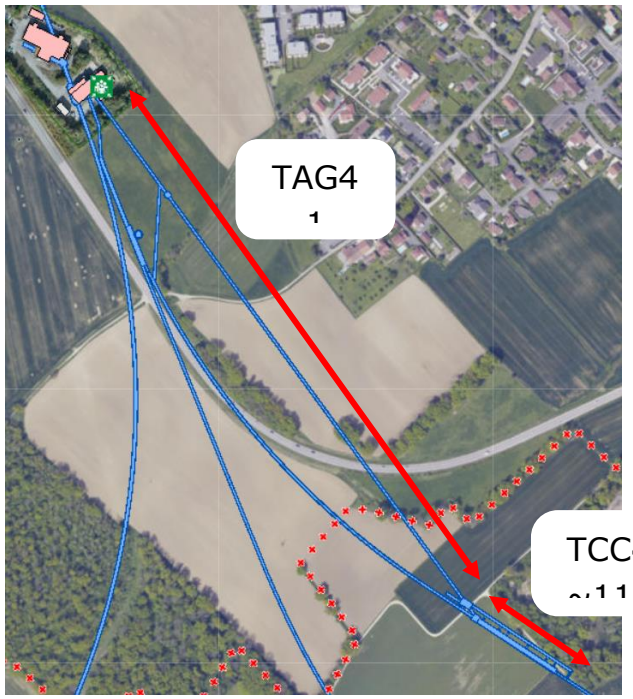



Figure 4 Top view of AWAKE (GIS portal)

## 3.2 Foreseen global schedule

The following figure shows the global schedule foreseen for AWAKE run 2. CNGS dismantling will take place during AWAKE run 2c. As hypothesis for this study, the dismantling will take place during LS3 in 2025. 15 months are dedicated to the dismantling in this global schedule.

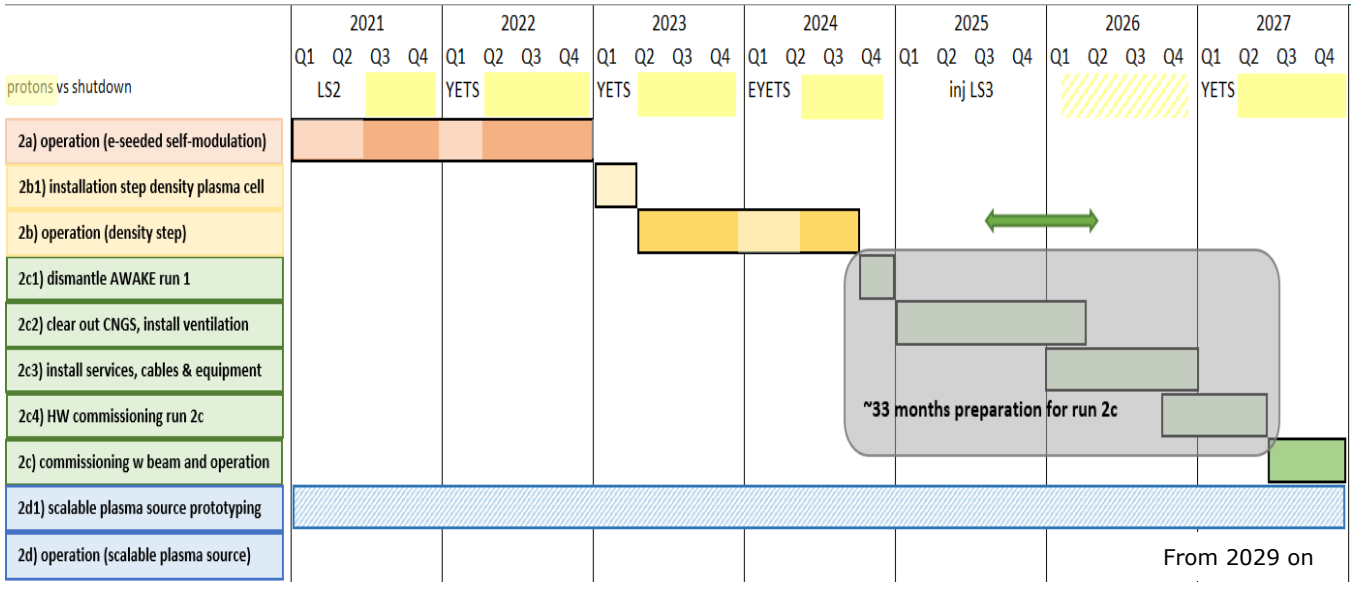


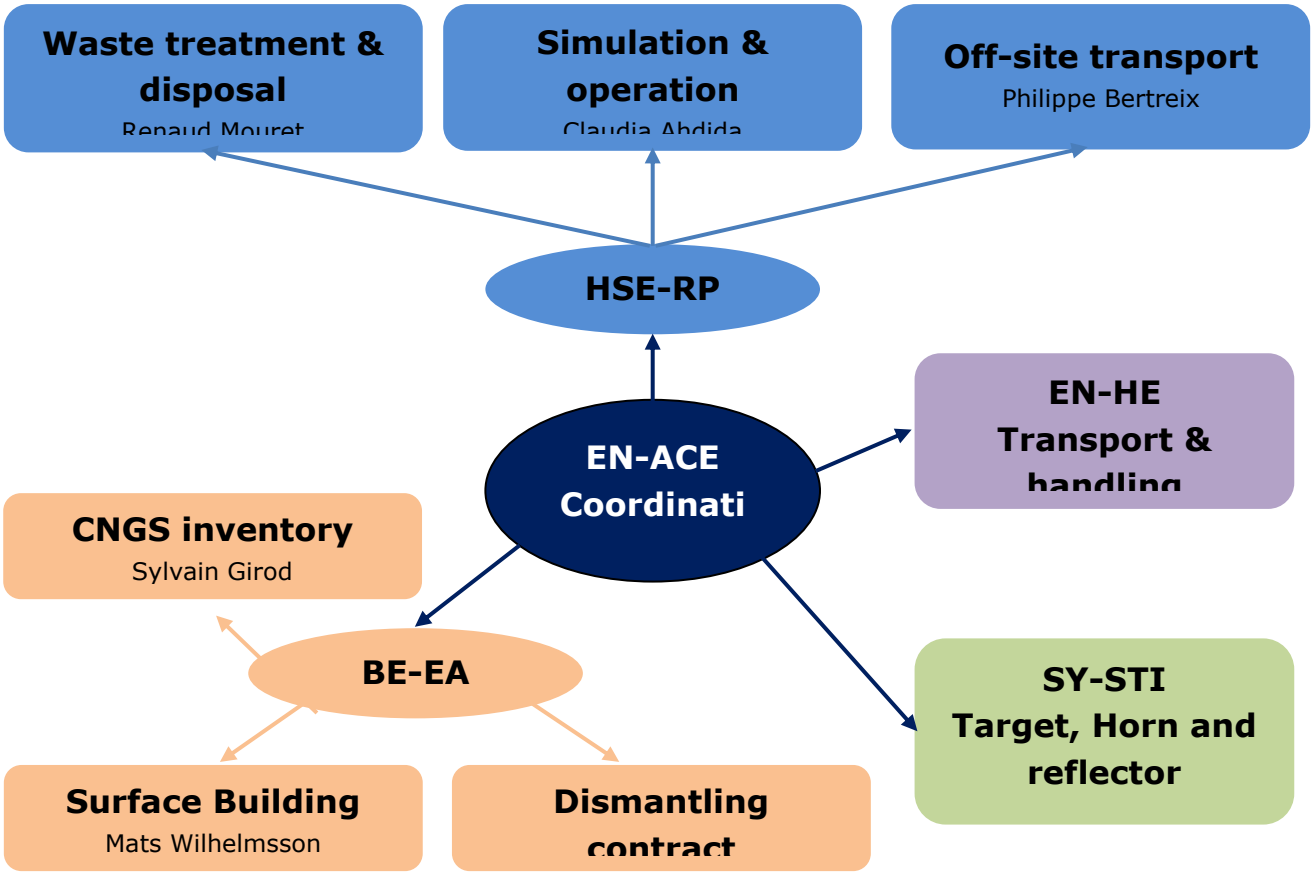

Figure 5 Global schedule of AWAKE run 2

3.3 Study structure and persons of contact

The main stakeholders giving input to the CNGS dismantling pre-study are the following :

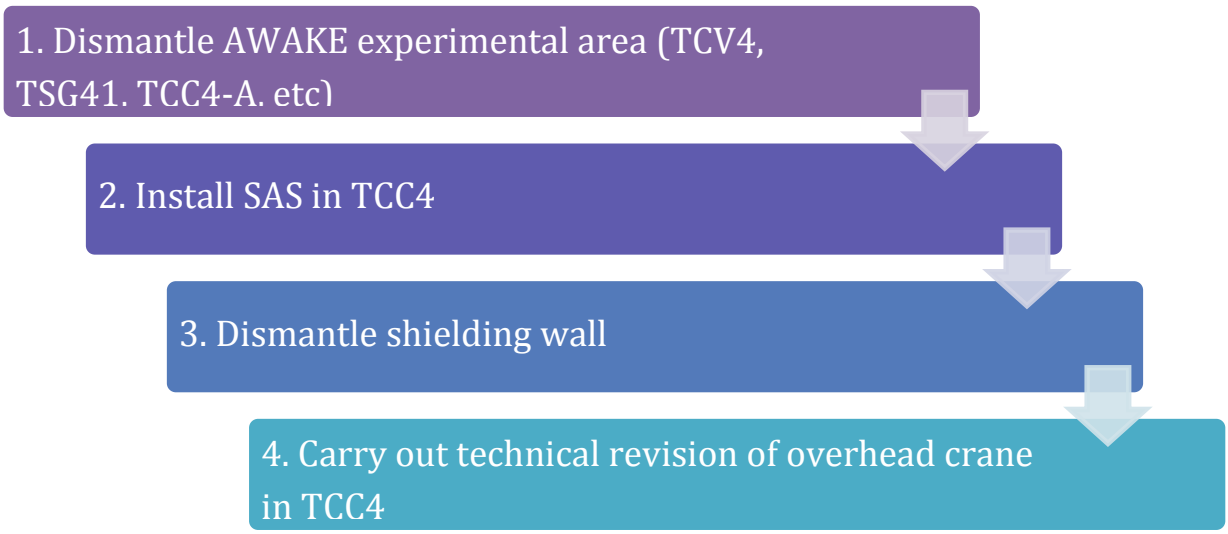
- HSE-RP for radioprotection aspects.
- EN-HE for on-site transport.
- SY-STI for the handling of the horn, the target, and the reflectors.
- BE-EA for the dismantling contract and study of a surface building.

The structure, along with the contact person for each team, is presented in the diagram below.

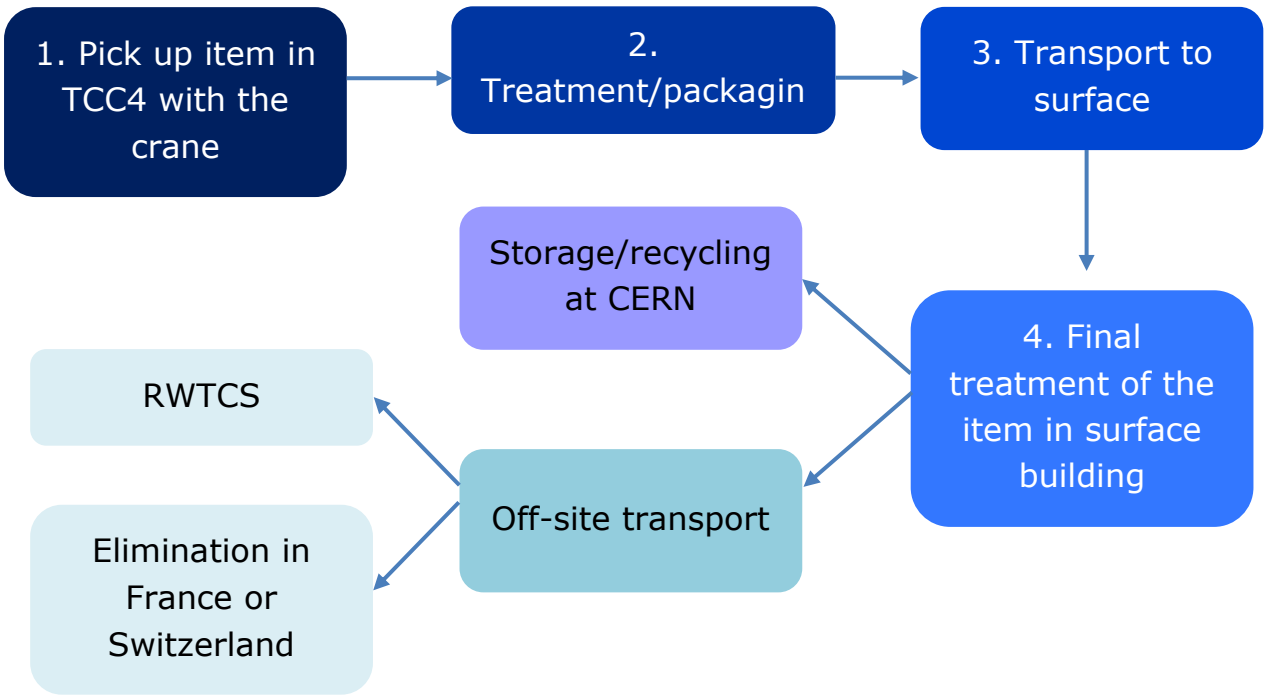


## 4. CNGS dismantling process

The CNGS dismantling consist of a preparatory phase (preparing the area and equipment for the start of the actual dismantling), an actual dismantling phase and finished with a renovation phase, where the emptied CNGS area is decontaminated, and basic services are installed. The preparatory phase is summarised as follows:




Once the area is ready, the actual dismantling can start, where the process for a typical item (e.g. a shielding block) is described in the process diagram below:.



Finally, when the area is emptied, the TCC4 cavern will be decontaminated, walls and vault will be painted with a contamination-fixing resin, and emergency services, as well as ventilation and light, will be installed. Where needed, to obtain the radiological "simple controlled area", shielding blocks may be installed and areas or surfaces with remanent dose rates above 50µSv/h will be fenced off or shielded.

## 4.1 Dismantling contract

Reference document (mode detailed information where relevant): EDMS … .

### 4.1.1 Summary

The dismantling work has been separated into three main phases:

- **Phase 1 ~195 kCHF**
  - Preparation of the SAS in TCC4
  - Treatment of shielding blocks before transfer to surface
  - Treatment of horn and reflector before transfer
- **Phase 2 ~550 kCHF**
  - Dismantling of Helium tanks
  - Dismantling of all remaining supports and equipment
  - Sanitation of the area
- **Phase 3 ~68 kCHF**
  - Renovation of shielding blocks in surface

This leads to an estimate for the dismantling contract for a total of **813 kCHF**.

### 4.1.2 Detailed study

## 4.2 Radiation protection aspects (HSE-RP)

Reference document (detailed HSE-RP study report): EDMS …

### 4.2.1 RP simulations

### 4.2.2 Public road transport

### 4.2.3 Waste treatment

### 4.2.4 RP operation

## 4.3 Handling and Transport (EN-HE)

### 4.3.1 Summary

This activity concerns all on-site transport and handling of the items to dismantle. The main assumptions and results are the following:

- HE team will work on average **4 days/week** (to account for usual disturbances).
- There are ~700 items to dismantle.
- In average, HE team will dismantle **3 items/day.**
- Regarding transport:
  - The crane in TCC4 travels at 8m/min, hence it takes around **15 minutes** to go up and down from **TCC4 to the SAS.**
  - With the shielded tractors, it takes **15 minutes** to go from the **SAS to ECA4**, and the return travel is around 60 minutes (accounting for unloading activities).
  - In BB4 the **lifting speed is 60m/min**, hence it takes 1 to 2 minutes to lift an item.

The CNGS dismantling is foreseen to last 15 months. The manpower is estimated at 911 kCHF (4 underground teams+2surface teams+1 truck driver). The tooling and studies are estimated at 175 kCHF. This brings the **total cost** for Handling and Transport to **1.1 MCHF**.

### 4.3.2 Detailed study

## 4.4 Target and Horn (SY-STI)

### 4.4.1 Summary

### 4.4.2 Detailed study

## 4.5 Surface building (BE-EA)

### 4.5.1 Summary

The purpose of the surface building is to receive elements from the CNGS dismantling for:

- Temporary storage
- Decontamination, cleaning, and painting
- RP measurements in low-dose-rate area

The building shall have the following characteristics:

- Useful surface ~400 $m^2$
- Simple "bardage" cladding
- Walls made of 80 cm-thick concrete shielding blocks
- Shielded mobile entrance door made of 20 cm-thick iron
- 5T overhead crane
- Lighting, Ventilation, Heating and standard electrical power supply sockets.

The total cost of this building is estimated at **1.44 MCHF**. The building permit request should start in 2022 for the building to be available by Q4 2024.

### 4.5.2 Detailed study

To answer the surface requirement, the proposed dimensions for the building are 27.2 meters by 15.2 meters with a height of 4.8 meters. This gives an internal surface of **389 $m^2$** (the external surface is 457 $m^2$). Hence, 94 big concrete blocks (2.4m*1.6m*0.8m), 4 "corners" and 2 small concrete blocks (1.2m*1.6m*0.8m) will be required. (see figure below). An additional x shielding blocks are needed to create the RP bunker inside the building.

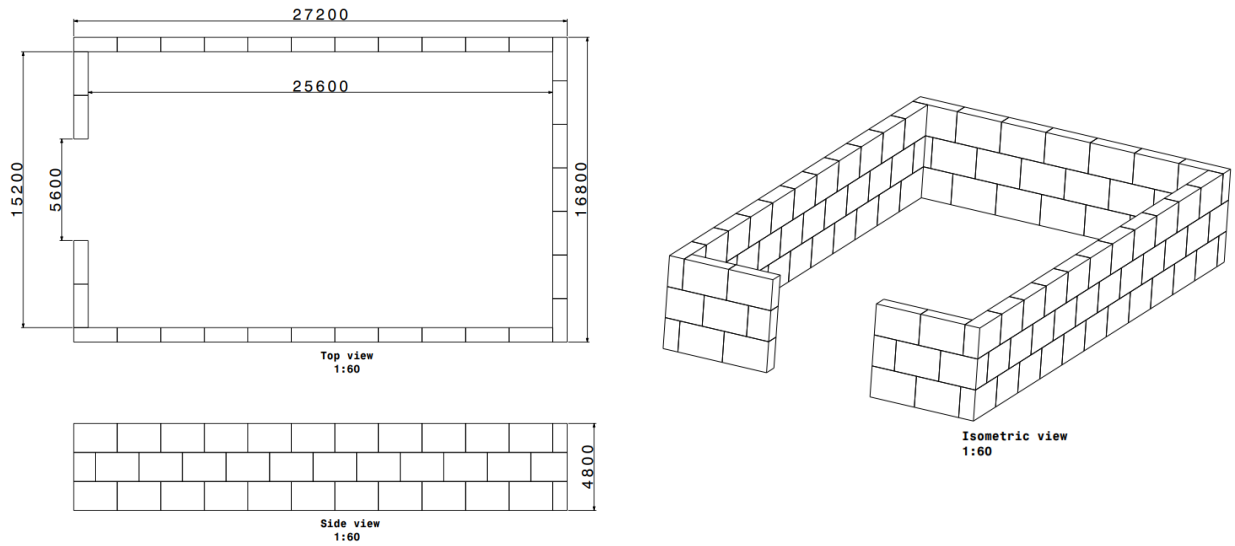



Figure 6 Surface building dimensions

The figure below shows a proposal for the internal layout according to RP requirements.

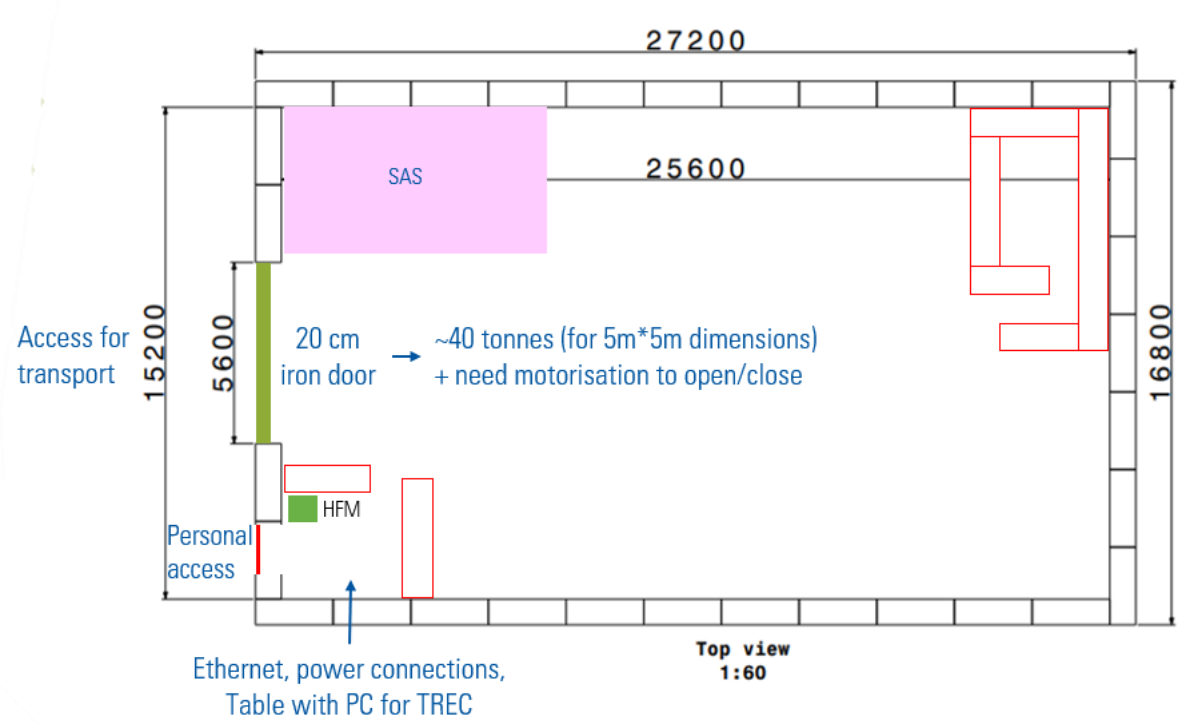



Figure 7 Internal layout of surface building

To limit the handling of radioactive components, it is important to have the building as near as possible to BB4. The suggested location is shown on the pictures below. As there is a hill at this position, there will be a need for excavation work.

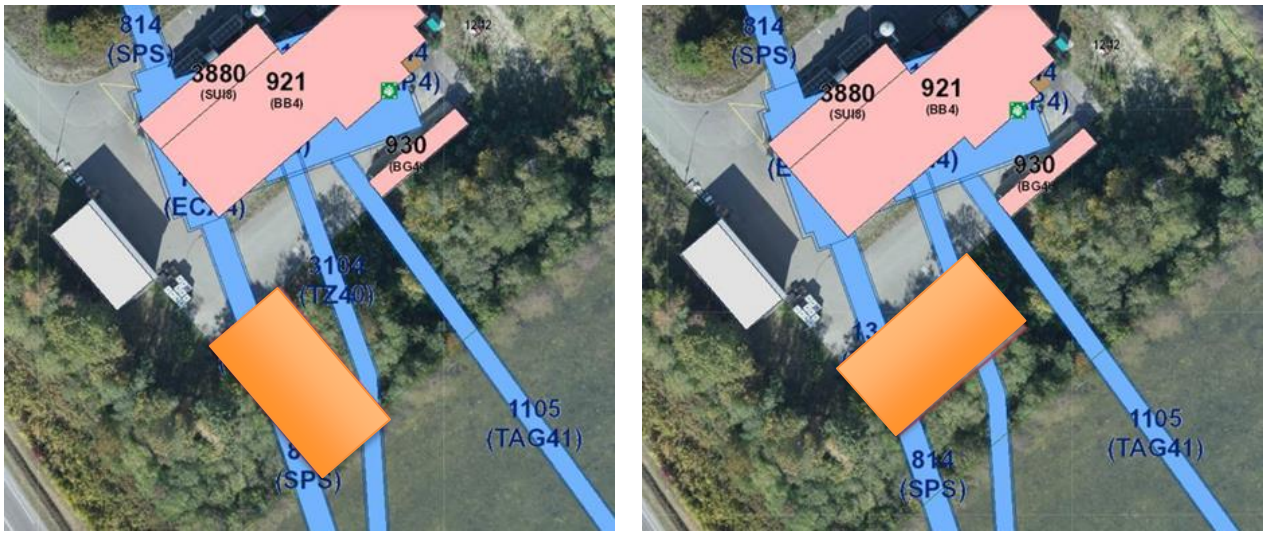



Figure 8 Surface building suggested location

# APPENDICES

## A.1 Detailed cost estimates: Material and Personnel

A.1.1 Preparation works not covered elsewhere

1. Dismantling AWAKE 2b TCC4 beam line equipment
2. Decabling works AWAKE 2b

A.1.2 Dismantling Contract

A.1.3 Radiation protection

A.1.4 Handling and Transport

1. Dismantling of AWAKE 2b
2. Dismantling of CNGS
3. On-road transport to CERN RWTC

…

A.1.5 Target and Horn

1. Shielded containers
2. Dismantling tools

…

A.1.6 Surface Building

The cost estimation for the surface building is based on the input of the following persons: John Osborne, Michael Lazzaroni, Roberto Rinaldesi, Juha Sakkinem, Sylvain Girod.

| Cost idea | kCHF |
|---|---|
| Building with "simple bardage insulation"<br>Ref: 2000 CHF/$m^2$ (400 $m^2$) | 800 |

| | |
|---|---|
| Concrete blocks<br>2.4*1.6*0.8 → 94 blocks at 1500 CHF<br>1.6*0.8*0.8 → 4 blocks at 1000 CHF | 145 |
| Painting of the blocks<br>(188 CHF per block) | 18.5 |
| Traveling crane | 150 |
| 20 cm iron door | 100 |
| Electricity supply (guess) | 150 |
| Heating (guess) | 75 |
| Installation of building (handling) | |
| | |
| **Total** | **1439** |