The CNGS Target Area Dismantling Project: Status and Timeline

Ans Pardons, for the project team

AWAKE collaboration Meeting 11-13/3/2024

EDMS 3061468

Outline

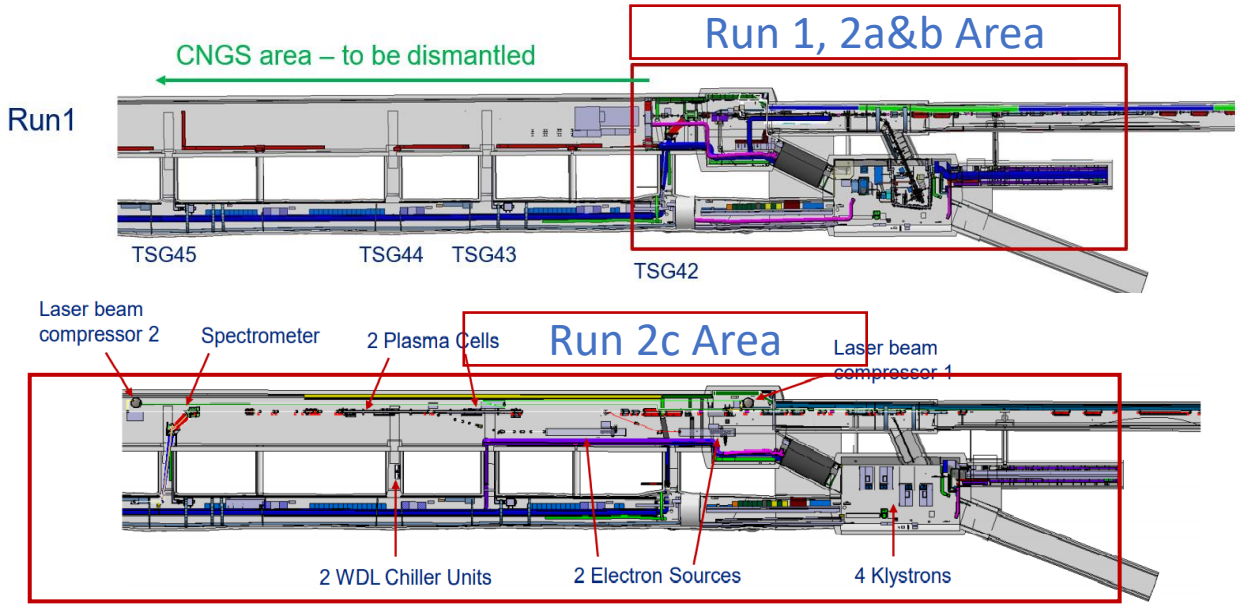
- CNGS dismantling
  - Why now? What? Where?
- New surface building BS4 - Status
- Dismantling processes:
  - Dose rates and contamination
  - Work areas
  - Work processes
  - After dismantling
- Timeline
- Status summary

Last presentation for AWAKE was in the Collaboration Meeting of 6/10/2023

CNGS Target Area Dismantling: Why now?

AWAKE Run 2:

- Demonstrate the possibility to use the AWAKE scheme for high-energy physics applications in the mid-term future
  → phased approach: 2a, 2b, 2c, 2d etc.
- AWAKE Run 2c and 2d require a longitudinal **extension of the AWAKE facility of 60-80 meters**.



AWAKE facility, with separation wall to CNGS target area on the left

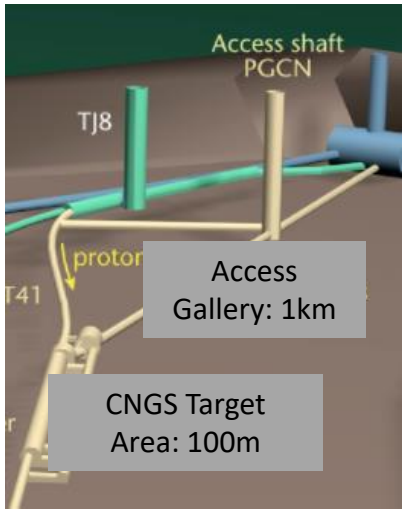
There is no other such location at CERN that also has its **own SPS proton extraction line and proton beam dump**.

→ The **dismantling of the CNGS target area** is a **prerequisite for AWAKE Run 2c & 2d**

CNGS Target Area: What? Where?

Area challenges:

- 6% **slope** → wedged supports, special crane
- **1km-long tunnel** and 60m-deep pit **to surface**
- Radiological **contamination**
- **Significant dose rates:** up to 50mSv/h



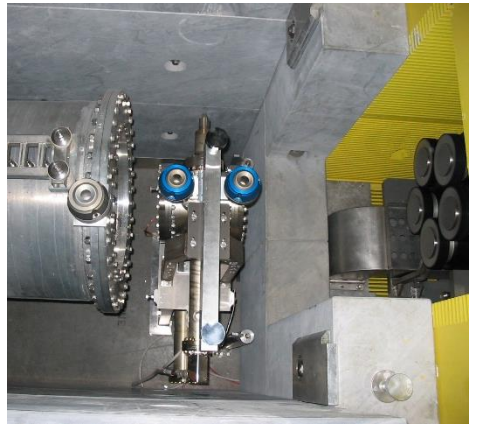
Area content:

- ~500m3 large shielding blocks (0,05-0,6 mSv/h on contact)
- A few high dose-rate elements (2-50mSV/h on contact)
  - All designed for remote handling
- 70-meter-long aluminum He-tank
- Various supports, ducts, cable trays, etc.

The decision to upcycle all concrete shielding blocks (~400m3 out of the total) rather than declare them as waste saves 5MCHF, but we need a building to store them.

→ Total dismantling project cost estimate = 12MCHF

CNGS target in shielding

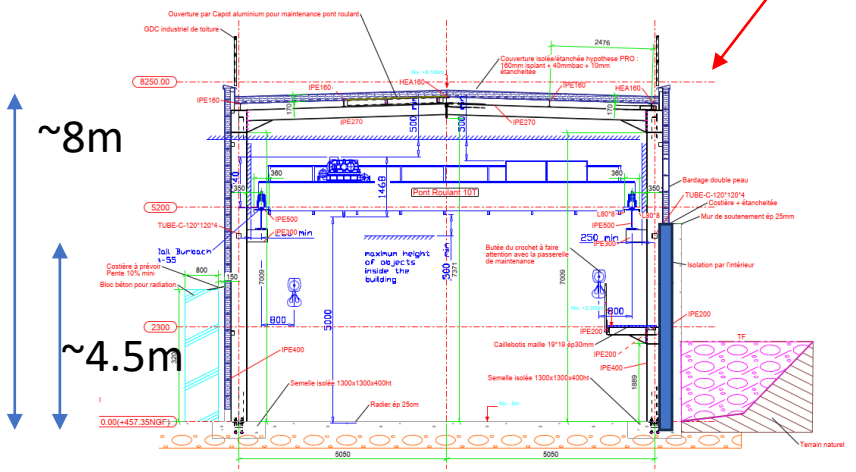


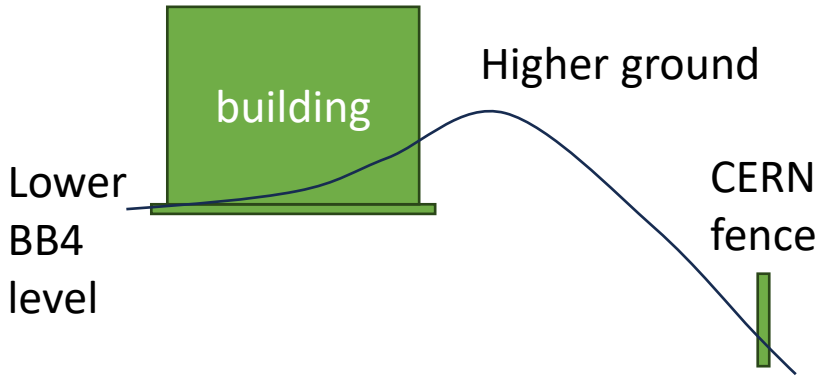
Horn, TBID and target (left to right)

Installation of horn roof shielding

New surface building BS4 - Status

- Green light from CERN committee Oct ‘23
- Design contract started late ‘23, drawings received and are being checked
- Preparing call for Tender, aim to place contract ~June ‘24 and start works September ‘24 → Building available for use ~May ‘25





25cm thick concrete soil-retaining wall

80cm thick concrete shielding blocks, height 3.2m

Close collaboration with RP experts led to a simpler and less expensive solution:

- Simulations show the significant (but not sufficient) shielding effect of the soil-retaining wall (25cm concrete)
- The area behind the building will become a **temporary** RP-exclusion zone during works and storage
  → no need for shielding blocks here, saving ~100k

Challenges: dose rate and contamination

- **High dose rates**: a few elements >2mSv/h, 80% is below 200µSv/h
  [limit for road transport: 2mSv/h at contact with truck, 0.1/mSv/h at 1m]
- **Possible surface** and airborne **contamination** (CS and CA) (rare at CERN)
  [limit is more complex]

$$\frac{c_1}{CS_1} + \frac{c_2}{CS_2} + \ldots + \frac{c_n}{CS_n} < 1$$

Radio-isotope¤	Activité··[Bq/cm2]·¤	Valeur·CS·[Bq/cm2]¤	Multiples·de·CS¤	¤
Na-22¤	4.12E+00¤	3.00E+00¤	1.37E+00¤	¤
Ti-44¤	1.02E-02¤	3.00E+01¤	3.40E-04¤	¤
Co-60¤	2.97E-01¤	3.00E+00¤	9.90E-02¤	¤
Ba-133¤	3.05E-02¤	1.00E+02¤	3.05E-04¤	¤
Total¤	¤	¤	**1.47E+00¤**	¤

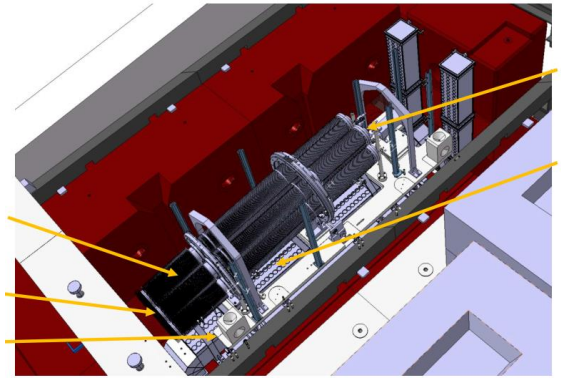
1. Perform a standard smear test (100cm2)
2. By gamma spectrometry, measure the activity for each isotope on the swab (c1, c2, …).
3. For each isotope, a “contamination limit if this were the only isotope” exists (CS1, CS2, …).

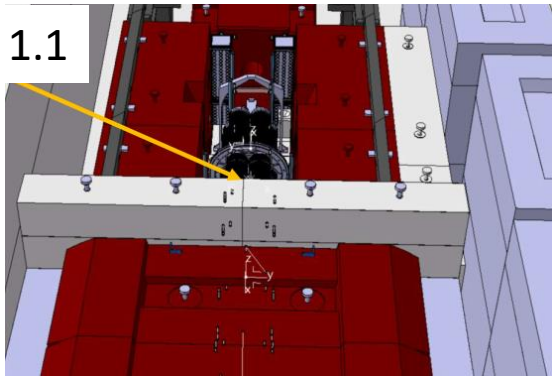
Several isotopes → each isotope’s measured activity value represents a % contamination limit.

E.g. c1/CS1 = 0.1, c2/CS2=0.5, etc. If the sum of these ratios for all isotopes is <1
→ the sample/location is considered not contaminated

Measured dose rate and contamination

- **Dose rates**: we have a very complete set of simulations, complemented by measurements





Dose rates (mSv/h) measured Nov 2023 around target (left/center) and at contact with CNGS target collimator (right)

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Mesures radiologiques dans la zone cible CNGS
by DIDIER ALBERTO, CHRISTELLE JOELLE SAURY

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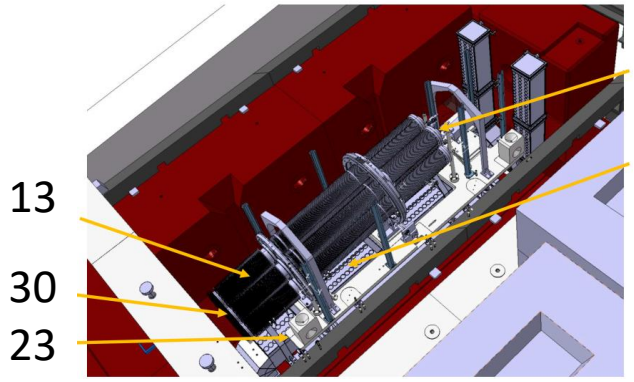
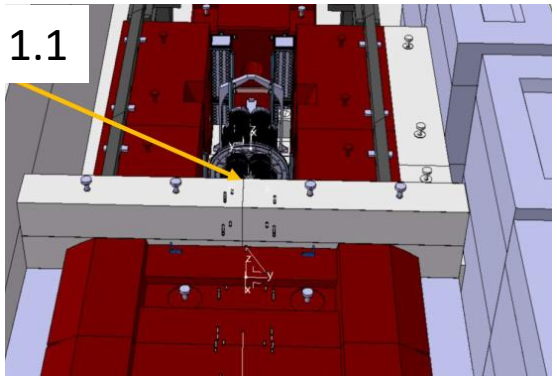
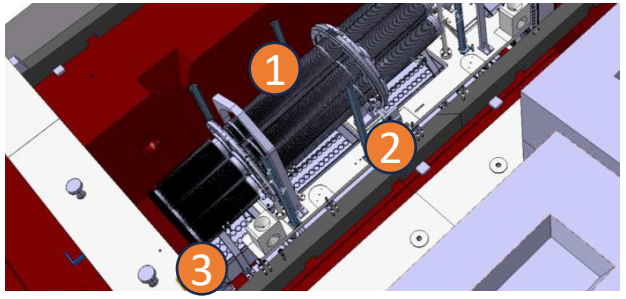




Dose rates (mSv/h) measured Nov 2023 around target (left/center) and at contact with CNGS target collimator (right)

- **Surface** and airborne **contamination** (CS and CA): not calculable, measured at a few accessible locations, including within target shielding (after moving roof shielding blocks remotely)



Loc	CS
1	1.8
2	1.5
3	0.8

Surface contamination measured Nov 2023 at target table and at CNGS target collimator (right)

All other contamination measurements in TCC4 outside shielding (accessible) were well below 1CS.
→ **Contamination checks** needed for all (most) elements, **decontamination** expected for a minority, **work areas** must be adapted to **avoid spread**

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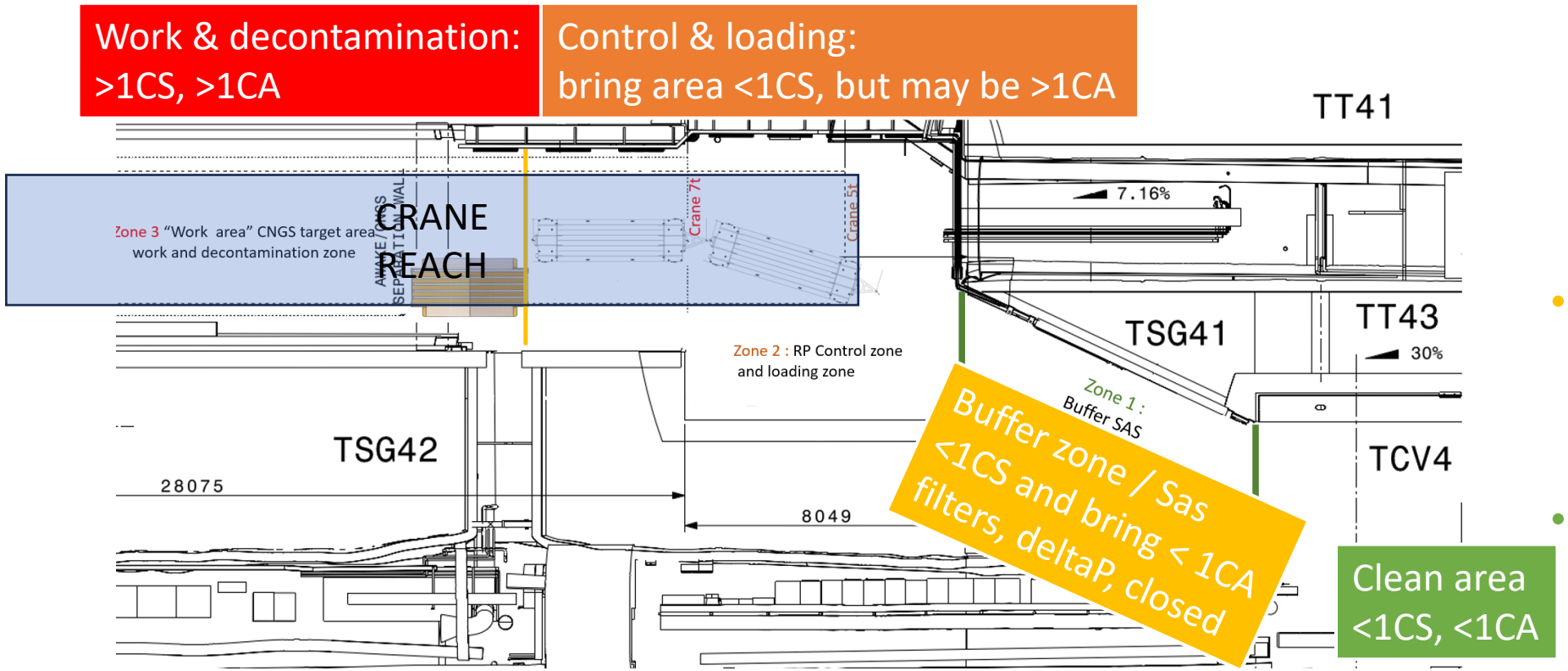
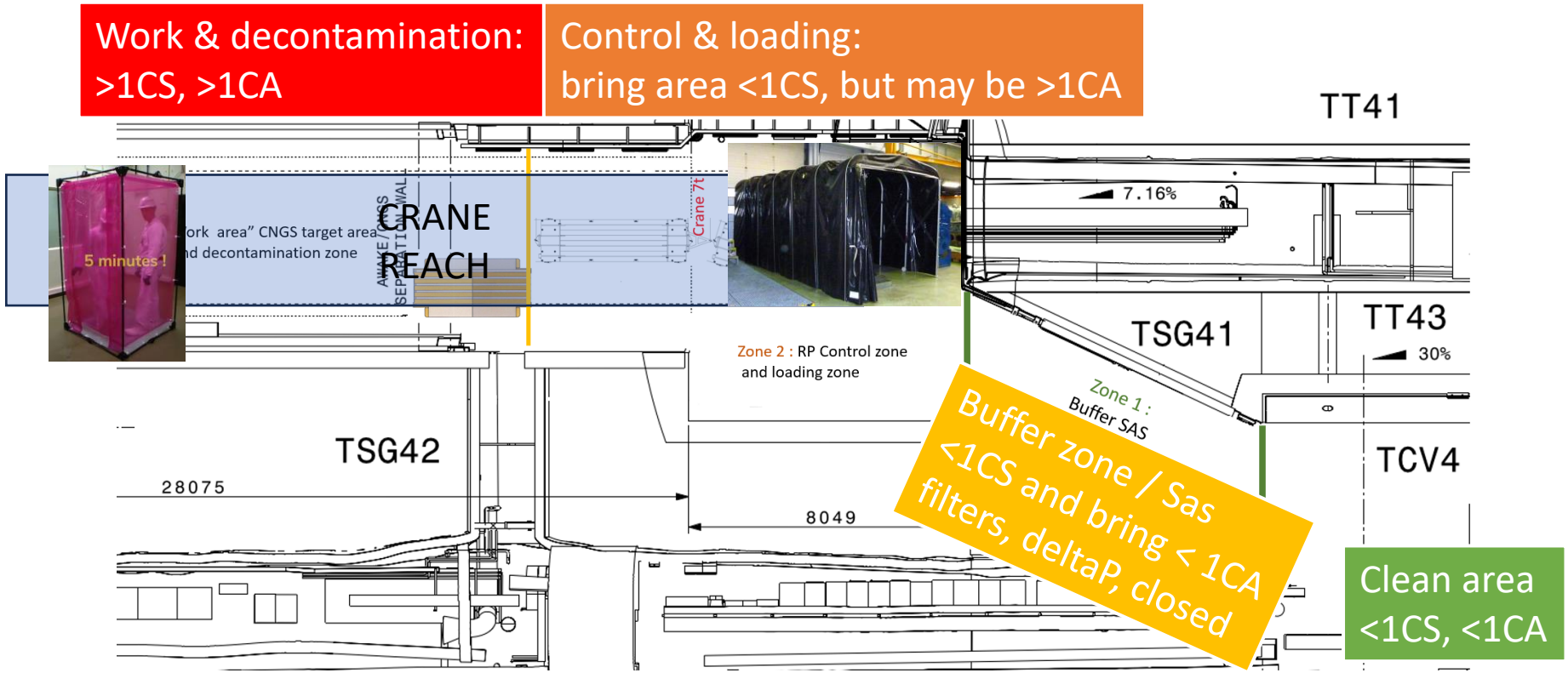
Work area set-up to contain contamination



- Work and decontamination area with CS>1, CA>1
- Transport by crane only to RP control area, with CS brought <1 (check, clean). CA can be >1 (no barrier). Tractors and trailers are allowed in to be loaded.
- Buffer zone with pressure difference, filters, closed to contain CA, opened to let tractor and trailers pass.
- Rest of area guaranteed <1CS, <1CA

Work area set-up to contain contamination



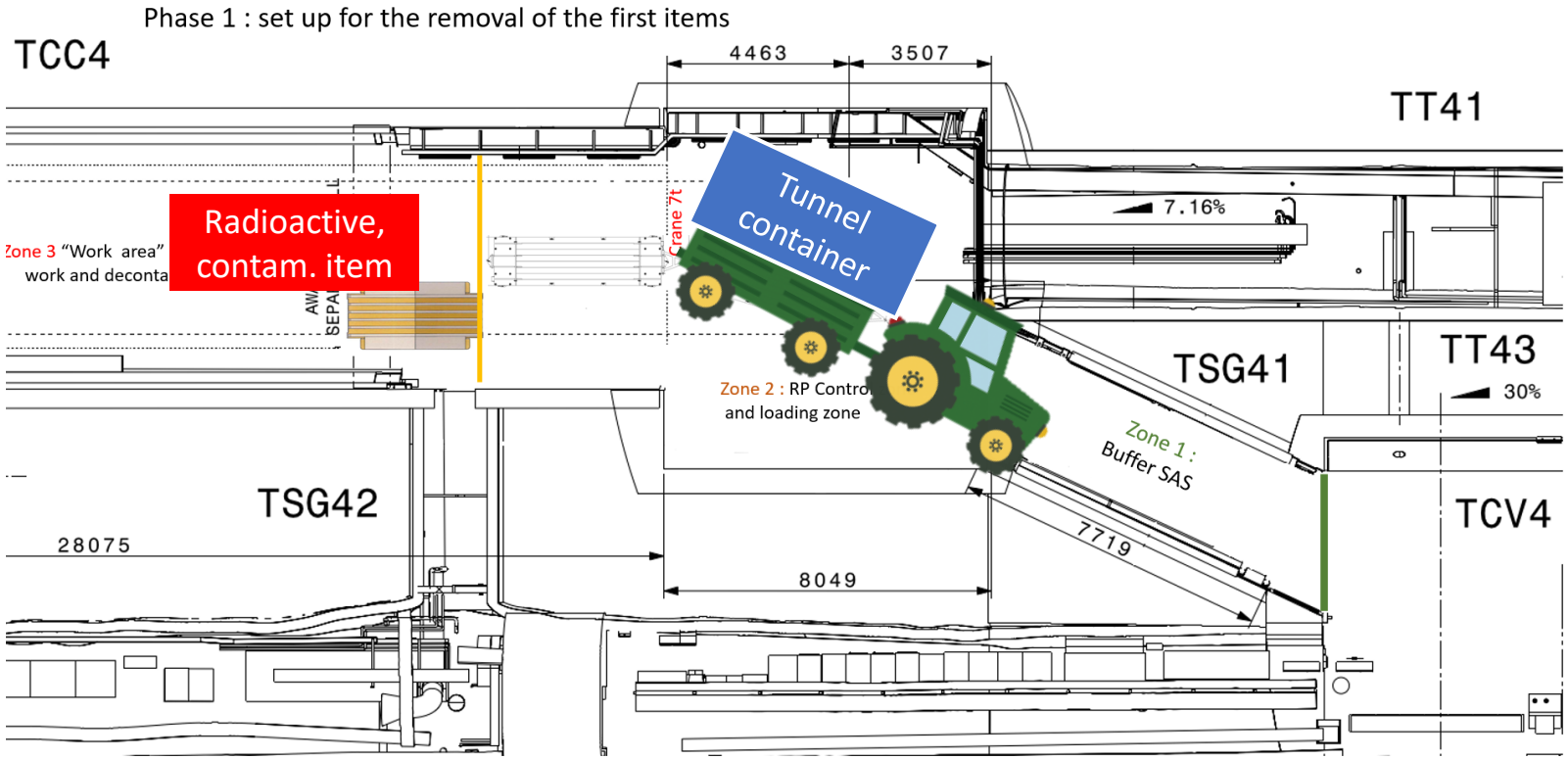
- Early on, the work and decontamination area may be too small
- Can install tent in RP control area, for decontamination and/or destructive works to avoid spread of CS and CA
- Even later, with more space available, smaller tents can be installed in the work area to limit contamination spread

Work processes

Group 1: Target, horn, reflector, TBID:

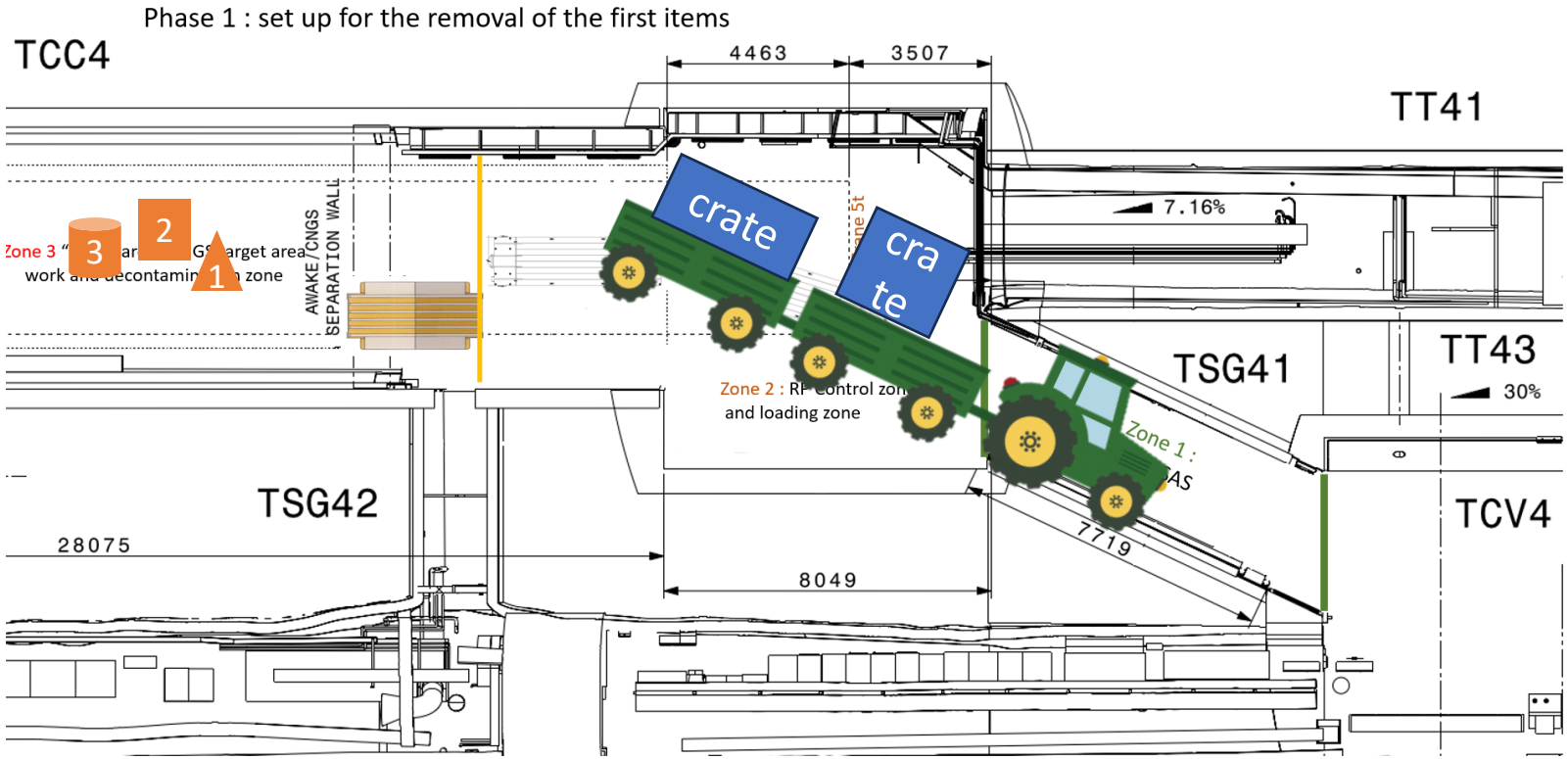
- High dose rate 2-50mSv/h
- High risk of surface contamination > 1CS
- Complex geometry
- Designed for semi-remote disconnect and full remote handling by crane

Group 1: Target, horn, reflector, TBID



- Remote removal from beam position
- Crane places in container, crane closes container
- Tractor leaves TCC4
  → surface building, where placed in road container (if different)
  → public road
  → radioactive waste center

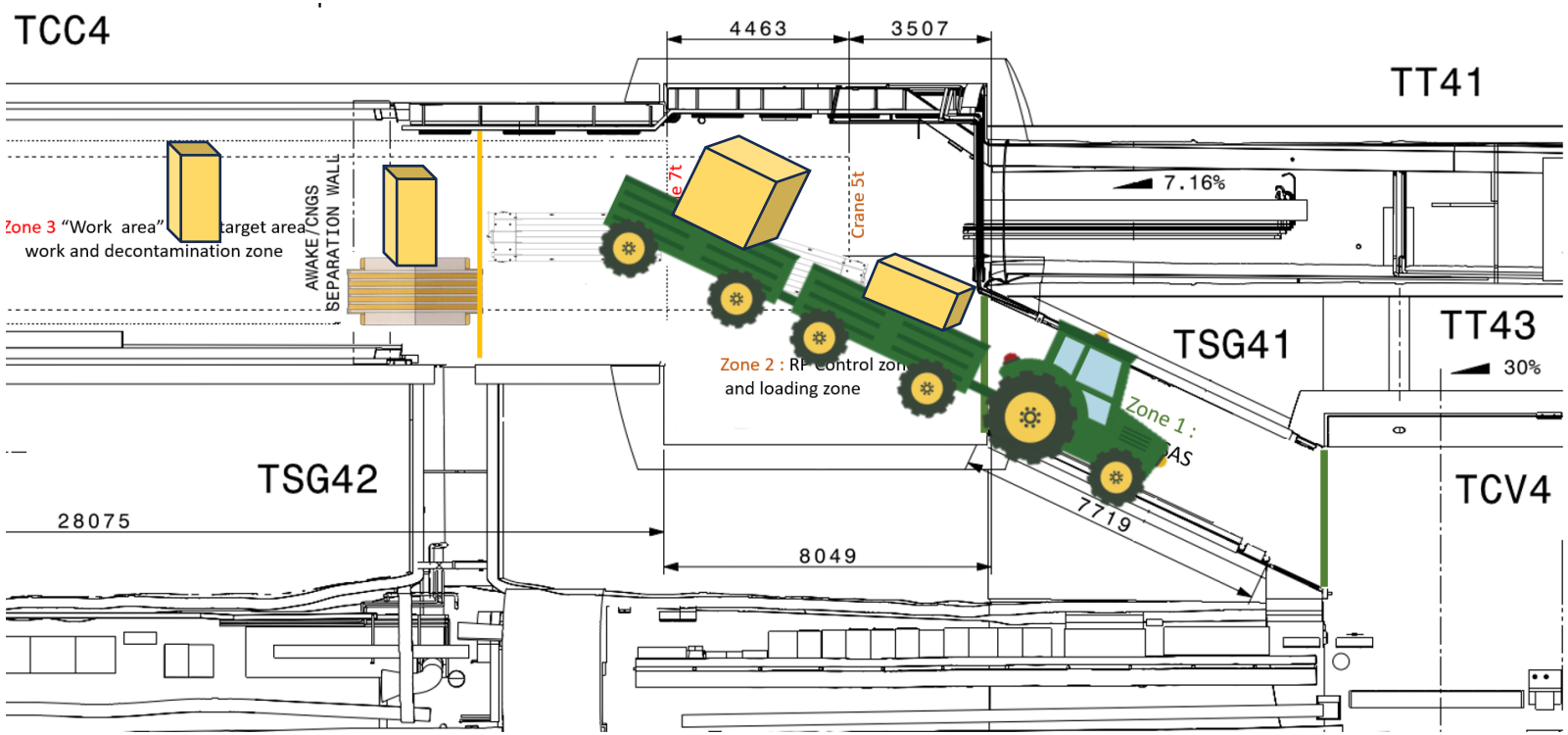
Group 2: Other items (except standard blocks)



- Manual removal from beam position with crane
- Objects are decontaminated and then controlled.
- Crane places items in correct crate with similar objects
- Two trailers per tractor, tractor leaves TCC4
  → surface building, where placed inn road truck
  → public road
  → radioactive waste center

Group 3: Standard shielding blocks

Most shielding blocks are exempt (dose rate, composition) from needing a container and can be transported on public roads, directly attached to the trailer



- Manual removal from beam position with crane
- Objects are decontaminated and then controlled.
- If needed, crane places the block on the "tourne-bloc" to be turned to correct position.
- Crane places items on trailer
- Two trailers per tractor, tractor leaves TCC4
  → surface building, where placed inn road truck
  → public road
  → radioactive waste center

After the dismantling: decontaminate & paint

- Decontaminate the floor, vault and crane rails until surface contamination levels at all locations <1CS
- Paint floor and walls (up to 1.5m) with a resin that
  - Fixes remaining contamination to the wall
  - Makes future decontamination easier





After the dismantling: shielding

- Simulations show some areas (under horn and reflector) may be >50µSv/h, and need permanent shielding.

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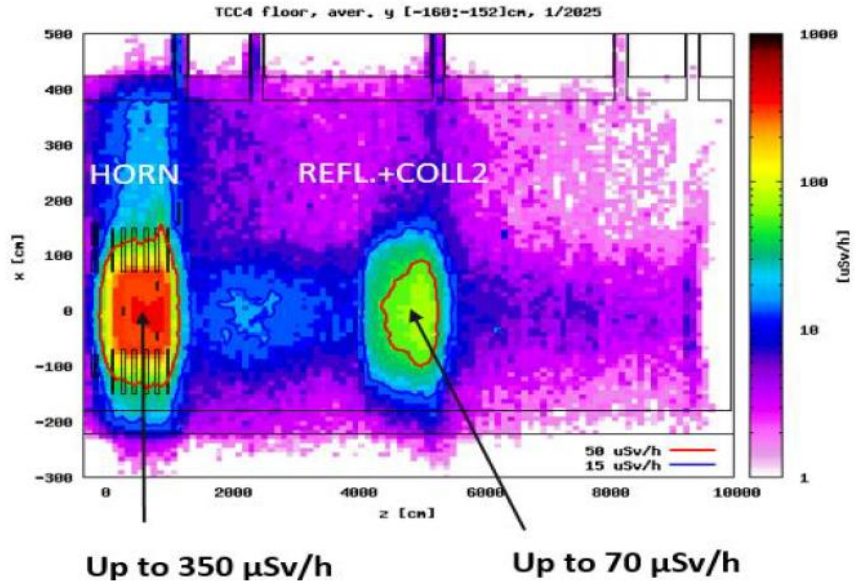
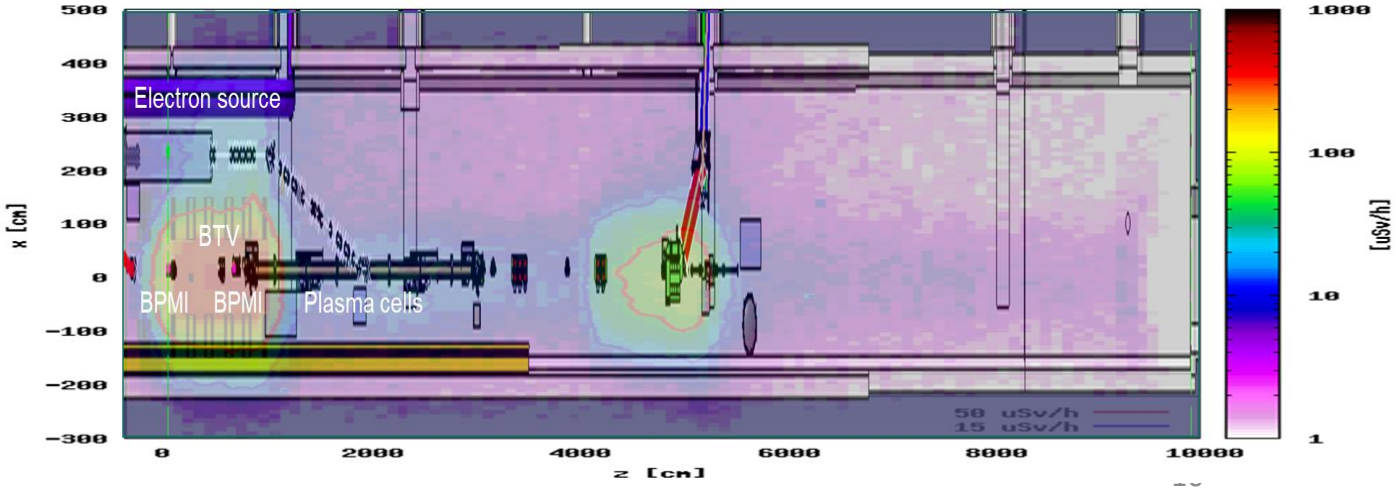
Ambient dose rates and shielding requirements for the empty TCC4 tunnel (after CNGS dismantling)

by ELZBIETA MARTA NOWAK, CLAUDIA AHDIDA

Region	Material	Thickness	Size
Horn floor	Fe	8.1 cm	13 m x 2.8 m
	Concrete	25.5 cm	
Reflector floor	Fe	3.6 cm	5 m x 1.5 m
	Concrete	11.4 cm	

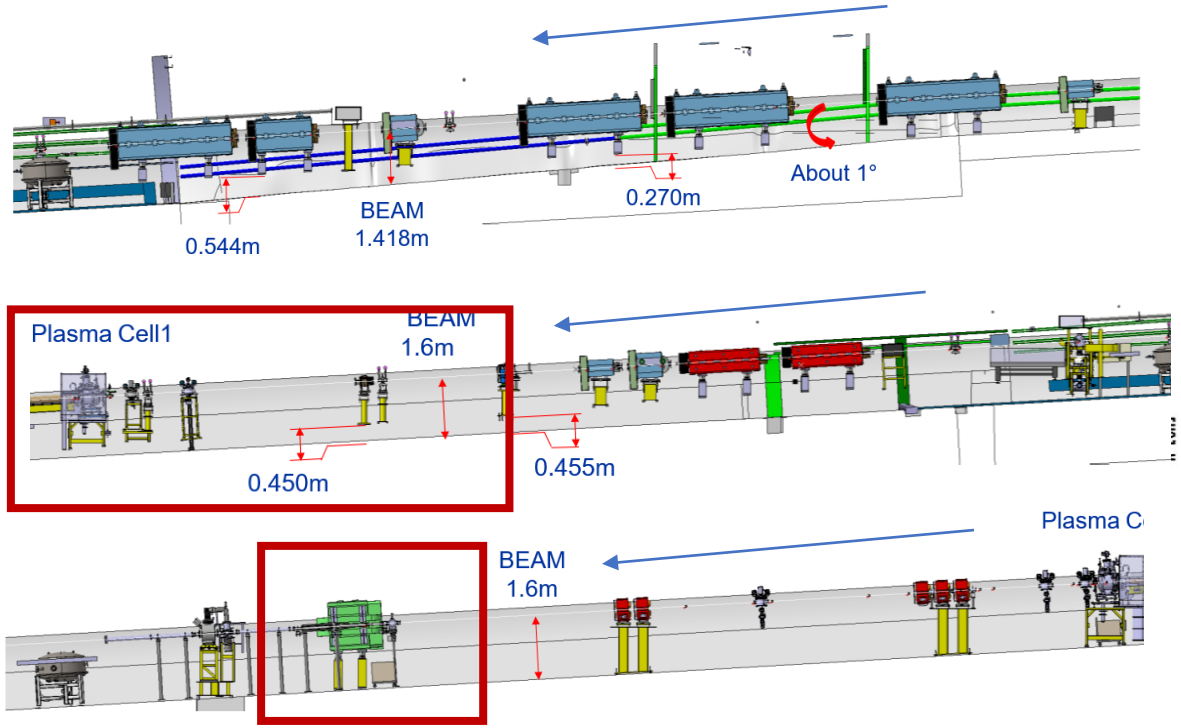
Top view of tunnel floor

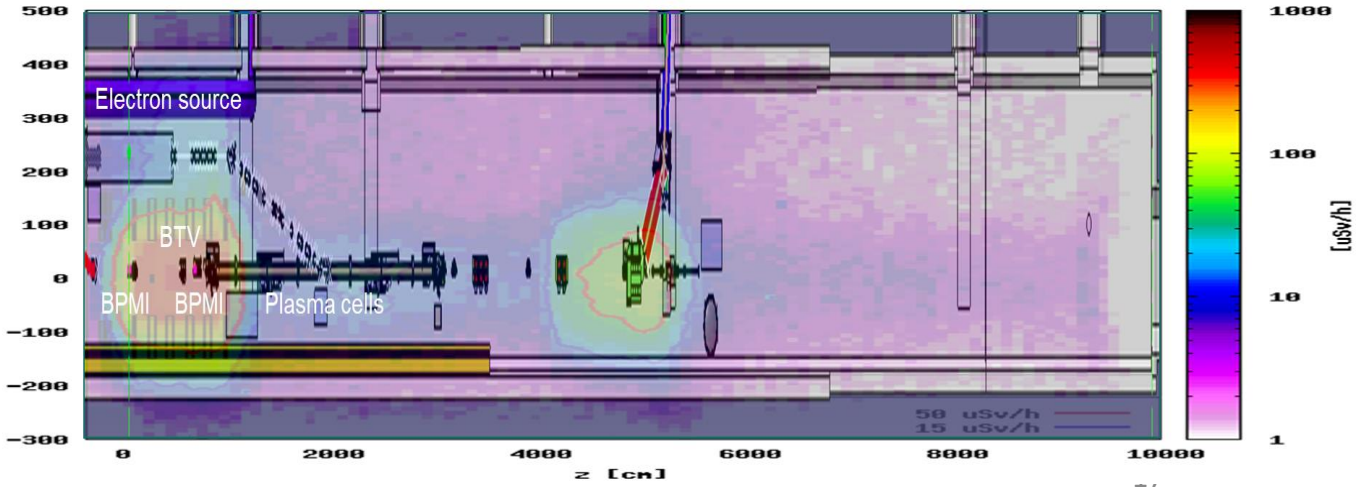




After the dismantling: shielding

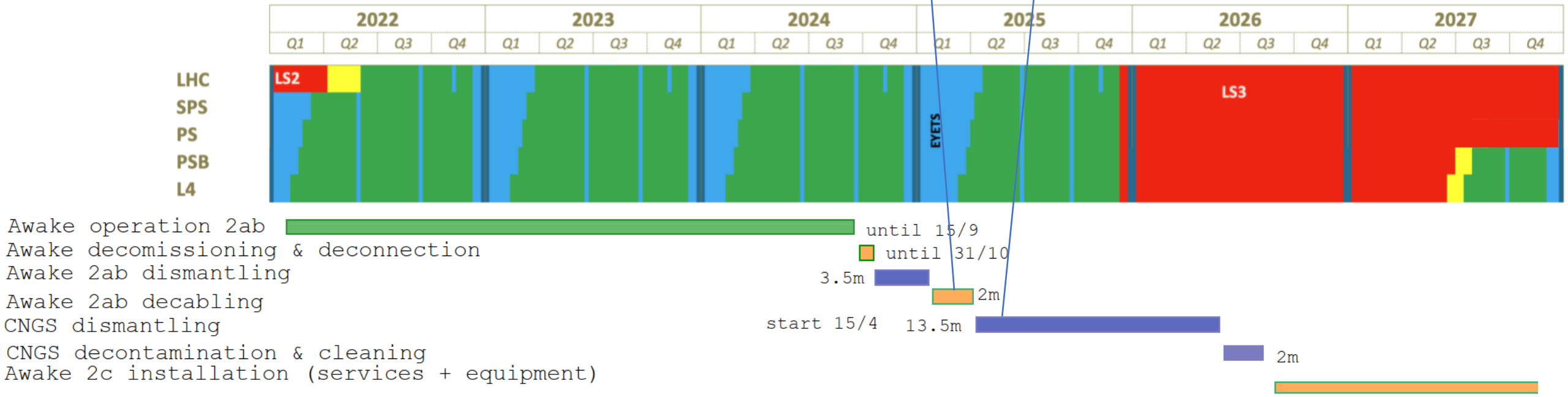
- Simulations show some areas (under horn and reflector) may be >50µSv/h, and need permanent shielding.
- 40cm shielding blocks would also help compensate for the height difference between AWAKE 2ab and AWAKE 2c supports upstream of the 1st plasma cell





Baseline planning “unchanged”

Surface building ready 15/5/2025, allows 1m of preparation before breaking down the wall



Last proton ~~15/9/2024~~ → 15/10/2024 = minor change

Start dismantling 1/12/2024

Start de-cabling 15/3/2024

Area emptied and cleaned AWAKE ~Q3 2026

Operation
Technical Stops
Long Shut-down
(Re)Commissioning

Summary of status CNGS dismantling

- CNGS dismantling detailed study is progressing:
  - Work areas and processes (contamination containment, logistics)
  - Dismantling procedures in TCC4 → Call for Tender Q3 2024 (ext. contract)
  - Radioactive transport on-road → Order containers/trailers/tractors Q2 2024
  - Radioactive waste processing steps being defined

- Main challenges & risks:
  - **Cost** uncertainty (building & dismantling contractor)
    → Try to prepare as well as possible → Ask me again late 2024
  - Changing of AWAKE's surroundings:
    New projects and priorities at CERN (CONS, HiLumi, FCC) as well as ~~likely~~ possible delays in CERN's LS3 planning affect **resource** availability for AWAKE
    → Many discussions in the coming months, too early to tell