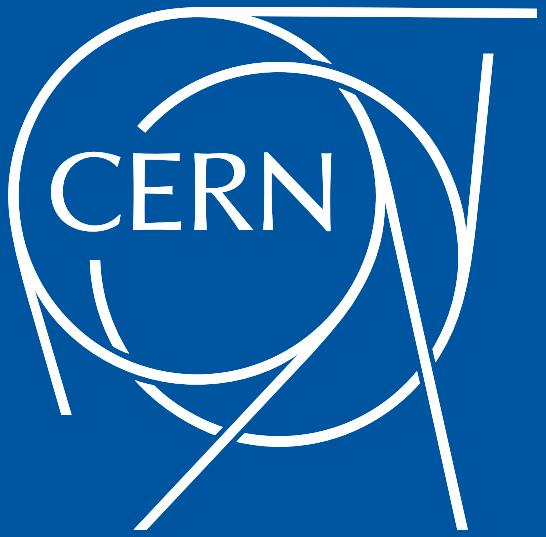
CERN

Update on the Concept for a New ISOLDE Experimental Hall

Jose Alberto Rodriguez (BE-OP-ISO)
Erwin Siesling (BE-OP-ISO)
Eliseo Perez (SCE-DOD-FS)
Johan Dauge (SCE-SAM-TG)

Outline:

- Introduction and Summary of the 2020 EPIC Workshop
- Initial 3D Model of the Facility
- Layout of the Underground and Surface Levels
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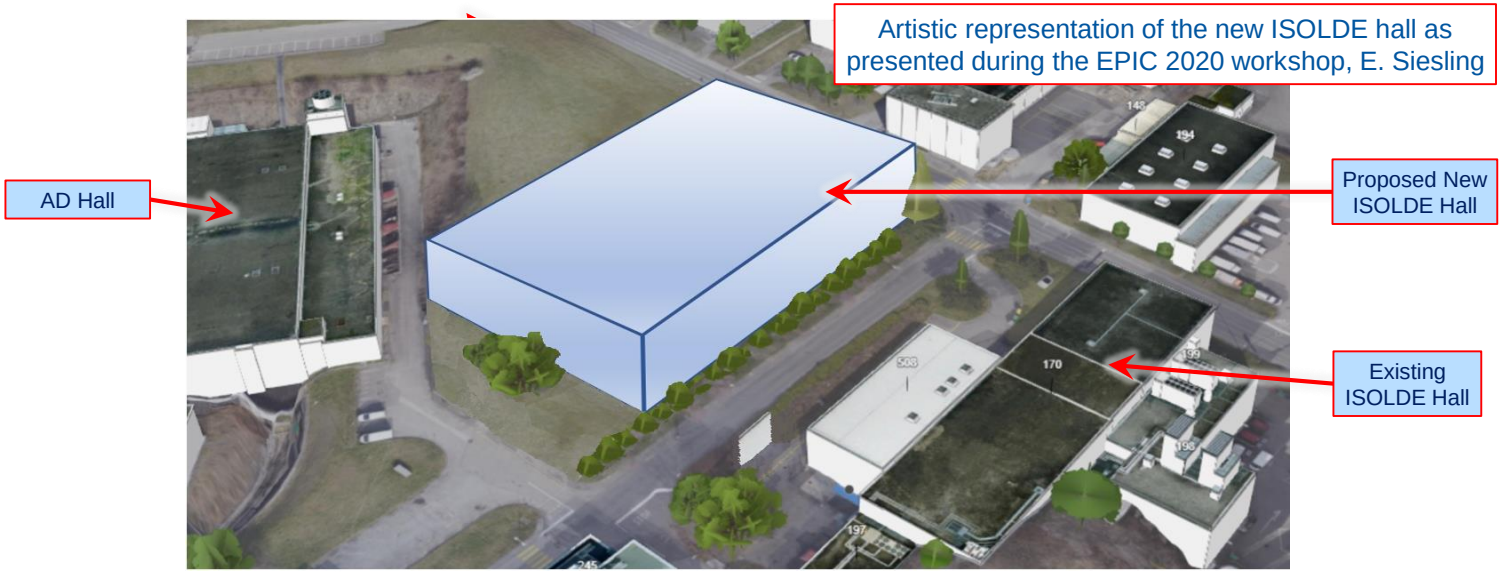
- Summary

Introduction and Summary of the 2020 EPIC Workshop:

From 2019 and 2020 **EPIC Workshops**:

- Strong demand to **increase the capacity** of the facility (additional experimental stations, multi-user operation, handling of higher intensity and energy proton beams, additional target stations…)
- Improve existing and adding **new capabilities** to the facility (beam purification, real-time RIB production monitoring, possible AD-ISOLDE and nToF-ISOLDE physics…)



To address these needs:

- A **new low-energy experimental hall** was proposed during the EPIC 2020 workshop (building, beamlines)
- Located across the street of the existing ISOLDE hall where the CERN's recuperation building is (bld. 133)
- The new experimental area (72 m x 50 m) could **accommodate ~ 20 experimental stations**
- Two new underground target areas used to produce the RIBs required to serve the experimental stations
- The construction of the new facility would **not interrupt the physics program of the existing facility**

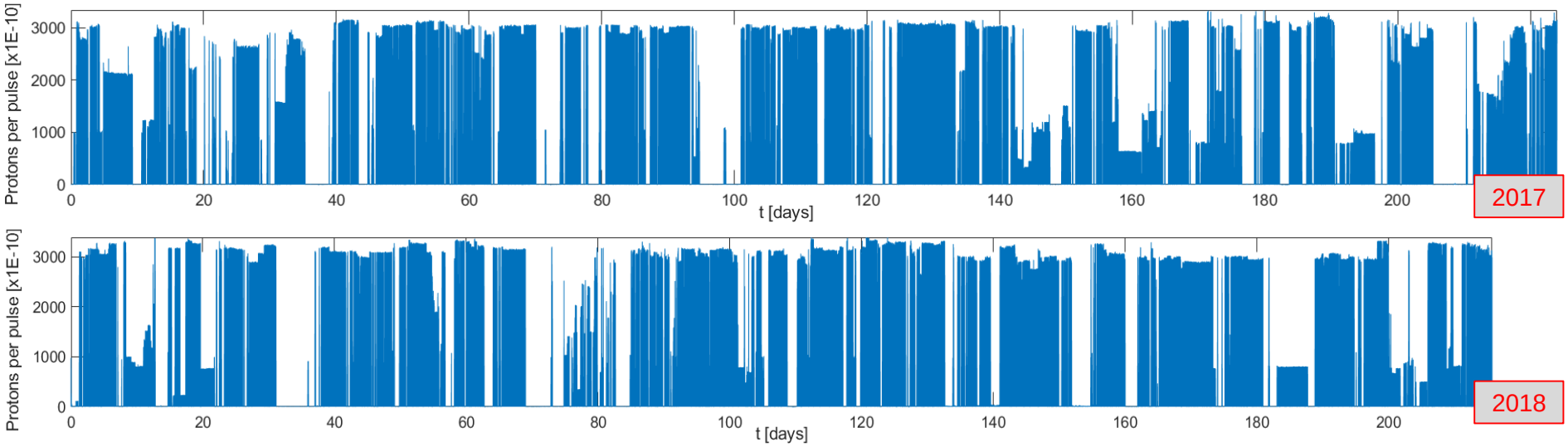
Introduction and Summary of the 2020 EPIC Workshop:

In order to produce enough RIBs to sustain physics programs in all experimental stations, the new facility:

- Should be able to handle both 1.4 and 2.0 GeV protons
- Should be able to handle a potentially higher proton intensity from Linac4 and the PSB
- Should minimize the idle time in between experiments (i.e. parallel physics and set-up). Currently:

	2018	2017
Start date	April 10th	April 24th
End date	Nov. 12th	Dec. 4th
Number of days	215.6	224
Protons at ISOLDE	9.6E19	9.0E19
I_{AVG} [uA]	0.83	0.74
Effective I_{AVG} [uA]	~ 0.95	~ 0.85

- The typical average proton current during a campaign is ~ 0.8 uA
- Once scheduled stops, downtime, machine studies… are factored in, the effective proton current is still ~ 0.9 uA far from the available 1.5 uA
- This gap is due to the time needed in between experiments for beam set-up, characterization and optimization, user requirements on the proton structure and occasional machine/target studies



Proton beam current delivered to the ISOLDE facility

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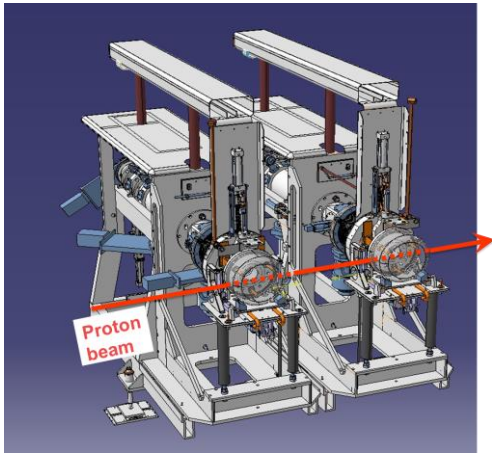
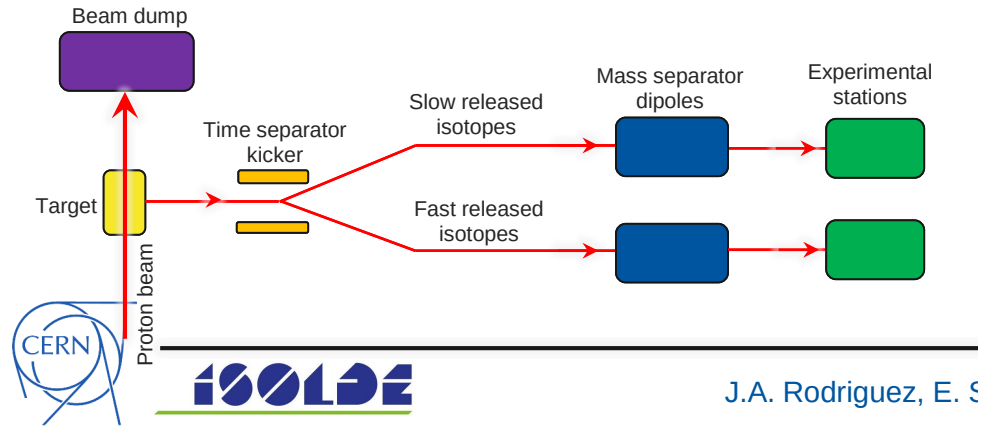
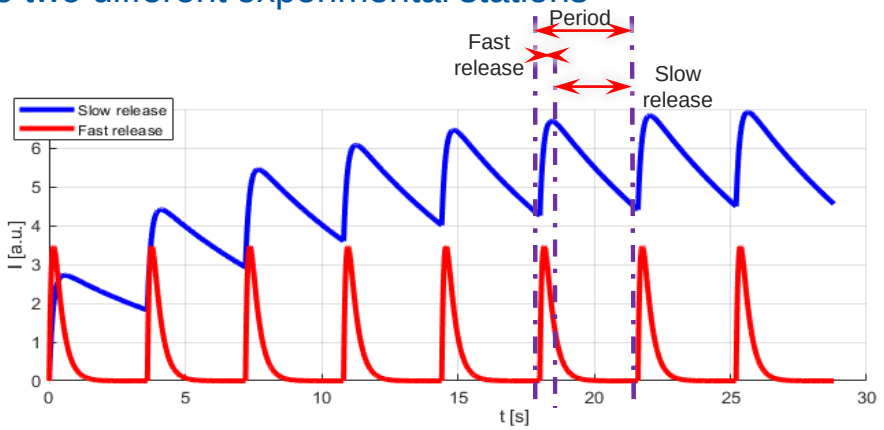


- Could be designed to profit from double-target front-ends:
  - Two target units in series in a target area to profit from the full proton current simultaneously
  - Each target unit is followed by a full on-line separator
  - Two RIBs delivered simultaneously to two different experimental stations

- Could be capable of separating fast and slow released RIBs :
  - A pulsed electrostatic kicker synchronized with the proton impact used to separate fast and slow released RIBs into two different beam lines
  - Each beamline is equipped with its own mass separator dipole
  - The two RIBs can be delivered simultaneously to two different experimental stations





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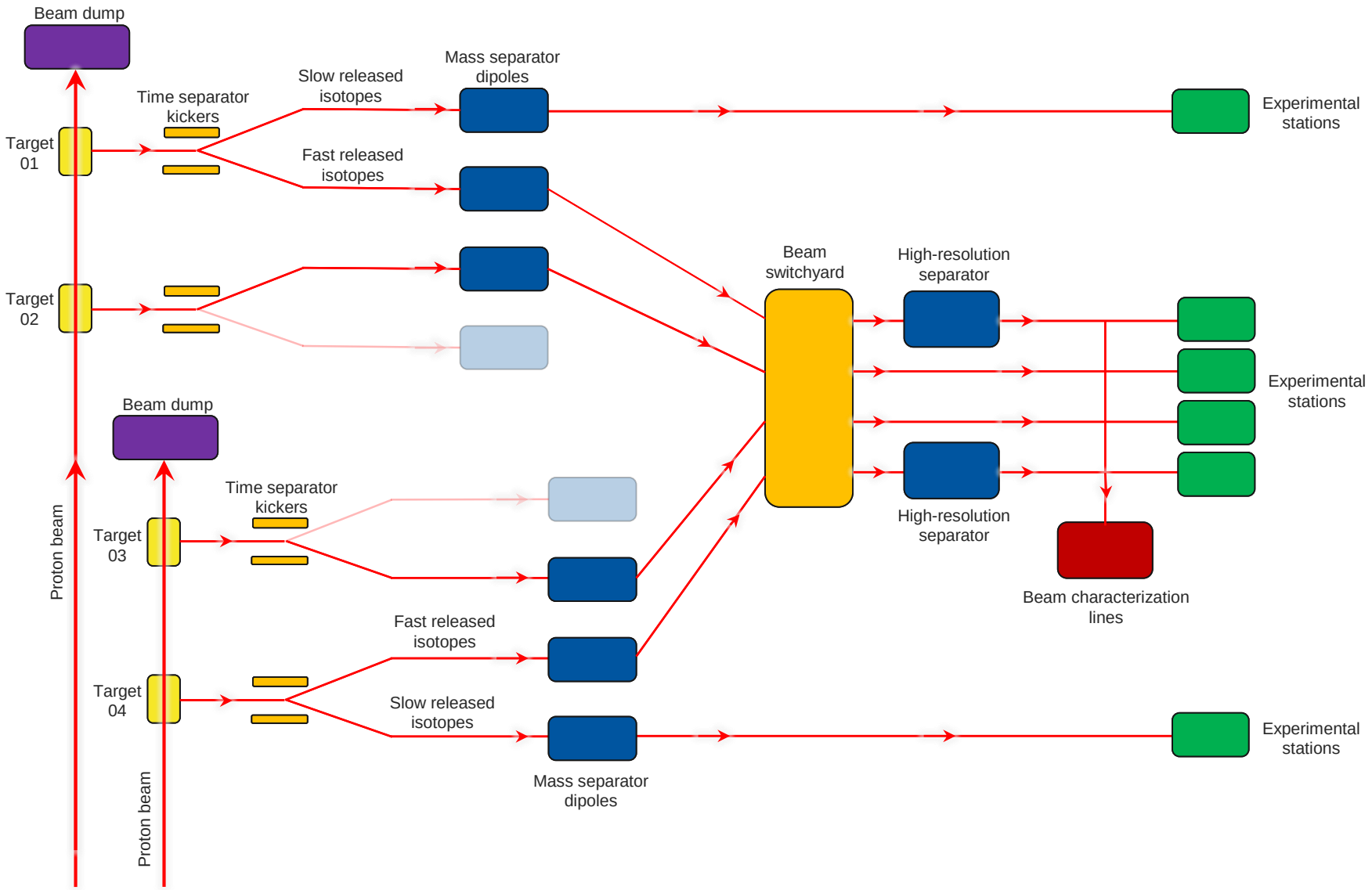

Outline:

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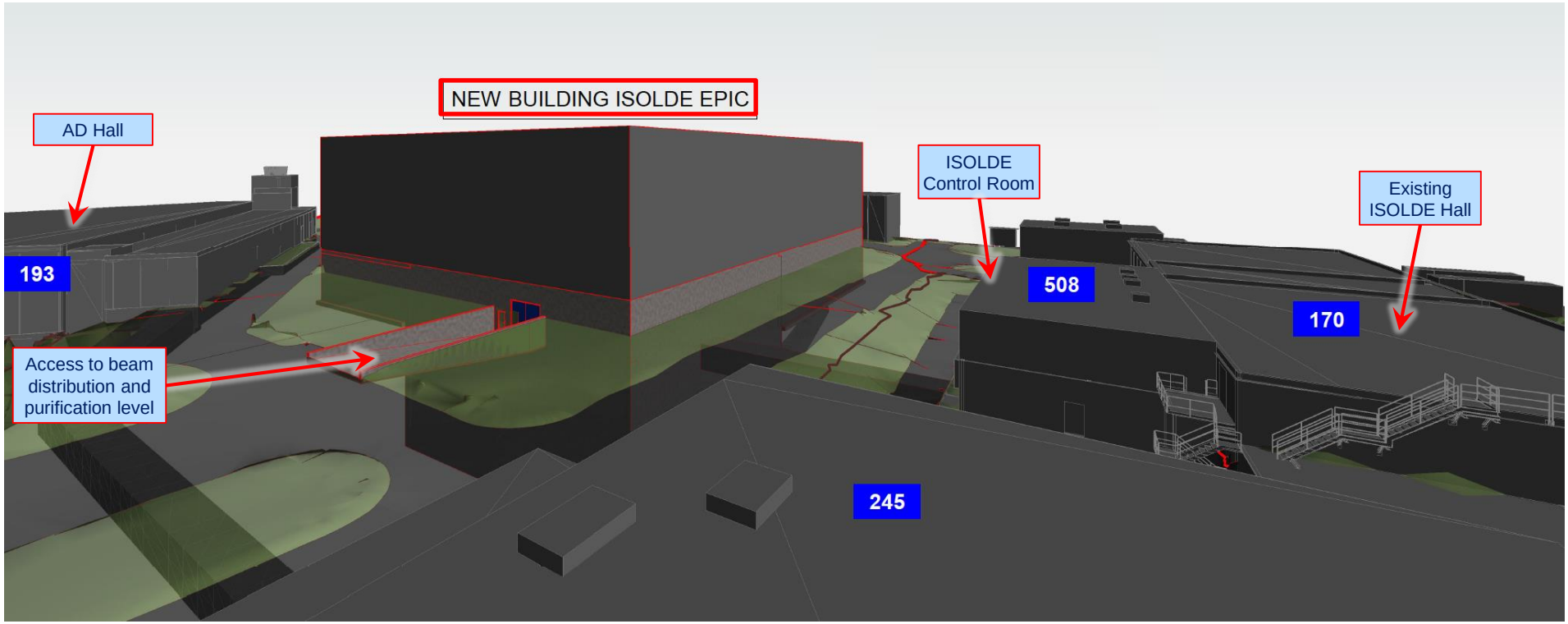
Initial 3D Model of the Facility:

- Thanks to the funds provided by the collaboration, colleagues from civil engineering have prepared an initial 3D model of the new experimental hall and the underground facilities
- Even though a lot of additional work is still needed, no blocking issues have surfaced so far and the proposal seems feasible



Initial 3D Model of the Facility: Top View

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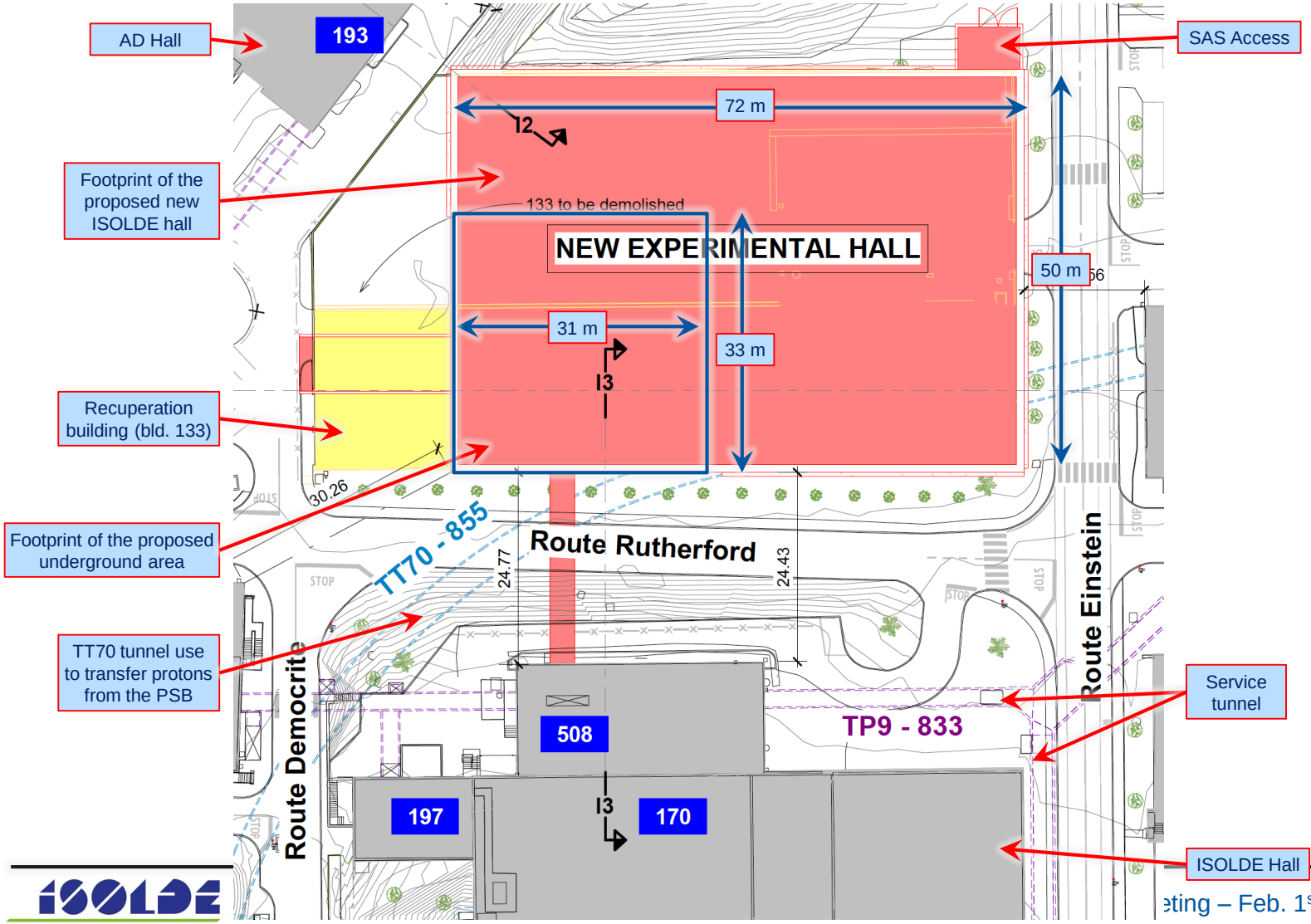
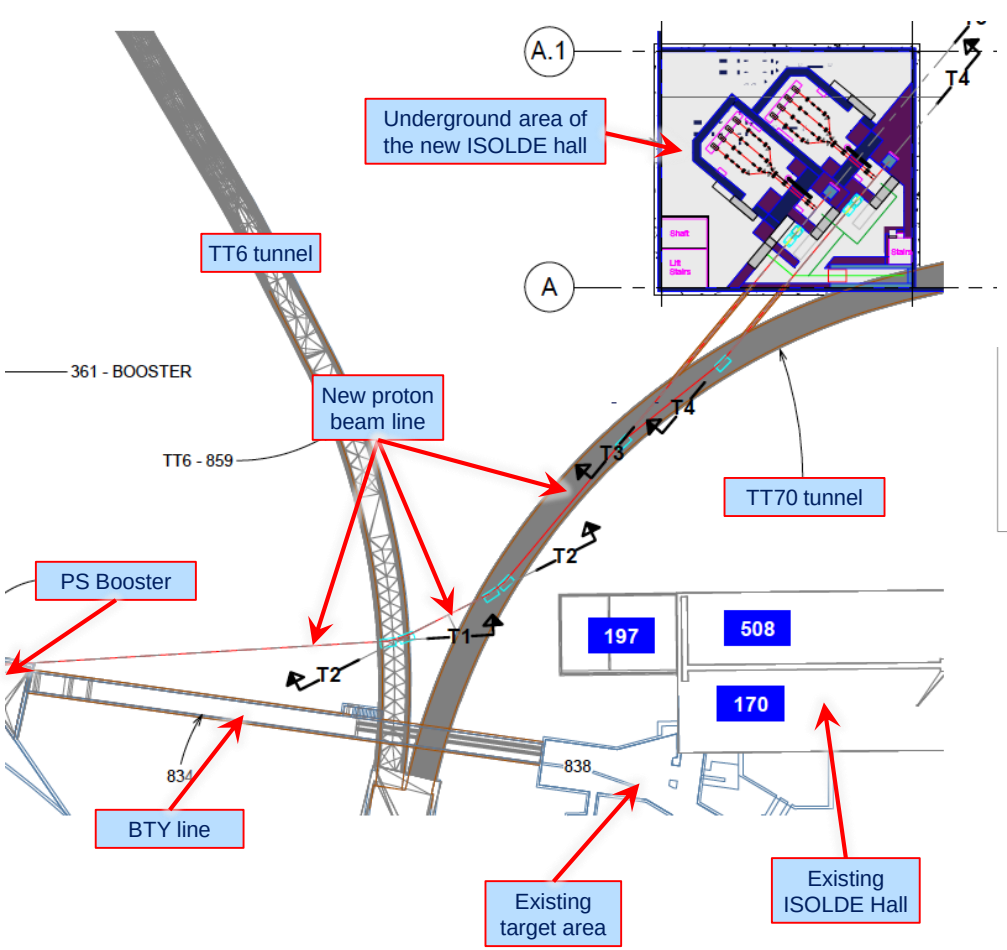
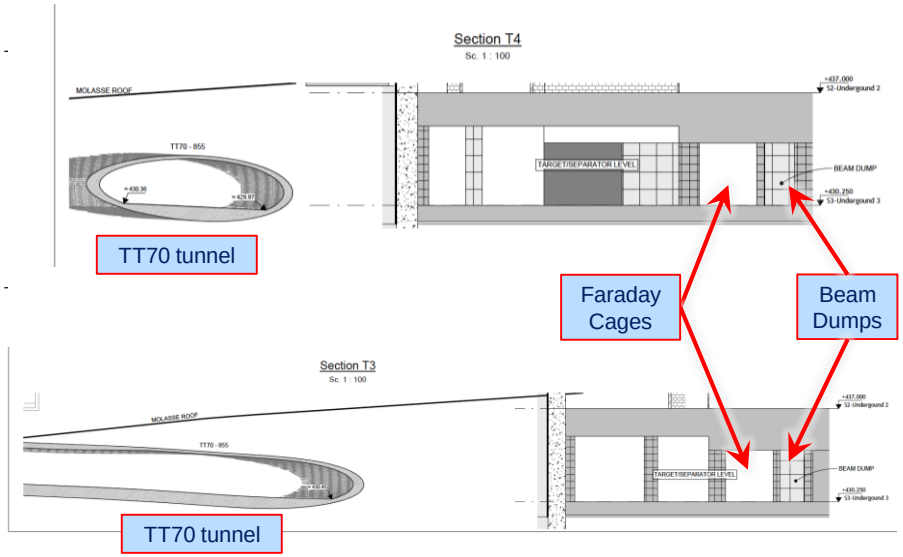


Initial 3D Model of the Facility: Connection to the PSB

- The connection between the PSB and the underground target area for the new ISOLDE hall studied
- Tentative layout of the proton beam line prepared





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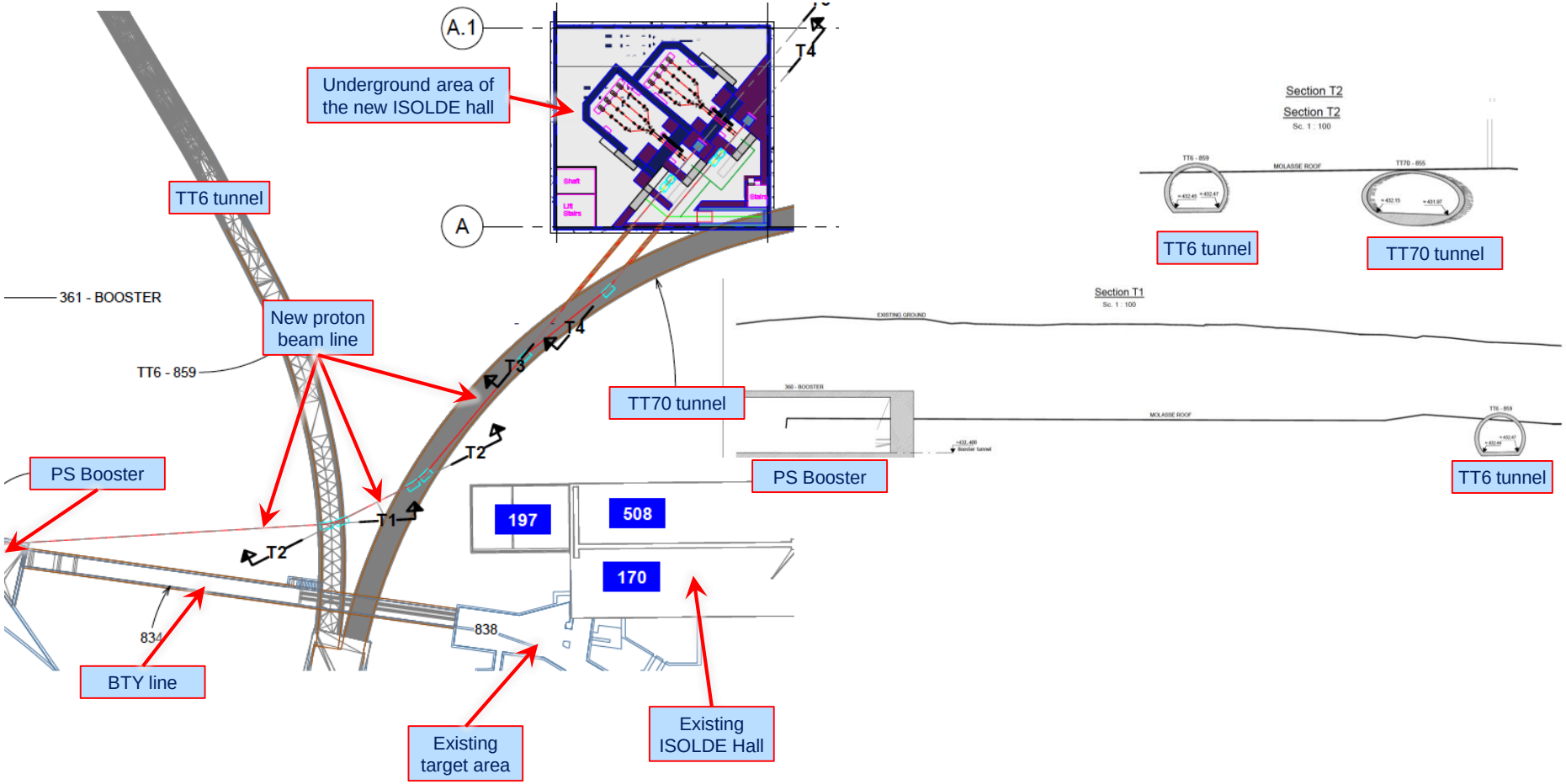
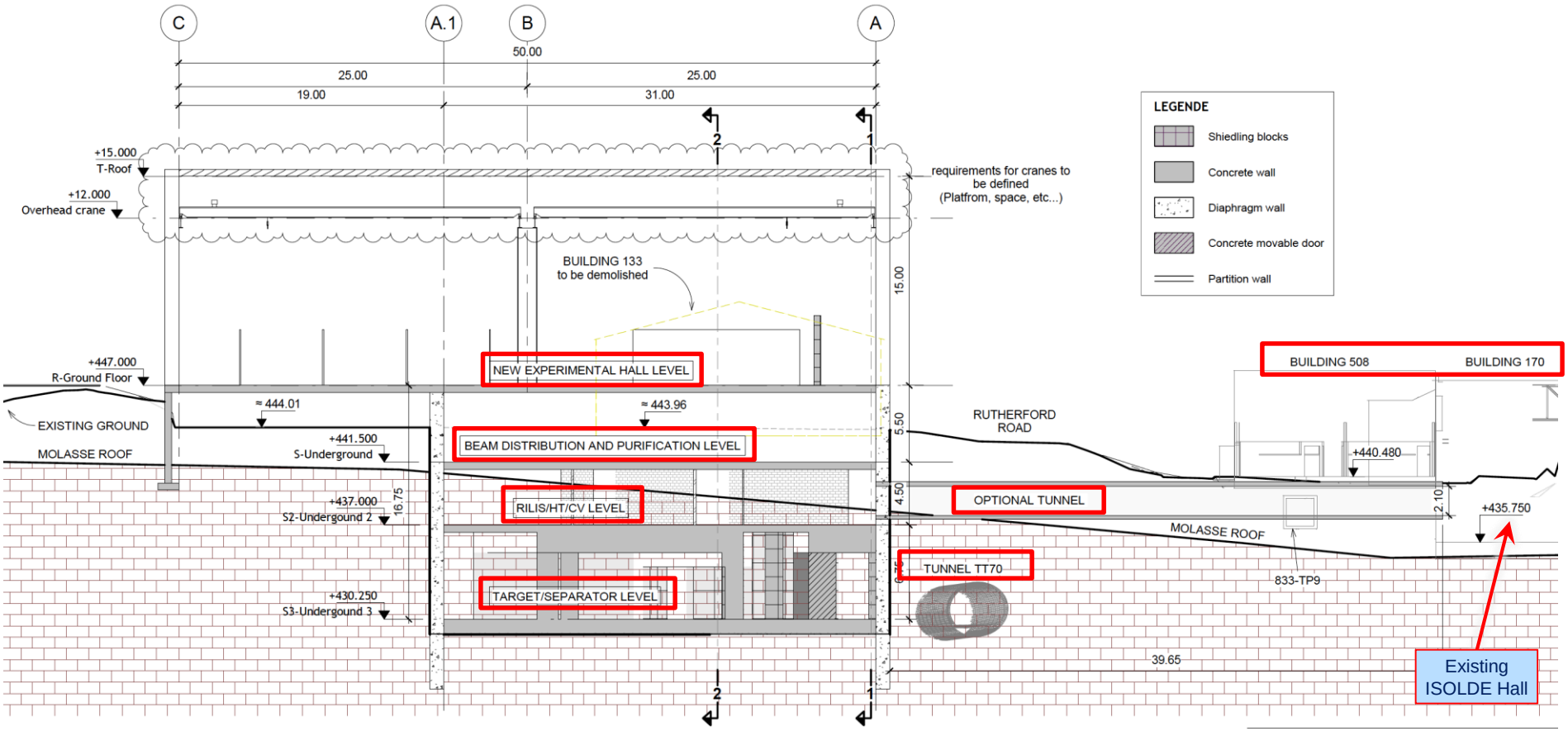


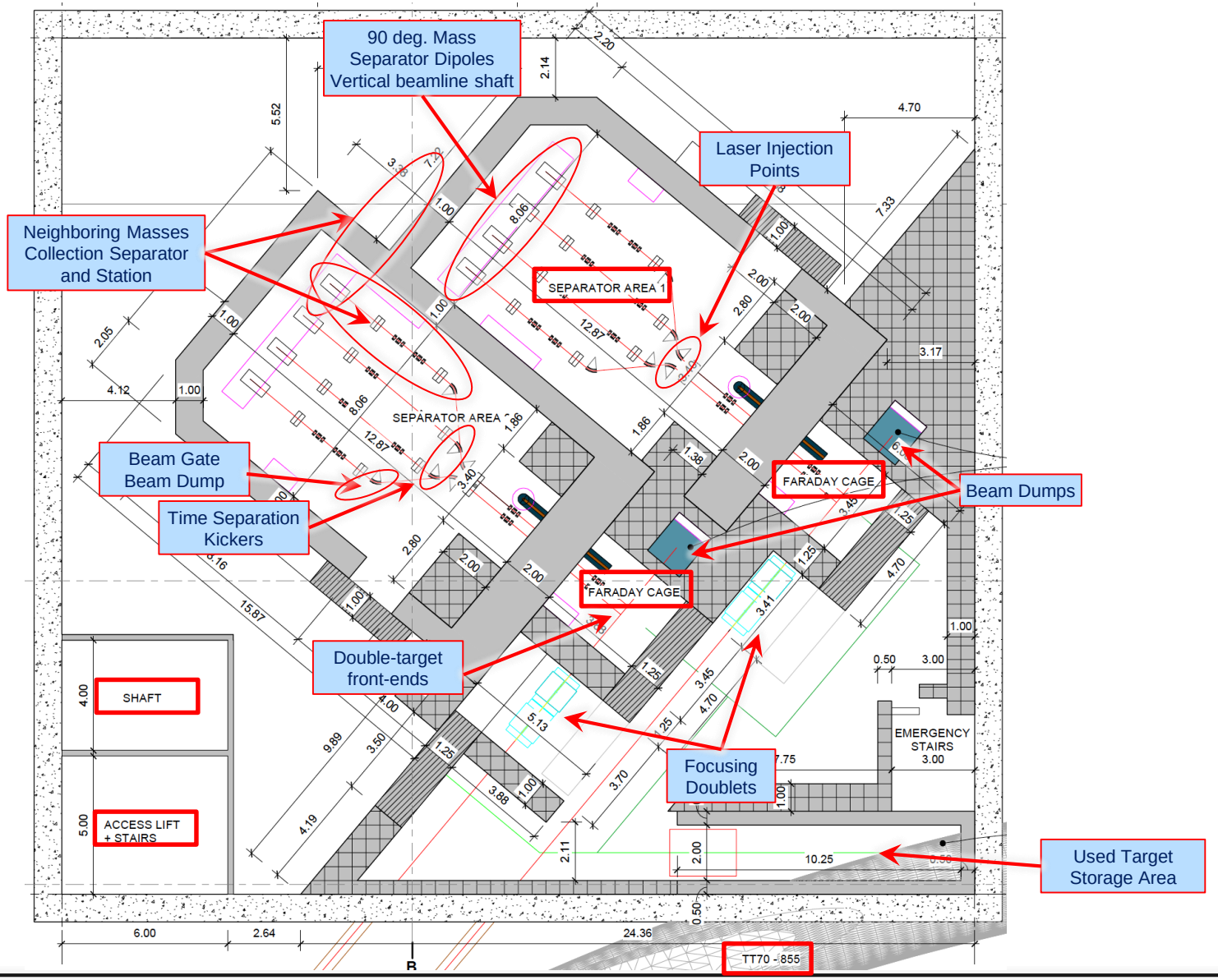
Initial 3D Model of the Facility: Cross Section



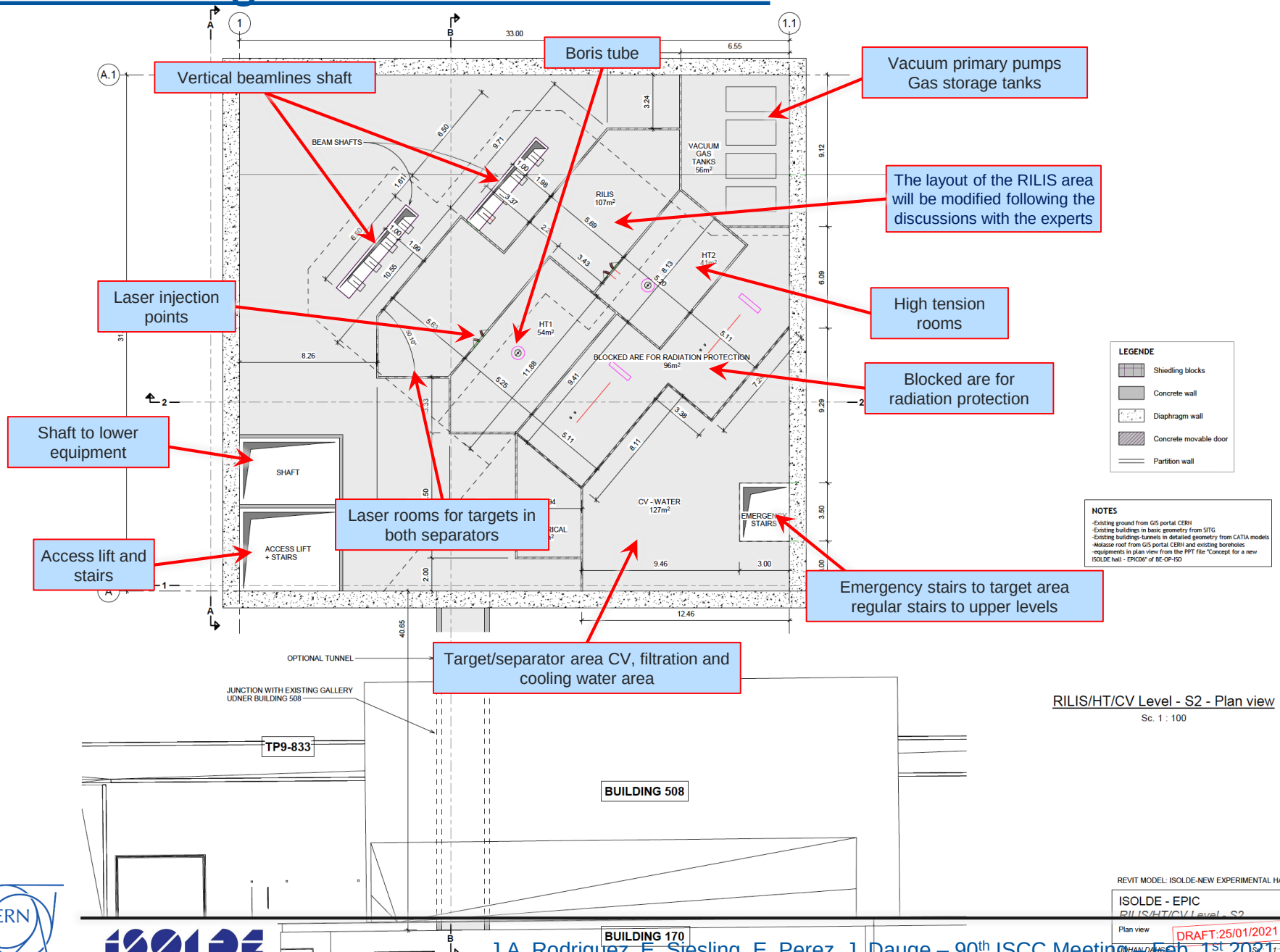
- An optional tunnel between the two experimental halls being studied to profit from the new beam purification possibilities during the high-energy experiments

Layout of the Underground and Surface Levels:

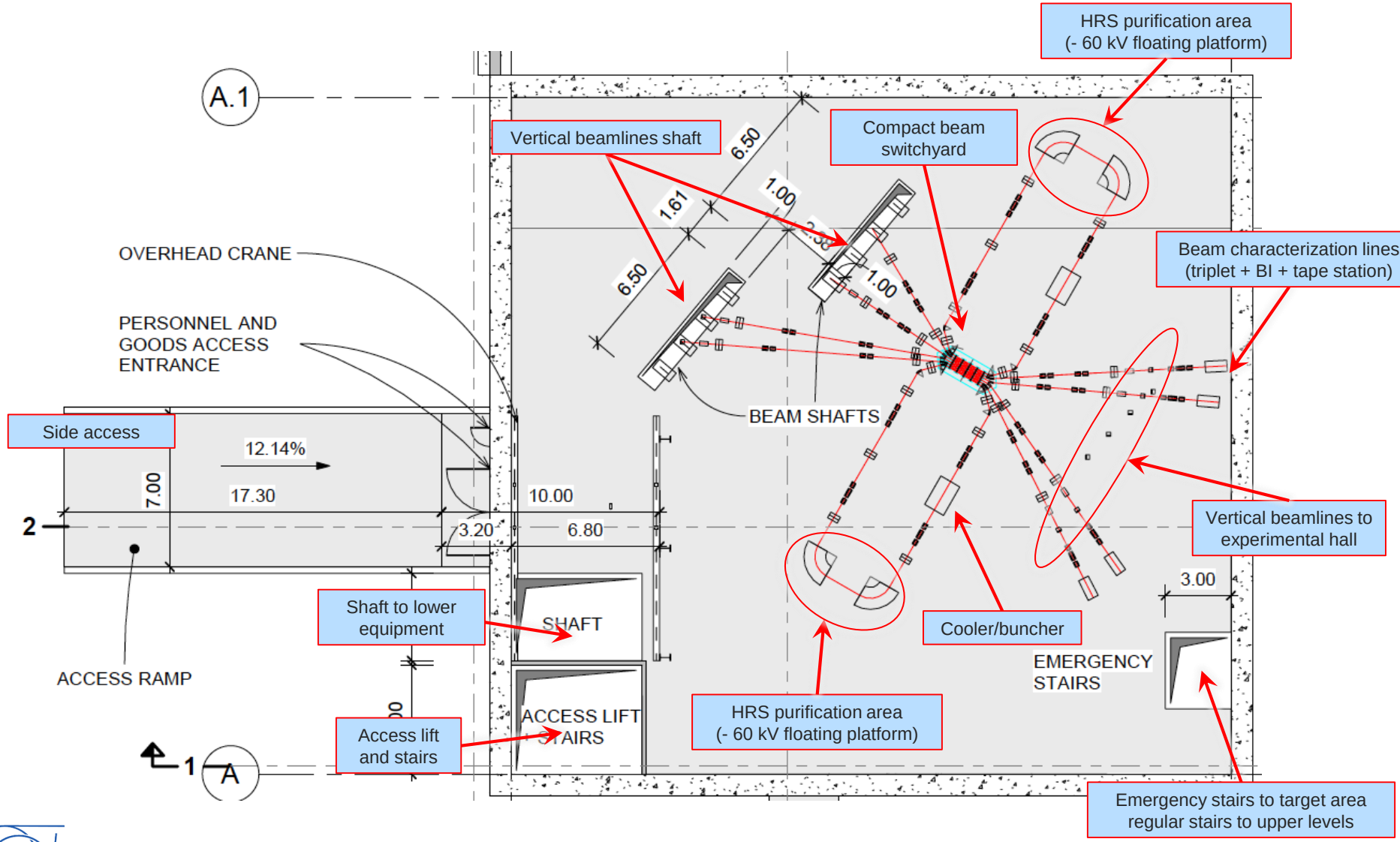
- The layout of the target / separator modified to reduce the cost of the proton beam line



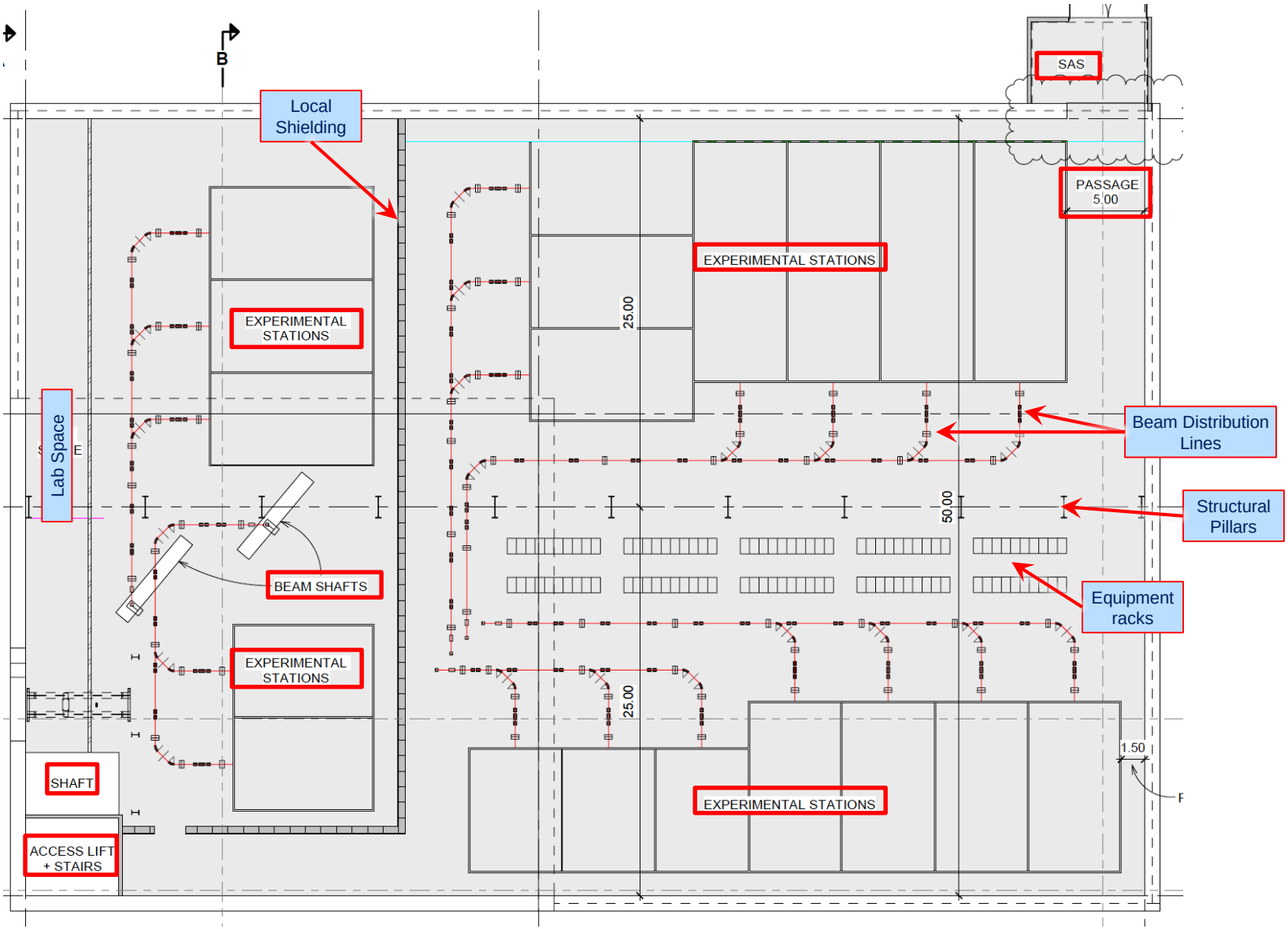
RILIS / High Tension / CV Level:



Beam Distribution and Purification Level:



Layout of the Underground and Surface Levels:



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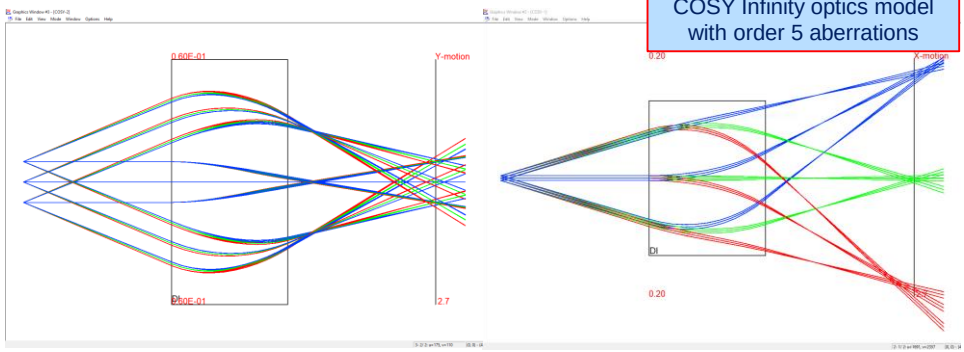
Optics and Electromagnetic Models: Mass Separator

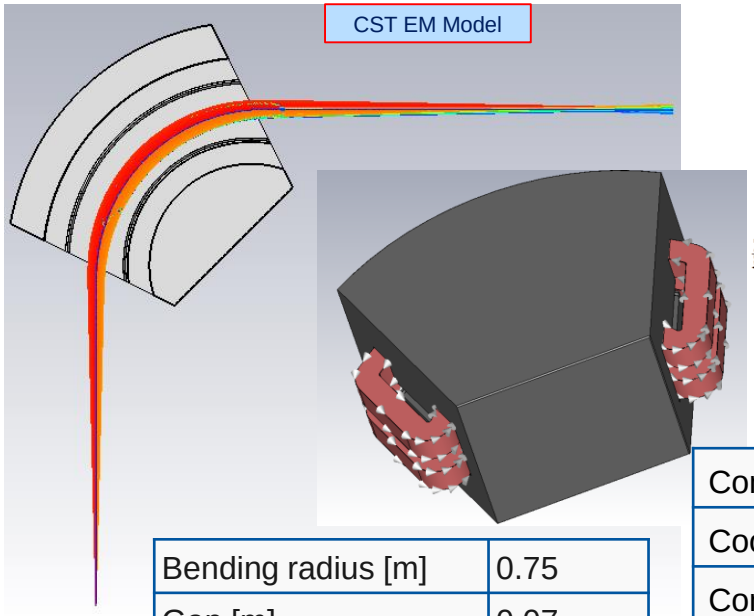
First iteration completed. Performance and cost optimization still pending

- COSY Infinity optics model completed
- Main parameters of the dipole and coils defined
- CST electromagnetic model completed
- Particle tracking for different masses and energies
- Potential power converter identified

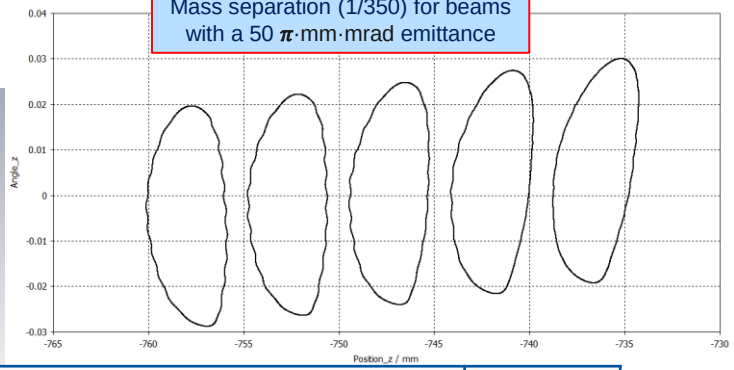
COSY Infinity optics model with order 5 aberrations



CST EM Model



Mass separation (1/350) for beams with a 50 π·mm·mrad emittance



COMET power converter

Bending radius [m]	0.75
Gap [m]	0.07
Effective gap [m]	0.06
Approx. B [T] at Imax	1.1848
Edge angle [deg]	26.57
Flat field region [m]	0.13

Conductor dimension [mm]	8
Cooling circuit radius [mm]	2.5
Conductor cross-section [mm2]	48.29
# Conductors xy-plane per coil	11 x 2
# Coils per magnet	12
Resistance magnet [Ohm]	0.318
Dimension xy with insulation [mm]	99 x 108

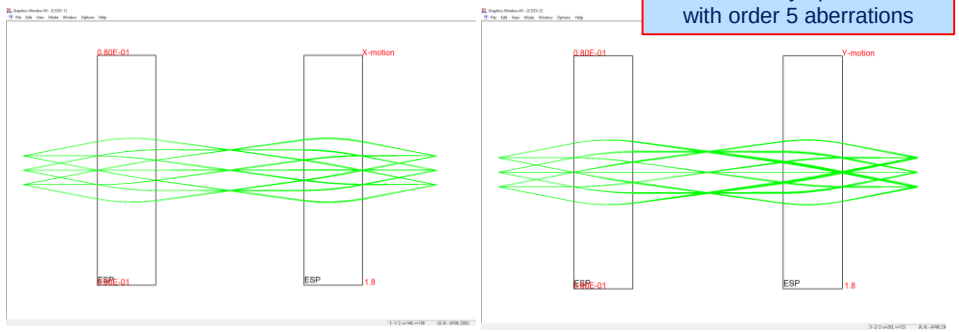
Model	COMET
Imax [A]	250
Vmax [V]	120
Vdrop at Imax [V]	79.5

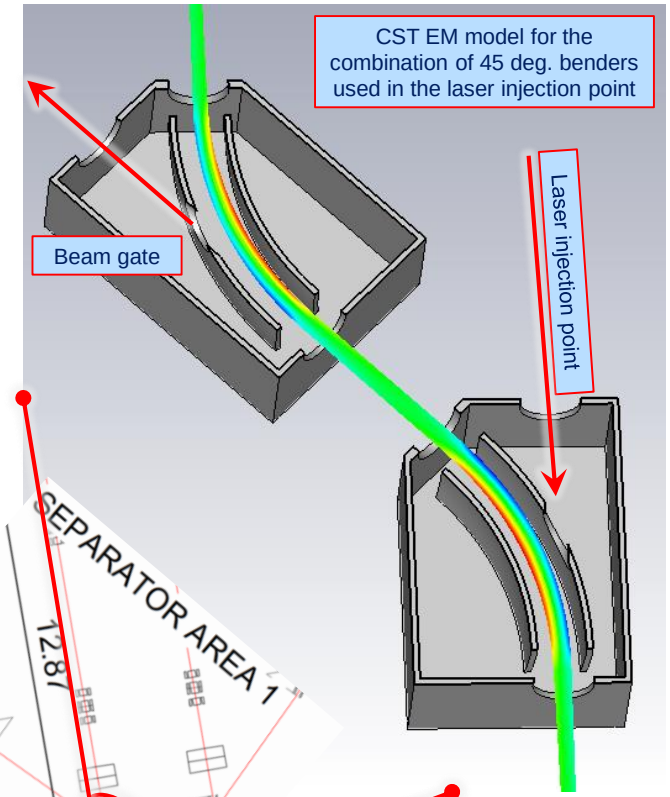
Optics and Electromagnetic Models: Electric Benders

First iteration for the 45 deg. electrostatic spherical benders completed

- COSY Infinity optics model completed
- CST electromagnetic model completed
- Particle tracking for beams with different emittances
- Several combinations studied (90 deg. bending, laser injection for ionization, beam gates…)

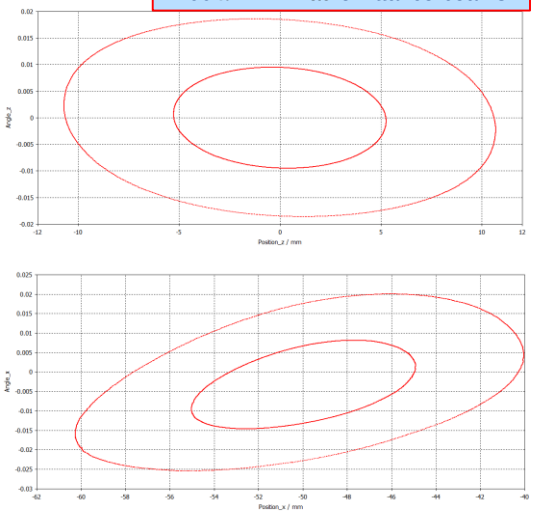
COSY Infinity optics model with order 5 aberrations





Bending radius [m]	0.5
Gap [m]	0.08
Emax [keV]	60 / 100
V [kV] at Emax	± 8.9 / 14.8
Dynamic aperture [π·mm·mrad]	200

Aberrations introduced for 50 and 200 π·mm·mrad emittance beams



Power converters:
- Iseg multichannel HV systems

Pulsing options:
- HV relays: Down to a few ms with HV relays
- Down to us with HV fast pulsers (e.g. DEI PVX-4110)

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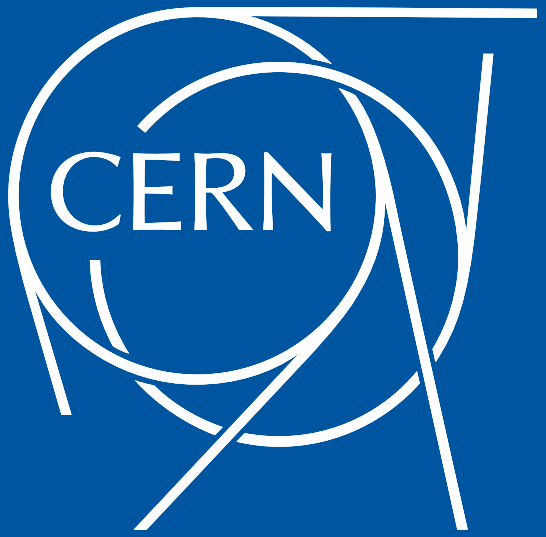
Summary:

- Concept for a new ISOLDE experimental hall introduced during the EPIC Workshops
  - Located at CERN's recuperation building (bld. 133)
  - Maximize the production of RIBs using double-target front-ends and time separation kickers
  - Protons from the PSB using the TT70 tunnel
  - Underground levels: Target/Separators, RILIS/HT/CV, Beam distribution and purification
  - Surface building dedicated to low-energy physics (space for ~ 20 experimental stations)

- Initial 3D model created by the Site and Civil Engineering (SCE) department
  - Both building and the connection to the PSB studied
  - Concept seems feasible from the civil engineering point of view

- Initial optics and electromagnetic models of critical elements developed by the Beams (BE) department
  - Separator dipoles
  - Electrostatic benders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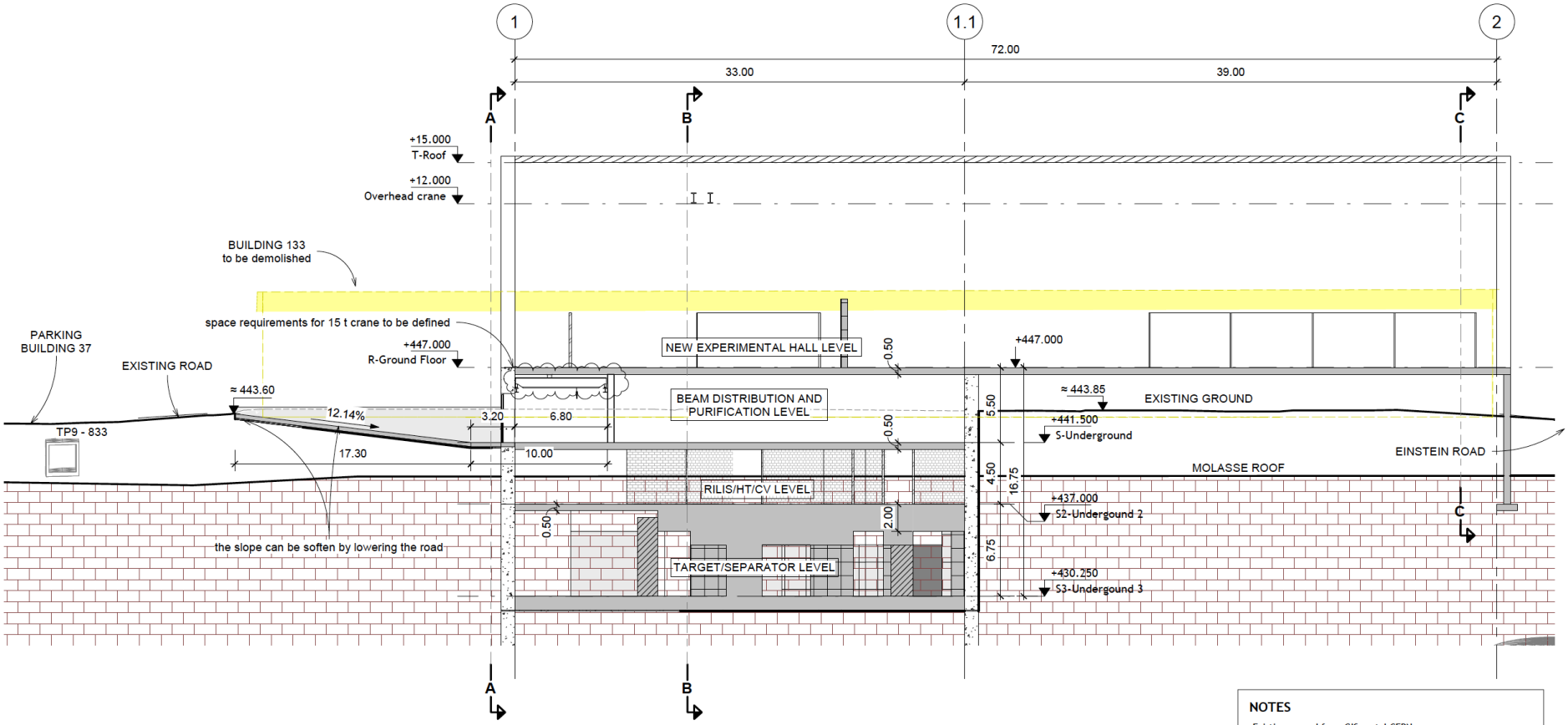
Facility Cross Section:



Section 2

Sc. 1 : 200

LEGENDE

- Shiedling blocks
- Concrete wall
- Diaphragm wall
- Concrete movable door
- Partition wall

NOTES

-Existing ground from GIS portal CERN
-Existing buildings in basic geometry from SITG
-Existing buildings-tunnels in detailed geometry from CATIA models
-Molasse roof from GIS portal CERN and existing boreholes
-equipments in plan view from the PPT file "Concept for a new ISOLDE hall - EPIC06" of BE-OP-ISO

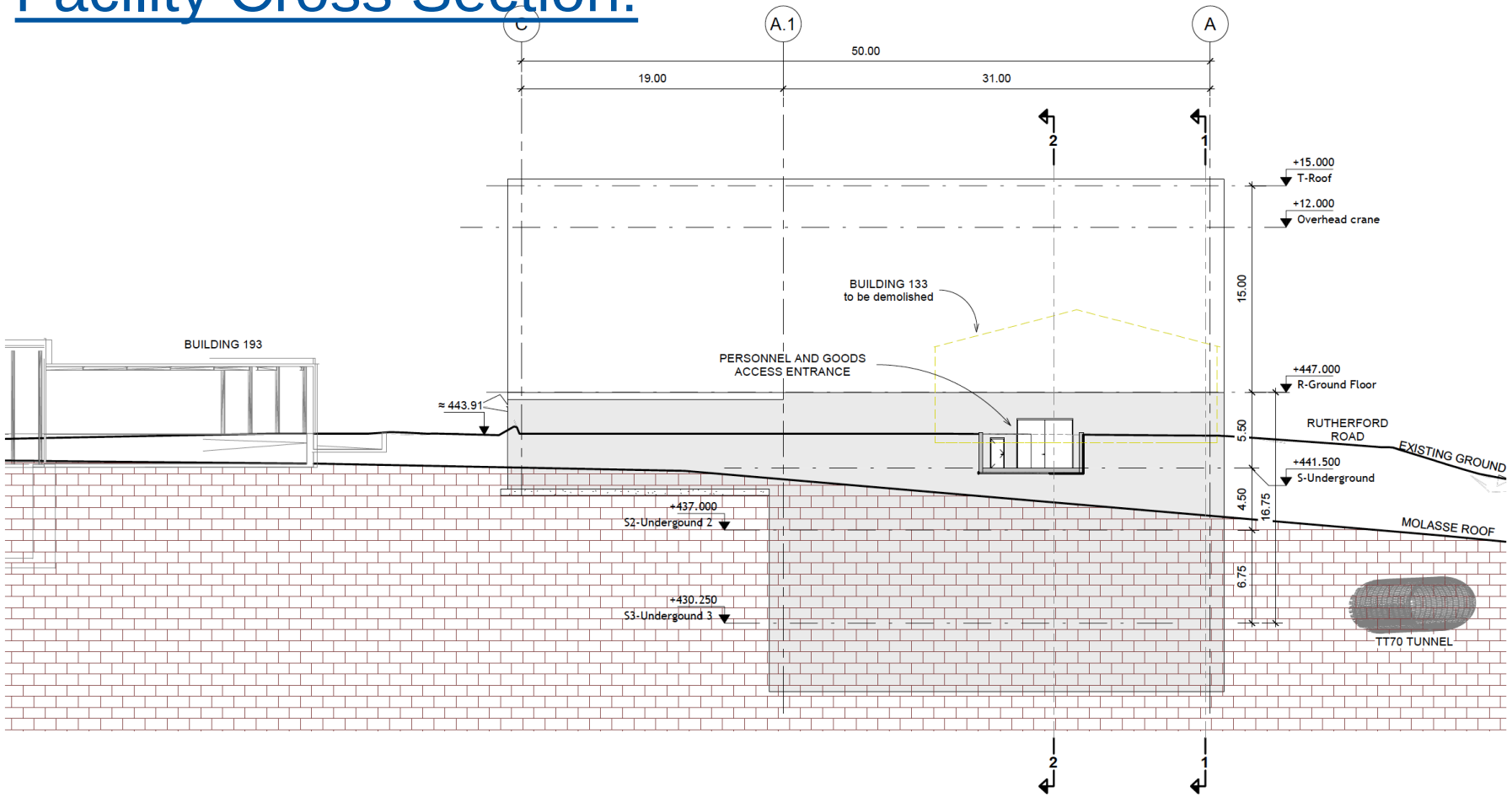
REVIT MODEL: ISOLDE-NEW EXPERIMENTAL HALL-BATIMENT-R20

ISOLDE - EPIC
Section 2
Plan view

DRAFT:25/01/2021

JOHAN DAUGE | Sc : 1:200 | A2
SCE-SAM-TG | V1 - 25/01/2021

Facility Cross Section:



Section A

Sc. 1 : 200

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ISOLDE - EPIC
Section A

DRAFT:21/01/2021

JOHAN DAUGE | *Sc : 1:200* | A2
SCE-SAM-TG | V1 - *21/01/2021*