

Forward Physics Facility Kick-off meeting



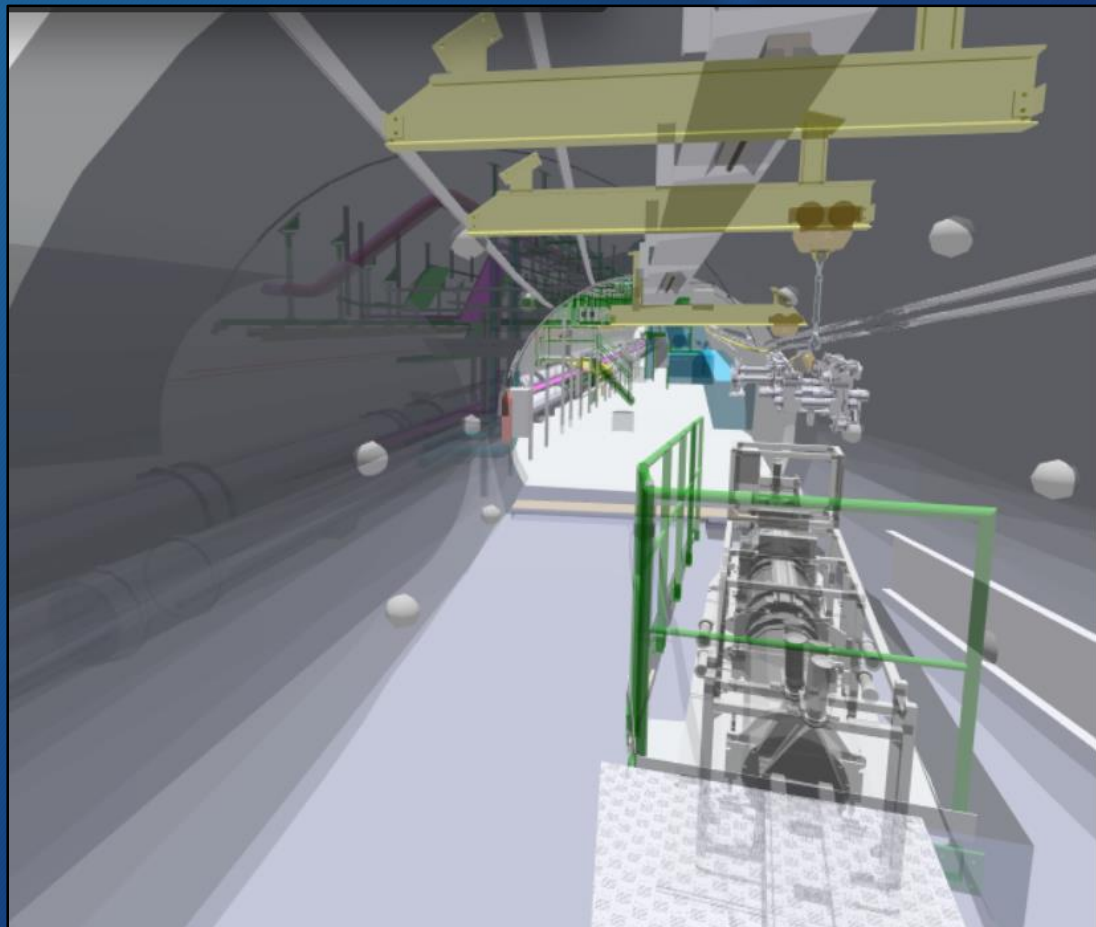
Civil Engineering Study Update

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Introduction



- Requirements
- Key considerations
- Options Review update
- Cost/ schedule
- Next Steps



Requirements - General



- Initial requirements estimated:
 - Provide experimental area ~500-600m away from interaction point on LoS
 - Access needed for construction, installation and periodic maintenance
 - Approx. minimum of 2m beyond Line of Sight (LoS) needed
 - Transport to allow for a maximum of 3x1.5x1.5m module
 - Ideally avoid disruption to FASER and FASERnu experiments
 - Some shielding may be required between LHC and experiments



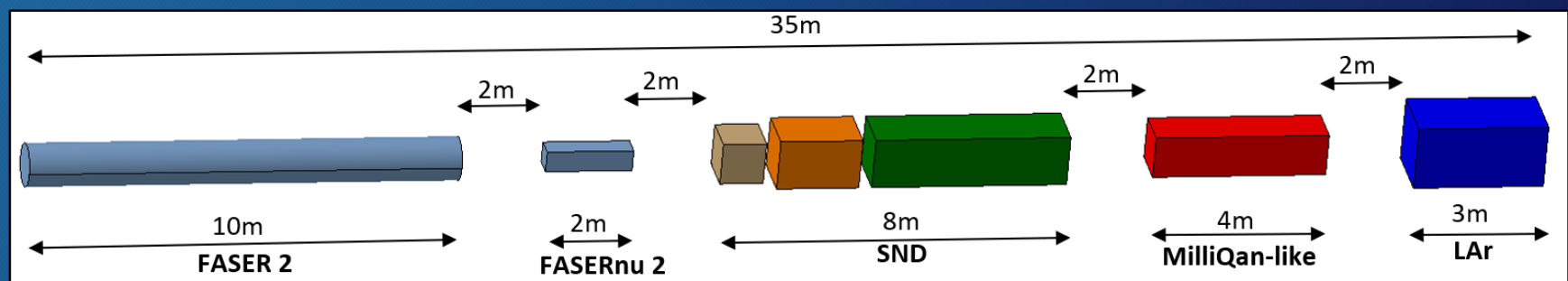
UJ12 looking towards IP1 (ATLAS) and TI12 (FASER)



Requirements - Experimental

- Estimated initial detector characteristics:

Name	Detector Type	Detector Approx dimensions	Detector Needs/ Notes
FASER 2	Tracking detector	Cylinder with 1m radius - 10 m long	
FASERnu 2	Neutrino emulsion detector	50 cm x 50cm x 2 m	
SND 2	Neutrino emulsion detector with tracker interleaved	1 m x 1 m x 8 m	
MilliQan-like detector	Scintillator detector to detect milli-charged particles	1m x 1m x 4 m	
LAr detector	To detect dark matter scattering	Dimensions uncertain - allow 1.5m x 1.5m x 3m	Likely small shielding wall requirement - width TBC. Single piece cryostat.



Key Considerations



Considerations driving selection of options:

- Existing infrastructure
- Access for construction
- Disruption to LHC machine/upgrades
- Geology
- Cost
- Schedule Timescales
- Future access for maintenance/operation



Options Review



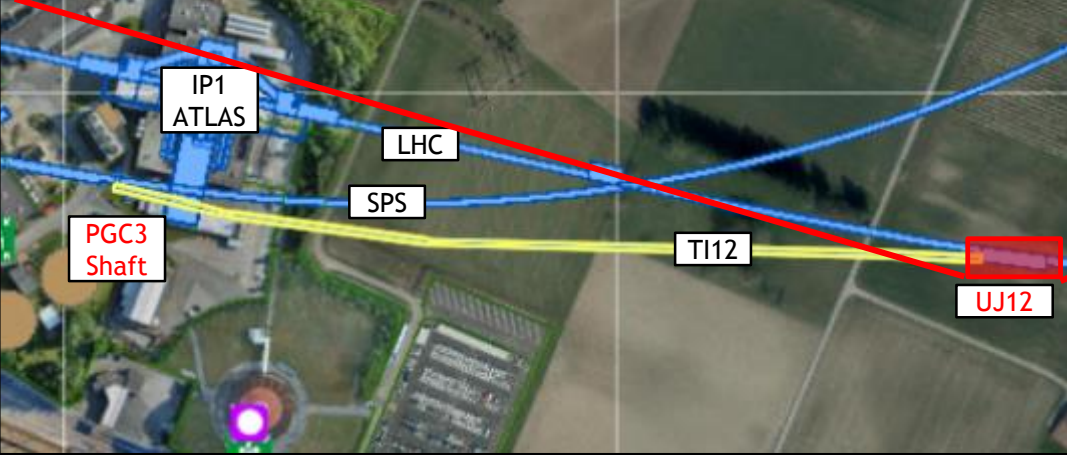
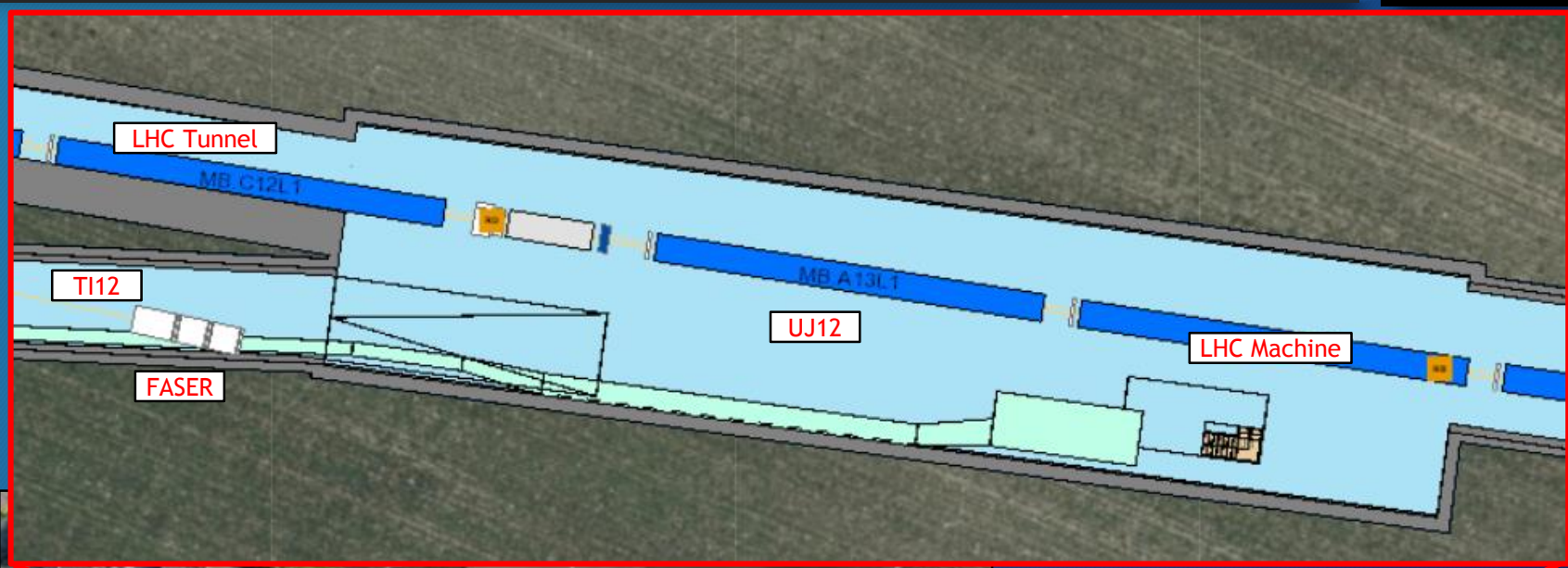
Initial thought to use existing LHC tunnel/caverns

- Minimise cost and disruption to LHC operations
- Reduce overall schedule

Consideration given to a number of options:

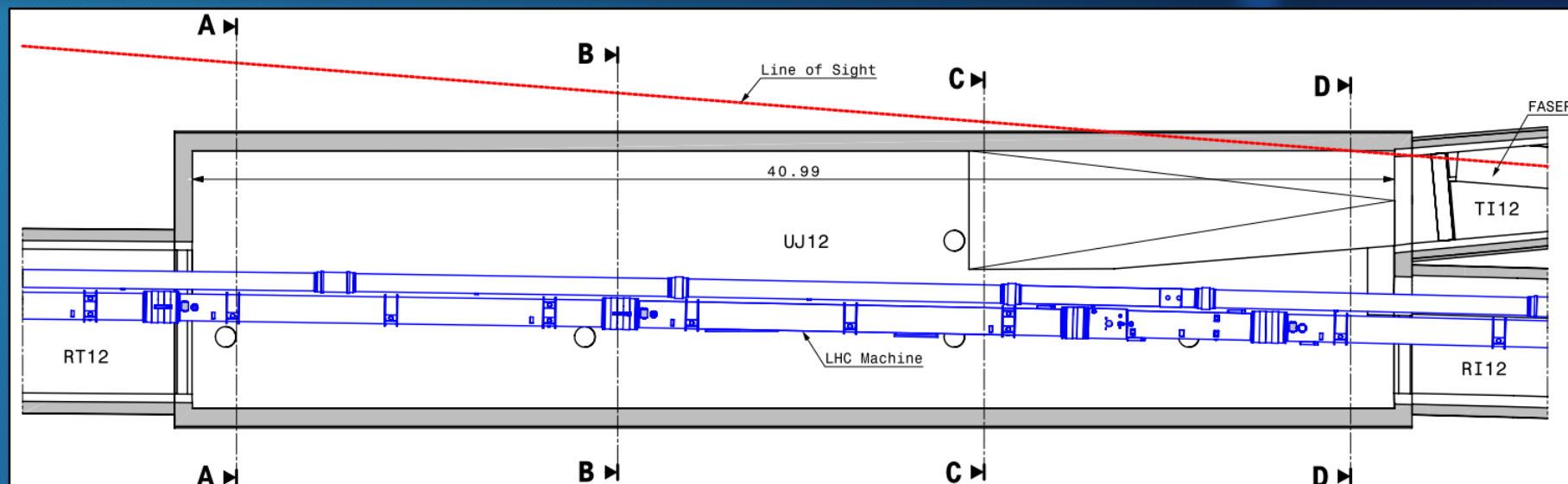
- UJ12 - Complete Demolition and Widening
- UJ12 - Alcoves plus Widening
- UJ18 - Complete Demolition and Widening
- UJ18 - Alcoves plus Widening

Options 1.1/1.2 - UJ12

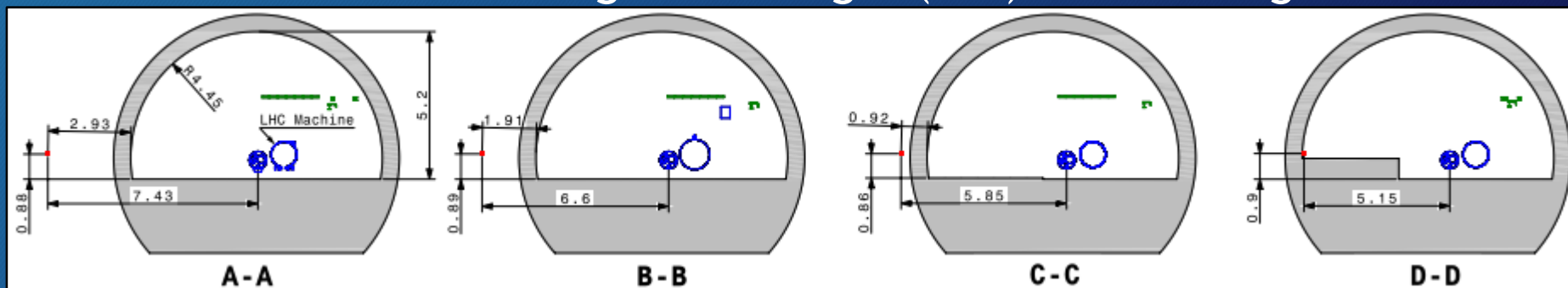


Entirely within Switzerland
~500m from LHC IP1 - ATLAS
Next to abandoned TI12
tunnel housing FASER

Experimental Area Options Existing UJ12 LoS

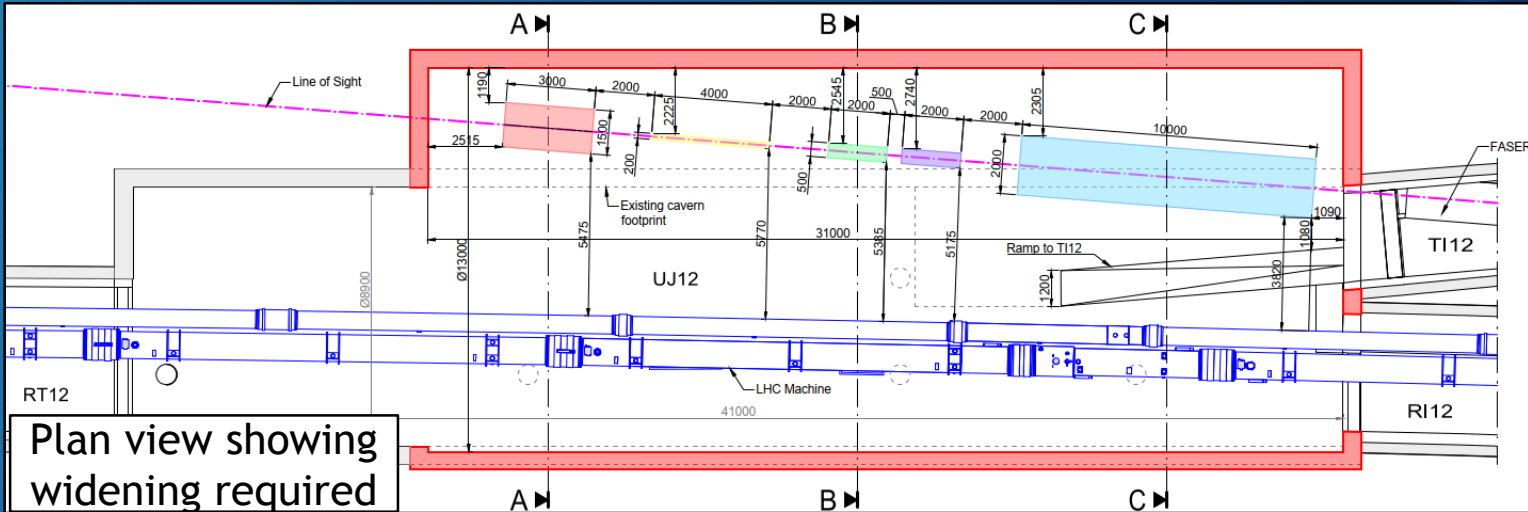


Plan view showing Line of Sight (LoS) and existing UJ12



LoS Position relative to existing

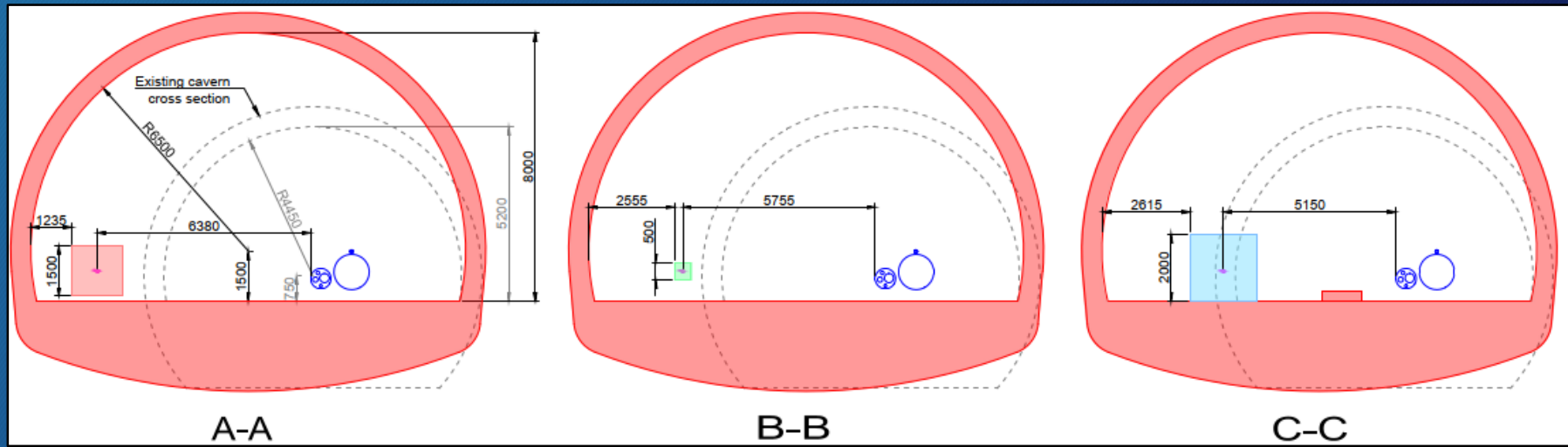
Option 1.1 Demolition/ widening



Plan view showing widening required

LEGEND

- Existing cavern/tunnels
- New cavern
- Demolished cavern
- Line of Sight
- LHC machine
- FASER 2
- FASERnu 2
- SND 2
- MilliQan-like detector
- LAr detector



Access Option A LHC via Point 1 PM15 shaft



- Access to UJ12 or UJ18
- Potentially 500m of beamline equipment to remove to gain access
- Cool-down and removal of equipment adds to cost/schedule
- Distance and time to UJ12 difficult for construction



Option 1.1 Demolition/ widening



Advantages

- Relatively simple/certain to design and construct
- Allows flexibility with experiments
- Single crane can service all experiments

Disadvantages

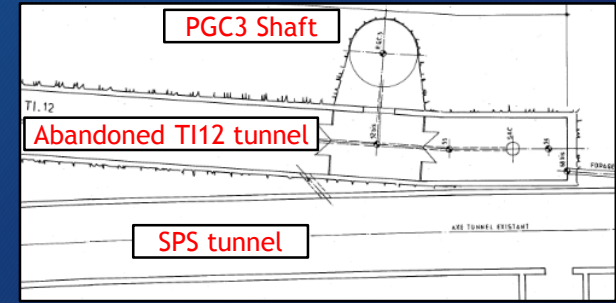
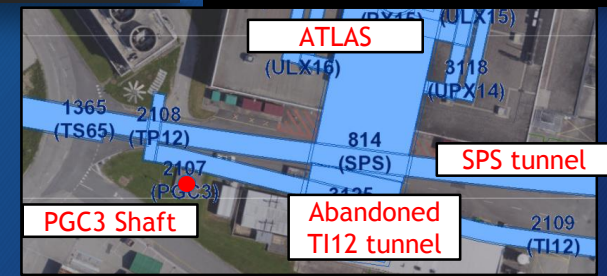
- Need large equipment to carry out works (access)
- Removal of 500m of LHC beamline equipment
- Removal of existing equipment/ services
- No access during LHC operation

Access Option B

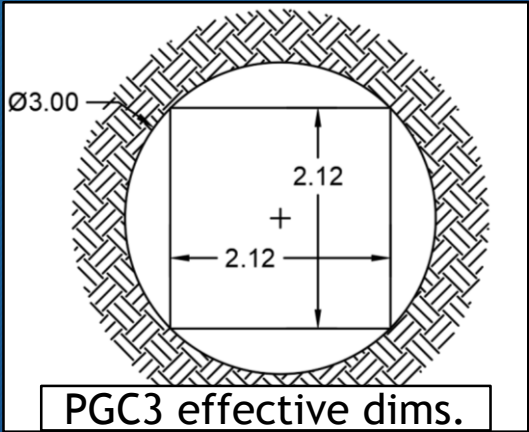
Access via T112 and PCG3 Shaft



- Good access to UJ12 from P1
- Access through abandoned T112
- Shaft is relatively small 3mØ
- Access route past existing FASER location



Plan view of T112/PCG3

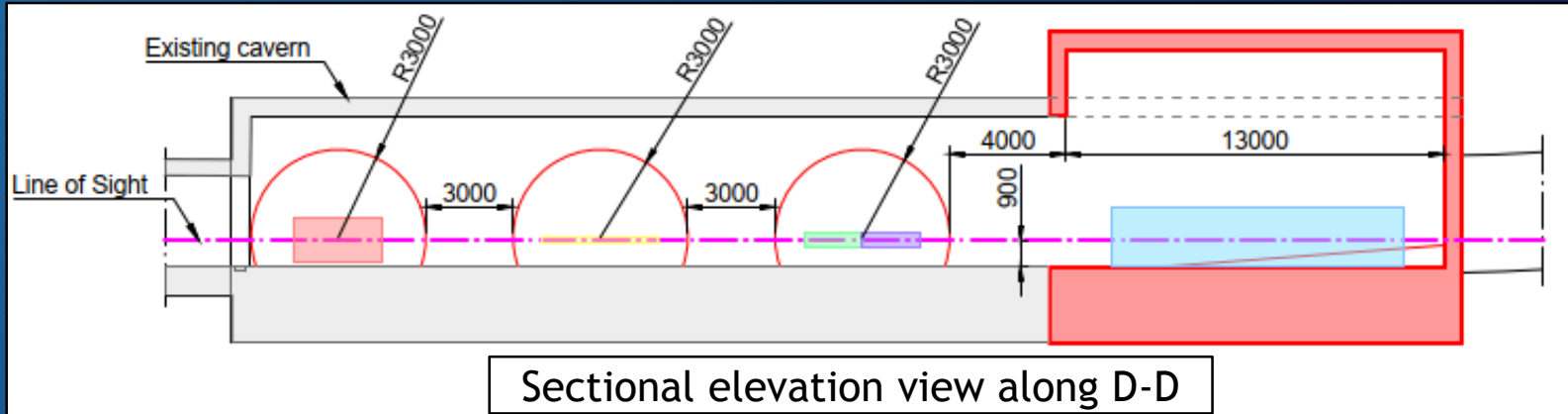
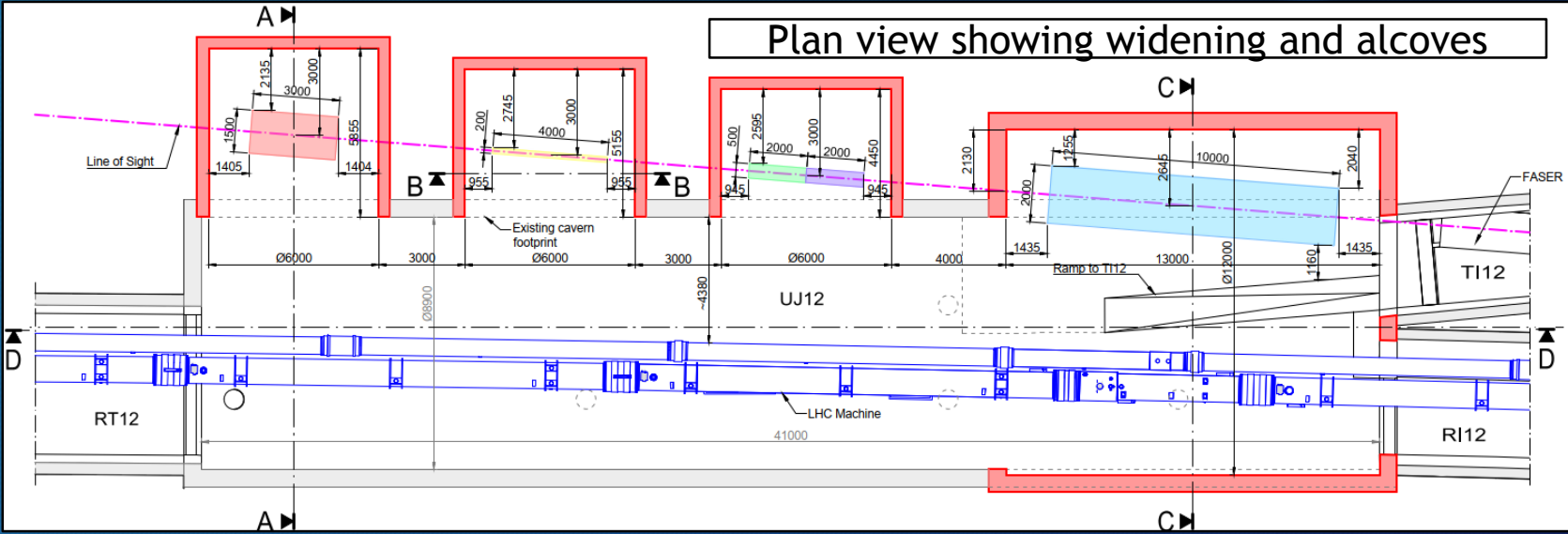


PGC3 access to T112

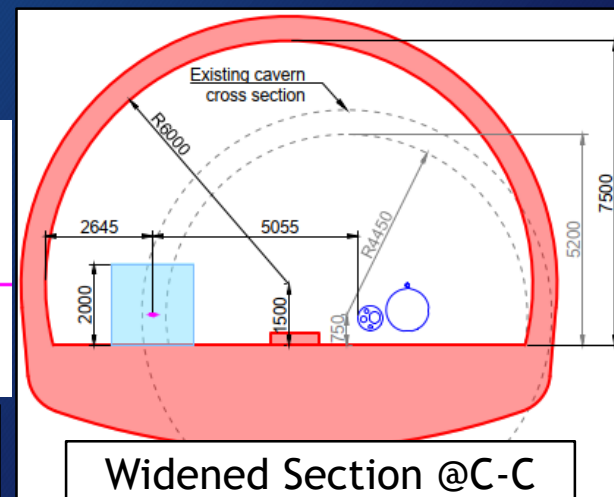
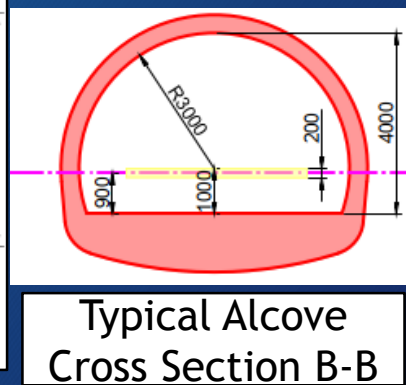
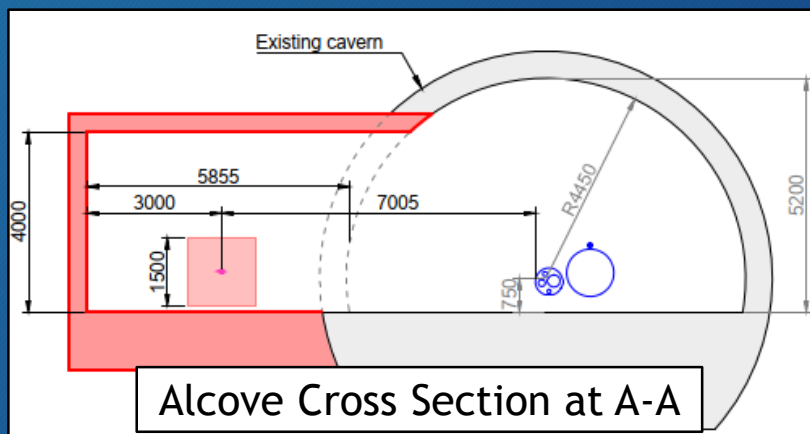
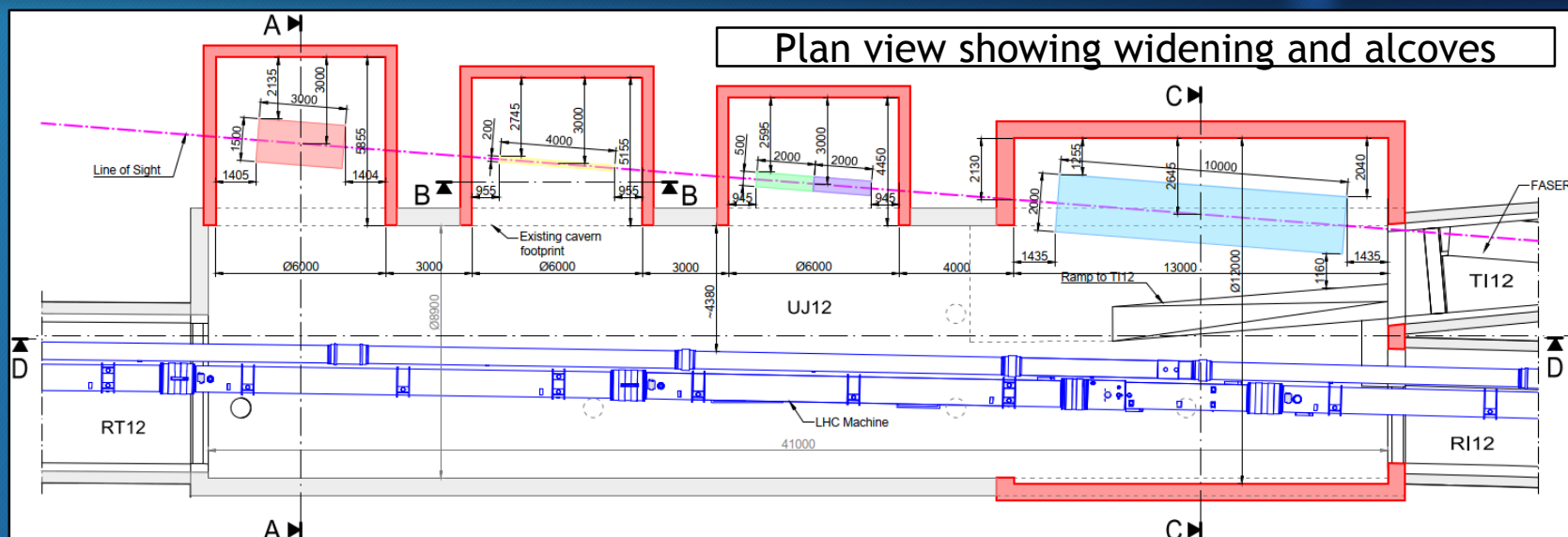


View from P1 @ surface

Option 1.2 Widening plus alcoves



Option 1.2 Widening plus alcoves



Option 1.2

Widening plus alcoves



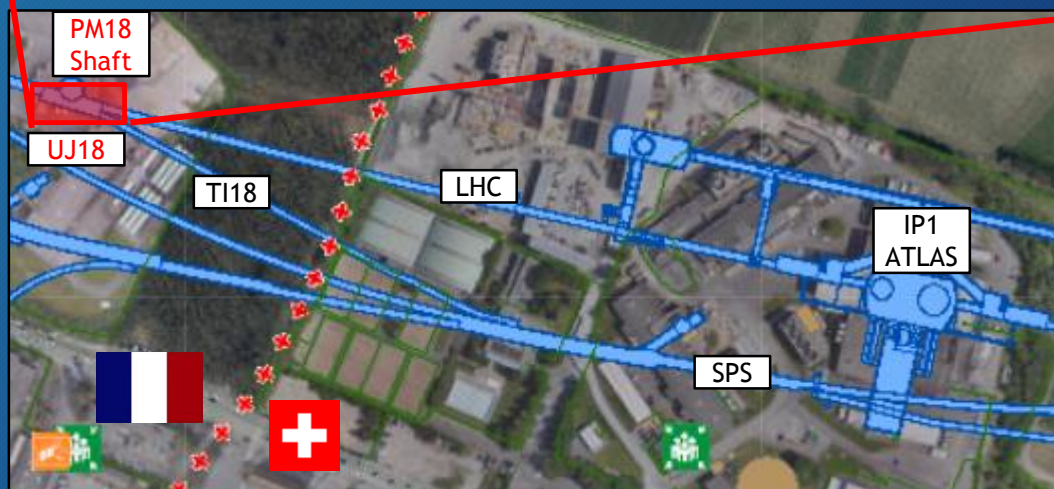
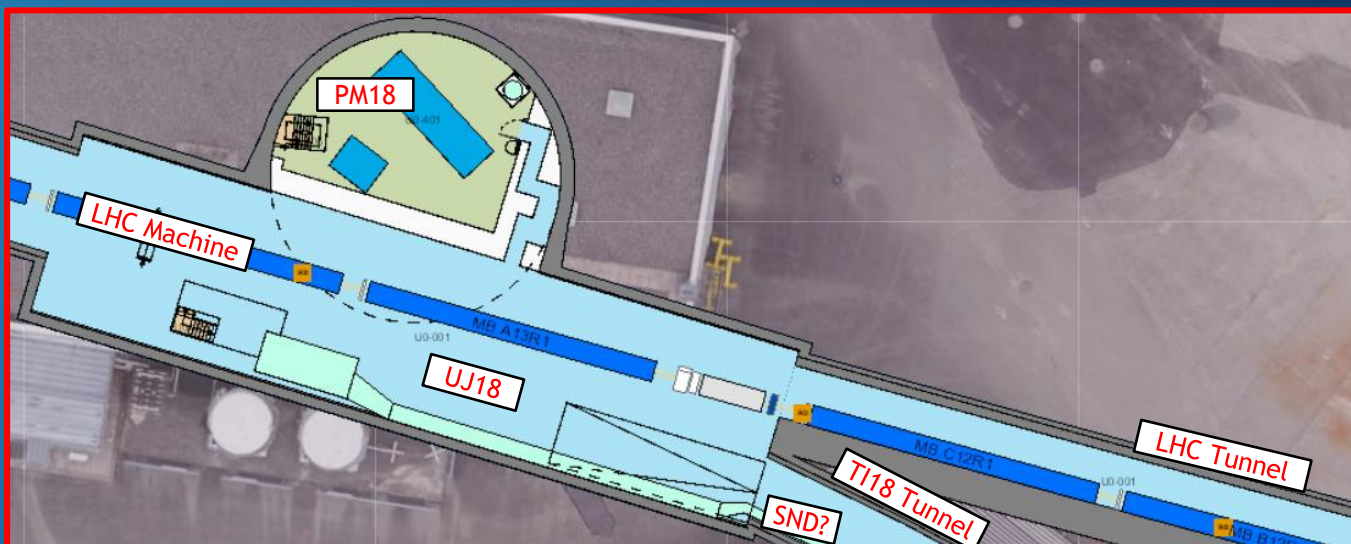
Advantages

- Equipment required for works slightly smaller
- May allow less disruptive access

Disadvantages

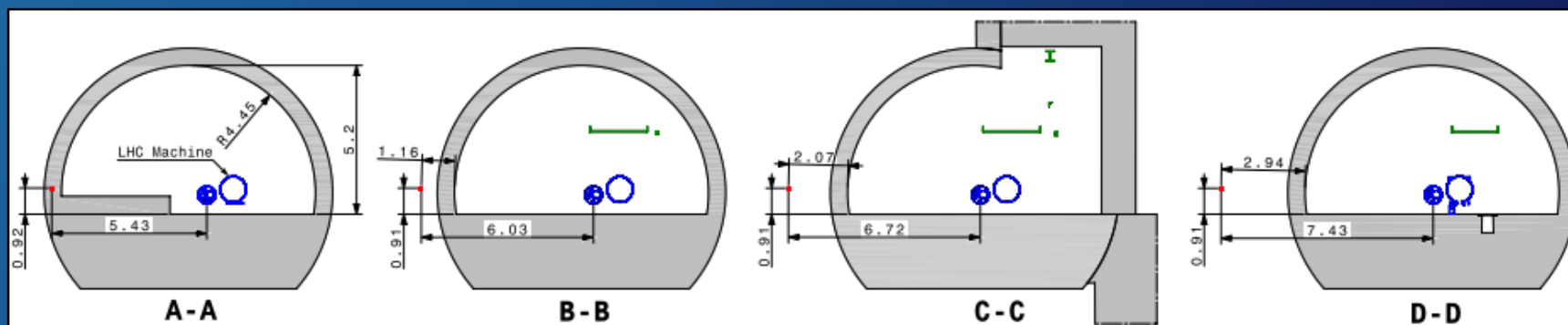
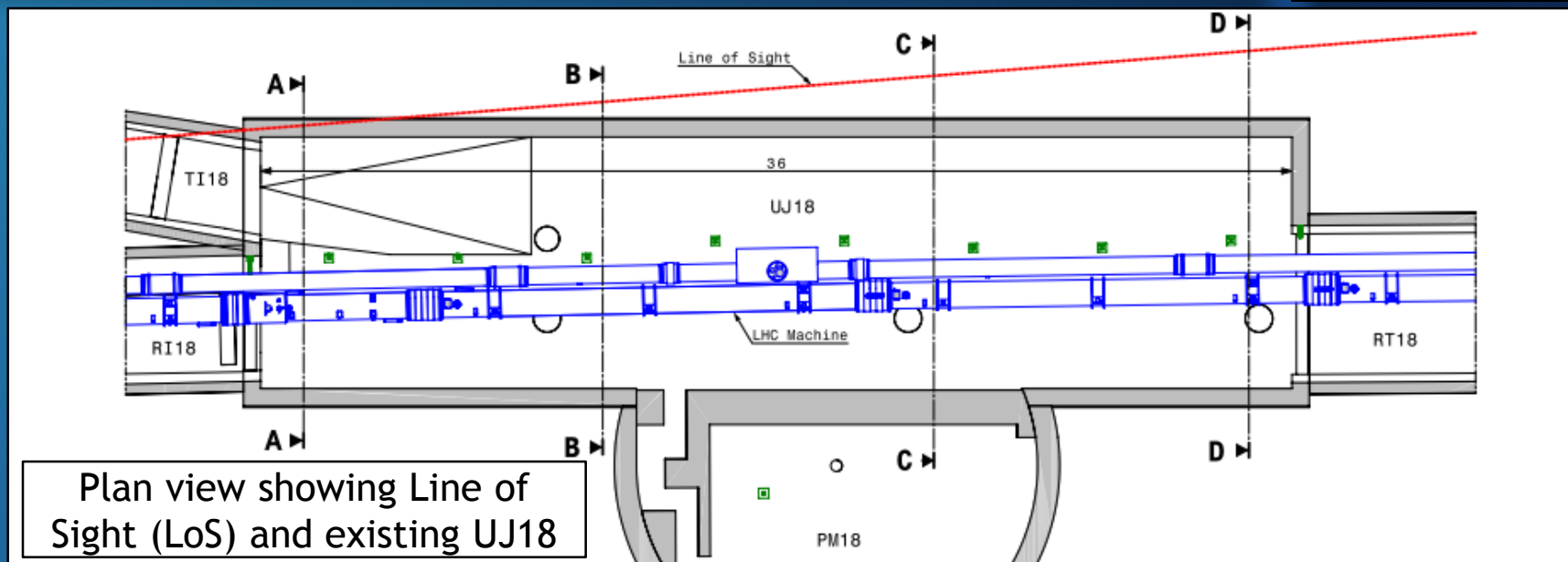
- Complex phasing required - longer schedule and larger cost
- Reduced flexibility with experiments
- Alcoves would not practically be feasible - removal of most of UJ12 would destabilise cavern

Options 2.1/2.2 - UJ18



- Main site within France
- ~500m from IP1, next to abandoned T118 tunnel
- Other side of LHC P1 - Atlas

Experimental Area Options Existing UJ18 LoS

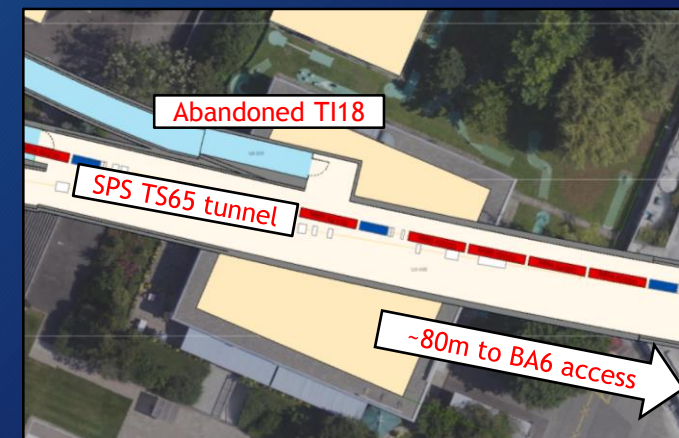


LoS Position relative to existing

Access Option C TI18 via SPS and PA6 shaft



- Access to UJ18
- Reduced size opening at TI18/SPS junction
- Through abandoned ~270m of TI18
- Access route past possible SND experiment location
- Restricted BA6 'Monte charge' material lift measuring 6.9m wide, 2.35m long, 2m high.
- Some limited removal of beamline elements necessary

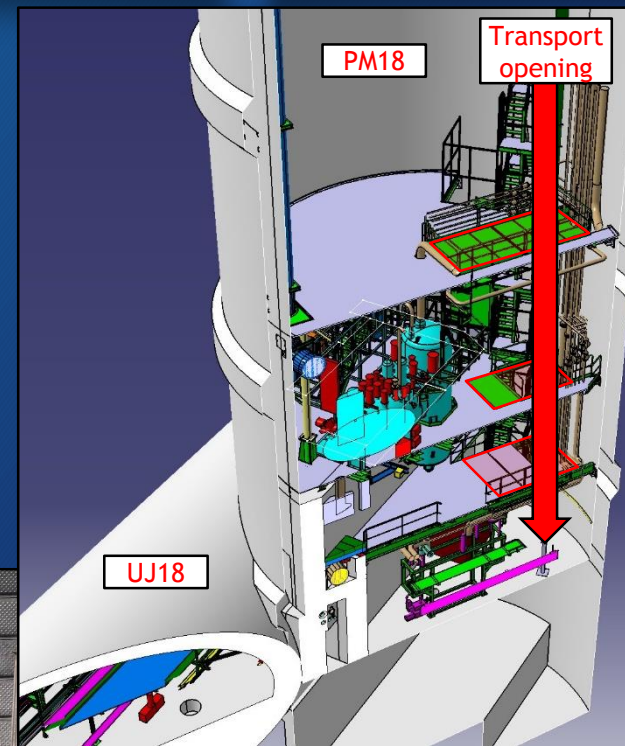


Plan view of SPS/TI18
interface

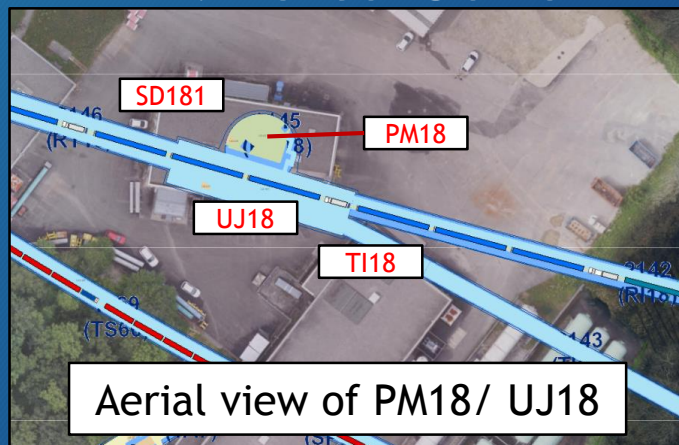
Access Option D Via PM18 shaft



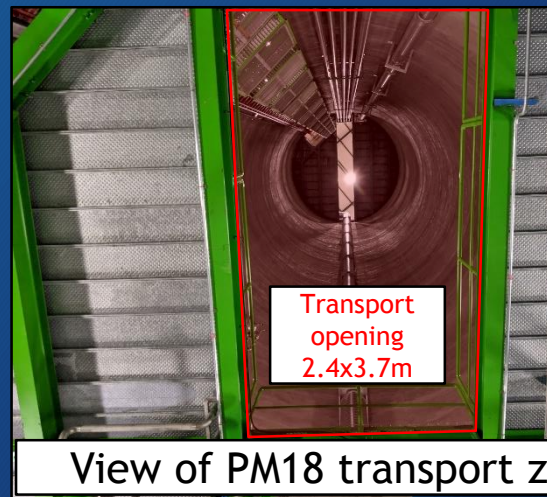
- Direct access to UJ18
- Existing opening for transport
- 20t crane and Alimak lift
- PM18 houses cryogenic equipment
- Would require new link from PM18 to UJ18



Model showing cut-away view of existing PM18 floor plan and Cryogenic equipment



Aerial view of PM18/ UJ18



View of PM18 transport zone

Options 2.1/2.2 - UJ18 Discussion



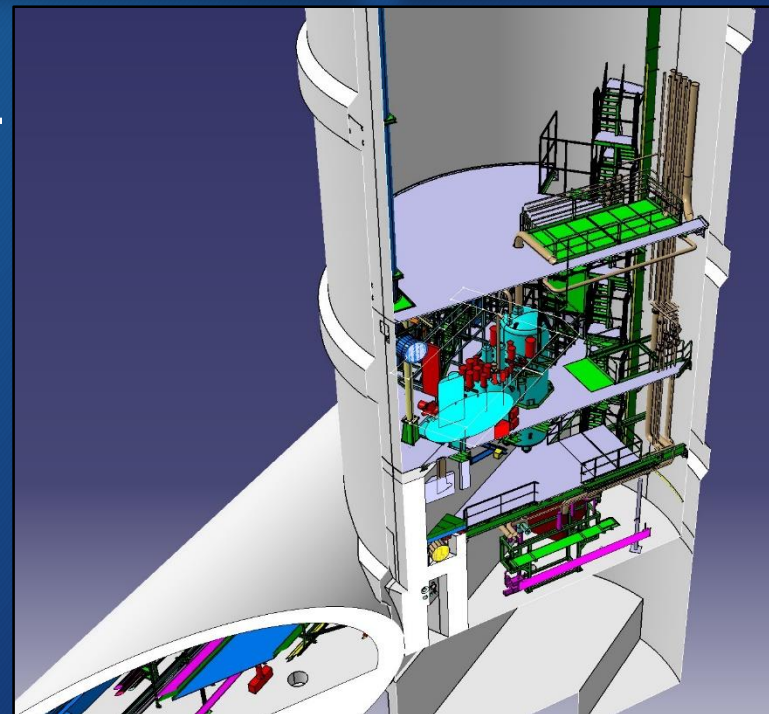
- Generally very similar to UJ12

Advantages

- Better options for access

Disadvantages

- Complex geometry due to interaction with PM18 shaft make widening significantly more complex



Options Reviewed



Revised Options:

- UJ12 - Complete Demolition and Widening
- ~~UJ12 - Alcoves plus Widening~~
- ~~UJ18 - Complete Demolition and Widening~~
- ~~UJ18 - Alcoves plus Widening~~

Additional Options to review:

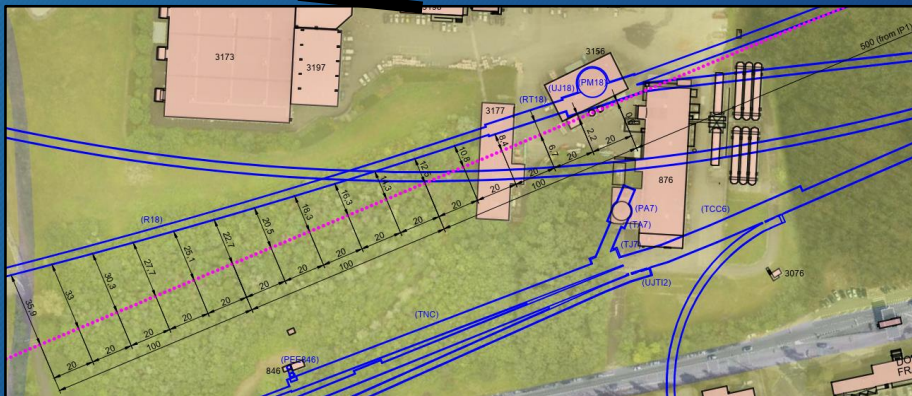
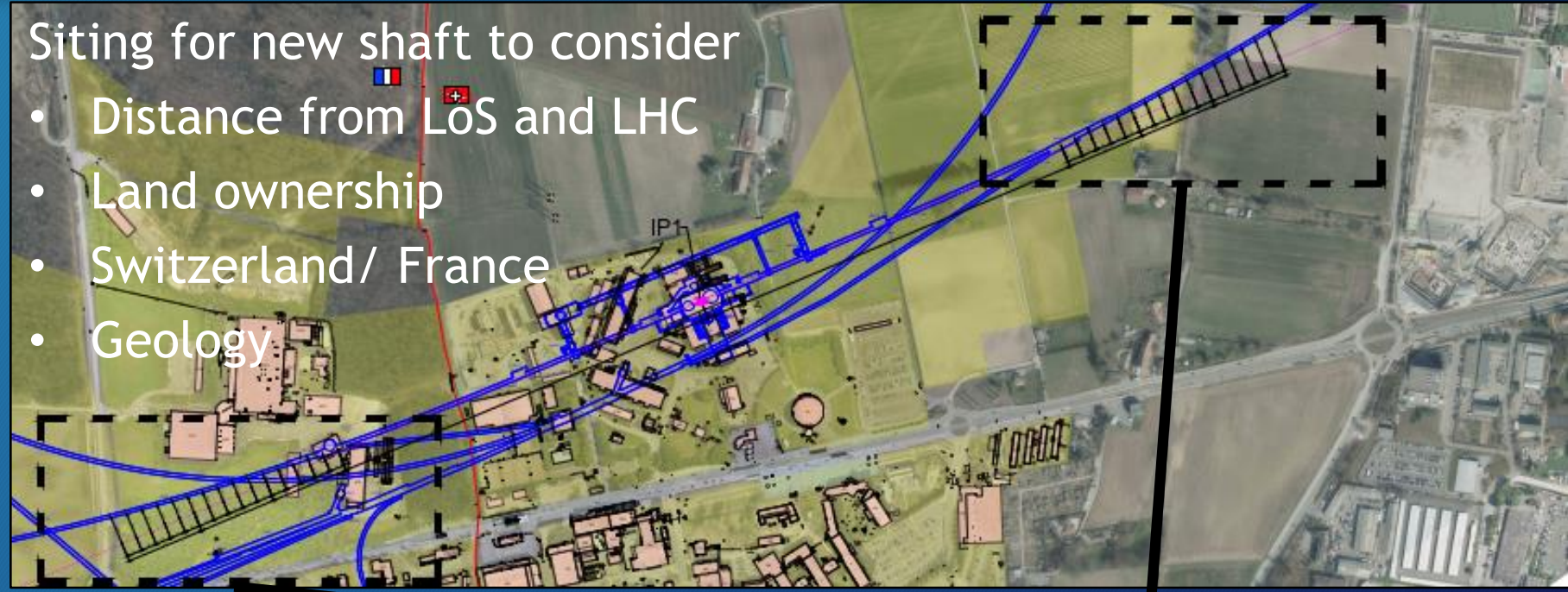
- New shaft to enable UJ12 - Complete Demolition and Widening
- New shaft and experimental area

New shaft to consider



Siting for new shaft to consider

- Distance from LoS and LHC
- Land ownership
- Switzerland/ France
- Geology





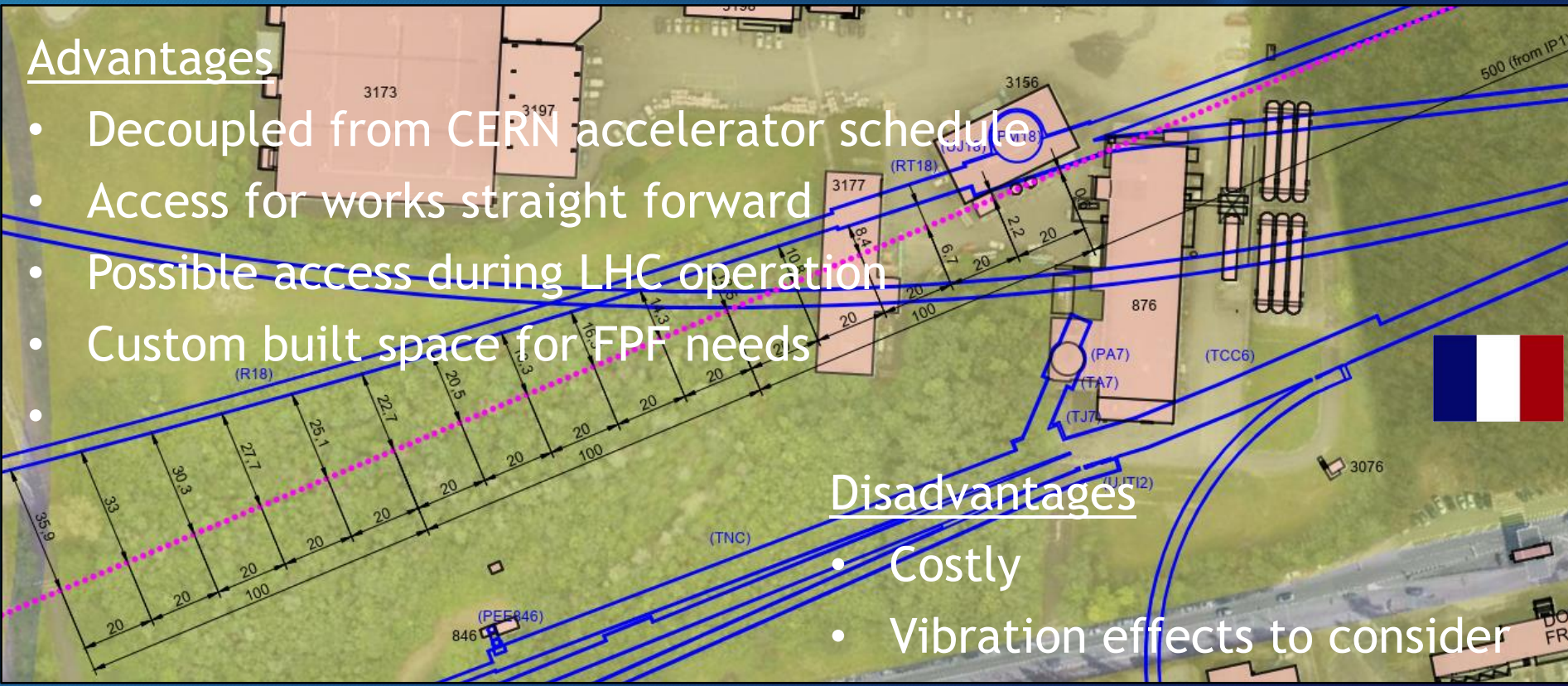
New shaft discussion

Advantages

- Decoupled from CERN accelerator schedule
- Access for works straight forward
- Possible access during LHC operation
- Custom built space for FPF needs

Disadvantages

- Costly
- Vibration effects to consider



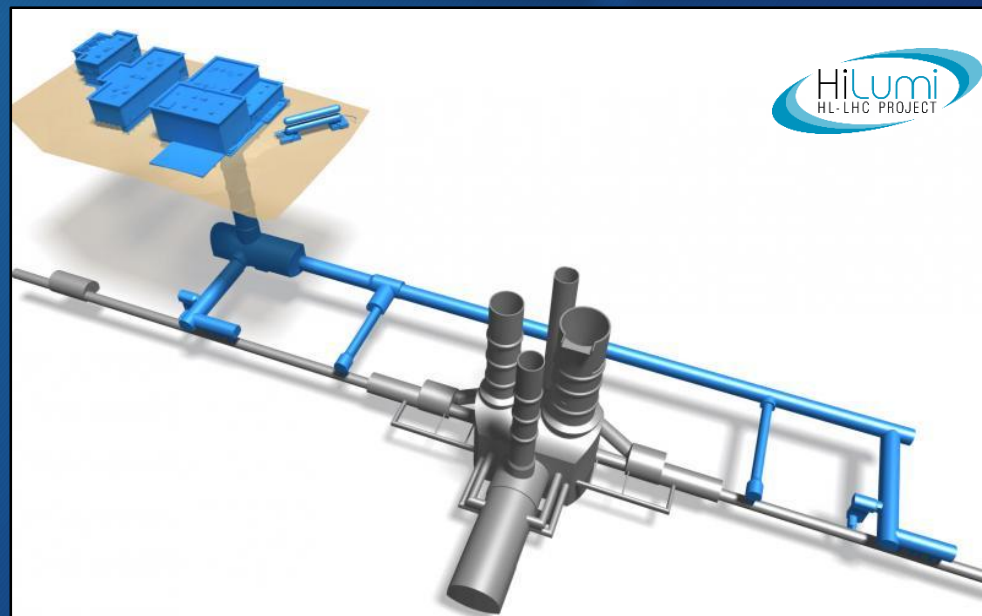
LEGEND

Line of Sight	Underground building	CERN LAND
Border	Surface building	Distance to LoS in meters

Cost and Schedule



- To be developed when option(s) are selected/ developed
- Requirements need to be confirmed
- Schedule to consider CERN accelerator operations
- HiLumi may provide some sense of scale



	2020				2021				2022				2023				2024				2025				2026				2027				2028				2029			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
LHC Operation Period	LS2				LHC run 3												LS3																							
HL-LHC Operation																									HL-LHC															

Next Steps



- Choose option(s) to progress
- Further discussions with integration, CERN coordination, Transport, etc
- Produce full concept design
- Confirm outline feasibility
- Schedule estimate
- Cost estimate

Thank You



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Any Questions?