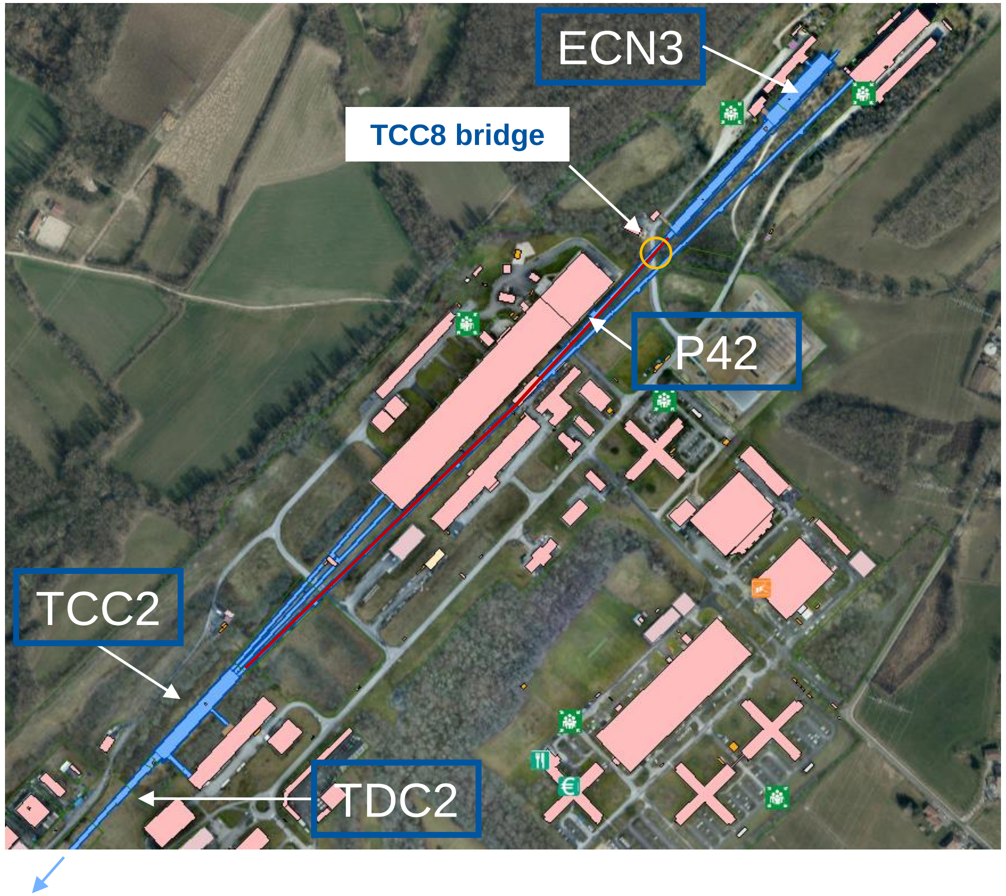
HIKECN3

TDC85/TCC8 bridge plans

C. Ahdida (HSE-RP)

EDMS 3214625

Introduction

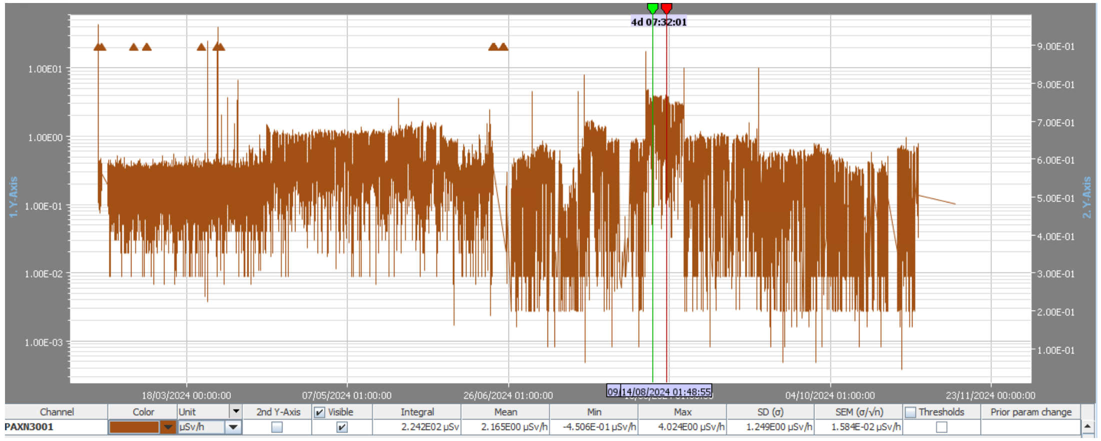


SPS extraction

- Within the ECN3 Beam Delivery Task Force the shielding weakness at the bridge towards TCC8/ECN3 above the P42 beamline in TDC85 was identified
- An RP survey had shown radiation levels close to the area classification limit (2.5 uSv/h, Non-designated Area) during NA62 beam operation (EDMS 2924384)
- In view of the future intensity increase for HI-ECN3 (BDF/SHiP) mitigation measures (e.g. additional shielding, beamline changes) must be identified to sufficiently reduce the radiation levels
- FLUKA studies for shielding improvements as well as beamline modifications were performed (EDMS 3053484)
- Furthermore, a CE study and cost estimate for a reinforcement of the TDC85/TCC8 bridge shielding was performed (EDMS 3135892)

Dose rates at TCC8 bridge during 2024 NA62 run

Measured dose rates (1 min) at TCC8 bridge during 2024



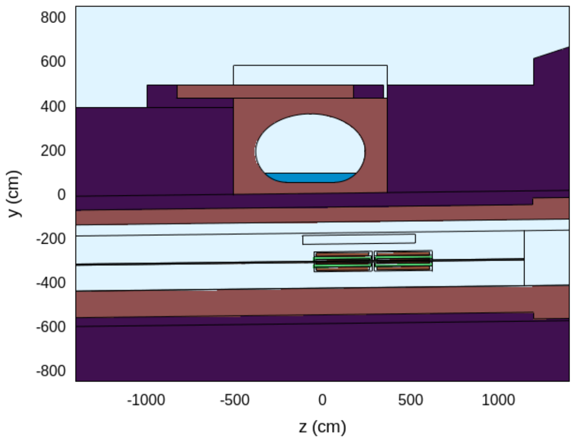
- PAXN3001 is an RP monitor located at the TCC8 bridge where the highest dose rates were measured in the past
- A stable high intensity beam operation during the NA62 beam dump run was selected and further analyzed:
  - Date/Time: 10/08/2024 11:06 until 17:51
  - Mean dose rate: 3.2 uSv/h (above the 2.5 uSv/h limit)
  - Max. dose rate: 3.9 uSv/h
  - Beam intensity: 4.3E+12 p/spill, 14 s repetition rate, 3E+11 p/s

➢ BDF operates with 4E13 p/spill, 7.2 s repetition rate, 5.6E12 p/s

➢ To meet the 2.5 uSv/h limit during future BDF/SHiP operation, a dose rate reduction of a factor 23.5 would have to be achieved

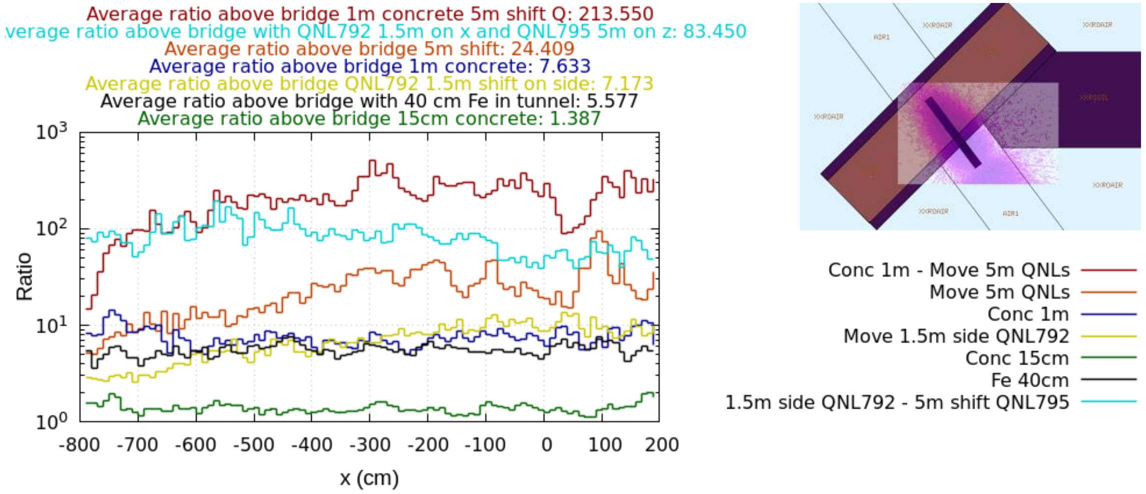
Summary of FLUKA studies

FLUKA model – Present geometry (reference)

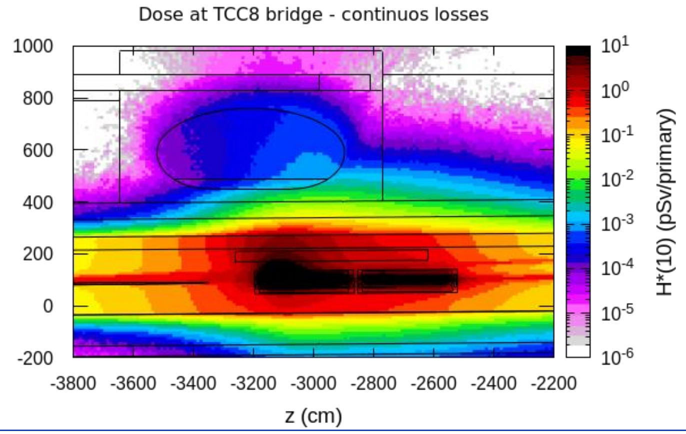


- *The present beamline and bridge shielding geometry was used as reference*
- *Various scenarios with shielding reinforcements (bridge, inside tunnel) and magnet displacements were studied*

Ratio prompt dose rates – Shielding/beamline changes vs. present geometry



Prompt dose rates for continuous losses



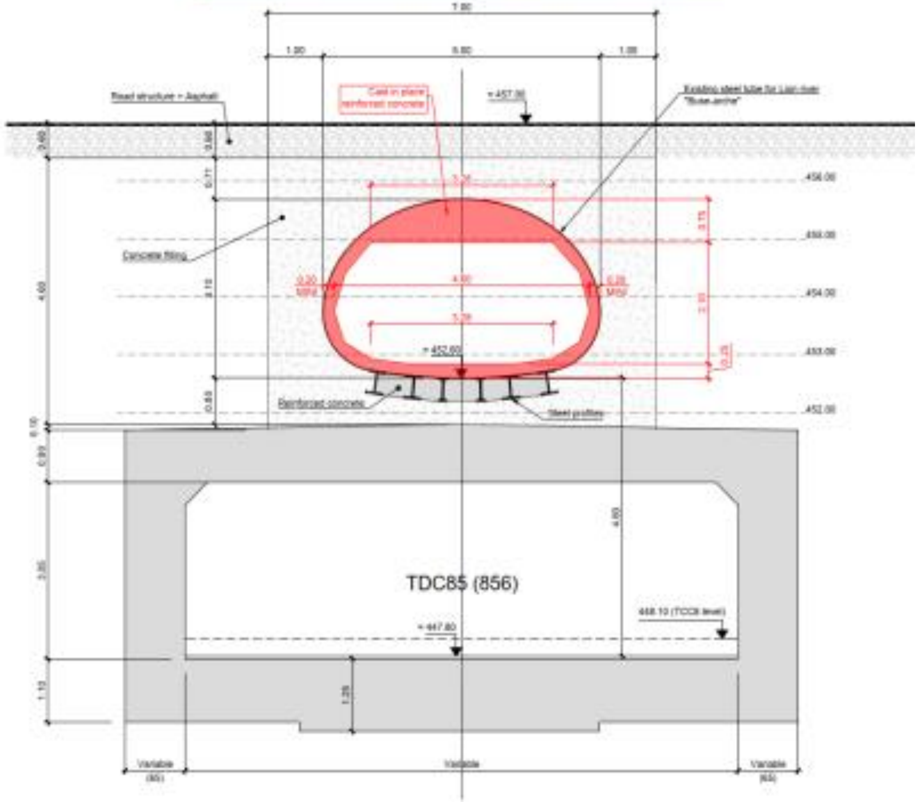
- *Continuous losses along the beamline were assumed as source term*
- *It aims to best represent the real beam losses with a qualitative (and not quantitative) approach*

Scenario	Reduction factor wrt. reference
Bridge +15 cm concrete	1.4
Tunnel +40 cm iron	5.8
Bridge +1 m concrete	7.4
QNL.792 lateral shift 1.5 m	8.6
QNL.792/5 shift 5 m downstream	30
QNL.792 shifted 1.5 m laterally + QNL.795 shifted 5 m downstream	76
Bridge +1 m concrete + QNL.792/5 shift 5 m downstream	253

- ➢ Bridge shielding improvement by 1 m of concrete would not be sufficient
- ➢ Shift of magnets QNL.792/5 was found to be an effective mitigation measure allowing to gain a factor 30 reduction

Summary of CE studies

Selected configuration - Typical section



SCE Site and Civil Engineering	TDC85/TCC8 RP - CE shielding Réduction passage du Lion sous le pont Route Budker (Prévessin)		Ludovic BARTHELEMY SCE-SAM-TG
COST ESTIMATE			12.07.2024
SELECTED CONFIGURATION : 25 cm of reinforced concrete at the bottom of the existing steel tube + 75 cm of reinforced concrete at the top of the existing steel tube + 20 cm of reinforced concrete at the edges of the existing steel tube			
Job description	**Cost estimate (€ HT)**		***Source***
DESIGN : Hxdrology and civil engineering - PROJECT (PRO)	€	12 500,00	*HYDRETUDES : CERN - LION - Hydretudes x OSC - Etudes PRO-EXE - Offre de prix*
DESIGN : Hxdrology and civil engineering - EXECUTION (EXE)	€	16 000,00	*HYDRETUDES : CERN - LION - Hydretudes x OSC - Etudes PRO-EXE - Offre de prix*
DESIGN : Hxdrology and civil engineering - TENDER (DO)	€	10 000,00	*CERN estimate*
DESIGN : Hxdrology and civil engineering - WORK SUPERVISION (DT)	€	20 000,00	*CERN estimate*
ADMINISTRATIVE PROCEDURES : Dossier d'autorisation IOTA ("Loi sur l'eau")	€	13 000,00	*HYDRETUDES : AE24-002_CERN_offre_DLE Ouvrage Lion_v1*
WORKS : Civil engineering works	€	380 000,00	*HYDRETUDES : Rapport_ARI_24-072 Etude Lion Blindage RP TDC85_v4*
TOTAL	€	**451 500,00**	

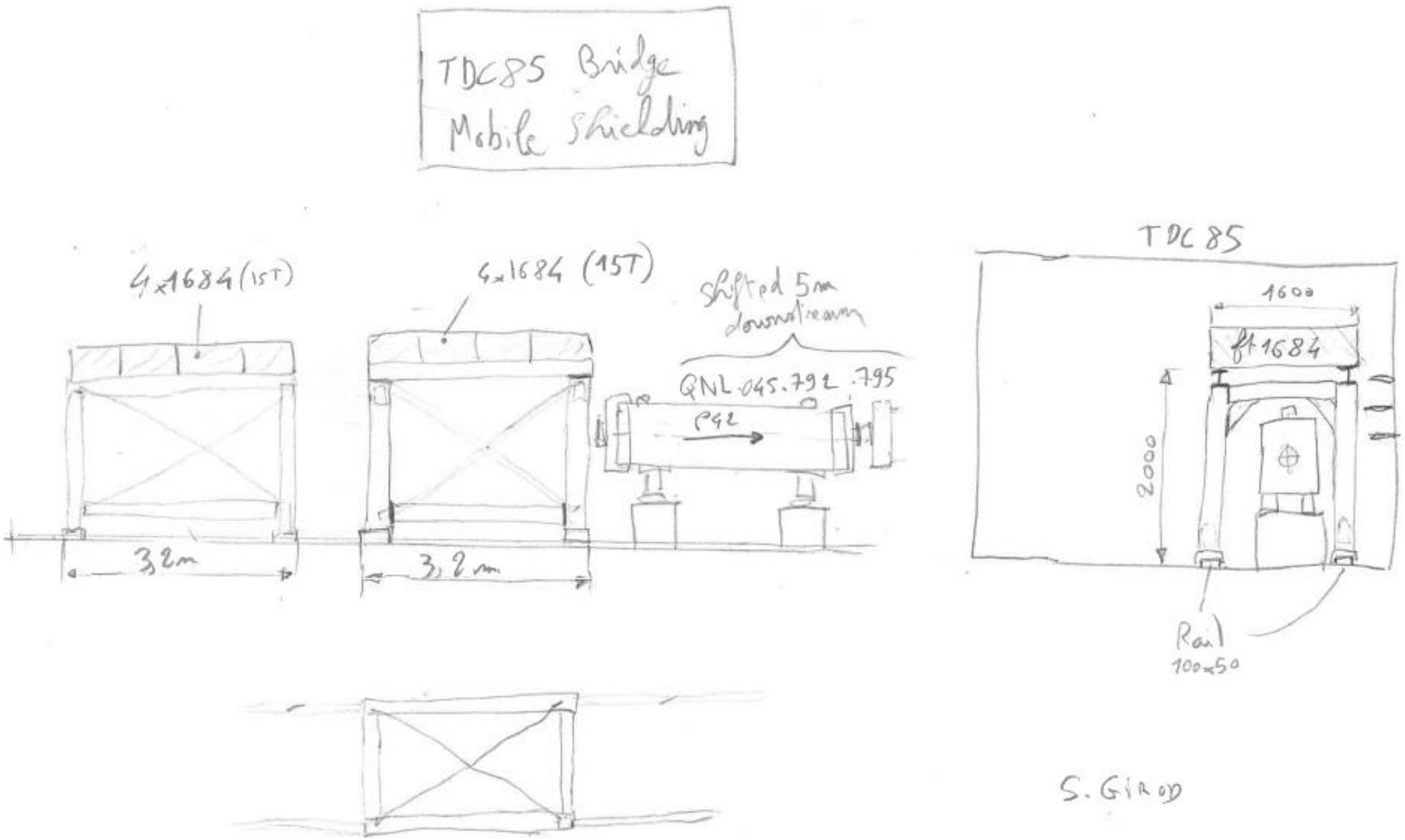
- A CE study with an external consultant for the bridge reinforcement has been performed
- The most suitable configuration was found to be the following:
  - +25 cm of concrete reinforcement at the bottom of the existing steel tube
  - +75 cm of concrete reinforcement at the top of the existing steel tube
  - +20 cm of concrete reinforcement at the top of the existing steel tube

➢ The cost for implementing this solution was estimate to amount to 450 kCHF

S. Girod, M. Lazzaroni

Summary of shielding studies inside TDC85

Sketch of mobile TDC85 shielding option



- The implementation and cost of mobile shielding above the P42 beamline in TDC85 were assessed
- A 40 cm thick shield, designed to move longitudinally by 6-7 meters, was included in the cost analysis
- The total cost for implementing this solution was estimated to amount to **~140 kCHF** with
  - ~25 kCHF include the structure, and installation
  - ~115 kCHF for shielding

Conclusions

- A shielding weakness at the bridge towards TCC8/ECN3 above the P42 beamline in TDC85 is present
- Future intensity increase for HI-ECN3 requires mitigation strategies (e.g., additional shielding or beamline changes) to reduce radiation levels and meet the 2.5 µSv/h classification limit for low-occupancy Non-designated Areas
- Based on dose rate measurements during the 2024 high intensity NA62 run and the conservative assumption of similar beam loss fractions for HI-ECN3 and NA62, a dose rate **reduction** by a **factor 23.5** should be achieved for HI-ECN3
- FLUKA studies of various shielding and beamline configurations indicate that **shifting** the **QNL.792/5 magnets** 5 m downstream can achieve a dose rate **reduction factor** of **30**
- Reinforcing the bridge with 1 m of concrete would only achieve a dose rate reduction factor of 7, with an estimated cost of 450 kCHF

➢ The 5 m downstream shift of the QNL.792/5 magnets is considered a sufficient mitigation measure for reducing dose rates at the TCC8/ECN3 bridge during future HI-ECN3 operation

➢ Further reductions are expected from beam loss minimization during the dedicated BDF/SHiP cycle and material optimization (no splitting, no interaction in T4, and vacuum in T4 XTAX) home.cern

Beam parameters

Increase wrt NA62 nominal

Experiment/operation	p/spill	spills/day	p/s	POT/y	POT/5y
NA62 nominal	3.36×10^{12}		2×10^{11}	2.6×10^{18}	
BDF/SHIP	4×10^{13}	12000	5.5×10^{12}	4×10^{19}	2×10^{20}

27.5