



EDMS NO. 0000000	REV. 0.0	VALIDITY DRAFT
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REFERENCE XXX-EQCOD-EC-XXXX

Date: 2021-12-17

ENGINEERING CHANGE REQUEST

Improvement of the shielding for the high intensity hadron operation of M2

BRIEF DESCRIPTION OF THE PROPOSED CHANGE(S):

The Drell-Yan operation of AMBER Phase 1 experiment, which has been approved by SPSC for operation in EHN2 hall, requires a hadron beam of higher intensity to be delivered to M2. The current request describes the shielding modification needed to make the high intensity beam operation compatible with the requirements of the Radiation Protection.

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DOCUMENT SENT FOR INFORMATION TO:

EATM members
IEFC members

SUMMARY OF THE ACTIONS TO BE UNDERTAKEN:

- Installation of additional shielding walls and access door around AMBER target
- Definition of the access procedures to the AMBER target area

Note: When approved, an Engineering Change Request becomes an Engineering Change Order.

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1. EXISTING SITUATION AND INTRODUCTION

M2 beam line is world's longest beam line for a fixed target experiment, with an overall length of 1138 m. it has been designed to deliver high intensity polarized muon beams to the EHN2 hall (see Figure 1), in which currently the COMPASS experiment is located, but is also capable of delivering a high intensity hadron beam.



Figure 1: A scheme of TT84 tunnel containing M2 beam line, leading to EHN2 hall.

The hadron beam has been requested by the follow-up experiment of COMPASS called AMBER, which has been approved for test runs and operation during LHC Run 3 period. It is envisaged to operate the beam line with an increased intensity of 4.8×10^8 hadrons of 190 GeV energy per spill at the location of AMBER target in EHN2. In order to ensure that this high intensity operation is compliant with the regulations of Radiation Protection, a study has been performed in the framework of Physics Beyond Colliders Conventional Beams Working Group. The results of the study and the proposal for the shielding layout modification are described in the current document.

2. REASON FOR THE CHANGE

The new shielding configuration at EHN2 aims at keeping the prompt Ambient dose Equivalent in operation in EHN2 within the limit of the CERN Radiation Area classification. In particular, the hall and control rooms are classified as Supervised Area (<6 mSv/year), and the outside of EHN2 as non-designated Area (<1 mSv/year). The objective is also to limit the exposure from CERN installations of members of the public, to values below 10μ Sv/year. Besides, residual dose rate near the target area and should be optimized allowing access after short cool down time to the detector, and air activation properly assessed to comply with CERN Radiation Area classification. The study performed by HSE-RP to assess the radiological impact of a new shielding design for EHN2 is detailed in a dedicated document ([EDMS 2670569](#)).

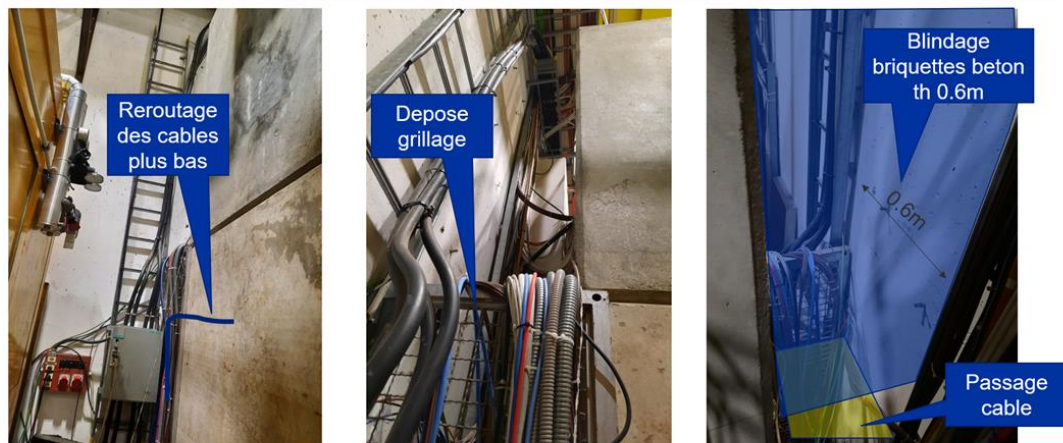
3. DETAILED DESCRIPTION

The improvements of the shielding of EHN2 consist of changes at 3 locations: the interface EHN2/TT84, the access chicane PPE211, and the shielding around AMBER target. A detailed description of each item is shown in this section.

3.1 Interface EHN2/TT84

The improvement of the shielding at the interface EHN2/TT84 consist in filling the hole between EHN2 hall and TT84, where there is currently a direct view to the CEDAR region (see Figure 2). The objective is to lower the prompt radiation going through this hole to EHN2 hall when having losses in the CEDAR region.

Jonction EHN2/TT84



DATE

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Figure 2: Improvement of the shielding at the interface EHN2/TT84

[Update figure with final design (BE-EA)]

[Add detailed description of the works (BE-EA)]

3.2 Access chicane PPE211

The improvement of the shielding at the access chicane PPE211 consist in adding concrete blocks to form a chicane maze, preventing direct view of the M2 beam line from outside the interlocked area (see Figure 3). The objective is to lower the prompt radiation going directly from the secondary beam area to EHN2 hall in case of losses in the region.

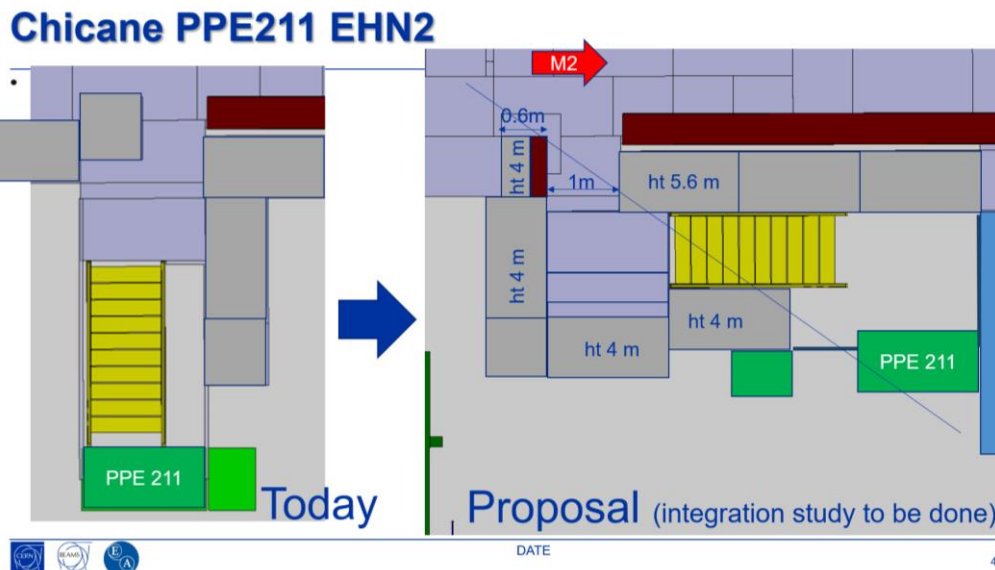


Figure 3: Improvement of the shielding at the access chicane PPE211
[Update figure with final design including additional block (BE-EA)]

[Add detailed description of the works (BE-EA)]

3.3 AMBER target bunker

The improvement of the shielding at the AMBER Target area is to build a bunker made of concrete block around target (see Figure 4) and has two main goals. First, lower the prompt radiation outside EHN2 and mainly due to sky-shine radiation. Second, allow a more optimized access in AMBER experimental area outside the bunker after short cool-down time by lowering the residual dose rate close generated by the targets, minimizing the effective dose received when working in the area. Radiation Area classification inside the AMBER target bunker will depend on the intensity and beam characteristics (see [EDMS 2670569](#)).

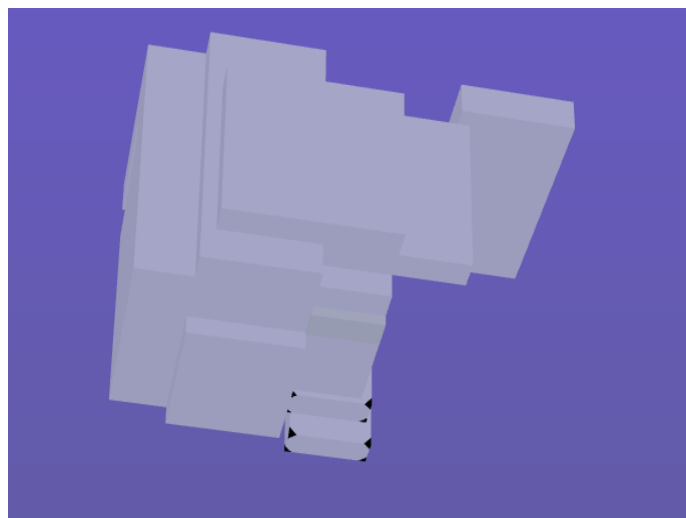


Figure 4: Improvement around AMBER Target of the shielding (AMBER target bunker)
[Update figure with final design including lateral reinforcements (BE-EA)]



4. IMPACT ON OTHER ITEMS

[section to be completed (BE-EA)]

4.1 IMPACT ON ITEMS/SYSTEMS

Layout	
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4.2 IMPACT ON UTILITIES AND SERVICES

Raw water:	
Demineralized water:	
Compressed air:	
Electricity, cable pulling (power, signal, optical fibres...):	
DEC/DIC:	
Racks (name and location):	
Vacuum (bake outs, sectorisation...):	
Special transport/handling:	
Temporary storage of conventional/radioactive components:	
Alignment and positioning:	
Scaffolding:	
Controls:	
GSM/WIFI networks:	
Cryogenics:	
Contractor(s):	
Surface building(s):	
Integration:	
Others:	



5. IMPACT ON COST, SCHEDULE AND PERFORMANCE

[section to be completed (BE-EA)]

5.1 IMPACT ON COST

Detailed breakdown of the change cost:	
Budget code:	

5.2 IMPACT ON SCHEDULE

Proposed installation schedule:	
Proposed test schedule (if applicable):	
Estimated duration:	
Urgency:	
Flexibility of scheduling:	

5.3 IMPACT ON PERFORMANCE

Mechanical aperture:	
Impedance:	
Optics/MADX	
Electron cloud (NEG coating, solenoid...)	
Insulation (enamelled flange, grounding...)	
Vacuum performance:	
R2E impact on performance and availability:	
Others:	

6. IMPACT ON OPERATIONAL SAFETY

[section to be completed (BE-EA)]

6.1 ÉLÉMENT(S) IMPORTANT(S) DE SECURITÉ

Requirement	Yes	No	Comments



EIS-Access			
EIS-Beam			
EIS-Machine			

6.2 OTHER OPERATIONAL SAFETY ASPECTS

What are the hazards introduced by the hardware?	
Could the change affect existing risk mitigation measures?	
What risk mitigation measures have to be put in place?	
Safety documentation to update after the modification	
Define the need for training or information after the change	

7. WORKSITE SAFETY

[section to be completed (BE-EA)]

7.1 ORGANISATION

Requirement	Yes	No	Comments
IMPACT – VIC:			
Operational radiation protection (surveys, DIMR...):			
Radioactive storage of material:		X	See RP assessment EDMS 2670569
Radioactive waste:		X	See RP assessment EDMS 2670569
Non-radioactive waste:			
Fire risk/permit (IS41) (welding, grinding...):			
Alarms deactivation/activation (IS37):			
Electrical lockout:			



Requirement	Yes	No	Comments
Others:			

7.2 REGULATORY INSPECTIONS AND TESTS

Requirement	Yes	No	Responsible Group	Comments
HSE inspection of pressurised equipment:				
Pressure/leak tests:				
HSE inspection of electrical equipment:				
Electrical tests:				
Others:				

7.3 PARTICULAR RISKS

Requirement	Yes	No	Comments
Hazardous substances (chemicals, gas, asbestos...):			
Work at height:			
Confined space working:			
Noise:			
Cryogenic risks:			
Industrial X-ray (<i>tirs radio</i>):			
Ionizing radiation risks (radioactive components):		X	See RP assessment EDMS 2670569
Others:			

8. FOLLOW-UP OF ACTIONS BY THE TECHNICAL COORDINATION

[section to be completed (BE-EA)]

Action	Done	Date	Comments
Carry out site activities:			
Carry out tests:			



Update layout drawings:			
Update equipment drawings:			
Update layout database:			
Update naming database:			
Update optics (MADX)			
Update procedures for maintenance and operations			
Update Safety File according to EDMS document 1177755 :			
Others:			
Action	Done	Date	Comments
Carry out site activities:			
Carry out tests:			
Update layout drawings:			
Update equipment drawings:			
Update layout database:			
Update naming database:			
Update optics (MADX)			
Update procedures for maintenance and operations			
Update Safety File according to EDMS document 1177755 :			
Others:			

9. REFERENCES

[1] Radiation Protection assessment of shielding improvements at EHN2 for Amber Drell-Yan run, A. Devienne, C. Ahdida, Technical Report [EDMS 2670569](#),2022