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	ENGINEERING CHANGE REQ	UEST	
Installa	tion of New Passive	Abso	rbers
TCAPM) for As a part of the c sertion (IR7), one This is planned for dose on warm ma tion of the downst sorber Passive Ma for implementatio	BRIEF DESCRIPTION OF THE PROPOSED CHANGE(onsolidation of the warm magnet systems of MQW module of the Q5 magnet will be remo- or LS2 as a part of the mitigation measures gnets and increase their lifetime. In order to cream magnets, a new passive absorber TCAR ask), will be installed. This document preser n in LS2. This activity is part of the consolidation	s): the betatron oved from the to reduce to ensure adeq PM (Target Co outs the solution tion project.	cleaning in- e tunnel [1]. he absorbed uate protec- ollimator Ab- on proposed
DOCUMENT PREPARED BY: S. Redaelli BE-ABP, R. Bruce BE-ABP, A. Mereghetti BE-ABP	DOCUMENT CHECKED BY: O. Aberle, J. Albertone, C. Adorisio, G. Arduini, M. Barberan, M. Bernardini, A. Bertarelli, F. Bertinelli, C. Bertone, C. Boccard, G. Bregliozzi, S. Bustamante, M. Calviani, F. Carra, G. Cattenoz, P. Chiggiato, J. P. Corso, R. De Maria, P. Fessia, R. Folch, J. F. Fuchs, C. Gaignant, L. Gentini, S. Gilardoni, G. Girardot, M. Giovannozzi, B. Goddard, E. Jensen, R. Jones, I. Lamas Garcia, M. Lamont, J. Lendaro, A. Masi, E. Metral, D. Missiaen, Y. Muttoni,	DOCUME F (on beh	NT APPROVED BY: P. Collier alf of the LMC)
	I. Otto, E. Page, S. Roesler, B. Salvant, P. Schwarz, R. Steerenberg, L. Tavian, M. Tavlet, C. Vollinger, J. Wenninger, C. Zamantzas		



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1. EXISTING SITUATION AND INTRODUCTION

Details of mitigation plans for the absorbed dose of warm quadrupoles and dipoles in the betatron cleaning insertion (IR7) of the LHC can be found in [1]. Mitigations include the removal of the first (along the incoming beam direction) MQW module of the Q5 assemblies at either side of IP7. This leaves the subsequent magnets more exposed to radiation doses. In order to make the intervention effective for the overall dose reduction, an upgrade of the passive collimation system is required. As a design goal for this upgrade, we set the design requirement that all remaining 5 magnets should receive doses not exceeding the levels that they receive in the present layout. This requires adding one new passive absorber per beam, called TCAPM (Target Collimator Absorber Passive Mask), at the locations of the magnets that will be removed i.e. at the location of the MQWA.E5.

The requirements and a detailed performance assessment of possible new layouts were discussed in various Collimation Upgrade Specification meetings (see the presentations by C. Bahamonde in [2, 3, 4, 5, 6]). Figure 1 shows an illustrative sketch, taken from the FLUKA geometry used in simulations, the present layout (top view) and the modified one (bottom view) [2,3]. The latest design was reviewed and endorsed in the 107^{th} ColUSM [7].



Figure 1 — Illustrative view of the present (top) and post-LS2 (bottom) layouts of the IR7 Q5 [2, 3]. The new TCAPM is represented by the brown box immediately upstream of the MQWA.D5, installed in the space freed by the removal of the MQWA.E5. A specular layout is planned for beam 2.

The present passive collimator TCAP (installed upstream of the present MQWA.E5, see Figure 1) will remain in place and the new passive absorber TCAPM will be added. The latter is outside the vacuum, contrary to the existing passive absorbers. The same elliptical chambers as the present MQW one will be used in this area.

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2. REASON FOR THE CHANGE

The computed doses in all modules of the Q5 magnets for beam 1, estimated for the whole lifetime of the HL-LHC project [8], are illustrated in Figure 2 for three different layouts [2, 3]:

- Present layout (top graph);
- Hypothetical layout without collimation upgrade after magnet removal (middle);
- Proposed post-LS2 layout (bottom) with TCAPM.

Dose values are estimated both for the coil and for the spacers [1]. Note that for all cases, the present TCAP (TCAPC.6L7.B1) collimator remains at the same location, as this was found to produce good performance. This also avoids intervening on a radioactive collimator. It is clear that without an improvement of the passive collimation layout (middle plot), doses on the downstream MQWs would be much higher than in the present layout. In particular, the dose on the coil spacers [1] of the most exposed magnet would be about a factor 4 larger. The proposed solution with TCAPM (bottom line) described in detail in the next section, solves this issue and brings the doses to an acceptable level.



Assuming 8.4 x 10¹⁶ protons lost in IR7 for the whole HL-LHC nominal operation

Figure 2 - Summary of doses in different magnets of the Q5 assembly for B1, in the present (top) and proposed post-LS2 (bottom) layouts. The middle plot shows the situation in case no upgrade of the passive collimation system is made. The new TCAPM is indicated by the brown box immediately upstream of the MQWA.D5L7. Courtesy of C. Bahamonde [2, 3]. We propose to call these new absorbers TCAPM.A5L7.B1 and TCAPM.A5R7.B2.

3. DETAILED DESCRIPTION

The new absorber's design [8] is shown in Figure 3. More details can be found in the mechanical layout drawings of the long straight section for high luminosity (LSXH_0014 for LSSR7 and LSXH_0013 for LSSL7) [1010, 1111] and in [12]. The SmarTeam references are

- TCAPM in IR7: ST0967099 (LHCTCAPM0001)
- TCAPM in IL7: ST1039969 (LHCTCAPM0039)

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Figure	3 — Overal	l design o	of the TC	CAPM. Lengths	are given i	n m	m. Courtesy	of L. G	ientini	[9].
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.1.1.1 C	URRE	ENT VAC	CUUM LA	AYOUT IN	SECT	OR B	5L7					
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(i	in blu	e) is loo	cated.									
			Table	1 – Currer	nt Layo (a)	out or Inter	n Vacuum mal line	Sector E	5L7.			
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ACSEC.B5L7.R	0.1	19849.5014 19849.6014	19849.6014 19849.8864	VMHDA.6L7.R BPMWE.5L7.B2	0.112	0.112	80 63	63 52/30	1		In Q5L7	
ACSEC.B5L7.R	0.2	19849.8864	19850.0864	VMGIA.B5L7.R	0.112	0.112	52/30	52/30	1			
VACSEC.B5L7.R	3.52 0.28	19850.0864 19853.6064	19853.6064 19853.8864	MQWA.E5L7 VMGIB.B5L7.R	0 0.112	0.112	52/30 52/30	52/30 52/30	IE		In Q5L7	
	3.52	19853.8864	19857.4064	MQWA.D5L7	0	0	52/30	52/30	IE		In Q5L7	
					(b) E:	xtern	al line					
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VACSEC.B5L7.B	0.1 0.285 0.2	19849.5014 19849.6014 19849.8864	19849.6014 19849.8864 19850.0864	VMHDA.6L7.B BPMWE.5L7.B1 VMGIA.B5L7.B MQWA.E5L7	-0.112 -0.112 -0.112	-0.112 -0.112 -0.112	80 63 30/52 30/52	63 30/52 30/52 30/52	E E E IE		In Q5L7	
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VACSEC.BSL7.B VACSEC.BSL7.B VACSEC.BSL7.B VACSEC.BSL7.B VACSEC.BSL7.B VACSEC.BSL7.R VACSEC.BSL7.R VACSEC.BSL7.R VACSEC.BSL7.R SUBSECTOR VACSEC.BSL7.R	LENGTH 0.285 0.2 0.285 0.28 0.28 0.28 0.28 0.28 0.28 0.28 0.28	19849.5014 19849.6014 19849.8864 19853.6064 2 shows talled in n cham <u>\$_\$TART</u> 19848.5614 19849.8864 19853.8864 19853.8864 19853.8864 19853.8864 19853.8864	19849,9014 19849,8864 19850,0864 19850,0864 19853,8864 19853,8864 19853,8864 19853,0864 19849,5014 19849,5014 19849,5014 19853,0864 19853,0864 19853,0864 19853,0864 19853,0864 19853,014	VMHDA.617.8 BPMWE.517.8 MQWA.ES17.8 MQWA.ES17.8 MQWA.ES17.8 MQWA.DS17 T IN SECT tract of th of the re Il be child e 2 - New NAME VCDTY.617.R VMHDA.617.R MQWA.DS17 NAME TCAPC.617.81 VMHDA.617.8	-0.112 -0.112 -0.112 -0.112 TOR B e new emove ren of Layou (a) Ir 0.112 0.112 0.112 0.112 0.112 0.112 0.112 0.112 0.112 0.112 0.112 0.112 0.112	-0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112	80 63 30/52 30/52 30/52 30/52 30/52 40/52 40/52 40/52 40/52 40/52 40/52 40/52 40/52 40/52 40/52 40/52 40/52 52/30 52/50 52/50 52/50 52/50 52/50 52/50 52/50 52/50 52/50 52/50 52/50 52/50 52/50 52/50 52/50 52/50	63 30/52 30/52 30/52 30/52 30/52 30/52 20/52 40/52 62/30 52/30 52/30 52/30 52/30 52/30 52/30 52/30 52/30 52/30 52/30	E E E E E E E E E E E E E E E	TCAPI ent Mi	In QSL3 M (in g QWA, t NOTE In QSL7 NOTE In QSL7 NOTE	reen) is to he VCELQ
VACSEC.BSI.7.B VACSEC.BSI.7.B VACSEC.BSI.7.B VACSEC.BSI.7.B VACSEC.BSI.7.B VACSEC.BSI.7.R VACSEC.BSI.7.R VACSEC.BSI.7.R VACSEC.BSI.7.R VACSEC.BSI.7.R VACSEC.BSI.7.R	LENGTH 0.285 0.2 0.285 0.28 0.2	19849.5014 19849.6014 19849.8864 19853.6064 2 shows talled in m cham <u>\$_stART</u> 19848.5614 19849.5014 19849.5014 19853.6064 19853.8064 19853.8064 19853.8064 19853.8064 19853.8064	19849,6014 19849,8864 19850,0864 19850,0864 19853,8864 19853,8864 19853,8864 19853,8864 19854,0014 19849,5014 19853,8864 19853,8864 19853,8064 19853,8064 19853,8064	VMHDA.617.8 BPMWE.517.8 MQWA.E517.8 MQWA.E517.8 MQWA.E517.8 MQWA.D517 T IN SECT tract of th of the ref ll be child e 2 - New NAME VMHDA.617.8 BPMWE.517.82 VMGIA.8517 MGIB.8517.R MQWA.D517 NAME TCAPC.617.81 VMHDA.617.8 BPMWE.517.81 VMGIA.8517 NAME TCAPC.617.81	-0.112 -0.112 -0.112 -0.112 TOR B e new emove ren of Layou (a) Ir U_START 0.112 0.122 0.122 0.122 0.122 0.122 0.122 0.122 0.122 0.122 0	-0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112	80 63 30/52 30/52 30/52 30/52 30/52 30/52 20/52 20/52 63 63 63 63 63 63 63 63 63 63 63 63 63	63 30/52 30/52 30/52 30/52 30/52 30/52 20/52 L7 where e in the seemblie Sector B5 Aperture End 80 63 52/30 52/30 52/30 52/30 52/30 63/52 30/52 30/52	E E E E E E E E CUTT S. L7. BEAM I I I E E E E E E E E E E E E	TCAP ent M vcelq.fsl	In QSL3 M (in g QWA, t NOTE In QSL3 NOTE In QSL3 In QSL3	reen) is to he VCELQ
VACSEC.BSI.7.B VACSEC.BSI.7.B VACSEC.BSI.7.B VACSEC.BSI.7.B VACSEC.BSI.7.R VACSEC.BSI.7.R VACSEC.BSI.7.R VACSEC.BSI.7.R VACSEC.BSI.7.R VACSEC.BSI.7.R VACSEC.BSI.7.B VACSEC.BSI.7.B	LENGTH 0.285 0.2 0.285 0.2 0.28 0.28 0.28 0.28 0.28 0.28 0.28	19849.5014 19849.6014 19849.8864 19853.6064 ACUUM 2 shows talled in m cham s_start 19848.5614 19849.6014 19853.6084 19853.8864 19853.8864 19853.8014 19849.5014 19849.5014 19849.5014 19849.5014 19849.5014	19849,9014 19849,8864 19850,0864 19850,0864 19853,8864 19853,8864 19853,8864 19849,5014 19849,5014 19849,5014 19853,8864 19853,8864 19853,8864 19853,8864	VMHDA.617.8 BPMWE.517.8 MQWA.E517.8 MQWA.E517.8 MQWA.E517.8 MQWA.D517 T IN SECT ract of th of the re Il be child e 2 - New NAME VCDTY.617.8 VMHDA.617.8 BPMWE.517.82 VMGIA.B517.8 TCAPC.617.81 VMGIA.B517.8 TCAPC.617.81 VMGIA.S517.8 TCAPC.617.81	-0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112	-0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112 -0.112	80 63 30/52 30/52 30/52 30/52 30/52 30/52 30/52 30/52 30/52 30/52 30/52 30/52 30/52 30/52 30/52	63 30/52 30/52 30/52 30/52 30/52 30/52 30/52 L7 where e in the seemblie Sector B5 Aperture End 80 63 52/30 52/30 52/30 52/30 52/30 52/30 52/30 52/30 52/30 52/30 52/30 52/30 52/30	E E E E E E E E Curr S. L7. BEAM I I I E E E E E E E E E E E E	TCAP ent M vcelq.fsl	In QSL3 M (in gu QWA, t NOTE In QSL3 NOTE In QSL3 NOTE	reen) is to he VCELQ of TCAPM.ASL7

												Page 7 of
1 2 10				CECTOR								-
.1.2 MC	DIFI	CATIO	NS IN	SECTOR	B2K/							
.1.2.1 C	URRE	NT VAC	CUUM LA	AYOUT IN	SECT	OR B	5R7					
Τa	able 3	3 shows	s an ext	ract of the	e curr	ent la	ayout on	B5R7 w	here	the re	moved	MQWA (ii
bl	ue) i	s locate	d.									
			Table	3 – Curren	t Layo	out on	Vacuum	Sector E	35R7			
					(a)	Inter	nal line					
SUBSECTOR	LENGTH	S_START	S_END	NAME MOWA D5R7	U_START	U_END	Aperture Start	Aperture End	I BEAM		NOTE	1
ACSEC.B5R7.R	0.28	20134.4384	20134.7184	VMGIB.B5R7.R	0.112	0.112	30/52	30/52	1		ni Qən	
ACSEC.B5R7.R	3.52 0.2	20134.7184 20138.2384	20138.2384 20138.4384	MQWA.E5R7 VMGIA.B5R7.R	0 0.112	0	30/52 30/52	30/52 30/52	IE		In Q5R	1
ACSEC BEDZ B	0.285	20138.4384	20138.7234	BPMWE.5R7.B2	0.112	0.112	30/52	63 80			In Q5R	1
ACSEC.BSK7.K	1	20138.7234	20138.8234	TCAPC.6R7.B2	0.112	0.112	80	80				
					(b) Ex	xterna	al line					
SUBSECTOR	LENGTH	S_START	S_END	NAME	U_START	U_END	Aperture Start	Aperture End	BEAM		NOTE	
ACSEC.B5R7.B	0.28	20134.4384	20134.7184	MQWA.D5R7 VMGIB.B5R7.B	- 0.112	-0.112	52/30 52/30	52/30 52/30	E			
ACSEC B587 B	0.2	20138,2384	20138.4384	MQWA.E5R7	-0.112	-0.112	52/30 52/30	52/30 52/30	IE E			
	0.285	20138.4384	20138.7234	BPMWE.5R7.B1	-0.112	-0.112	52/30	63	E		In Q5R	7
/acsec.bsr7.b /acsec.bsr7.b	0.1 0.94 EW V	20138.7234 20138.8234	20138.8234 20139.7634 LAYOU	VMHDA.6R7.B VCDTY.6R7.B	-0.112 -0.112	-0.112 -0.112 5R7 -able 4	63 80 <u>4</u>	80	E			
/ACSEC.B5R7.B /ACSEC.B5R7.B .1.2.2 N 	0.1 0.94 EW V able e inst de of	ACUUM shows alled in point	20138.8234 20139.7634 LAYOU s an ext place o 7, the	VMHDA.6R7.B VCDTY.6R7.B T IN SECT ract of the of the rem VCELQ va	-0.112 -0.112 FOR B	-0.112 -0.112 5R7 able d layou MQW char	63 80 4 ut on B5 /A. Just nbers wi	80 80 R7 wher as expla ill be ch	re the ined	e TCAP for the	M (in g e left si e TCAF	reen) is to de the lef 2M assem
ACCSEC.BSR7.B ACCSEC.BSR7.B .1.2.2 N Tr be Si bl	0.1 0.94 EW V able 4 e inst de of ies.	20138.7234 20138.8234 ACUUM shows called in f point	20138.8234 20139.7634 LAYOU an ext place o 7, the	VMHDA.6R7.B VCDTY.6R7.B T IN SECT cract of the of the rem VCELQ va	-0.112 -0.112 FOR B I te new noved cuum	-0.112 -0.112 5R7 able d layou MQW char	63 80 4 ut on B5 /A. Just nbers wi	80 80 R7 wher as expla ill be ch	re the ined ildrei	e TCAP for the	M (in g e left si e TCAF	reen) is to de the lef M assem
ACCSEC.BSR7.B (ACCSEC.BSR7.B .1.2.2 N	0.1 0.94 EW V able de inst de of ies.	20138.7234 20138.8234 ACUUM 4 shows called in f point	20138.8234 20139.7634 LAYOU s an ext place o 7, the	VMHDA.6R7.B VCDTY.6R7.B T IN SECT tract of the of the rem VCELQ va	-0.112 -0.112 FOR B I e new noved cuum	-0.112 -0.112 5R7 <u>able o</u> Iayou MQW char	63 80 4 ut on B5 /A. Just nbers wi	R7 wher as expla ill be ch	re the ined ildrei	e TCAP for the n of th	M (in g e left si e TCAF	reen) is to de the lef PM assem
,1.2.2 N ,1.2.2 N Transformed and the second	0.1 0.94 EW V able 4 e inst de of ies.	20138.7234 20138.8234 ACUUM 4 shows called in f point	LAYOU an ext place o 7, the Table	VMHDA.6R7.B VCDTY.6R7.B T IN SECT aract of the of the rem VCELQ va e 4 – New	-0.112 -0.112 FOR B TOR B Tore new noved cuum Layou (a) Ir	-0.112 -0.112 5R7 -able - layou MQW char t on V	63 80 4 ut on B5 /A. Just nbers wi /acuum S	80 80 R7 wher as expla ill be ch Sector B5	e the ined ildre	e TCAP for the	M (in g e left si e TCAF	reen) is to de the lef M assem
ACCSEC.BSR7.B ACCSEC.BSR7.B .1.2.2 N Tri be si bl	0.1 0.94 EW V able 4 e inst de of ies.	20138.7234 20138.8234 ACUUM 4 shows called in f point	20138.8234 20139.7634 LAYOU s an ext place o 7, the Table S END	VMHDA.6R7.B VCDTY.6R7.B T IN SECT tract of the of the rem VCELQ va e 4 – New	-0.112 -0.112 FOR B Tork B toved cuum Layou (a) Ir	-0.112 -0.112 5R7 able of Iayou MQW char t on V nterna	63 80 4 ut on B5 /A. Just nbers wi /acuum S al line Aperture Start	80 80 R7 wher as expla ill be ch Gector B5	e the ined ildrei	e TCAP for the n of th	M (in g e left si e TCAF	reen) is to de the lef M assem
ACCSEC.BSR7.B (ACCSEC.BSR7.B .1.2.2 N Tr be si bl subsector	0.1 0.94 EW V able 4 e inst de of lies.	20138.7234 20138.8234 ACUUM 4 shows alled in f point	20138.8234 20139.7634 LAYOU 5 an ext place o 7, the Table 5_END 20134.4384	VMHDA.6R7.B VCDTY.6R7.B T IN SECT tract of the of the rem VCELQ va e 4 – New NAME MQWA.05R7	-0.112 -0.112 FOR B re new hoved cuum Layou (a) Ir	-0.112 -0.112 5R7 able of layou MQW char t on V t on V terna	63 80 4 ut on B5 /A. Just nbers wi /acuum S al line Aperture Start 30/52	80 80 R7 wher as expla ill be ch Sector B5 Aperture End 30/52	E E E E E E E E E E E E E E E E E E E	e TCAP for the	M (in g e left si e TCAF NOTE In QSR	reen) is to de the lef M assem
ACCSEC.BSR7.B .1.2.2 N .1.2.2 N 	0.1 0.94 EW V able 4 e inst de of ies.	20138.7234 20138.8234 ACUUM 4 shows called in f point 5 <u>stART</u> 20130.9184 20134.4384 20134.7184	20138.8234 20139.7634 LAYOU 5 an ext place o 7, the Table 20134.4384 20134.7184 20138.2384	VMHDA.6R7.B VCDTY.6R7.B T IN SECT ract of the of the rem VCELQ va e 4 – New NAME NAME VMGIB.8SR7.R TCAPM.ASR7	-0.112 -0.112 FOR B re new noved cuum Layou (a) Ir 0.112 0.112 0.112	-0.112 -0.112 5R7 able of layou MQW char t on V terna	63 80 4 ut on B5 /A. Just nbers wi /acuum S al line Aperture Start 30/52 30/52 30/52	80 80 R7 wher as expla ill be ch Sector B5 Aperture Ent 30/52 30/52	E E E E E E E E E E E E E E E E E E E	e TCAP for the n of th	M (in g e left si e TCAF In Q5R 77.R as child	reen) is to de the lef PM assem
ACSEC.BSR7.B (ACSEC.BSR7.B .1.2.2 N Tr be SUBSECTOR (ACSEC.BSR7.R (ACSEC.BSR7.R	0.1 0.94 EW V able de inst de of ies.	20138.7234 20138.8234 ACUUM 4 shows called in f point 20130.9184 20134.4384 20134.7184 20134.2384	20138.8234 20139.7634 LAYOU 5 an ext place o 7, the Table 5 END 20134.4384 20138.2384 20138.2384	VMHDA.6R7.B VCDTY.6R7.B T IN SECT of the rem VCELQ va e 4 – New NAME MQWA.05R7 VMGIB.B5R7.R TCAPM.A587 VMGIB.A587.R	-0.112 -0.112 FOR B TOR B Toved cuum Layou (a) Ir U_START 0 0.112 0 0.112 0	-0.112 -0.112 5R7 -able - layou MQW char t on V t on V nterna 0 0.112 0 0.112 0 0.112	63 80 4 ut on B5 /A. Just nbers wi /acuum S al line Aperture Start 30/52 30/52 30/52 30/52	80 80 R7 wher as expla ill be ch Sector B5 Sector B5 30/52 30/52 30/52 30/52 30/52	E E E the ined ildref R7.	e TCAP for the n of th	M (in g e left si e TCAF In QSR 17.R as child	reen) is to de the lef PM assem
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4. IMPACT ON OTHER ITEMS

4.1 IMPACT ON ITEMS/SYSTEMS

LHC collimation system	No changes to the other IR7 movable and passive collimators.
BE/BI	No dedicated BI equipment, like BLMs, will be needed for this passive ab- sorber: with the removal of the MQWA.E5 magnets, its protection using the BLM system also becomes unnecessary. Therefore, the corresponding detector (see list below) will be disconnected from the tunnel acquisition system and removed together with their supports. The BLM configuration database will be also updated at the same time to declare this as a spare/empty channel and remove its virtual connection to the BIS system: - BLMQI.05L7.B2I10_MQWA.E5L7 (19851.85 m) - BLMQI.05R7.B1E30_MQWA.E5R7 (20136.48 m)
Machine protection	No impact.
BE/OP	No impact.
TE/VSC	No impact.

4.2 IMPACT ON UTILITIES AND SERVICES

Raw water:	No.
Demineralized water:	No.
Compressed air:	No.
Electricity, cable pulling (power, signal, optical fibres):	No.
DEC/DIC:	A electrical junction boxes presently below each magnet will have to be re- moved for the installation of the TCSPM collimators. See attached image.



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Racks (name and loca- tion):	No.
Vacuum (bake outs, sec- torisation):	Yes
Special transport/ han- dling:	Transport of heavy assemblies to be planned.
Temporary storage of conventional/radioactive components:	-
Alignment and position- ing:	Activities for the survey team: Fiducialisation of the assemble TCAPM, to be done on surface. « Tracage » of the TCAPM position on the tunnel floor; Alignment of different components.
Scaffolding:	Not needed.
Controls:	-
GSM/WIFI networks:	Needed for TE-VSC intervention
Cryogenics:	No.
Contractor(s):	N/A
Surface building(s):	N/A
Others:	

5. IMPACT ON COST, SCHEDULE AND PERFORMANCE

5.1 IMPACT ON COST

Detailed breakdown of the change cost:	All activities will be covered by the Consolidation project.
Budget code:	Collimation consolidation code 61727.

5.2 IMPACT ON SCHEDULE

Proposed installation schedule:	Installation toward end of LS2.
Proposed test schedule (if applicable):	No special tests planned after the assembly.
Estimated duration:	Less than 1 week installation time for EN/STI group. 2-3 weeks intervention for TE-VSC.
Urgency:	
Flexibility of scheduling:	Hardware is unlikely to be available before the end of 2019.
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5.3 IMPACT ON PERFORMANCE

Mechanical aperture:	No impact as the new hardware is outside the beam vacuum.
Impedance:	No impact as the new hardware is outside the beam vacuum.
Optics/MADX	The active absorbing parts of the new TCAPM is installed outside the vacuum. It is proposed to add these new objects as elements in the MADX sequence with names TCAPM.A5L7.B1 and TCAPM.A5R7.B2. Vacuum chambers can be added as child to these elements.
Electron cloud (NEG coating, solenoid)	-
Insulation (enamelled flange, grounding)	-
Vacuum performance:	-
Layout database:	It should be updated with the new TCAPM in the old MQW position. The 2 vacuum chambers will be children of the TCAPM.

6. IMPACT ON OPERATIONAL SAFETY

6.1 ÉLÉMENT(S) IMPORTANT(S) DE SECURITÉ

Requirement	Yes	No	Comments
EIS-Access		Х	-
EIS-Beam		Х	-
EIS-Machine		Х	-

6.2 OTHER OPERATIONAL SAFETY ASPECTS

Have new hazards been created or changed?	Implications of removal of MQW magnets discussed in [1].
Could the change affect existing risk control measures?	No.
What risk controls have to be put in place?	None.
Safety documentation to update after the modification	-
Define the need for training or information after the change	-
	·



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7. WORKSITE SAFETY

7.1 ORGANISATION

Requirement	Yes	No	Comments
IMPACT - VIC:	Х		IMPACT will be created.
Operational radiation protection (surveys, DIMR):	х		Installation in high radiation environment must be done by taking the ALARA principle into account.
Radioactive storage of material:	x		Works on magnets and vacuum components discussed in $\begin{bmatrix} 1+\\ 2 \end{bmatrix}$.
Radioactive waste:	Х		Seals and bolts for TE-VSC mechanics
Fire risk/permit (IS41) (welding, grinding):		х	
Alarms deactiva- tion/activation (IS37):		х	
Others:			

7.2 REGULATORY TESTS

Requirement	Yes	No	Responsible Group	Comments
Pressure/leak tests:	х		TE-VSC	Leak test of the sector after mechanical inter- vention
Electrical tests:		Х		
Others:				

7.3 PARTICULAR RISKS

Requirement	Yes	No	Comments
Hazardous substances (chemicals, gas, asbes- tos):		х	
Work at height:		х	
Confined space working:		х	
Noise:		х	
Cryogenic risks:		х	
Industrial X-ray (<i>tirs radio</i>):		х	
Ionizing radiation risks (radioactive components):		х	
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Others:		

8. FOLLOW-UP OF ACTIONS BY THE TECHNICAL COORDINATION

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 mainte- nance and operations			
Update Safety File according to EDMS document <u>1177755</u> :			
Others:			

9. REFERENCES

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- [2] 95th ColUSM, <u>https://indico.cern.ch/event/676111</u>.
- [3] 83rd ColUSM, <u>http://indico.cern.ch/event/614887</u>.
- [4] 81st ColUSM, <u>http://indico.cern.ch/event/588072</u>.
- [5] 77th ColUSM, <u>http://indico.cern.ch/event/568895</u>.
- [6] 76th ColUSM, <u>http://indico.cern.ch/event/562586</u>.
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- [8] G. Apollinari, I. Bejar Alonso, O. Bruning, P. Fessia, M. Lamont, L. Rossi, and L. Tavian (editors). High-Luminosity Large Hadron Collider (HL-LHC): Technical Design Report V. 0.1. CERN Yellow Reports: Monographs. CERN-2017-007-M. CERN, Geneva, 2017.
- [9] 17th HiColDEM meeting, "HL-LHC Collimators: Design, Engineering and Prototyping" <u>https://indico.cern.ch/event/699699</u>.

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[10] https://ed	lms.cern.ch/document/1395378/	0 (LSSR7)		
[11] https://ed	lms.cern.ch/document/1395377/	0 (LSSL7)		
[12] M. Pasqua Magnet Protect	ali, Engineering evaluation of Nev ion in IR7, <u>https://edms.cern.ch</u>	v Passive Abso /document/20	rbers (TCAPM) <u>32498/1</u> ,	for Warm
[13] <u>https://ed</u>	lms.cern.ch/document/2038153/	<u>0</u>		
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