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ENGINEERING CHANGE REQUEST

Rotation of PPS Roman Pots to Adapt to Vertical Beam Crossing in IP5

BRIEF DESCRIPTION OF THE PROPOSED CHANGE(S):

[Brief description of the proposed change and detail the equipment concerned]

DOCUMENT PREPARED BY:	DOCUMENT TO BE CHECKED BY:	DOCUMENT TO BE APPROVED BY:
D. Druzhkin (EP-UCM), J. Baechler & M.Deile (EP-CMT)	[FisrtName LastName Dept-Grp]	Mike Lamont (On behalf of the LMC)

DOCUMENT SENT FOR INFORMATION TO:

[List of persons to whom the document is sent]

SUMMARY OF THE ACTIONS TO BE UNDERTAKEN:

[List the main actions to be undertaken]

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

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1. EXISTING SITUATION AND INTRODUCTION

The present layout of the PPS installation in the LHC tunnel at IP5 in the sectors 4-5 and 5-6 corresponds to Figure 1, Figure 2, Figure 3, Table 1 and Table 2. Due to a change of the collision plane requested by the LHC management to be implemented at the restart of LHC after the EYETS 2024/2025 [1], the XRP detectors would lose significantly in acceptance.

2. REASON FOR THE CHANGE

To restore the acceptance needed to reach the physics goals of PPS with the changed collision plane at IP5, a mechanical rotation of the horizontal RP horizontal stations by 27° clockwise with respect to the axis of the beam tube (looking from IP5 towards the XRP) is required [2]. This activity needs to be performed during the EYETS 2024/2025 to restart the data taking with the optimized acceptance of the XRP detectors.

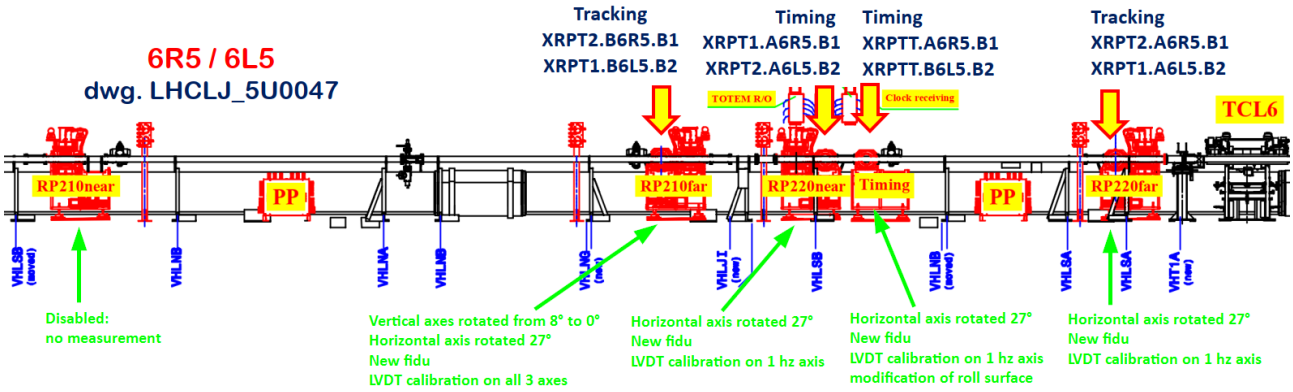


Figure 1: The horizontal XRP stations that will be rotated in the sectors 4-5 and 5-6 are indicated by yellow arrows.

Table 1: Vacuum layout of 6R5 before the EYETS 2024/2025. The XRP units concerned by the present ECR are underlaid in dark red.

Outer beam														
Element name	Expert name	IP Offset	Positions and Length				Transformations					Sectors	Flanges	
			Start	End	Length	S	U	V	B	A	C		Upstream	Downstream
VMAAB.6R5.B	VMAAB.20.6R5.B	203.063	13532.2026	13532.5046	0.302	1.853	-0.097	0	0	0	0	A6R5.B	DN100	DN100
XRPT1.B6R5.B1		203.993	13532.5046	13533.4346	0.93	2.155	-0.097	0	0	0	0			
VCDAD.A6R5.B	VCDAD.29.6R5.B	203.993	13533.1026	13533.4346	0.332	0.598	0	0	0	0	0	A6R5.B	DN100	DN100
VAMFY.A6R5.B	VAMFY.32.6R5.B	204.293	13533.4346	13533.7346	0.3	3.085	-0.097	0	0	0	0	A6R5.B	DN100	DN100
VMAAF.A6R5.B	VMAAF.32.6R5.B	204.293	13533.4346	13533.7346	0.3	0	0	0	0	0	0	A6R5.B	DN100	DN100
VAZNP.A6R5.B	VAZNP.32.6R5.B	204.075	13533.5166	13533.5166	0	0.082	-0.125	0	0	0	0	A6R5.B		
VFCBF.A6R5.B	VFCBF.32.6R5.B	204.075	13533.5166	13533.5166	0	0.082	0	-0.125	0	0	0	A6R5.B		
VFCBD.A6R5.B	VFCBD.32.6R5.B	204.075	13533.5166	13533.5166	0	0.082	0	0.112	0	0	0	A6R5.B		
VPNCA.A6R5.B	VPNCA.32.6R5.B	204.075	13533.5166	13533.5166	0	0	0	0	0	0	0	A6R5.B		
VPIAN.A6R5.B	VPIAN.32.6R5.B	204.075	13533.5166	13533.5166	0	0	0	0	0	0	0	A6R5.B		
VCDAF.6R5.B	VCDAF.55.6R5.B	208.563	13533.7346	13538.0046	4.27	3.385	-0.097	0	0	0	0	A6R5.B	DN100	DN100
VAMFD.6R5.B	VAMFD.78.6R5.B	208.863	13538.0046	13538.3046	0.3	7.655	-0.097	0	0	0	0	A6R5.B	DN100	DN100
VMAAF.B6R5.B	VMAAF.78.6R5.B	208.863	13538.0046	13538.3046	0.3	0	0	0	0	0	0	A6R5.B	DN100	DN100
VAZBD.6R5.B	VAZBD.77.6R5.B	208.645	13538.0866	13538.0866	0	0.082	0	-0.125	0	0	0	A6R5.B		
VAZAG.6R5.B	VAZAG.77.6R5.B	208.645	13538.0866	13538.0866	0	0.082	0	0.112	0	0	0	A6R5.B		
VAZAE.6R5.B	VAZAE.77.6R5.B	208.645	13538.0866	13538.0866	0	0.082	-0.125	0	0	0	0	A6R5.B		
VVFMF.6R5.B	VVFMF.77.6R5.B	208.645	13538.0866	13538.0866	0	0	0	0	0	0	0	A6R5.B		
VGRB.A6R5.B	VGRB.77.6R5.B	208.645	13538.0866	13538.0866	0	0	0	0	0	0	0	A6R5.B		
VGI.6R5.B	VGI.77.6R5.B	208.645	13538.0866	13538.0866	0	0	0	0	0	0	0	A6R5.B		
VCDAE.6R5.B	VCDAE.96.6R5.B	212.084	13538.3046	13541.5256	3.221	7.955	-0.097	0	0	0	0	A6R5.B	DN100	DN100
VHLNB.C6R5.C	VHLNB.82.6R5.C	209.113	13538.5546	13538.5546	0	0.25	0.097	0	0	0	0	A6R5.R A6R5.B		
VHLNB.D6R5.C	VHLNB.105.6R5.C	211.4385	13540.8801	13540.8801	0	2.5755	0.097	0	0	0	0	A6R5.R A6R5.B		
VHLNA.B6R5.C	VHLNA.129.6R5.C	213.764	13543.2056	13543.2056	0	4.901	0.097	0	0	0	180	A6R5.R A6R5.B		
VAMFY.B6R5.B	VAMFY.113.6R5.B	212.384	13541.5256	13541.8256	0.3	11.176	-0.097	0	0	0	0	A6R5.B	DN100	DN100
VMAAF.C6R5.B	VMAAF.113.6R5.B	212.384	13541.5256	13541.8256	0.3	0	0	0	0	0	0	A6R5.B	DN100	DN100
VFCBF.C6R5.B	VFCBF.113.6R5.B	212.166	13541.6076	13541.6076	0	0.082	0	-0.125	0	0	0	A6R5.B		
VAZNP.B6R5.B	VAZNP.113.6R5.B	212.166	13541.6076	13541.6076	0	0.082	-0.125	0	0	0	0	A6R5.B		
VFCBD.B6R5.B	VFCBD.113.6R5.B	212.166	13541.6076	13541.6076	0	0.082	0	0.112	0	0	0	A6R5.B		
VPNCA.B6R5.B	VPNCA.113.6R5.B	212.166	13541.6076	13541.6076	0	0	0	0	0	0	0	A6R5.B		
VPIAN.B6R5.B	VPIAN.113.6R5.B	212.166	13541.6076	13541.6076	0	0	0	0	0	0	0	A6R5.B		
XRPT2.B6R5.B1		213.314	13541.8256	13542.7556	0.93	11.476	-0.097	0	8	0	0			
VMAAB.D6R5.B	VMAAB.126.6R5.B	213.614	13542.7556	13543.0556	0.3	12.406	-0.097	0	0	0	0	A6R5.B	DN100	DN100
VCDBX.6R5.B	VCDBX.129.6R5.B	214.014	13543.0556	13543.4556	0.4	12.706	-0.097	0	0	0	0	A6R5.B	DN100	DN100
VMAAB.A6R5.B	VMAAB.133.6R5.B	214.314	13543.4556	13543.7556	0.3	13.106	-0.097	0	0	0	0	A6R5.B	DN100	DN100
XRPT1.A6R5.B1		215.244	13543.7556	13544.6856	0.93	13.406	-0.097	0	0	0	0			
VMAAB.B6R5.B	VMAAB.145.6R5.B	215.544	13544.6856	13544.9856	0.3	14.336	-0.097	0	0	0	0	A6R5.B	DN100	DN100
XRPTT.A6R5.B1		215.876	13544.9856	13545.3176	0.332	14.636	-0.097	0	0	0	0			
VAMFY.C6R5.B	VAMFY.151.6R5.B	216.176	13545.3176	13545.6176	0.3	14.968	-0.097	0	45	0	0	A6R5.B	DN100	DN100
VMAAF.D6R5.B	VMAAF.151.6R5.B	216.176	13545.3176	13545.6176	0.3	0	0	0	-45	0	0	A6R5.B	DN100	DN100
VFCBF.D6R5.B	VFCBF.151.6R5.B	215.958	13545.3996	13545.3996	0	0.082	-0.088388	-0.088388	-45	0	0	A6R5.B		
VFCBD.C6R5.B	VFCBD.151.6R5.B	215.958	13545.3996	13545.3996	0	0.082	0.079196	0.079196	-45	0	0	A6R5.B		
VAZNP.C6R5.B	VAZNP.151.6R5.B	215.958	13545.3996	13545.3996	0	0.082	-0.088388	0.088388	-45	0	0	A6R5.B		
VPIAN.C6R5.B	VPIAN.151.6R5.B	215.958	13545.3996	13545.3996	0	0	0	0	0	0	0	A6R5.B		
VPNCA.C6R5.B	VPNCA.151.6R5.B	215.958	13545.3996	13545.3996	0	0	0	0	0	0	0	A6R5.B		
VCDAC.6R5.B	VCDAC.167.6R5.B	219.084	13545.6176	13548.5256	2.908	15.268	-0.097	0	0	0	0	A6R5.B	DN100	DN100
VHLSB.A6R5.B	VHLSB.155.6R5.B	216.426	13545.8676	13545.8676	0	0.25	0	0	0	0	0	A6R5.B		
VHLSA.6R5.B	VHLSA.179.6R5.B	218.834	13548.2756	13548.2756	0	2.658	0	0	0	0	180	A6R5.B		
VAMEY.C6R5.B	VAMEY.183.6R5.B	219.384	13548.5256	13548.8256	0.3	18.176	-0.097	0	180	0	0	A6R5.B	DN100	DN100
VMAAE.A6R5.B	VMAAE.183.6R5.B	219.384	13548.5256	13548.8256	0.3	0	0	0	0	0	0	A6R5.B	DN100	DN100
VPIAN.D6R5.B	VPIAN.183.6R5.B	219.166	13548.6076	13548.6076	0	0.082	0.125	0	180	-180	0	A6R5.B		
VFCBF.E6R5.B	VFCBF.183.6R5.B	219.166	13548.6076	13548.6076	0	0.082	0	-0.125	270	0	0	A6R5.B		
VPNCA.D6R5.B	VPNCA.183.6R5.B	219.166	13548.6076	13548.6076	0	0.082	0.125	0	180	0	0	A6R5.B		
VFCBD.D6R5.B	VFCBD.183.6R5.B	219.166	13548.6076	13548.6076	0	0.082	0	-0.112	180	90	0	A6R5.B		
XRPT2.A6R5.B1		220.314	13548.8256	13549.7556	0.93	18.476	-0.097	0	0	0	0			
VAMNA.6R5.B	VAMNA.197.6R5.B	220.834	13549.7556	13550.2756	0.52	19.926	-0.097	0	0	0	180	A6R5.B	DN100	QCF100
VMTNC.A6R5.B	VMTNC.197.6R5.B	220.834	13549.7556	13550.2756	0.52	0	0	0	0	0	0	A6R5.B	DN100	QCF100
VPNCA.E6R5.B	VPNCA.197.6R5.B	220.574	13550.0156	13550.0156	0	0.26	0.13	0	0	0	180	A6R5.B		
VPIAN.E6R5.B	VPIAN.197.6R5.B	220.574	13550.0156	13550.0156	0	0.26	0.13	0	0	0	180	A6R5.B		
TCL.6R5.B1		222.314	13550.2756	13551.7556	1.48	19.926	-0.097	0	0	0	0			

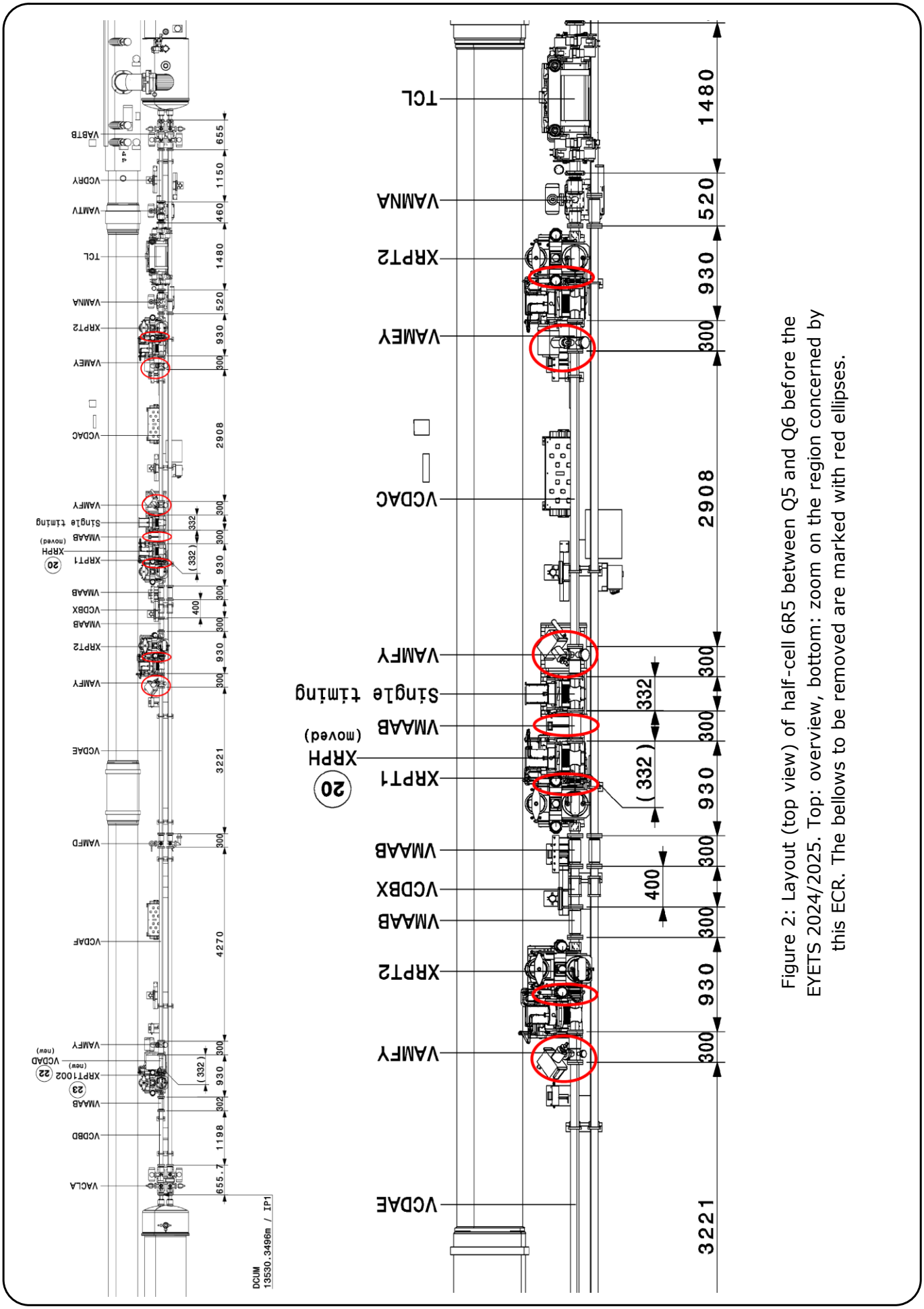


Figure 2: Layout (top view) of half-cell 6R5 between Q5 and Q6 before the EYETS 2024/2025. Top: overview, bottom: zoom on the region concerned by this ECR. The bellows to be removed are marked with red ellipses.

Table 2: : Vacuum layout of 6L5 before the EYETS 2024/2025. The XRP units concerned by the present ECR are underlaid in dark red.

Element name	Expert name	IP Offset	Outer beam Positions and Length Start	End	Length	S	Transformations U	V	B	A	C	Sectors	Flanges Upstream	Downstream
TCL.6L5.B2		-220.824	13107.1376	13108.6176	1.48	9.897	-0.097	0	0	0	0			
VAMTW.6L5.R	VAMTW.203.6L5.R	-220.314	13108.6176	13109.1276	0.51	11.887	-0.097	0	0	0	180	A6L5.R	QCF100	DN100
VMTND.A6L5.R	VMTND.203.6L5.R	-220.304	13108.6176	13109.1376	0.52	-0.01	0	0	0	0	0	A6L5.R	QCF100	DN100
VPNCA.E6L5.R	VPNCA.203.6L5.R	-220.564	13108.8776	13108.8776	0	0.25	0.13	0	0	0	180	A6L5.R		
VPIAN.E6L5.R	VPIAN.203.6L5.R	-220.564	13108.8776	13108.8776	0	0.25	0.13	0	0	0	180	A6L5.R		
XRPT1.A6L5.B2		-219.384	13109.1276	13110.0576	0.93	11.887	-0.097	0	0	0	0			
VAMEY.D6L5.R	VAMEY.189.6L5.R	-219.084	13110.0576	13110.3576	0.3	13.117	-0.097	0	90	0	180	A6L5.R	DN100	DN100
VMAAE.E6L5.R	VMAAE.189.6L5.R	-219.084	13110.0576	13110.3576	0.3	0	0	0	90	0	0	A6L5.R	DN100	DN100
VPNCA.D6L5.R	VPNCA.189.6L5.R	-219.166	13110.2756	13110.2756	0	0.082	0	-0.125	90	0	180	A6L5.R		
VPIAN.D6L5.R	VPIAN.189.6L5.R	-219.166	13110.2756	13110.2756	0	0.082	0	-0.125	90	0	180	A6L5.R		
VCDAC.6L5.R	VCDAC.173.6L5.R	-216.176	13110.3576	13113.2656	2.908	13.117	-0.097	0	0	0	0	A6L5.R	DN100	DN100
VHLSA.6L5.R	VHLSA.185.6L5.R	-218.834	13110.6076	13110.6076	0	0.25	0	0	0	0	0	A6L5.R		
VAMEY.A6L5.R	VAMEY.157.6L5.R	-215.876	13113.2656	13113.5656	0.3	16.025	-0.097	0	-135	0	0	A6L5.R	DN100	DN100
VMAAE.A6L5.R	VMAAE.157.6L5.R	-215.876	13113.2656	13113.5656	0.3	0.3	0	0	135	0	180	A6L5.R	DN100	DN100
VPIAN.A6L5.R	VPIAN.157.6L5.R	-215.958	13113.4836	13113.4836	0	0.218	0.088388	-0.088388	135	0	0	A6L5.R		
VPNCA.A6L5.R	VPNCA.157.6L5.R	-215.958	13113.4836	13113.4836	0	0.218	0.088388	-0.088388	135	0	0	A6L5.R		
XRPTT.A6L5.B2		-215.544	13113.5656	13113.8976	0.332	16.325	-0.097	0	0	0	0			
VMAAB.B6L5.R	VMAAB.151.6L5.R	-215.244	13113.8976	13114.1976	0.3	16.657	-0.097	0	0	0	0	A6L5.R	DN100	DN100
XRPT2.A6L5.B2		-214.314	13114.1976	13115.1276	0.93	16.957	-0.097	0	0	0	0			
VMAAB.A6L5.R	VMAAB.139.6L5.R	-214.014	13115.1276	13115.4276	0.3	17.887	-0.097	0	0	0	0	A6L5.R	DN100	DN100
VCDBX.6L5.R	VCDBX.135.6L5.R	-213.614	13115.4276	13115.8276	0.4	18.187	-0.097	0	0	0	0	A6L5.R	DN100	DN100
VMAAB.E6L5.R	VMAAB.132.6L5.R	-213.314	13115.8276	13116.1276	0.3	18.587	-0.097	0	0	0	0	A6L5.R	DN100	DN100
XRPT1.B6L5.B2		-212.384	13116.1276	13117.0576	0.93	18.887	-0.097	0	8	0	0			
VAMEY.B6L5.R	VAMEY.119.6L5.R	-212.084	13117.0576	13117.3576	0.3	20.117	-0.097	0	0	0	180	A6L5.R	DN100	DN100
VMAAE.C6L5.R	VMAAE.119.6L5.R	-212.084	13117.0576	13117.3576	0.3	0	0	0	0	0	0	A6L5.R	DN100	DN100
VPIAN.B6L5.R	VPIAN.119.6L5.R	-212.166	13117.2756	13117.2756	0	0.082	0.125	0	0	0	180	A6L5.R		
VPNCA.B6L5.R	VPNCA.119.6L5.R	-212.166	13117.2756	13117.2756	0	0.082	0.125	0	0	0	180	A6L5.R		
VCDAE.6L5.R	VCDAE.102.6L5.R	-208.863	13117.3576	13120.5786	3.221	20.117	-0.097	0	0	0	0	A6L5.R	DN100	DN100
VAMVD.6L5.R	VAMVD.84.6L5.R	-208.563	13120.5786	13120.8786	0.3	23.638	-0.097	0	0	0	180	A6L5.R	DN100	DN100
VMAAE.B6L5.R	VMAAE.84.6L5.R	-208.563	13120.5786	13120.8786	0.3	0	0	0	0	0	0	A6L5.R	DN100	DN100
VAZAG.6L5.R	VAZAG.83.6L5.R	-208.645	13120.7966	13120.7966	0	0.082	0	0.112	0	0	180	A6L5.R		
VAZBD.6L5.R	VAZBD.83.6L5.R	-208.645	13120.7966	13120.7966	0	0.082	0	-0.125	0	0	180	A6L5.R		
VAZAE.6L5.R	VAZAE.83.6L5.R	-208.645	13120.7966	13120.7966	0	0.082	0.125	0	0	0	180	A6L5.R		
VGRB.A6L5.R	VGRB.83.6L5.R	-208.645	13120.7966	13120.7966	0	0	0	0	0	0	0	A6L5.R		
VVFMF.6L5.R	VVFMF.83.6L5.R	-208.645	13120.7966	13120.7966	0	0	0	0	0	0	0	A6L5.R		
VGI.6L5.R	VGI.83.6L5.R	-208.645	13120.7966	13120.7966	0	0	0	0	0	0	0	A6L5.R		
VCDAF.6L5.R	VCDAF.61.6L5.R	-204.293	13120.8786	13125.1486	4.27	23.638	-0.097	0	0	0	0	A6L5.R	DN100	DN100
VAMEY.C6L5.R	VAMEY.38.6L5.R	-203.993	13125.1486	13125.4486	0.3	27.908	-0.097	0	0	0	0	A6L5.R	DN100	DN100
VMAAE.D6L5.R	VMAAE.38.6L5.R	-203.993	13125.1486	13125.4486	0.3	0	0	0	0	0	0	A6L5.R	DN100	DN100
VFCBF.D6L5.R	VFCBF.39.6L5.R	-204.191	13125.2506	13125.2506	0	0.102	0	-0.125	0	0	0	A6L5.R		
VAZNP.C6L5.R	VAZNP.39.6L5.R	-204.191	13125.2506	13125.2506	0	0.102	-0.125	0	0	0	0	A6L5.R		
VFCBD.C6L5.R	VFCBD.39.6L5.R	-204.191	13125.2506	13125.2506	0	0.102	0	0.112	0	0	0	A6L5.R		
VPIAN.C6L5.R	VPIAN.39.6L5.R	-204.191	13125.2506	13125.2506	0	0	0	0	0	0	0	A6L5.R		
VPNCA.C6L5.R	VPNCA.39.6L5.R	-204.191	13125.2506	13125.2506	0	0	0	0	0	0	0	A6L5.R		
XRPT2.B6L5.B2		-203.063	13125.4486	13126.3786	0.93	28.208	-0.097	0	0	0	0			
VCDAD.A6L5.R	VCDAD.35.6L5.R	-203.661	13125.4486	13125.7806	0.332	0	0	0	0	0	0	A6L5.R	DN100	DN100
VMAAB.F6L5.R	VMAAB.26.6L5.R	-202.763	13126.3786	13126.6786	0.3	29.138	-0.097	0	0	0	0	A6L5.R	DN100	DN100
VCDAG.6L5.R	VCDAG.16.6L5.R	-200.956	13126.6786	13128.4856	1.807	29.438	-0.097	0	0	0	0	A6L5.R	DN100	DN100

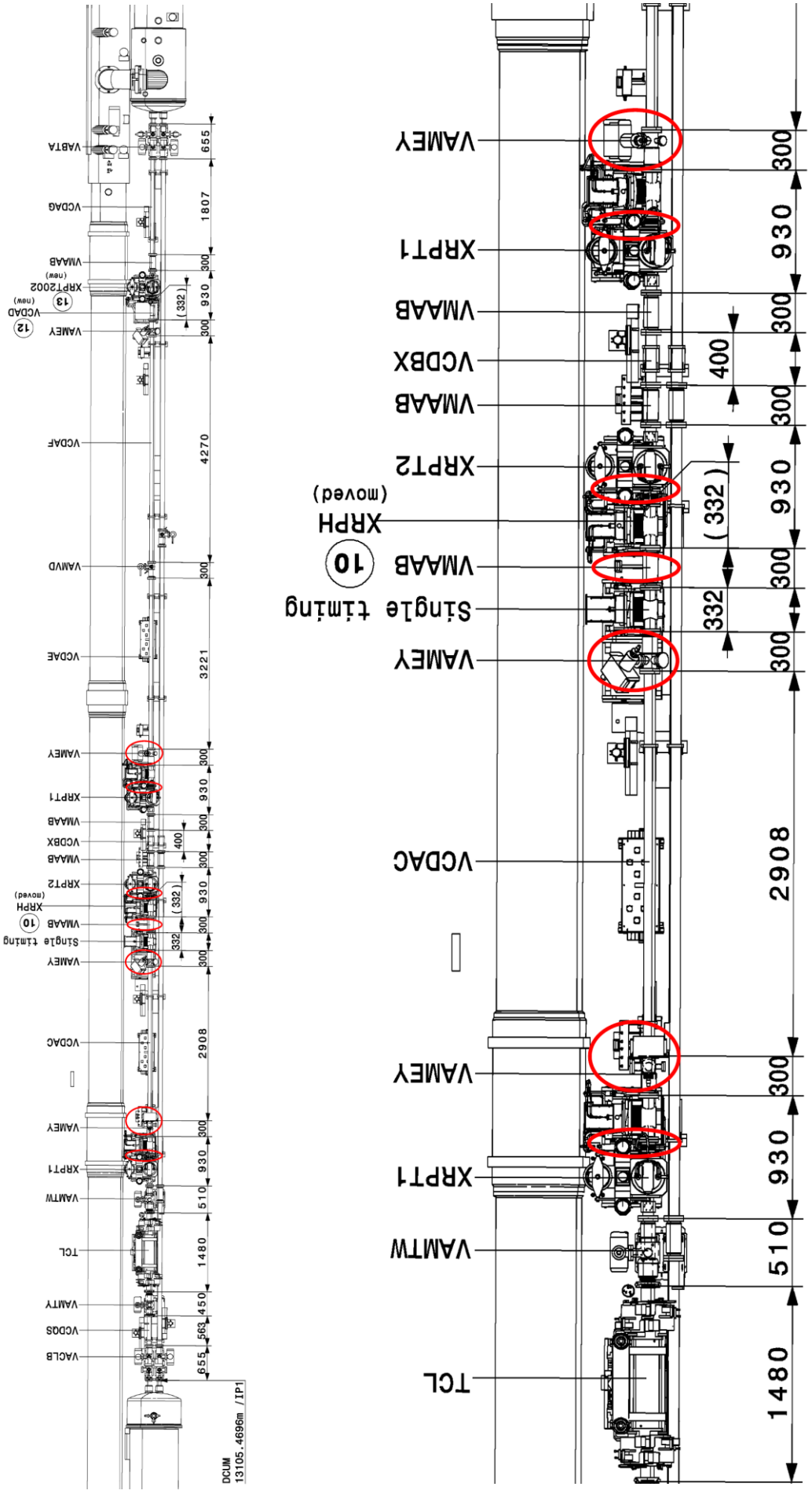


Figure 3: Layout (top view) of half-cell 6L5 between Q5 and Q6 before the EYETS 2024/2025. Top: overview, bottom: zoom on the region concerned by this ECR. The bellows to be removed are marked with red ellipses.

3. DETAILED DESCRIPTION

The individual horizontal stations and their locations are listed in Table 1 and Table 2.

At the beginning of the operation, all detector packages of all XRP units (horizontal and vertical) are removed and the service lines disconnected. Only when the detector packages have been dismounted, the LHC beam tubes should be ventilated to avoid that the thin window, separating the XRP detectors from the primary beam vacuum volume, bulges towards the detectors due to the pressure difference. The list of flanges that have to dismounted by TE-VSC are marked in Figure 2 and Figure 3.

To perform the rotation (Figure 4, Figure 5), each horizontal XRP unit will be first disconnected from the beam tube by removing the connection bellows.

For the units 210-F (XRPH.D6R5.B1 and XRPH.D6L5.B2), an additional preparatory step is needed, see Paragraph (*).

In the next step, the screws fixing the XRP unit to the base structure are loosened. With a special mounting tool (Figure 5, bottom), the individual XRP unit (about 70 kg) will be lifted from the base structure by about 40 cm, and the fixation brackets are dismounted. After reinstallation of the new brackets defining the rotation angle, the XRP unit is lowered and reconnected to the base structure. After the rotation, the service cables of the motor drives are reconnected. To test the XRP movement with the motor under the new rotation angle, the XRP vessel is driven in and out for about 1000 cycles. At the end of the movement cycle, the XRP is extracted with the spring.

The next step is the re-fiducialisation of the XRP flanges by BE-GM-ASG.

Before the final reconnection of the bellows to the beam tubes, the x-ray control of the RF finger positions is performed and the bake-out prepared by closing the XRPs with special flanges and O-rings. After successful bake-out, the detector packages are reinstalled and connected to the services. Finally, the LASER alignment of the moving vessel relative to the beam centre is performed by BE-GM-ASG.

The timeline of work sequences is summarized in Table 3.

(*) Special mechanical intervention on the 210-F units

The units XRP-45-210-F and XRP-56-210-F units (150 kg weight for these triple units, horizontal pot + vertical pair) were already rotated by 8° during LS1 (Figure 6, top). However, the rotation was mechanically performed by an inclination of the base structure with special brackets. This unit needs to be rotated back to 0° by removing these brackets, prior to the axial rotation with the new 27° brackets. This procedure requires a special lifting tool (Palfinger). The entire unit with a weight of about 150 kg will be lifted about 50 cm with the Palfinger via a carrying structure (Figure 6, bottom).

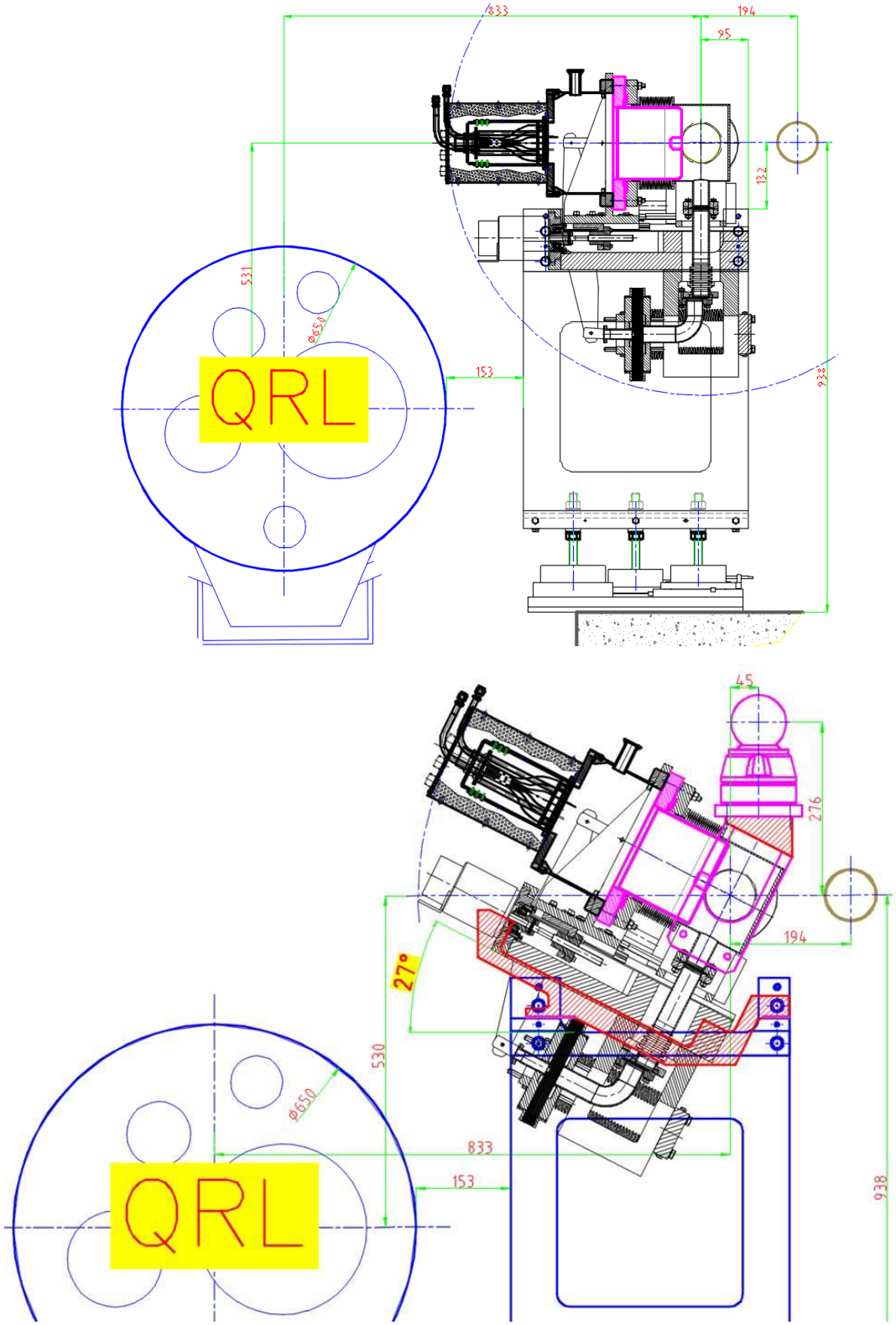


Figure 4: Horizontal XRP before and after rotation. The red wedge in the bottom picture was requested by BE-GM-ASG to turn the alignment target vertical.

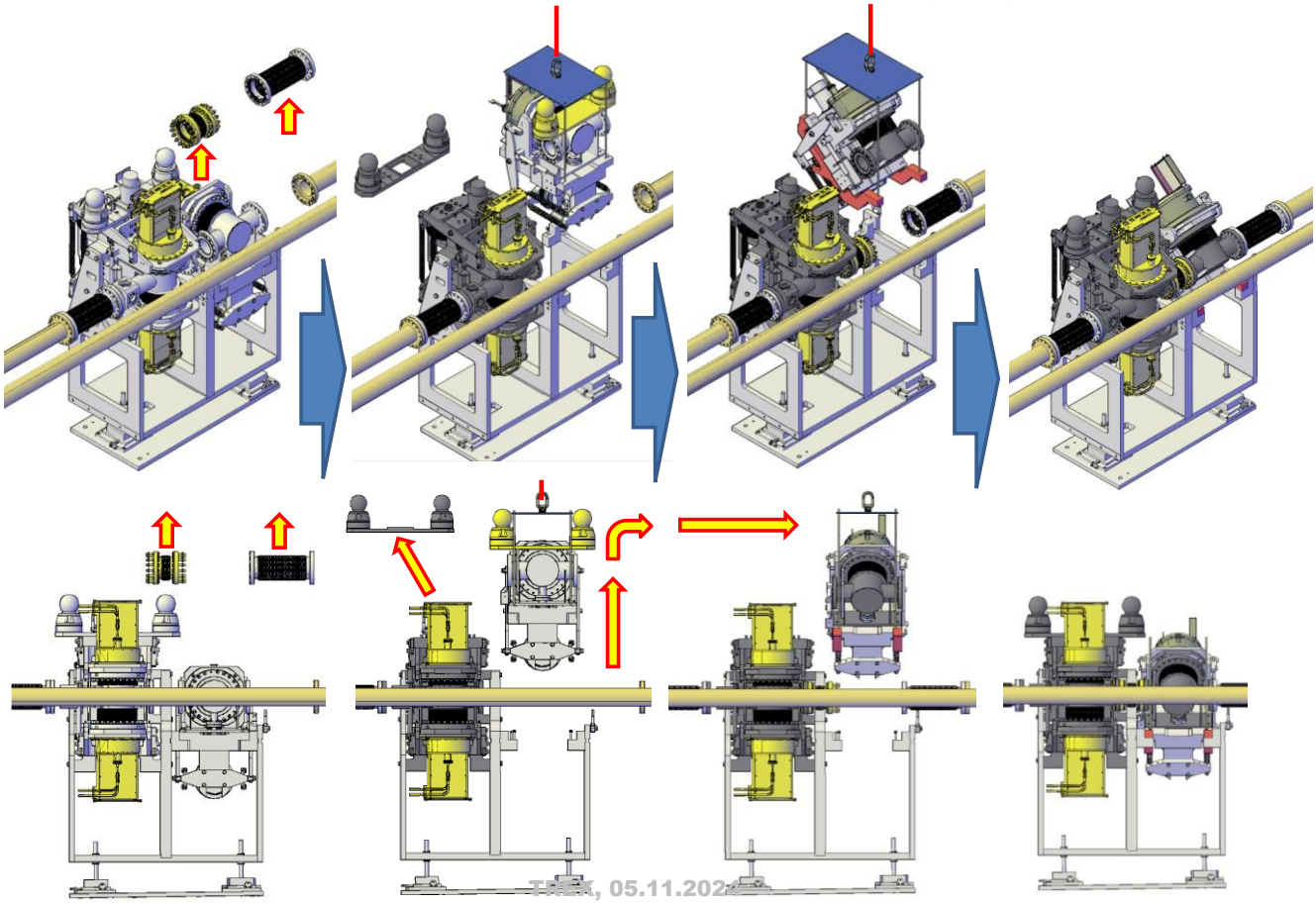


Figure 5: Top: sequence of operation for horizontal XRP rotation. Bottom: Mounting tool used in the LHC tunnel to lift the horizontal XRP.

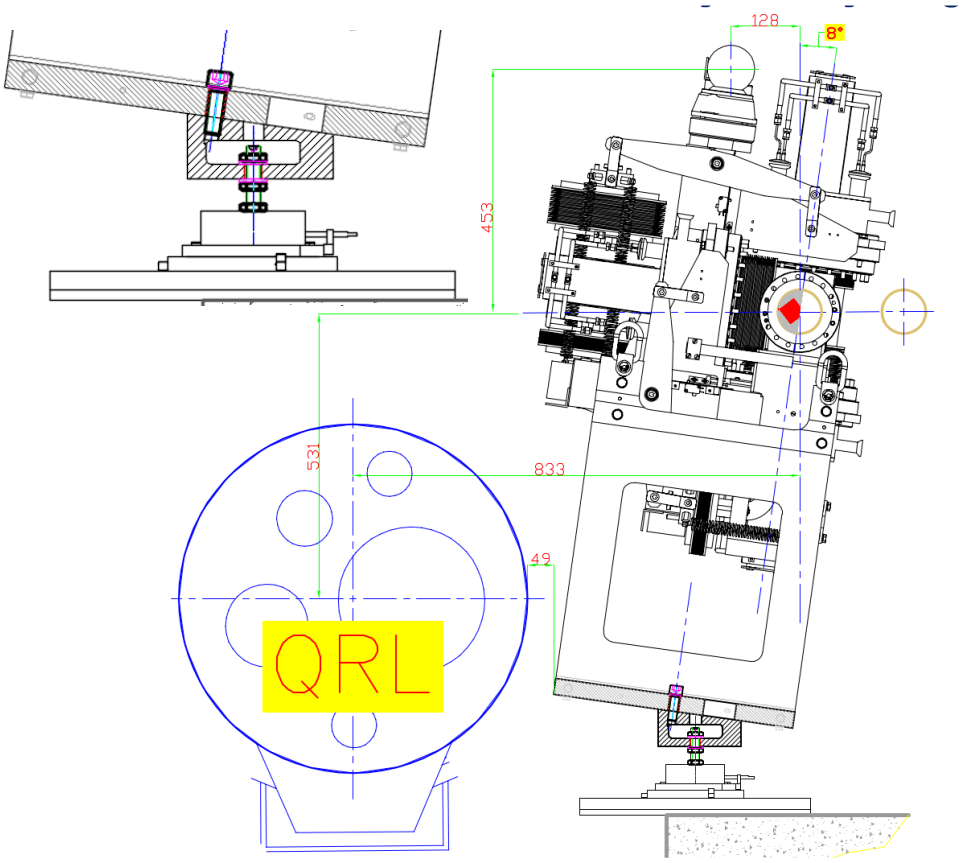
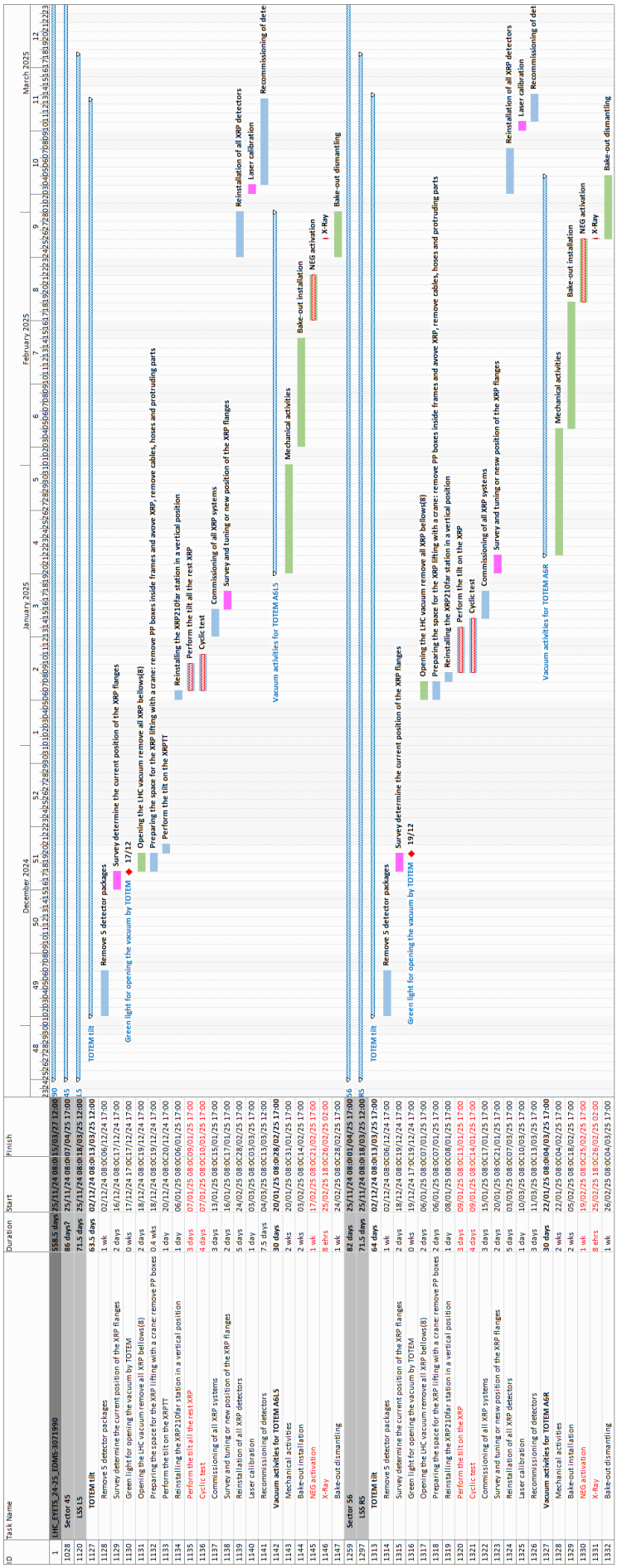


Figure 6: Top: present situation of the XRP-210-F units in sectors 4-5 and 5-6, rotated by 8° since LS1. The unit will be lifted up by 50 cm to remove the rotation brackets under the support frame. After the operation the unit is ready for the rotation of only the horizontal XRP by 27°. Bottom: Palfinger lifting tool with carrying structure.

Table 3: Time schedule of the PPS activities during the EYETS 2024/2025.



4. IMPACT ON OTHER ITEMS

4.1 IMPACT ON ITEMS/SYSTEMS

Item/System xxxxx	[Use this table to detail the impact on any equipment, items or systems that will be affected by the change.]
Item/System xxxxx	

4.2 IMPACT ON UTILITIES AND SERVICES

Raw water:	
Demineralized water:	
Compressed air:	
Electricity, cable pulling (power, signal, optical fibres…):	[If powering sources are involved, indicate their references here.]
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:	[Indicate the reference(s) of the new 3D model(s) taking into account the change.]

Others:	

5. IMPACT ON COST, SCHEDULE AND PERFORMANCE

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:	[To be completed with BE-ABP and/or SY-ABT. Consider injection, extraction, top energy, resonant excursion, when applicable.]
Impedance:	[To be completed with the impedance team (BE-ABP, SY-RF). Check the longitudinal and transverse contributions to minimise beam induced heating and instabilities. In case of potential impedance issues asses the need of: damping resistors (SPS), ferrites (SPS or LHC), coating, tapered transitions… Consider the full integration of the device in the existing beam line (transitions, bellows and insulation).]
Optics/MADX	[To be completed by BE-ABP.]
Electron cloud (NEG coating, solenoid…)	[To be completed with BE-ABP and/or TE-VSC.]
Insulation (enamelled flange, grounding…)	[To be completed with SY-RF. Detail insulation requirements. Consider the EMC/EMI aspects of the installed device.]
Vacuum performance:	[To be completed with TE-VSC.]
R2E impact on performance and availability:	[To be competed with the R2E team for systems with active electronic components to operate in radiation areas. Linked to R2E Radiation Hardness Assurance validation document for concerned equipment (template: EDMS document 2028777)]
Others:	

6. IMPACT ON OPERATIONAL SAFETY

[This chapter aims at assessing the impact of the modification on people safety, on the environment, and on the safety of operations, including maintenance, access, egress, circulation and evacuation.]

[Following the implementation of the change, the Safety File of the facility shall be updated. In the temporary absence of the Safety File, the hazards inventory and risk analysis of the concerned installation shall be established.]

6.1 ÉLÉMENT(S) IMPORTANT(S) DE SECURITÉ

[Indicate if the change will have an impact on an *Elément Important de Sécurité* (EIS). The list of EIS components is available in EDMS document: 1182293 – "Définition et Inventaire des EIS-Faisceau et EIS-Machine en Opération".]

Requirement	Yes	No	Comments
EIS-Access			[Provide further details on the impacted EIS]
EIS-Beam			
EIS-Machine			

6.2 OTHER OPERATIONAL SAFETY ASPECTS

[This chapter aims at assessing the impact of the modification during operation and maintenance of the hardware on people safety, on the environment, including access, egress, circulation and evacuation.

It doesn't concern the installation of the hardware. Worksite safety is addressed in the next chapter.]

What are the hazards introduced by the hardware?	- Is it standard CERN equipment or a new design? - Reference here the risk analysis if it exists. If there is no risk analysis, evaluate here what new hazards are introduced, such as: new chemical, new power supply, possible obstruction of evacuation paths, etc. - Indicate if the hardware complies with CERN safety rules, or if a derogation has been granted.
Could the change affect existing risk mitigation measures?	[e.g. safety systems may need relocation, or additional safety systems or monitoring systems have to be installed, etc.]
What risk mitigation measures have to be put in place?	Indicate here the measures taken to eliminate or reduce the hazards, either by design, by interlocks, or by procedure.
Safety documentation to update after the modification	
Define the need for training or information after the change	

7. WORKSITE SAFETY

[Refer to EDMS document: 1155899 – "Working on the CERN Site".]

[The information in this chapter, to be prepared with the WSS in charge, are intended to help preparing the operation on the field.]

7.1 ORGANISATION

Requirement	Yes	No	Comments
IMPACT – VIC:			
Operational radiation protection (surveys, DIMR…):			[Consider ALARA. If relevant, at what level?]
Radioactive storage of material:			[Radioactive storage space needed and available?]
Radioactive waste:			[Components become radioactive waste?]
Non-radioactive waste:			[Specify waste category as per EDMS 1738461; waste quantity; collection/elimination means (i.e. SCE Dept. centralised services or contractor).]
Fire risk/permit (IS41) (welding, grinding…):			
Alarms deactivation/activation (IS37):			
Electrical lockout:			[Indicate the powering source reference for each equipment requiring electrical lockout, as well as the equipment ID]
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 (*tirs radio*):			
Ionizing radiation risks (radioactive components):			[Traceability by TREC.]
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 maintenance and operations			
Update Safety File according to EDMS document 1177755:			
Others:			

9. REFERENCES

[1] M. Solfaroli, "Proposal for the 2025 and 2026 LHC Configuration", LMC meeting, 6 November 2024: https://indico.cern.ch/event/1473710/ .

[2] M. Deile, "2025/2026 Optics configurations - feedback from PPS", LPC meeting, 28 October 2024: https://indico.cern.ch/event/1462122/ .