



EDMS NO.

REV.

1

VALIDITY

DRAFT

REFERENCE : EDMS 3121958

## NOTE

## VACUUM LAYOUT EXCHANGE FOR THE TWOCRIST PROJECT

## Abstract

This document describes the vacuum layout modifications to be performed in LSS3 (vacuum sectors A4L3.R and A5R3.R) for the installation of the double-crystal setup TCCS and TCCP (+ 2 XRPV) during EYETS 24-25. This activity is within the framework of the TWOCRIST project [1].

## TRACEABILITY

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Rev. No.	Date	Description of Changes
0.1	2024-05-22	First draft for discussion
0.2	2024-05-27	Paragrapgh 3.2 modified: Exchange of a VMAAA by VMAAB
1	2024-06-19	Added differential layout. Document ready for distribution.

## 1 INTRODUCTION

This document summarizes the vacuum layout changes necessary for the upgrade of the vacuum sector A5R3.R (DCUM 6780.27m to 6715.25m) for the installation of a TCCS (Target Collimator Crystal Splitting) and the upgrade of the vacuum sector A4L3.R (DCUM 6662.19m to 6614.27m) for the installation of a TCCP (Target Collimator Crystal for Precession) and double Roman Pot setup (XRPV).

The requested position of the elements is as follows:

- **TCCS:** DCUM 6775m ( $\pm 2$ m). ST1727900
- **TCCP:** DCUM 6655m ( $\pm 2$ m). ST1756862
- **Two individual vertical Roman Pot stations:** Distance range between the TCCP and the closest Roman Pot: 500mm up to 1100mm (tank's central point). ST1860748

The TWOCRYST is planned to be removed at the beginning of the LS3 and therefore the vacuum layout will be reversed.

## 2 VACUUM LAYOUT MODIFICATIONS OF THE LINE A5R3.R

### 2.1 Current layout in the external line (B2) of A5R3

**Table 1** shows the present vacuum layout in vacuum sector A5R3.R, with the support structures of the elements. For an explanation of the colour code used on the vacuum layout tables, please refer to [Annex 1](#).

**Table 1: Current Vacuum Layout in Vacuum Sector A5R3.R [2]**

Subsector	Name / Slot	Description	S_START	S_END	Length	Mechanical aperture Start [mm]	Mechanical aperture End [mm]	Note
VACSEC.A5R3.R	VMAAB.B5R3.R	Warm Module – no port	6772.7208	6773.0208	0.3	80	80	
VACSEC.A5R3.R	VHLCB.K5R3.C	Double support 950 mm - mobile	6773.2708	-	0	-	-	
VACSEC.A5R3.R	VHLCA.G5R3.C	Double support 950 mm - fixed	6776.5208	-	0	-	-	
VACSEC.A5R3.R	VHLCB.L5R3.C	Double support 950 mm - mobile	6779.7708	-	0	-	-	
VACSEC.A5R3.R	VCDA.C5R3.R	Vacuum chamber – drift ID80	6773.0208	6780.0208	7	80	80	
VACSEC.A5R3.R	VMANC.5R3.R	Warm Module – two ports	6780.0208	6780.3208	0.3	80	100	VPIA, VGRB, VGPB
VACSEC.B5R3.R	VVGSW.A5R3.R	Vacuum gate valve	6780.2783	6780.3633	0.085	100	100	

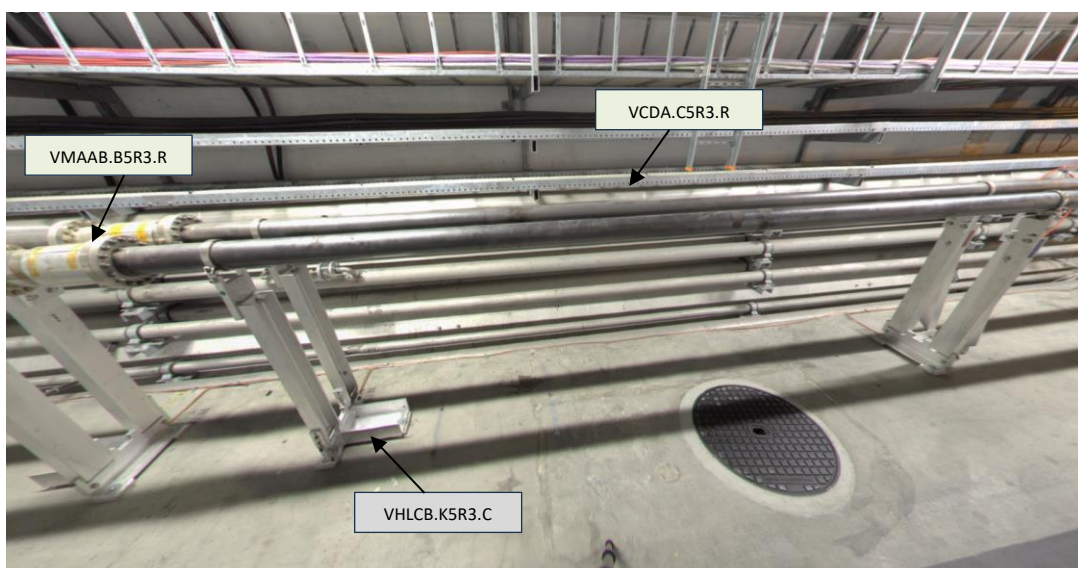


Figure 1: Area of the TCCS installation in A5R3.R

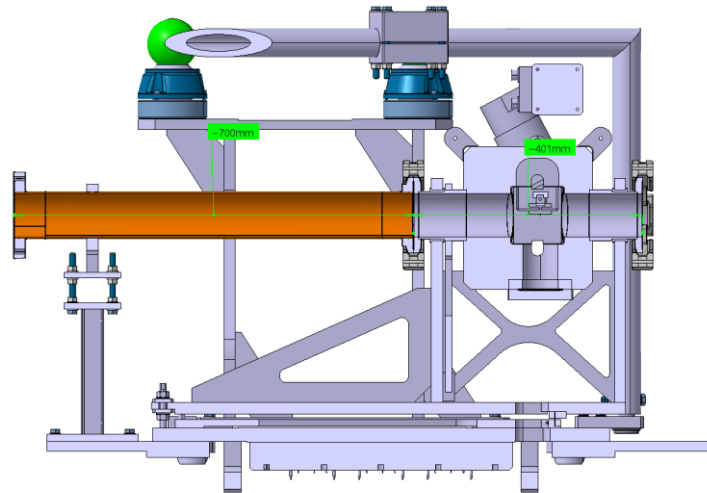


Figure 2: 3D image with dimensions of the TCCS fix target (= refurbished TCPC). ST1727900.

## 2.2 New layout in the external line (B2) of A5R3

The new layout will require the removal of the existing vacuum chamber ID80 of 7 m. and the removal of the double vacuum support located in DCUM 6773.27, to introduce:

- The TCCS from DCUM 6773.72 to 6774.12. It will be equipped with one drift ID80 chamber L=700 mm (CF/QCF flanges) that will be part of the instrument itself, being held by a fixed support which is part of the TCCS's support.
- A new drift chamber ID80 of 5.7 m.
- A new warm module type VMGAA (CF/QCF flanges) to be installed on the right of the TCCS.
- The removed double vacuum support will be relocated downstream in DCUM 6774.47.

A standard collimator supporting device for the TCCS tank will be installed beforehand by SY-STI.

**Table 2** shows the new vacuum layout in the corresponding area of the sector A5R3.R

**Table 2: New Vacuum Layout in A5R3.R**

Subsector	Name / Slot	Description	S_START	S_END	Length	Mechanical aperture Start [mm]	Mechanical aperture End [mm]	Note
VACSEC.A5R3.R	VMAAB.B5R3.R	Warm Module – no port	6772.7208	6773.0208	0.3	80	80	
VACSEC.A5R3.R	VCBIIFAA.z5R3.R*	Vacuum chamber – drift ID80 (flanges QCF/CF)	6773.0208	6773.7208	0.7	80	80	
VACSEC.A5R3.R	TCCS.5R3.R	TCCS	6773.7208	6774.1218	0.401			
VACSEC.A5R3.R	VMGAA.y5R3.R	Warm Module – no port (flanges QCF/CF)	6774.1218	6774.3218	0.2	80	80	
VACSEC.A5R3.R	VHLCB.K5R3.C	Double support 950 mm - mobile	6774.4718	-	0	-	-	
VACSEC.A5R3.R	VHLCB.L5R3.C	Double support 950 mm - fixed	6776.5208	-	0	-	-	
VACSEC.A5R3.R	VHLCB.L5R3.C	Double support 950 mm - mobile	6779.7708	-	0	-	-	
VACSEC.A5R3.R	VCBIIAAA.x5R3.R*	Vacuum chamber – drift ID80	6774.3218	6780.0208	5.699	80	80	
VACSEC.A5R3.R	VMANC.5R3.R	Warm Module – two ports	6780.0208	6780.3208	0.3	80	100	VPIA, VGRB, VGPB
VACSEC.B5R3.R	VVGSW.A5R3.R	Vacuum gate valve	6780.2783	6780.3633	0.085	100	100	

\* The occurrences x, y and z will be generated by Layout DB.

For further clarification on the vacuum layout modifications in A5R3 please refer to [Annex 2](#), where the differential layout of the area is shown. For a list of the components to be extracted from the machine, please refer to [Annex 4](#).

### 2.3 New layout on the internal line (B1) of A5R3

The double support VHLCB.K5R3.C relocated downstream also impacts the internal line. No other changes are required.

## 3 VACUUM LAYOUT MODIFICATIONS IN THE INTERNAL LINE OF A4L3.R

### 3.1 Current layout in the external line (B2) of A4L3

**Table 3** shows the present vacuum layout in vacuum sector A4L3.R, with the support structures of the elements. For an explanation of the colour code used on the vacuum layout tables, please refer to [Annex 1](#).

**Table 3: Current Vacuum Layout in Vacuum Sector A4L3.R [2]**

Subsector	Element name	Description	S_START	S_END	Length	Mechanical aperture Start [mm]	Mechanical aperture End [mm]	Note
VACSEC.A4L3.R	VMGAB.4L3.R	Warm module – no ports	6647.2908	6647.5908	0.3	80	80	
VACSEC.A4L3.R	VHLCB.B4L3.C	Double support 950 mm - fixed	6647.8408	-	-	-	-	
VACSEC.A4L3.R	VHLCB.D4L3.C	Double support 950 mm- mobile	6651.0908	-	-	-	-	
VACSEC.A4L3.R	VHLCB.C4L3.C	Double support 950 mm - mobile	6654.3408	-	-	-	-	
VACSEC.A4L3.R	VCDA.C4L3.R	Vacuum chamber – drift ID80	6647.5908	6654.5908	7	80	80	
VACSEC.A4L3.R	VMAAE.A4L3.R	Warm module – two ports	6654.5908	6654.8908	0.3	80	80	VVF, VGI

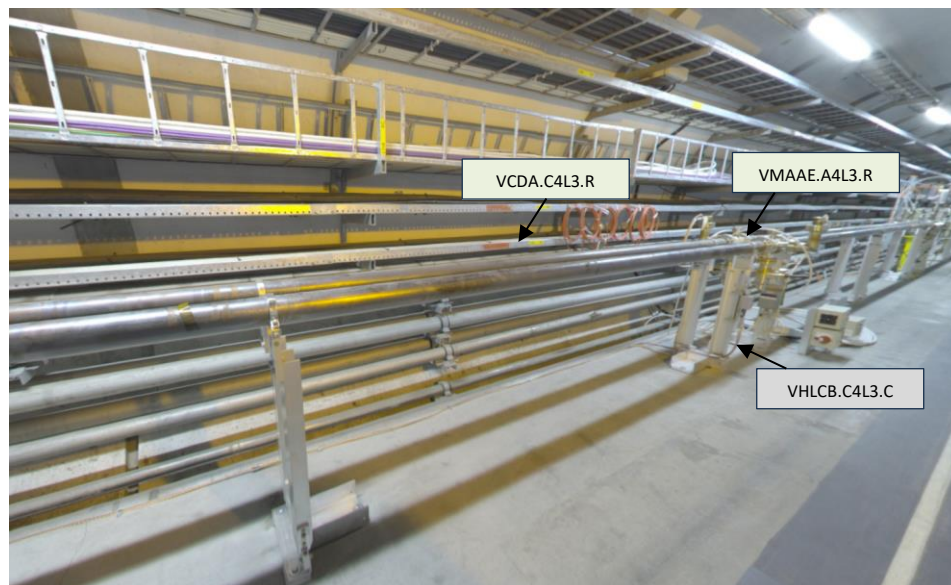


Figure 3: Area of the TCCP (+ 2 Roman Pot) installation in A4L3.R

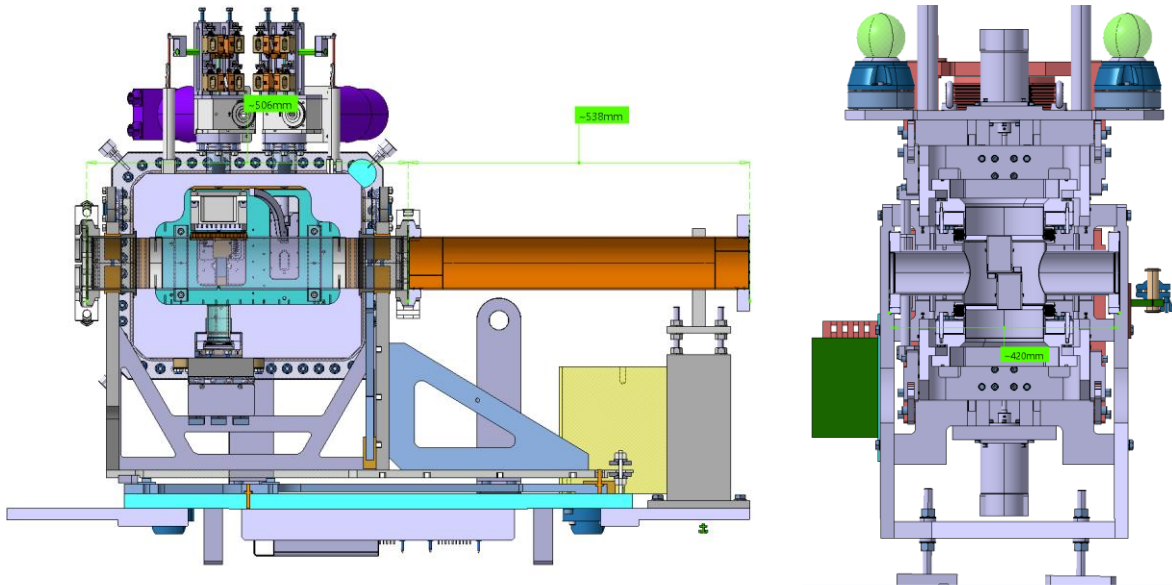


Figure 4 and 5: Preliminary 3D image with dimensions of the TCCP fix target (left), ST1756862, and a vertical Roman Pot station (right), ST1860748.

### 3.2 New layout in the external line (B2) of A4L3

The new layout will require the removal of the existing vacuum chamber ID80 of 7 m. to introduce:

- A drift ID80 chamber L=500 from DCUM 6654.09. to 6654.59.
- The TCCP from DCUM 6653.04 to 6653.55. It will be equipped with one drift ID80 chamber L=538 mm (CF/QCF flanges) that will be part of the instrument itself, being held by a fixed support which is part of the TCCP's support.
- A warm module VMGAA (CF/QCF flanges) is to be installed on the left of the TCCP, which is connected with the XRPV #1.
- A Roman Pot (XRPV #1) from DCUM 6652.42 to 6652.84.
- A Roman Pot (XRPV #2) from DCUM 6651.70 to 6652.12.
- A warm modules type VMAAB to be installed between the XRPVs.
- A warm module type VMAAA to be installed on the left of the XRPV #2.
- A drift ID80 chamber L=3916 from DCUM 6647.59 to 6651.50.

**Table 4** shows the new vacuum layout in the corresponding area of the sector A4L3.R

**Table 4: New Vacuum Layout in A4L3.R**

Subsector	Name / Slot	Description	S_START	S_END	Length	Mechanical aperture Start [mm]	Mechanical aperture End [mm]	Note
VACSEC.A4L3.R	VMGAB.4L3.R	Warm module – no ports	6647.2908	6647.5908	0.3	80	80	
VACSEC.A4L3.R	VHLCB.4L3.C	Double support 950 mm - fixed	6647.8408	-	-	-	-	
VACSEC.A4L3.R	VHLCB.D4L3.C	Double support 950 mm- mobile	6651.0908	-	-	-	-	
VACSEC.A4L3.R	VCBIAAA.x4L3.R*	Vacuum chamber – drift ID80	6647.5908	6651.5068	3.916	80	80	
VACSEC.A4L3.R	VMAAA.v5R3.R*	Warm Module – no port	6651.5068	6651.7068	0.2	80	80	
VACSEC.A4L3.R	XRPV.B4L3.R	XRPV #2	6651.7068	6652.1268	0.42			
VACSEC.A4L3.R	VMAAB.w5R3.R*	Warm Module – no port	6652.1268	6652.4268	0.3	80	80	
VACSEC.A4L3.R	XRPV.A4L3.R	XRPV #1	6652.4268	6652.8468	0.42			
VACSEC.A4L3.R	VMGAA.x5R3.R*	Warm Module – no port (flanges QCF/CF)	6652.8468	6653.0468	0.2	80	80	
VACSEC.A4L3.R	TCCP.4L3.R	TCCP	6653.0468	6653.5528	0.506			
VACSEC.A4L3.R	VCBIAAA.v4L3.R*	Vacuum chamber – drift ID80 (flanges QCF/CF)	6653.5528	6654.0908	0.538	80	80	
VACSEC.A4L3.R	VHLCB.C4L3.C	Double support 950 mm - mobile	6654.3408	-	-	-	-	
VACSEC.A4L3.R	VCBIAAA.z4L3.R*	Vacuum chamber – drift ID80	6654.0908	6654.5908	0.5	80	80	
VACSEC.A4L3.R	VMAAE.A4L3.R	Warm module – two ports	6654.5908	6654.8908	0.3	80	80	VVF, VGI

\* The occurrences u, v, w, x, y and z will be generated by Layout DB.

For further clarification on the vacuum layout modifications in A4L3 please refer to [Annex 3](#), where the differential layout of the area is shown. For a list of the components to be extracted from the machine, please refer to [Annex 4](#).

### 3.3 New layout on the internal line (B1) of A4L3

No changes.

## 4 TE-VSC CABLING REQUIREMENTS

No new cabling.

## 5 ONGOING STUDIES

None to report.

## 6 PROCUREMENT

- 1x ID80 drift chamber of 5.7 m. ST1870027\_02 – To be manufactured
- 1x ID80 drift chamber of 0.7 m. ST1895013 – To be manufactured
- 1x ID80 drift chamber of 0.5 m. ST1870097\_02 – In stock
- 1x ID80 drift chamber of 0.538 m. ST1870038 – To be manufactured
- 1x ID80 drift chamber of 3.916 m. ST1870132\_02 – To be manufactured
- 1x VMAAA warm modules – In stock
- 2x VMGAA warm modules – In stock
- 1x VMAAB warm modules – In stock

## 7 COATINGS AND CHEMICAL CLEANING

**Table 5** lists the chemical cleaning and coating requirements for each of the components to be installed.

**Table 5 – Coatings and chemical cleaning for each of the new components to be installed.**

Component Type	Name	Qty	Drawing	UHV Cleaning	Coatings		
					NEG	Copper Plating	Carbon
Vacuum Chambers	VCBIIAAA570*	1	LHCVCBIIAAA0006				
	VCBIIFAA070*	1	LHCVCBIIFAA0003				
	VCBIIAAA050*	1	LHCVCBIIAAA0004				
	VCBIIFAA054*	1	LHCVCBIIFAA0002				
	VCBIIAAA392*	1	LHCVCBIIAAA0005				
Vacuum modules	VMGAA	2	LHCVMGAA0001	x			
	VMAAA	2	LHCVMAAA0001	x			
	VMAAB	1	LHCVMAAB0001	x			

\* These new codes are just a proposal and have not been yet validated by the Accelerators Naming Service.



## 8 REQUIRED RESOURCES

- CAD requests and manufacturing at the main workshop (EN/MME) of 4x NEG vacuum chambers: **12 kCHF**
- TE/VSC will provide standard NEG-coated vacuum chambers to be cut to the right length and the required DN100CF sleeves (both TE/VSC stock): **10 kCHF\***
  - 2x 7m. NEG coated chambers (for the production of 4 new chambers).
  - 2x sleeves DN100CF
  - 2x sleeves DN100QCF
- One VMAAA and one VMAAB warm modules CF/CF L=0.2 and 03 m. equipped with RF-contacts and RF-inserts 80/80 (in TE/VSC stock): **12 kCHF\***
- Two VMGAA warm modules CF/QCF L=0.2 m equipped with RF-contacts and RF-inserts 80/80 (in TE/VSC stock): **12 kCHF\***
- TE/VSC services (UHV cleaning, leak detections, etc.): **5 kCHF**
- Industrial support AL4030 (mechanical activities in the tunnel): **6 kCHF**
- Industrial support AL4030 (support for the vacuum acceptance test activities): **6 kCHF**
- Industrial support FSU (bake-out activities in the tunnel): **5 kCHF**

*\* The money will be used to buy raw materials to then replace the parts.*

The total estimated cost of the VSC support for the layout upgrade is around **68 kCHF**.

The budget code communicated is the 61701 (PBC LHC Fixed Target).

## 9 REFERENCES

- [1] Functional specification and operational conditions for the double-crystal setup in the LHC IR3, EDMS 2742008
- [2] Extraction from LSS3 CERN Layout Database Vacuum Layout, v. 2024/05.

## 10 ANNEXES

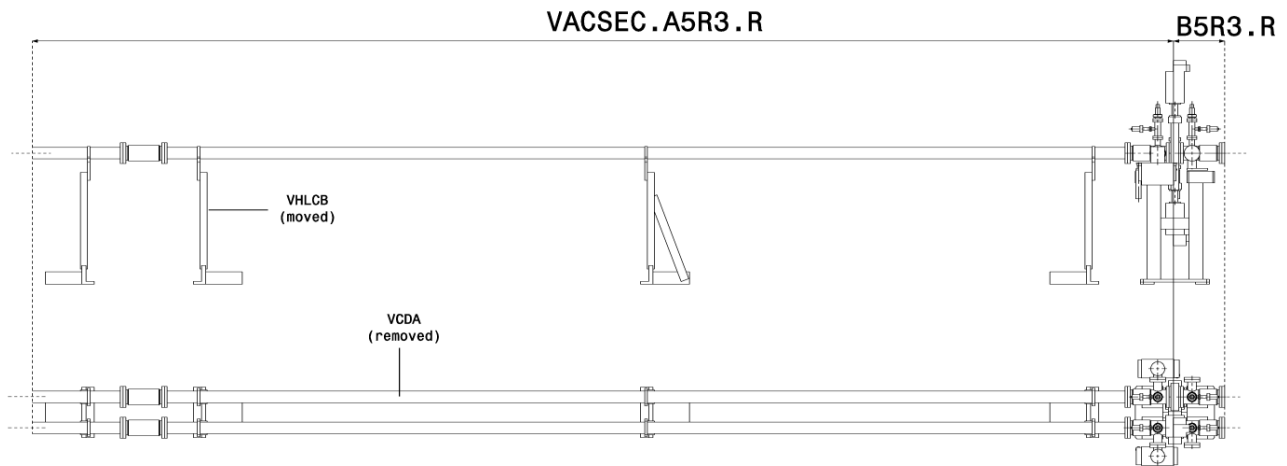
### 10.1 Annex 1 – Vacuum Layout Table Color Scheme

**Table 6 - Vacuum Layout Table Color Scheme**

	Vacuum Component
	Vacuum support
	Optical Component
	New Component
	Moved/modified Component
	Removed Component

## 10.2 Annex 2 – Differential Layouts of A5R3

### BEFORE EYETS24-25



### AFTER EYETS24-25

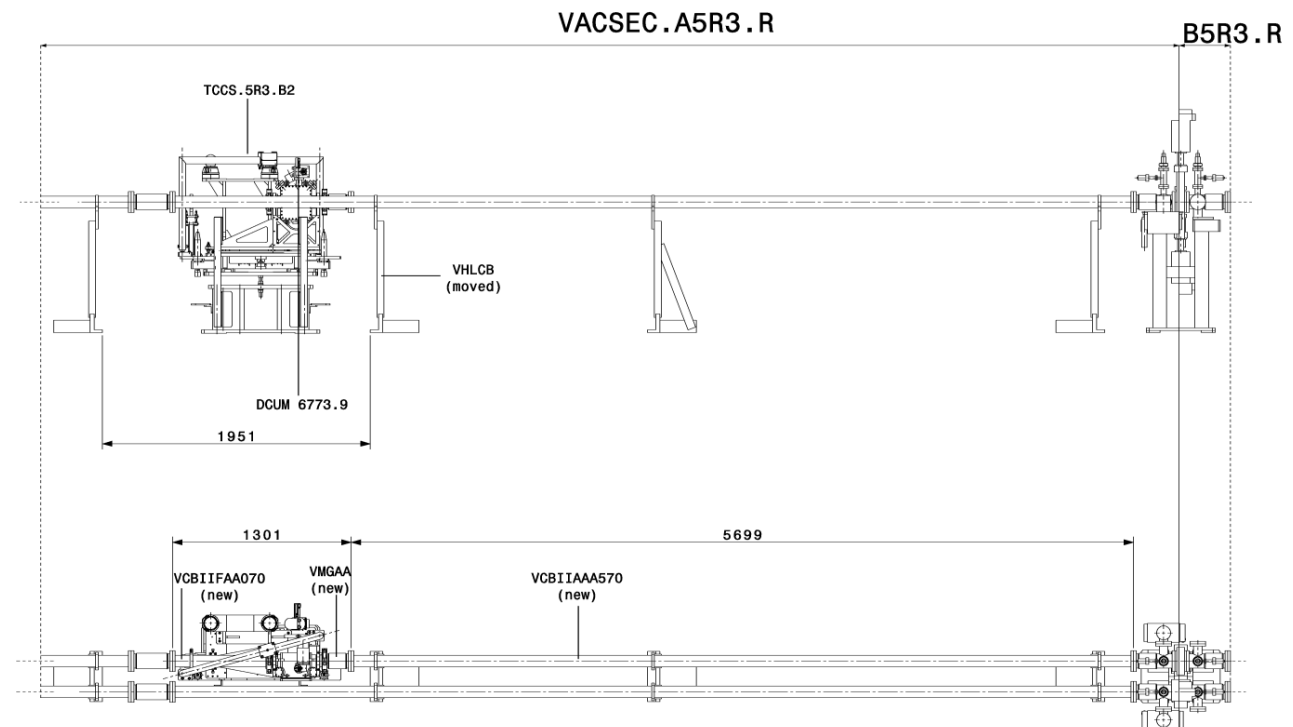
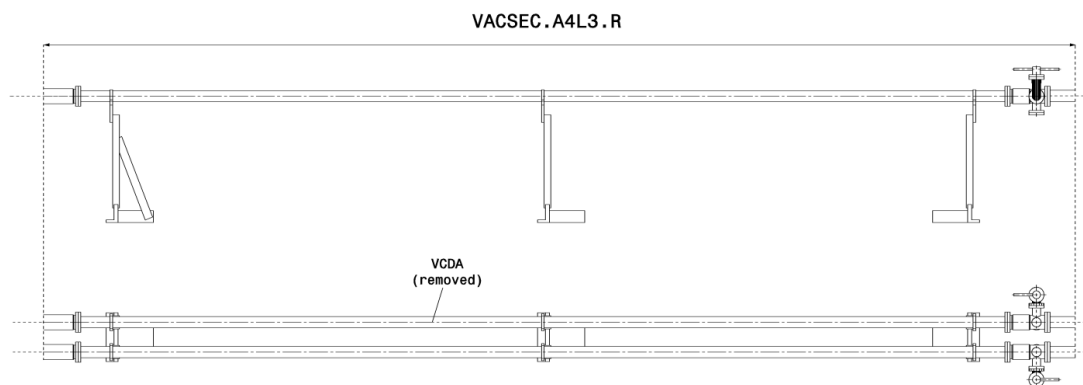


Figure 6: Differential layout, EDMS 3118297, CERN CDD LHCLJ\_3U0048, Smarteam ST1783887\_2



### 10.3 Annex 3 – Differential Layouts of A4L3

#### BEFORE EYETS24-25



#### AFTER EYETS24-25

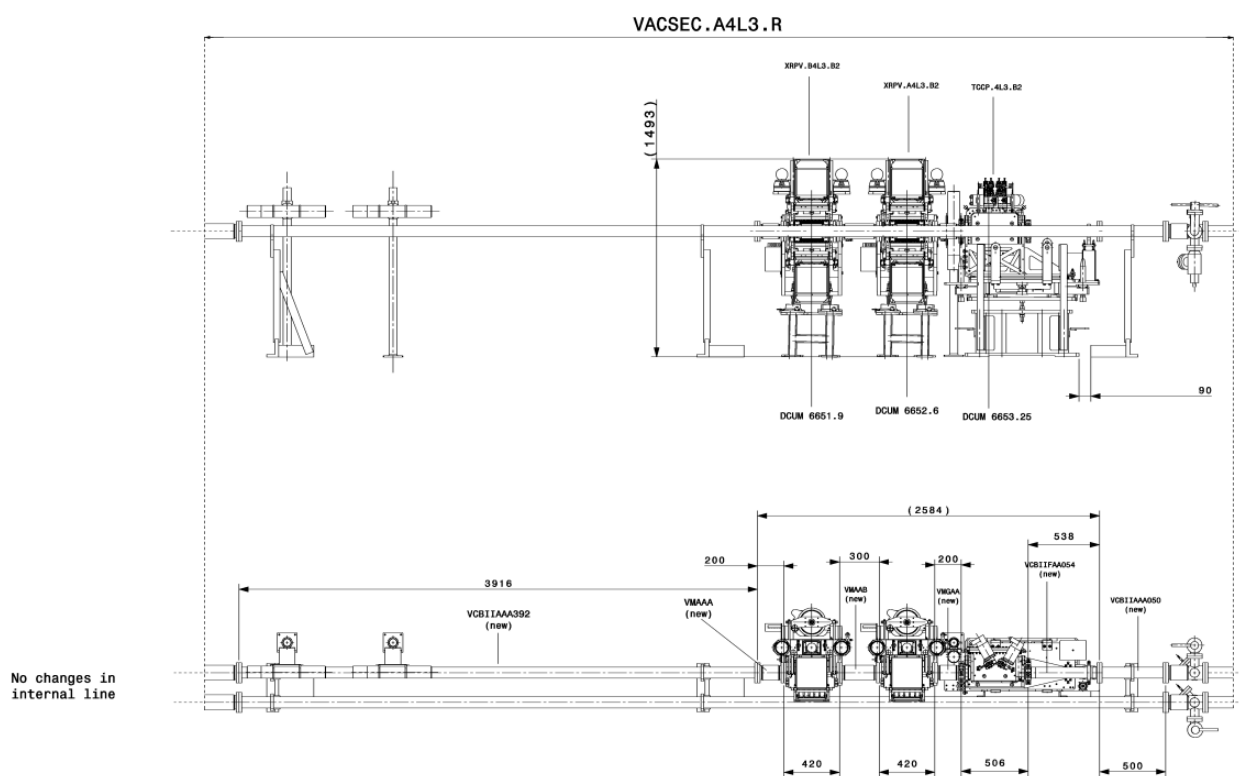


Figure 7: Differential layout, EDMS 3105243, CERN CDD LHCLJ\_3U0047, Smarteam ST1783800\_02



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1

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#### 10.4 Annex 4 – Vacuum Components to be extracted from the machine

**Table 7 - Vacuum components to be temporarily stored in the machine**

Stored in the tunnel PZ33 during RUN 2025

Component	Name	Quantity	Description	Comments Or Drawing	Volume (m3)	Weight (kg)
Vacuum chambers	VCDA	2	Vacuum - Chamber - Circular - Drift space - standard drift ID 80 mm-Type A		0.07 Length: 7 m	45