



Series production

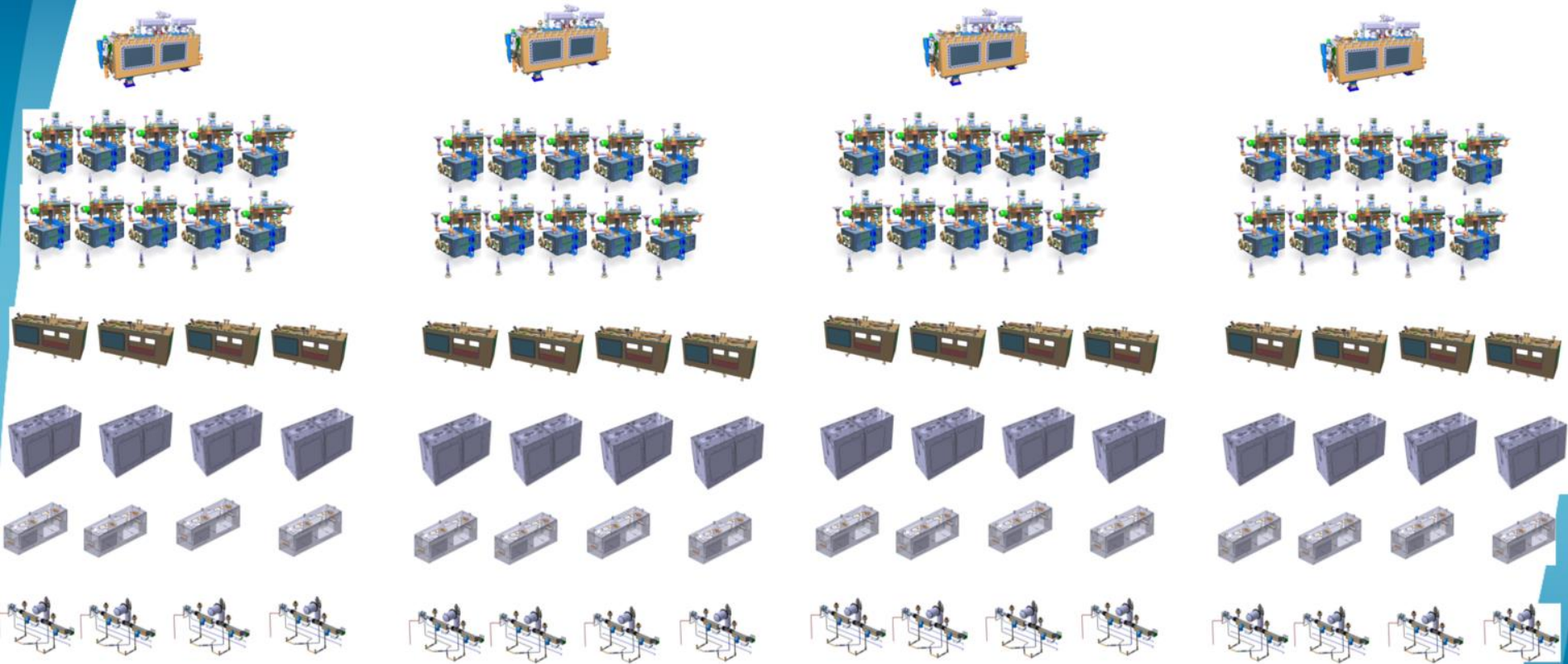
HL-LHC PDQR Office
EDMS [2895509](#)



Series production

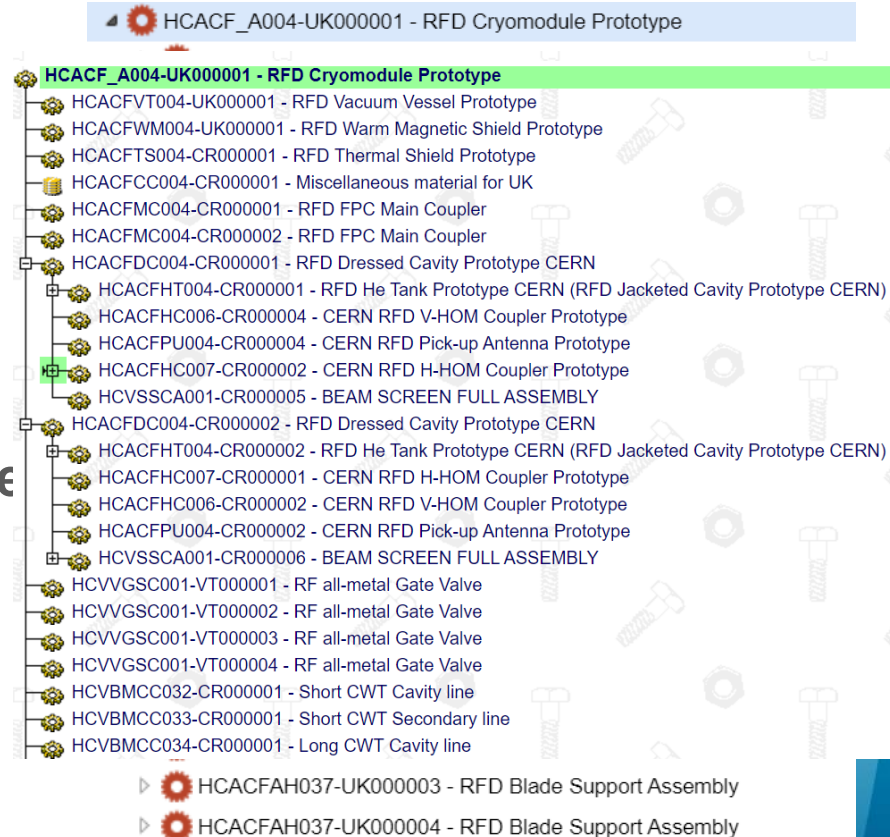
- We are now moving to **Series production** for **cryomodules** (for the Cavities, it was already the case)
- The equipment will be installed in the LHC machine so we need to have proper **traceability** in terms of components and **documentation**
- The approach is the the same as for the **prototypes**, but it will be **more demanding** as there will be **several items** built **in parallel**
- **Quality** activities to go **in line** with **production**

What goes where



What goes where








- **MTF** used to grant the **traceability** of the **equipment** and **sub-equipment** (Serial numbers)
- People **on site** should provide the **inputs** in terms of **components usability**
- **Documentation** to be attached to the **step** of the corresponding asset
- **Documentation/manufacturing data** is to be provided on regular bases and not at the end of production



What we need from you to create the assets

- In principle, the components to be traced will be similar to the RFD Cryomodule prototype (See the UK structure)
- In addition to the ‘main’ cryomodule components, other ones can also be traced (supports for instance were also issued in MTF for the RFD Cryomodule) – This is to be defined in the BOM

Serial numbers (MTF identification) is already foreseen for Vacuum Vessels, WMS, Thermal Shield, MLI, Cryogenic Lines main assembly and Cryomodule Assembly)

	EQUIP. CODE	3D VIEW	Prototypes SPS Test (CERN)		Pre-Series/Series LHC	
			SERIAL NUMBER MTF	OTHER IDENTIFIER	SERIAL NUMBER MTF	OTHER IDENTIFIER
DQW VACUUM VESSEL	ACFVT		HCACFVT001-CR000001		HCACFVT003-XY000001 ¹ HCACFVT003-UK000002-5	
DQW WARM MAGNETIC SHIELD	ACFWM		HCACFWM001-CR000001		HCACFWM003-CR000001 HCACFWM003-UK000002-5	
DQW THERMAL SHIELD	ACFTS		HCACFTS001-CR000001		HCACFTS003-CR000001 HCACFTS003-UK000002-5	
DQW MLI	ACFCC		HCACFCC002-CR000001		HCACFCC007-CR000001 HCACFCC007-UK000002-5	
DQW CRYOGENIC LINES	ACFQC		HCACFQC001-CR000001		HCACFQC003-CR000001 HCACFQC003-UK000002-5	
DQW RF LINES	ACFCC		HCACFCC003-CR000001		HCACFCC006-CR000001-10	
DQW CRYOMODULE FULL ASSEMBLY	ACF_A		HCACF_A001-CR000001		HCACF_A003-CR000001 HCACF_A003-UK000001-4	
REMARKS						

What we need from you to create the assets

- MTF assets are created by us (PDQR Office)
- N° assets for main components is known
- Serial numbers are foreseen
- Access rights (EDMS Group) is by default HL-LHC-WP4-CANADA-MTF (we will make sure you all are inside and have the proper rights)
-so what we need from you?
 - **Production Workflow, which shall be based on an approved Manufacturing and Inspection Plan (MIP)**

What we need from you to create the assets

Equipment Identifier: HCACF_A004-UK000001
Other Identifier: None
Description: RFD Cryomodule Prototype

Main Made of Equipment data **Manufacturing** Operation Non-conformities Documents History Map

Actions: Add extra step

Workflow Diagram

No workflow diagram is defined for this equipment

Workflow Steps

Step	R/E	Other name	Description	Status	Last repeated	INC
10	E	()	Step 1: Cavity String	Pending		
11	E	()	Cavity Line Leak Test	Pending		
20	E	(STEP 2)	FPC	Pending		
21	E	()	Cavity String RF Measurements at Warm	Pending		
22	E	()	Secondary Line Leak Test	Pending		
30	E	(STEP 3)	Upper Cryoline + Tuner Frame	Pending		
40	E	(STEP 4)	Cryolines + Thermal Braids + Tuner Pipe	Pending		
50	E	(STEP 5)	Cryolines Ancillaries	Pending		
60	E	(STEP 6)	FPC Clamp + Cavity Support + PSI	Pending		
70	E	(STEP 7)	Lower Cryolines	Pending		
80	E	(STEP 8)	2K MLI + Coax Lines	Pending		
90	E	(STEP 9)	50K MLI + Thermal Screen	Pending		
100	E	(STEP10)	Vacuum Vessel Marriage	Pending		
110	E	(STEP 11)	BL Extremity Groups + Vacuum Instrumentation	Pending		
120	E	(STEP 12)	Final Ancillaries Assembly	Pending		
130	E	(STEP 13)	FAT Testing	Pending		
140	E	(STEP 14)	Preparation for Transport	Pending		
150	E	(STEP 15)	Shipment to CERN	Pending		

- The workflow is to be defined beforehand for proper implementation
- This workflow is settled based on the Manufacturing and Inspection Plan and in agreement with WP4 colleagues
- Steps to be implemented based on the production and inspection steps (normally there is a document to be provided)
- Extra steps shall only be added for activities that were not foreseen or due to a NCR which requires to repeat step(s)

What we need from you to create the assets

Equipment Identifier: HCACFVT004-UK000001
Other Identifier: None
Description: RFD Vacuum Vessel Prototype

Clientel / Customer LANCASTER UNIVERSITY		Ordine cliente / Purchase Order 500163000 17/09/2020		Motto / Object VACUUM VESSEL OVC		Commissa / Shop Order 21576-20	
Descrizione Description		Disegno Drawing		Materiale Material		Data di consegna Delivery date	
Note Notes							

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Pos	Pr	Descrizione Description	Disegno Drawing	Materiale Material	Data di consegna Delivery date	Note Notes	
1	1	VACUUM VESSEL OVC	LHCACF-T1141	ANSI 304L/316L	31/03/2021		
N.	Fase operativa	Procedura	ALCA Technology	Lancaster/Cern	NC	Certificati emessi/Notes	
	Operational Stage	Procedure	Resp. / Firm/Date	Typo / Firm/Date		Issued Certificate/ Notes	
			Reason / Sign/Date	Signature			
141	Trial fitting tests	Construction drawings Technical Spec: LHC-ACFVT-C1-0002	JM 26/03/20		<input type="checkbox"/>	R	
150	He leak test		JM 28/03/20	A-P	<input type="checkbox"/>	R	
151	Lifting Test	Technical Spec: LHC-ACFVT-C1-0002 (EIMS: 2207136)	JM 29/03/20		<input type="checkbox"/>	R	
160	FAT	Technical Spec: LHC-ACFVT-C1-0002 (EIMS: 2207136)	JM 30/03/20	A-P	<input type="checkbox"/>	R	
170	Packing		JM 31/03/20		<input type="checkbox"/>		
180	Marking	Technical Spec: LHC-ACFVT-C1-0002 (EIMS: 2207136)	JM 31/03/20		<input type="checkbox"/>		
190	Transport		JM		<input type="checkbox"/>	R	
P=Presenza (Hold point) C=Convocazione (Notification) R= Rapporto (Certification) JM=Job Manager A=Approval							Documento Doc. n° 3

Main Made of Equipment data Manufacturing Operation Non-conformities Documents History Map

Actions: Add extra step

Workflow Diagram
 No workflow diagram is defined for this equipment

Workflow Steps

Step #	R/E	Other name	Description	Last Repeated	Status	Result	INC
5			Traceability of Materials		Done	Ok	
10			Cutting and Rough machining		Done	Ok	
15			Vacuum Vessel Welding		Done	Ok	
20			Vibrating Stress Relieving		Done	Ok	
25			Visual check		Done	Ok	
30			Final Machining (*)		Accepted	Not Ok	
35			Dimensional Control (*)		Accepted	Not Ok	
40			Final Welding (tubes and flanges) (*)		Accepted	Not Ok	
45			Visual check		Done	Ok	
50			Visual check sealing surfaces after blasting outside and pickling inside		Done	Ok	
55			Final cleaning and assembly		Done	Ok	
60			Trial Fitting		Done	Ok	
65			He Leak Test		Done	Ok	
70			Lifting Test		Accepted	Ok	
75			FAT Test		Done	Ok	
80			Ready for transportation		Done	Ok	
85	E		Shipment to UK		Done	Ok	
90	E		Reception in the UK		Accepted	Ok	
95	E		Visual Inspection		Accepted	Ok	
100	E		Helium Leak Test		Accepted	Ok	
105	E		Final Acceptance by UK		Accepted	Ok	



Conclusions

- We are moving to Series production, and we need to be even more attentive to the QA/QC activities (much more demanding than building just one cryomodule)
- Proper traceability is a must – What goes where / What is the equipment made of
- Regular reporting during production including NCRs (which should be taken as a learning process and improvement)
- You are responsible to upload the documentation and close the steps unless a step is set as HOLD POINT. Then it is up to CERN to give clearance and close the step.



Thank you for your attention

