



DFX - Production Readiness Review (PRR)

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3rd March 2020

DFX - Production Readiness Review

Contents

1. General quality plan
2. Manufacturing and Inspection Plan
3. Procedures (fabrication and inspection)
4. Component procurement plan – SOTON
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The DFX prototype quality plan should filter down through the following steps and collect/store all required documentation:

1. Design phase

The design phase shall lead to the production of all required documentation and terminates upon approval by CERN.

2. Manufacturing preparation phase

The manufacturing preparation phase shall lead to the production of all required documentation and terminates upon approval by CERN.

Note: The manufacturing shall not start without CERN's acceptance based on a Production Readiness Review.

3. Manufacturing preparation phase

The manufacturing phase shall lead to the manufacture of all the DFX prototype components, and production of all required documentation

4. Assembly and qualification phase

The assembly and qualification phase shall lead to the assembly of the DFX prototype and production of all required documentation.

5. Archiving

All documentation shall be uploaded to MTF (Manufacturing & Test Folder).

6. Delivery

CERN's approval shall release the DFX prototype for delivery to CERN.

7. Acceptance

Acceptance of the DFX prototype shall be subject to the successful completion of the tests by the supplier and the submission to CERN of all compliant tests results or other certificates

General quality plan information

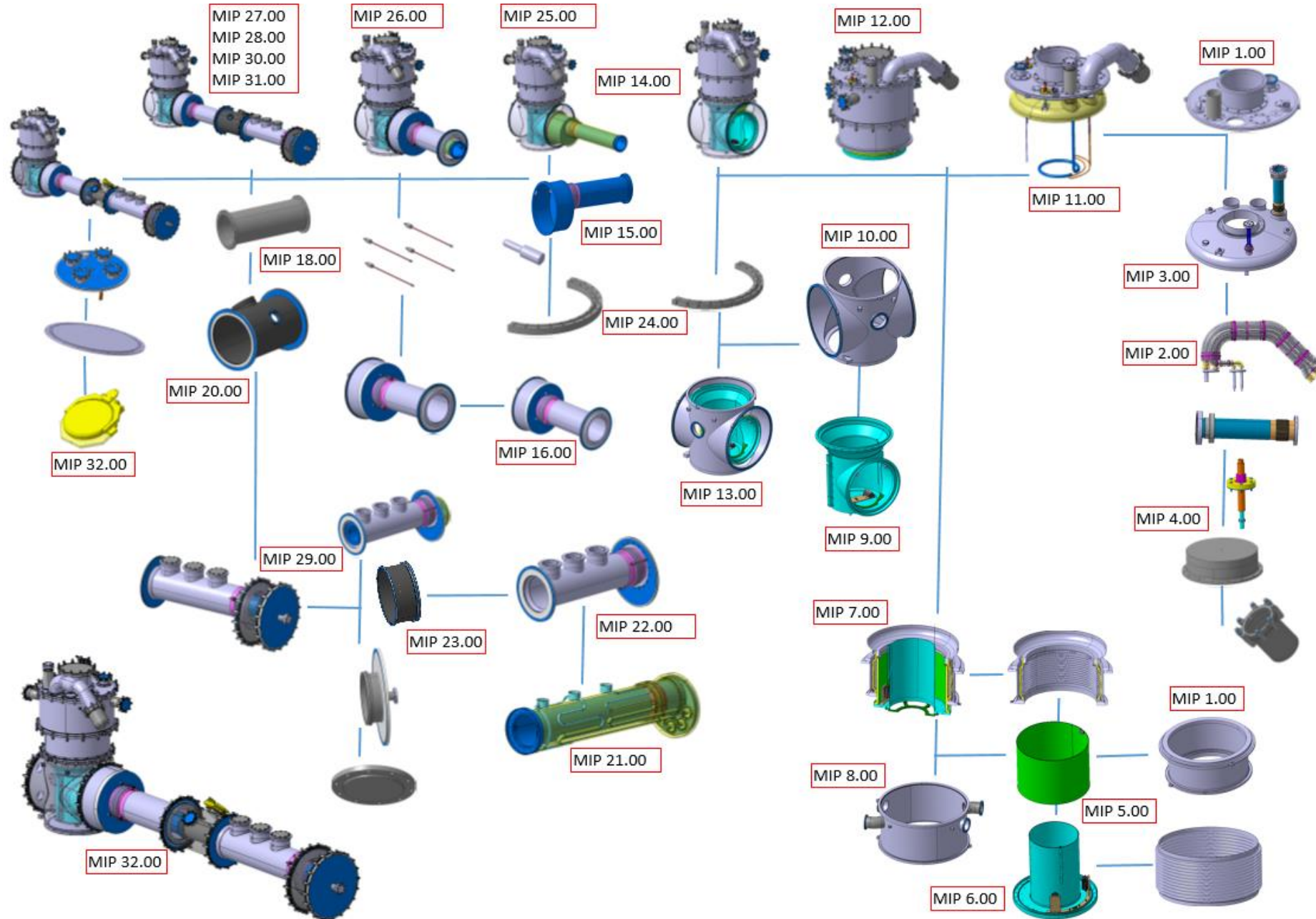
1. SOTON and CERN team have submitted the General Quality Plan (DRAFT) document as part of the HLC Project and setup of the MTF
2. SOTON defined the definition “quality team” and accepted the rules and processes that must be undertaken and followed as part of the HLC project
3. SOTON have selected to work with LTi Metaltech (UK precision fabricators) to manufacture DFX “prototype” and beyond...
 - LTi Metaltech are ISO 9001,14001 & 18001 accredited
 - LTi Metaltech use **British Engineering Services** to validate vessel design and testing protocol, welding procedures, weld maps, weld NDT and weld inspection

Quality plan working template

	Design			Procurement				Manufacturing, assembly and qualification												QA			
	Design report	Safety file		Manufacturing drawings	CE certif.	Calculations reports	Pressure test procedure	Material certificate	Manuf. & Inspection Plan	Dimensional report	Welding		Weld inspection			Leak test		Cleaning	Procedures				
	Thermo-mech. Fluid mech.	Risk analysis	Pressure relief device design								Welder	Procedure	NDT personel	Visual inspection	X-ray proc.	X-ray result	Procedure	Operator	Procedure	MTF archiving	Installation	maintenance	
Standard	EN13445-3 EN13458-2	NA	ISO21013-3 EN4126-6	ISO-GPS	PED	EN13445 EN14917+A1	EN13458-2	EN10028 HL-LHC_QA	NA	NA	ISO 9606-1 ISO14732	ISO 15614-1	ISO 9712 NDT level2	ISO 17637	ISO 17636	ISO 5817 Quality B	EN1779A1 EN13185	ISO 9712 Level2	EN12300	NA	NA	NA	
Qualification by notified body					(X)	(X)					X	X	X					X					
Components																							
Vacuum vessel	X	X	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Bellows vacuum			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Helium vessels	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bellows helium			X	X	X	X	X	X	X	X	X	X	X	X	(X)	(X)	X	X	X	X	X	X	X
MLI			X						X		X											(X)	
Structural supports	X		X					X		X								X		(X)			

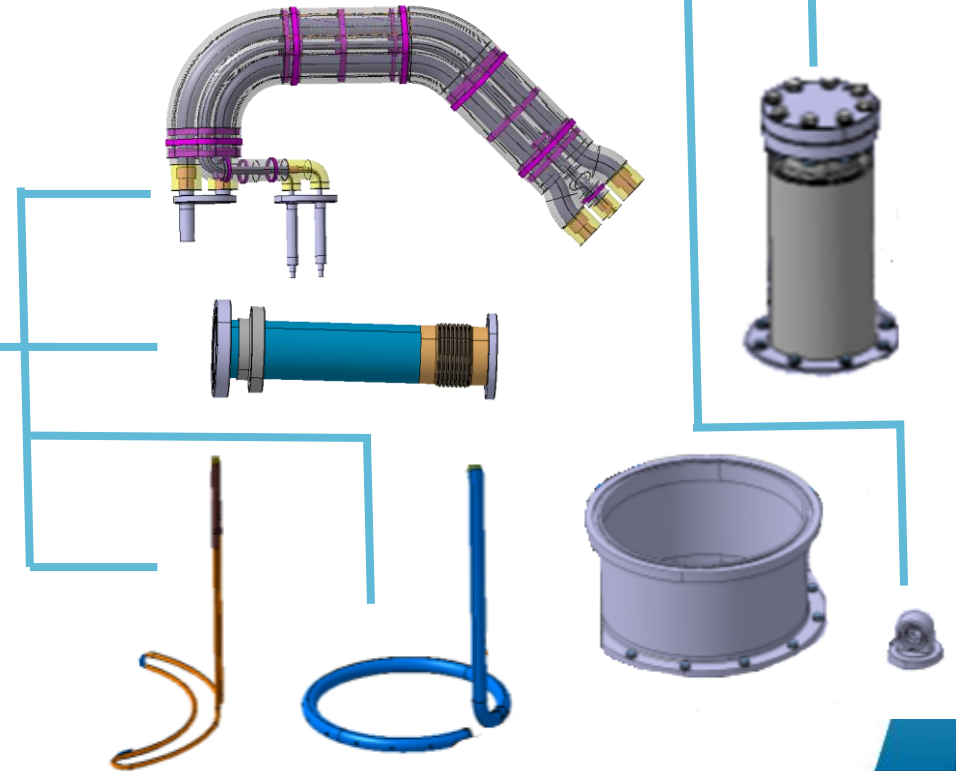
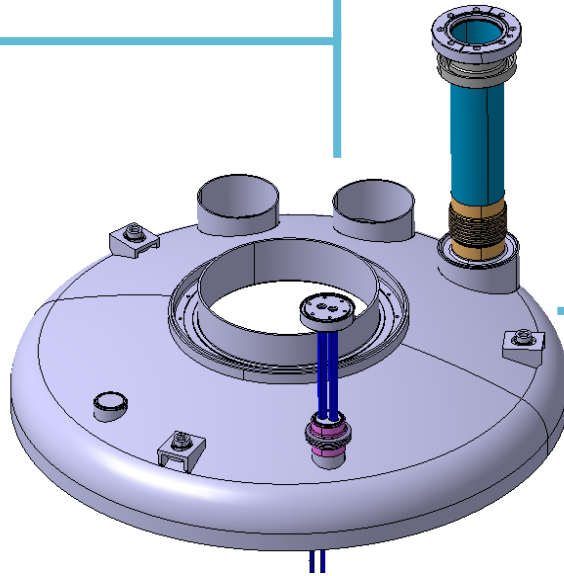
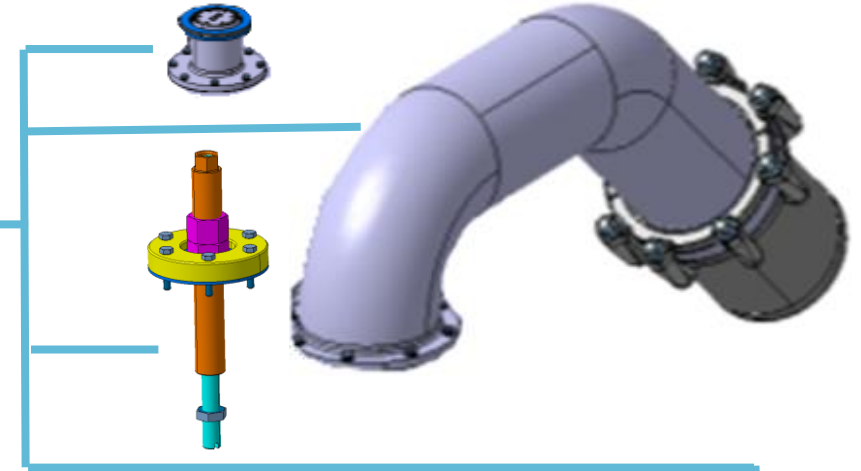
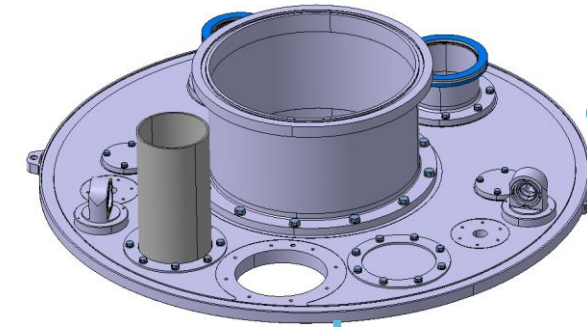
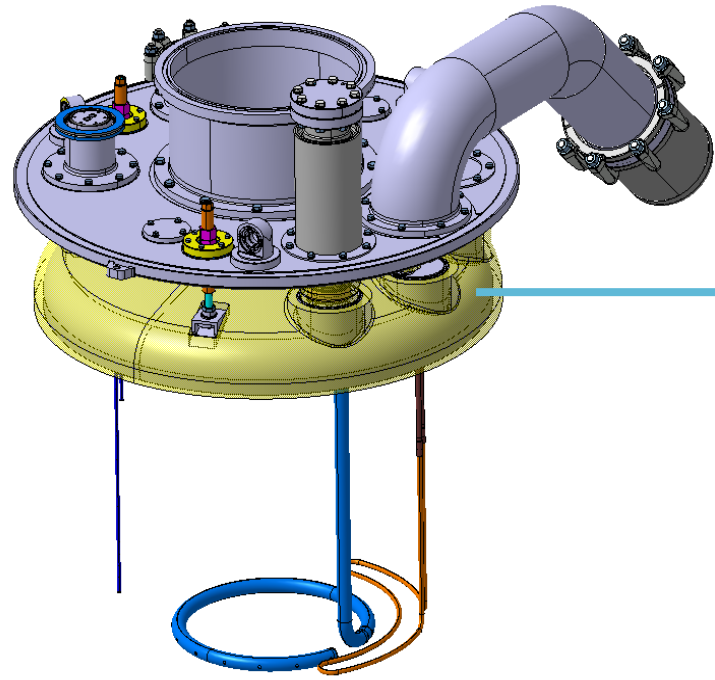
Manufacturing and Inspection Plan (MIP)

MIP map



MIP example

Detailed MIP example for top flange + top dome assembly



MIP example

KEY	Task type
	Activity title
	Metrology
	Machining/fabrication/procure
	Welding
	X-ray report
	Leak detection
	Cleaning
	MLI application
	Assembly

HL-LHC: QUALITY - Manufacturing and Inspection Plan for DFX Cryostat

Prepared by: W. Bailey, Y. Yang Date: 20-02-2020	Project: HL-LHC	Supplier: Uni of Southampton
Verified by: Date:	Work Package: WP6a	Client: CERN
Approved by: Date:		

No.	Activity	DWG ID Number	Appl. Standards/Procedures/Certificates											Supplier Name		
			Material		Metrology			Welding			Cleaning	Weld Inspection			Leak detection	
			Material cert	Dimensional note	Welder	Procedure	NDT personel	Procedure	Visual inspection	X-ray procedure	X-ray result	Procedure	Operator			
		ISO GPS	EN10028	n/a	ISO9606-1	ISO9606-2	ISO9712	EN12300	ISO17637	ISO17636	ISO5817	EN1779A1	ISO9712			
					ISO14732		NDT Level 2				Quality B	EN13185	Level 2			
1.00	Manufacturing of top flange	LHCDFX_0129														
1.01	Machine top flange	LHCDFX_0125	X											LTI Metaltech		
1.02	Machine SCLink "hat" components	LHCDFX_0073	X											LTI Metaltech		
1.03	Machine blank flanges	LHCDFX_0096	X											LTI Metaltech		
1.04	Machine burst disc components	LHCDFX_0100	X											LTI Metaltech		
1.05	Machine dust protection flange	LHCDFX_0098	X											LTI Metaltech		
1.06	Machine VV mounting flange blind	LHCDFX_0099	X											LTI Metaltech		
1.07	Machine fisheye supports components	LHCDFX_0126	X											LTI Metaltech		
1.08	Machine level gauge VV lower components	LHCDFX_0118	X											LTI Metaltech		
1.09	Machine level gauge VV upper components	LHCDFX_0120	X											LTI Metaltech		
1.10	Machine/procure safety valve (SV) port components	LHCDFX_0101	X											LTI Metaltech		
1.11	Machine VV safety port components	LHCDFX_0001	X											LTI Metaltech		
1.12	Check dimensions, tolerances and surface finish of completed components			X										LTI Metaltech		
1.13	Clean all fabricated parts								X					LTI Metaltech		
1.14	Weld burst disc tube to ring flange to complete assembly					X	X							LTI Metaltech		
1.15	Check perpendicularity of burst disc tube with flange			X										LTI Metaltech		
1.16	Clean burst disc assembly								X					LTI Metaltech		
1.17	Weld inspection									X				LTI Metaltech		
1.18	Perform leak detection											X	X	LTI Metaltech		
1.19	Weld fisheye supports to mounting flange to complete assembly					X	X							LTI Metaltech		
1.20	Check perpendicularity between flange with fisheye unit			X					X					LTI Metaltech		
1.21	Clean burst fisheye assembly													LTI Metaltech		

MIP example

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Prepared by: W. Bailey, Y. Yang		Project: HL-LHC					Supplier: Uni of Southampton							
Date: 20-02-2020		Work Package: WP6a					Client: CERN							
Verified by:														
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No.	Activity	DWG ID Number	Appl. Standards/Procedures/Certificates										Supplier Name	
			Material	Metrology	Welding			Cleaning	Weld Inspection			Leak detection		
			Material cert	Dimensional note	Welder	Procedure	NDT personel	Procedure	Visual inspection	X-ray procedure	X-ray result	Procedure	Operator	
		ISO GPS	EN10028	n/a	ISO9606-1	ISO9606-2	ISO9712	EN12300	ISO17637	ISO17636	ISO5817	EN1779A1	ISO9712	
					ISO14732		NDT Level 2				Quality B	EN13185	Level 2	
2.00	Manufacturing of cryogenic insertion	LHCDFX_0112												
2.01	Fabricate/procure Flex. DN20 He out	LHCDFX_0026	X											Kompaflex+LTI
2.02	Fabricate/procure Flex. DN20 He in	LHCDFX_0025	X											Kompaflex+LTI
2.03	Fabricate/procure Flex. DN6 Heater 1	LHCDFX_0028	X											Kompaflex+LTI
2.04	Fabricate/procure Flex. DN6 Heater 2	LHCDFX_0029	X											Kompaflex+LTI
2.05	Fabricate/procure cryogenic insertion outer sleeve components	LHCDFX_0023	X											LTI Metaltech
2.06	Weld rigid elbows to flange				X	X	X							LTI Metaltech
2.07	Weld flexibles to rigid elbows				X	X	X							LTI Metaltech
2.08	Weld adapting ends to flexibles				X	X	X							LTI Metaltech
2.09	Cleaning of all welded interfaces							X						LTI Metaltech
2.10	X-ray of all joints in assembly									X	X			LTI Metaltech
2.11	Cleaning of all flexibles and end fittings							X						LTI Metaltech
2.12	Independent leak detection of all flexible sub-assemblies											X	X	LTI Metaltech
2.13	Apply MLI to all flexibles													SOTON
2.14	Group and apply Nylon spacers to form bundle													SOTON
2.15	Complete cryogenic insertion outer sleeve assembly	LHCDFX_0023												LTI Metaltech
2.16	Weld outer cryogenic sleeve [90 Deg elbow] to mounting flange	ST0307660			X	X								LTI Metaltech
2.17	Weld outer cryogenic sleeve [90 Deg elbow + flange] to straight tube	ST1197480			X	X								LTI Metaltech
2.18	Check rotational alignment between 90 Deg elbow and 45 Deg elbow			X										LTI Metaltech
2.19	Weld outer cryogenic sleeve [90 Deg elbow + flange + straight tube] to 45 Deg elbow	ST0307660 (Cut)			X	X								LTI Metaltech
2.20	Weld outer cryogenic sleeve [90 Deg elbow + flange + straight tube + 45 Deg elbow] to straight tube 2	ST1197515			X	X								LTI Metaltech
2.21	Weld DN150 flange to assembly to complete assembly	ST1188239			X	X								LTI Metaltech
2.22	Check total length of assembly between back of mounting flange and top tip of DN150 flange			X										LTI Metaltech
2.23	Clean all ports and surfaces							X						LTI Metaltech
2.24	X-ray sample of butt welds and visually inspect welds to end flanges								X	X	X			LTI Metaltech
2.25	Perform leak detection of completed assembly											X	X	LTI/SOTON/CERN

MIP example

HL-LHC: QUALITY - Manufacturing and Inspection Plan for DFX Cryostat

Prepared by: W. Bailey, Y.Yang Date: 20-02-2020 Verified by: Date: Approved by: Date:		Project: HL-LHC				Supplier: Uni of Southampton								
		Work Package: WP6a				Client: CERN								
No.	Activity	DWG ID Number	Appl. Standards/Procedures/Certificates										Supplier Name	
			Material	Metrology	Welding			Cleaning	Weld Inspection			Leak detection		
			Material cert	Dimensional note	Welder	Procedure	NDT personel	Procedure	Visual inspection	X-ray procedure	X-ray result	Procedure		Operator
		ISO GPS	EN10028	n/a	ISO9606-1 ISO14732	ISO9606-2	ISO9712 NDT Level 2	EN12300	ISO17637	ISO17636	ISO5817 Quality B	EN1779A1 EN13185	ISO9712 Level 2	
3.25	Weld level straight guide tubes to flanges at either end to form sub-assembly				X	X								LTI Metaltech
3.26	Check squareness between opposing flanges			X										LTI Metaltech
3.27	Clean surfaces after welding							X						LTI Metaltech
3.28	X-ray weld								X	X	X			LTI Metaltech
3.29	Perform leak detection											X	X	LTI Metaltech
3.30	Weld extended level sensor guide tubes					X	X							LTI Metaltech
3.31	Clean surfaces after welding							X						LTI Metaltech
3.32	Weld DN50 bellows to level sensor guide tube sub-assembly													LTI Metaltech
3.33	Check ends of tubes and flange surface are parallel within tolerance			X										LTI Metaltech
3.34	Clean surfaces after welding						X							LTI Metaltech
3.35	X-ray weld								X	X	X			LTI Metaltech
3.36	Weld completed level sensor guide tube sub-assembly to dome													LTI Metaltech
3.37	Check squareness between welded interface and top flange of level sensor guides			X										LTI Metaltech
3.38	Clean surfaces after welding							X						LTI Metaltech
3.39	X-ray weld								X	X	X			LTI Metaltech
3.40	Weld dome lifting pads to top dome in three locations					X	X							LTI Metaltech
3.41	Check position of pads is within assigned tolerances			X										LTI Metaltech
3.42	Clean all surfaces to finalise assembly							X						LTI Metaltech
4.00	Manufacturing of other ancillaries for top dome + top flange assembly													
4.01	Fabricate gas heater lines	LHCDFX_0015	X											LTI Metaltech
4.02	Vacuum braze/procure (with no flux) stainless steel to copper transition (x2) to form heating loop						X							LTI Metaltech
4.03	Clean tube assembly							X						LTI Metaltech
4.04	Leak test tube assembly											X	X	LTI Metaltech
4.05	Fabricate liquid in diffuser	LHCDFX_0013	X											LTI Metaltech
4.06	Drill radial array of holes - Remove swarf and sharp edges													LTI Metaltech
4.07	Weld diffuser end cap					X	X							LTI Metaltech
4.08	Clean tube assembly							X						LTI Metaltech
4.09	Leak test tube assembly											X	X	LTI Metaltech
4.10	Machine lifting/jacking tool components	LHCDFX_0105	X											LTI Metaltech
4.11	Fabricate SV lower assembly	LHCDFX_0131 ST1207019	X											LTI Metaltech
4.12	Weld bellows to lip weld flange and straight tube to begin SV lower assembly					X	X	X						LTI Metaltech
4.13	Check length of tube + bellows is within nominal tolerance			X										LTI Metaltech
4.14	Weld concentric adapter to straight tube section	LHCDFX_0090				X	X	X						LTI Metaltech
4.15	Check distance between lip weld flange and lengthwise position of concentric adapter			X										LTI Metaltech
4.16	Weld rotating DN63 flange assembly to top of straight tube					X	X							LTI Metaltech
4.17	Check concentricity between SV value lower assembly			X										LTI Metaltech
4.18	X-ray a selection of welds within the completed assembly								X	X	X			LTI Metaltech
4.19	Clean SV lower assembly							X						LTI Metaltech
4.20	Perform leak detection											X	X	LTI Metaltech
														LTI/SOTON/CERN

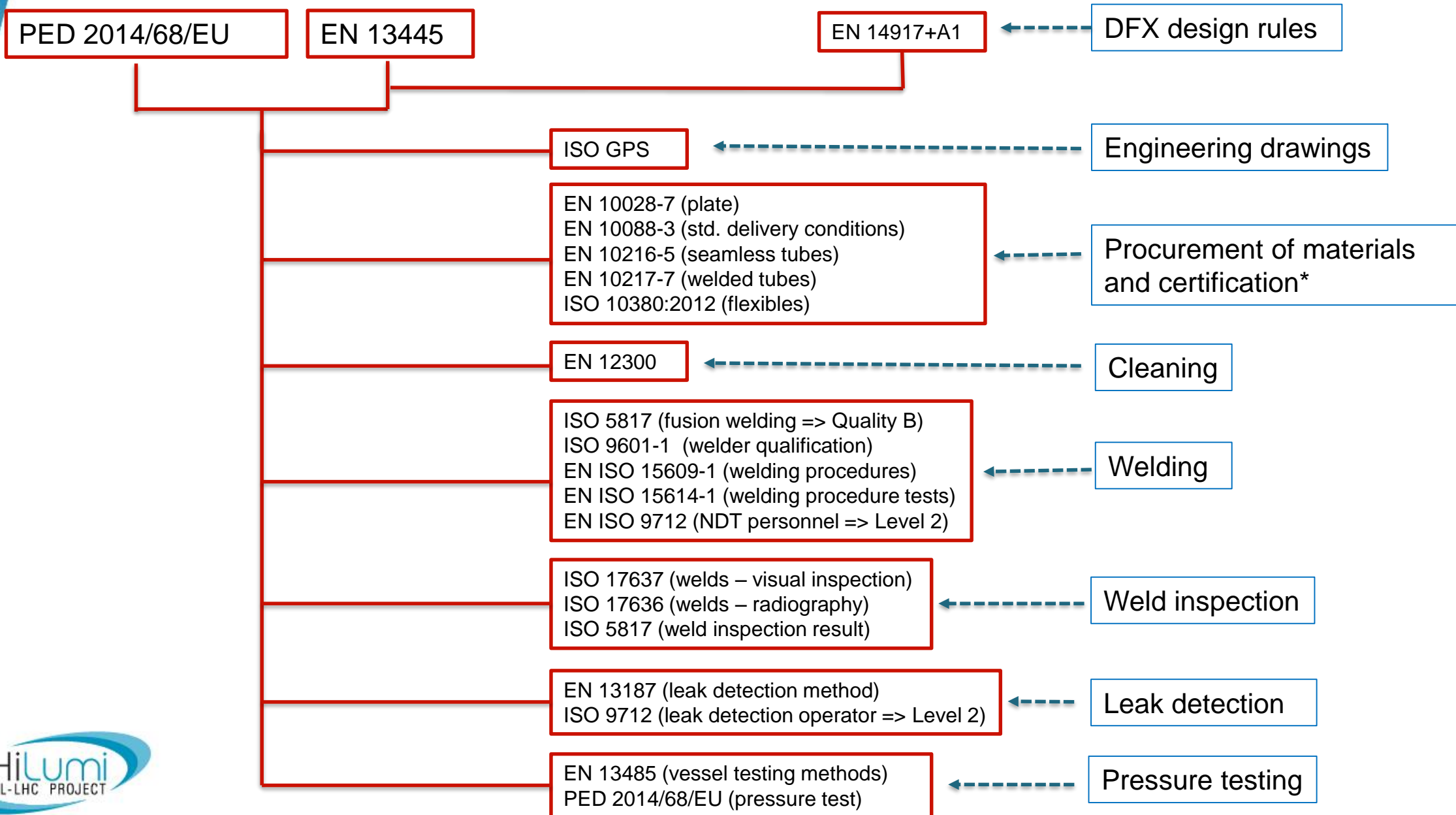
MIP example

HL-LHC: QUALITY - Manufacturing and Inspection Plan for DFX Cryostat

Prepared by: W. Bailey, Y. Yang Date: 20-02-2020 Verified by: Date: Approved by: Date:		Project: HL-LHC				Supplier: Uni of Southampton								
		Work Package: WP6a				Client: CERN								
No.	Activity	DWG ID Number	Appl. Standards/Procedures/Certificates										Supplier Name	
			Material	Metrology	Welding			Cleaning	Weld Inspection			Leak detection		
			Material cert	Dimensional note	Welder	Procedure	NDT personnel	Procedure	Visual inspection	X-ray procedure	X-ray result	Procedure	Operator	
		ISO GPS	EN10028	n/a	ISO9606-1 ISO14732	ISO9606-2	ISO9712 NDT Level 2	EN12300	ISO17637	ISO17636	ISO5817 Quality B	EN1779A1 EN13185	ISO9712 Level 2	
11.00	Manufacturing of top dome + top flange assembly	LHCDFX_0145												
11.01	Install SV vacuum tube assembly to top dome													LTi Metaltech
11.02	Install cryogenic insertion assembly to top dome and engage flanges for welding	LHCDFX_0112												LTi Metaltech
11.03	Support top flange above top dome													LTi Metaltech
11.04	Clean all O-ring selaing interfaces								X					LTi Metaltech
11.05	Ensure Seal + SV vacuum tube assmebly installed to top flange													LTi Metaltech
11.06	Align and thread cryogenic insertion bundle through correct bore in top flange without snagging MLI													LTi Metaltech
11.07	Ensure level gauge guide tube assembly fixed to top dome is aligned with correct bore in top flange			X										LTi Metaltech
11.08	Install lifting tool stud bars to join top dome with top flange													LTi Metaltech
11.09	Install SV lower assembly + MLI through the top flange until weld flange engages port in top dome	LHCDFX_0091												LTi Metaltech
11.10	Use jacking mechanism to separate a fixed distance between top flange and top dome													LTi Metaltech
11.11	Ensure parallism between the bottom of top dome and base of top dome			X										LTi Metaltech
11.12	Install Seal and cryogenic insertion assembly outer vacuum sleeve assembly													LTi Metaltech
11.13	Slide cryogenic insertion bundle through elbow section and fix mating flange to top flange													LTi Metaltech
11.14	Ensure welded interfaces are cleaned								X					LTi Metaltech
11.15	Weld both cryogenic insertion flanges to top dome				X	X	X							LTi Metaltech
11.16	Weld engaged flange of SV lower assembly to top dome				X	X								LTi Metaltech
11.17	Weld engaged flange of level sensor guide tube assembly to top dome				X	X								LTi Metaltech
11.18	Clean surfaces after welding								X					LTi Metaltech
11.19	X-ray 3 welds									X	X	X		LTi Metaltech
11.20	Weld upper flange of SV lower assembly engaging with SV outer vacuum tube mounted to top flange				X	X								LTi Metaltech
11.21	Clean surfaces after welding								X					LTi Metaltech
11.22	Inspect welds													LTi Metaltech
11.23	If another weld is introduced to shorten length of the level sensor guide tubes - Could perform a leak detection									X				LTi Metaltech
11.24	Install blanking flange to top of SV assembly													LTi Metaltech
11.25	Install Seal + level sensor guide vacuum lower assembly to top flange	LHCDFX_0118												LTi Metaltech
11.26	Install Seal + level sensor guide vacuum upper vessel to vacuum pipe assembly	LHCDFX_0120												LTi Metaltech
11.27	Install blanking flange to top of level sensor guide tube assembly													LTi Metaltech
11.28	Install blanks to cryogenic insertion lines													LTi Metaltech
11.29	Perform leak detection test of top dome assembly with welded ports											X	X	LTi Metaltech
11.30	Apply MLI blankets to top dome and complete wraps to vertical tube walls													SOTON

Procedures - fabrication and inspection (F&I)

Key standards for F&I



F&I (HOLD Points)

A **HOLD** point: = CERN/authorised representative, is informed that a specific step has been completed.

The work-flow is stopped until CERN, or its authorized representative, provides a Hold Point Clearance.

- The clearance is provided within 5 working days upon submission of the quality control documentation relative to the performed step.
- In case of clearance the work-flow can continue.
- In case of rejection, a recovery plan shall be discussed with CERN and submitted to CERN for final approval within 10 working days.

Typically a HOLD point has been introduced to bring closure to an activity, i.e. the final leak detection/pressure test performed to confirm completion of a sub-assembly after completion of a critical weld/dimension check

A total of 15 **HOLD points** (H) have been introduced into the DFX F&I schedule

F&I (NOTIFIED Points)

A **NOTIFIED** point: = CERN/authorised representative, is informed 5 working days in advance that a specific step has been completed and that the following step in the approved work-flow will be performed.

Notification Point does not affect the work-flow. Work can continue without CERN/authorised representatives reply

A total of 24 **NOTIFIED points** (N) have been introduced into the DFX F&I schedule

F&I (WITNESS Points)

A **WITNESS** point: = CERN/authorised representative, intends to attend any specific step of the production. The supplier will notify the client with 10 working days in advance that the activity will be performed.

At this stage in the project plan SOTON will need some guidance as to the typical number of witness points CERN/authorised representatives anticipate to factor in the production plan

A total of 31 **WITNESS points** (W) have been introduced into the DFX F&I schedule for SOTON and LTi Metaltech to be jointly present – these can be adapted to include a CERN/representative.

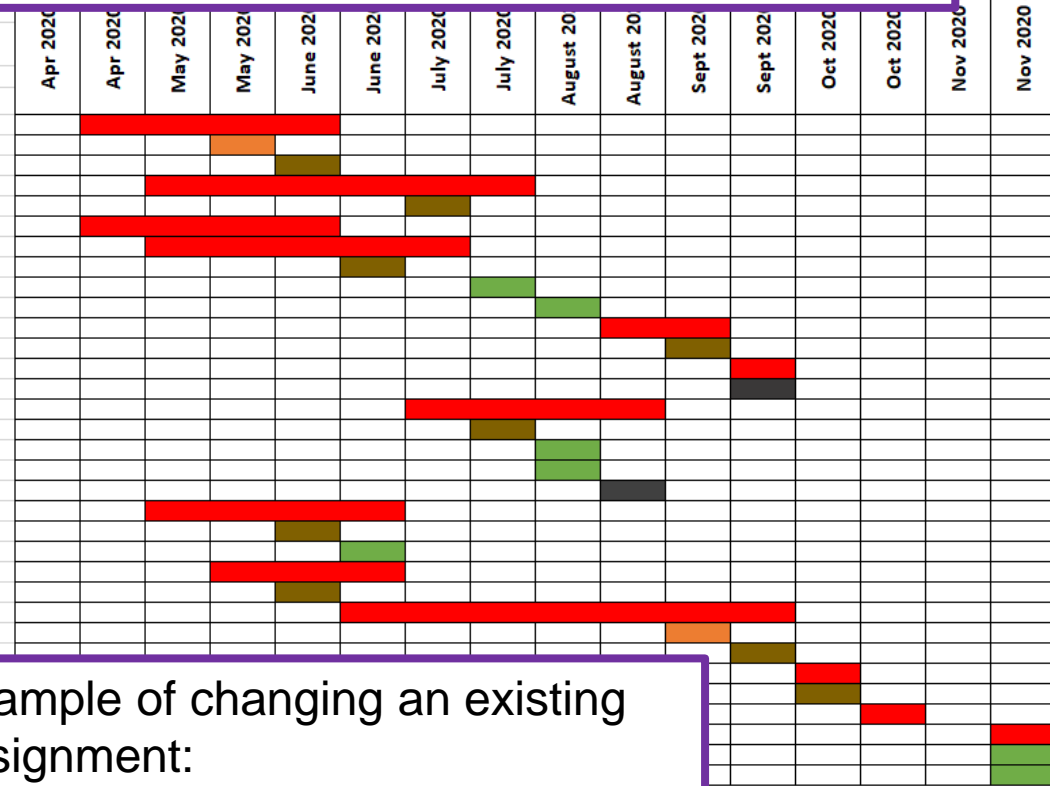
Alternatively, previous HOLD or NOTIFIED points changed to WITNESS points so an observation is carried out onsite

F&I (Potential Witness Points)

HL-LHC: QUALITY - Manufacturing and Inspection Plan for DFX Cryostat (SHORT OVERVIEW)

by: W. Bailey, Y. Yang 02-2020		Item Eq. Code:		Asset Code: (LHC Part Identifier)				
by:		Item description: DFX Cryostat (Proto)		EDMS Report No: 2337452				
Activity	Inspection						Notes	
	Manufacturer/ Control		Institute / Verification		3rd Party / Surveillance			Rev. Doc.
	Code	Signature/Date	Code	Signature/Date	Code	Signature/Date		
Manufacturing of top flange								
Vacuum braze/procure (with no flux) stainless steel to copper transition (x2) to form heating loop	W	X	W	X				
X-ray weld of outer fountain flange to fountain base flange	N	X	N	X	N	X		
Manufacturing of mid-section sub-assembly								
X-ray weld - VB membrane to ISO680 flange	H	X	H	X	H	X		
Manufacturing of additional vertical vacuum vessel components								
Manufacturing of "cold" elbow								
X-ray lip weld of bottom flange to elbow assembly	W	X	W	X				
Manufacturing of top dome + top flange assembly								
Perform leak detection test of top dome assembly with welded ports	H	X	H	X	H	X		
Manufacturing of top dome + top flange assembly with mid-section assembly								
X-ray weld of top dome + bottom dome	H	X	H	X	H	X		
Manufacturing of combined top + mid-section assembly to lower elbow + VV cross assembly								
Elevate VV cross section and close vacuum by fitting clamps	N	X	N	X	N	X		
Manufacture of cold horizontal section 1								
X-ray weld of long tube section Dia219 to end of bellows	N	X	N	X	N	X		
Perform leak detection test	W	X	W	X				
Perform pressure test of sub-assembly	H	X	H	X	H	X		
Apply MLI blankets to all external interfaces								
Manufacture of VV horizontal section 1								
Inspect weld of ISO630 reducer flange to bellows	N	X	N	X	N	X		
Perform leak detection of closed assembly - using special blanks plates to perform test	H	X	H	X	H	X		
Manufacture of "cold" horizontal sliding sleeve REAL PART								
X-ray weld of flared ring to tube	W	X	W	X				
Manufacture of cold horizontal IFS section								
Weld x6 IFS small lip weld flange	N	X	N	X	N	X		
X-ray welds x6 IFS small lip weld flanges	H	X	H	X	H	X		
Manufacturing of cold IFS section with VV IFS section								
Weld x3 vacuum manifolds in-situ	W	X	W	X				
Inspect welds of IFS vacuum manifolds	H	X	H	X	H	X		
DFX pressure testing								
Perform pressure test at room temperature and 4.9 bar applied to DFX helium vessel	N	X	N	X	N	X		
Review pressure test data	N	X	N	X	N	X		

Example of adding to an existing assignment:
X-ray of lip weld of bottom flange in elbow



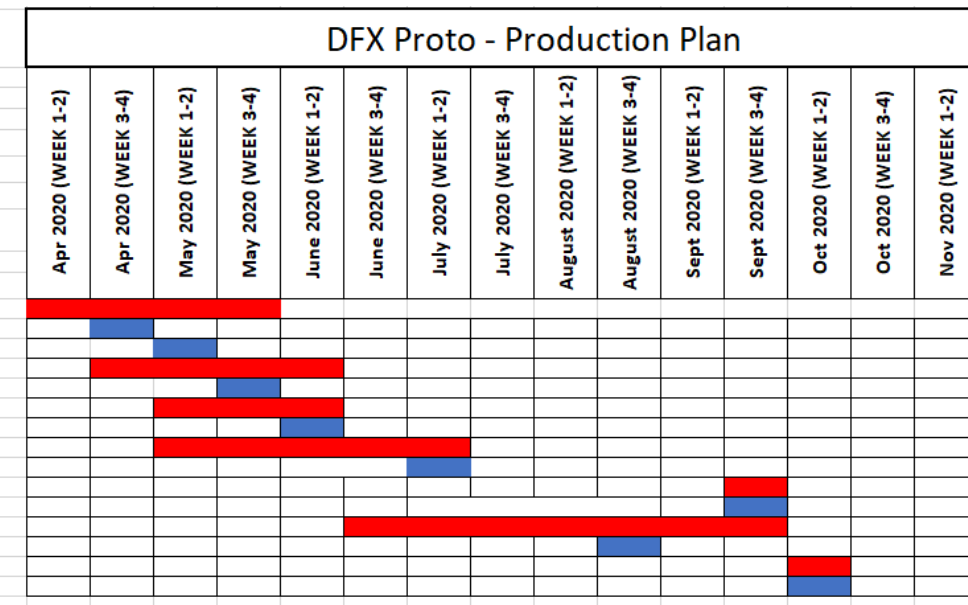
Example of changing an existing assignment:
X-ray of top dome to bottom dome

F&I (REVIEW Points)

A **REVIEW** point: = A review of the quality plan and could be integrated as part of a joint project meeting with all parties

A total of 8 **REVIEW points** (R) have been introduced into the DFX F&I schedule

HL-HLC: QUALITY - Manufacturing and Inspection Plan for DFX Cryostat (SHORT OVERVIEW)											
Prepared by: W. Bailey, Y.Yang		Item Eq. Code:		Asset Code: (LHC Part Identifier)							
Date: 26-02-2020											
Verified by:		Item description: DFX Cryostat (Proto)		EDMS Report No: 2337452							
Date:											
Approved by:											
Date:											
No.	Activity	Inspection								Notes	
		Manufacturer/ Control		Institute / Verification		3rd Party / Surveila		Rev. Doc.			
		Code	Signature/Date	Code	Signature/Date	Code	Signature/Date				
0.00	Procurement of materials/off-shelf components/bellows/flexibles										
0.03	Completion of standard ISO vacuum flanges (ring flanges, blank flanges)	R	X	R	X						
0.07	Completion of procurement of 3D forged round plates and billets	R	X	R	X						
1.00	Manufacturing of top flange										
1.13	Intermediate review point	R	X	R	X						
4.00	Manufacturing of other ancillaries for top dome + top flange assembly										
END	Intermediate review point	R	X	R	X						
9.00	Manufacturing of "cold" elbow										
9.43	Intermediate review point	R	X	R	X						
14.00	Manufacturing of combined top + mid-section assembly to lower elbow + VV cross assembly										
END	Intermediate review point	R	X	R	X						
21.00	Manufacture of cold horizontal IFS section										
21.32	IFS sub-assembly 3 (received)	R	X	R	X						
29.00	Manufacturing of cold IFS section with VV IFS section										
END	Intermediate review point	R	X	R	X						



F&I (SOTON Points)

A **SOTON** point: = An activity that is led by SOTON on LTi Metaltech site.

These include activities such as “applying MLI” and performing the electrical testing of heaters

A total of 15 **SOTON points** (S) have been introduced into the DFX F&I schedule

HL-HLC: QUALITY - Manufacturing and Inspection Plan for DFX Cryostat (SHORT OVERVIEW)							DFX Proto - Production Plan																
Prepared by: W. Bailey, Y.Yang Date: 26-02-2020		Item Eq. Code:			Asset Code: (L		Apr 2020 (WEEK 1-2)	Apr 2020 (WEEK 3-4)	May 2020 (WEEK 1-2)	May 2020 (WEEK 3-4)	June 2020 (WEEK 1-2)	June 2020 (WEEK 3-4)	July 2020 (WEEK 1-2)	July 2020 (WEEK 3-4)	August 2020 (WEEK 1-2)	August 2020 (WEEK 3-4)	Sept 2020 (WEEK 1-2)	Sept 2020 (WEEK 3-4)	Oct 2020 (WEEK 1-2)	Oct 2020 (WEEK 3-4)	Nov 2020 (WEEK 1-2)	Nov 2020 (WEEK 3-4)	
Verified by:		Item description: DFX Cryostat (Proto)			EDMS Report																		
Date:		Inspection																					
Approved by:		Manufacturer/ Control		Institute / Verification		3rd Party / Surveila																	
Date:		Code	Signature/Date	Code	Signature/Date	Code	Signature/Date																
0.00	Procurement of materials/off-shelf components/bellows/flexibles																						
7.00	Manufacturing of mid-section sub-assembly																						
7.36	Insert MLI blanket between VB cage support and VV mid-section wall	S	X	S	X																		
7.39	Insert MLI blanket between VB membrane and cage support	S	X	S	X																		
7.44	Install heater + thermometer plate + wiring loom	S	X	S	X																		
7.45	Perform electrical test and record data	S	X	S	X																		
9.00	Manufacturing of "cold" elbow																						
9.39	Fix heater mounting plates to bottom elbow flange	S	X	S	X																		
9.40	Install heater and thermometer and route wiring loom	S	X	S	X																		
9.42	Apply MLI to "cold" elbow	S	X	S	X																		
11.00	Manufacturing of top dome + top flange assembly																						
11.30	Apply MLI blankets to top dome and complete wraps to vertical tube walls	S	X	S	X																		
19.00	Manufacture of "cold" horizontal sliding sleeve REAL PART																						
19.16	Apply MLI blanket for tube section	S	X	S	X																		
21.00	Manufacture of cold horizontal IFS section																						
21.30	Apply MLI blanket to tubular assembly	S	X	S	X																		
21.31	Apply MLI to IFS wiring assemblies	S	X	S	X																		
21.39	Install MLI to reducer flange	S	X	S	X																		
21.40	Tie down vacuum manifolds of each IFS wiring assembly for further operations	S	X	S	X																		
32.00	Manufacturing of DFX for pressure test																						
32.01	Install and check additional instrumentation (strain gauging and load sensors) to DFX Proto	S	X	S	X																		
33.00	DFX pressure testing																						
33.02	Collect pressure test data from additional instrumentation	S	X	S	X																		

Component procurement plan

Procurement plan summary

- SOTON will contract LTi Metaltech to use their own list of approved suppliers to procure material/components to specification
- SOTON will assist LTi Metaltech with the procurement of certain materials/components to meet specification
 - Sheet metal/billets that satisfy < 0.1 % Cobalt content requirement*
 - *It has been proposed that sheet material or billets could be procured from the same known batch and several samples produced for material testing of Cobalt content to confirm compliance
 - 3-D forged plates in stainless steel grade 316LN for any lip welded flanges part of the helium vessel (Abbey Forged Product)
 - Bellows fabricated to custom sizes, welded with radial lip welds and fabricated from SS grades from the approved list (Kompaflex)
 - Flexible convoluted tubes fabricated from SS grades from the approved list (Kompaflex)
- If SOTON find it difficult to source any of the items listed above (especially within sensible budgets/lead-time), SOTON may place a request for CERN to assist with supply or materials/components from stores or own network of suppliers.

Production schedule and associated resource

Production schedule overview

		DFX Proto - Production Plan															
		Apr 2020 (WEEK 1-2)	Apr 2020 (WEEK 3-4)	May 2020 (WEEK 1-2)	May 2020 (WEEK 3-4)	June 2020 (WEEK 1-2)	June 2020 (WEEK 3-4)	July 2020 (WEEK 1-2)	July 2020 (WEEK 3-4)	August 2020 (WEEK 1-2)	August 2020 (WEEK 3-4)	Sept 2020 (WEEK 1-2)	Sept 2020 (WEEK 3-4)	Oct 2020 (WEEK 1-2)	Oct 2020 (WEEK 3-4)	Nov 2020 (WEEK 1-2)	Nov 2020 (WEEK 3-4)
No.	Activity																
0.00	Procurement of materials/off-shelf components/bellows/flexibles																
1.00	Manufacturing of top flange																
2.00	Manufacturing of cryogenic insertion																
3.00	Manufacturing of top dome assembly																
4.00	Manufacturing of other ancillaries for top dome + top flange assembly																
5.00	Manufacturing of outer fountain assembly																
6.00	Manufacturing of inner fountain components																
7.00	Manufacturing of mid-section sub-assembly																
8.00	Manufacturing of additional vertical vacuum vessel components																
9.00	Manufacturing of "cold" elbow																
10.00	Manufacturing of lower VV cross section																
11.00	Manufacturing of top dome + top flange assembly																
12.00	Manufacturing of top dome + top flange assembly with mid-section assembly																
13.00	Manufacturing of "cold" elbow + VV cross section																
14.00	Manufacturing of combined top + mid-section assembly to lower elbow + VV cross assembly																
15.00	Manufacture of cold horizontal section 1																
16.00	Manufacture of VV horizontal section 1																
18.00	Manufacture of "cold" horizontal sliding sleeve TEST																
19.00	Manufacture of "cold" horizontal sliding sleeve REAL PART																
20.00	Manufacture of VV horizontal sliding sleeve																
21.00	Manufacture of cold horizontal IFS section																
22.00	Manufacture of VV horizontal IFS section																
23.00	Manufacture of VV horizontal sleeve - plug end																
24.00	Manufacturing of additional parts for final assembly and testing																
25.00	Manufacturing of cold horizontal section 1 to DFX vertical section																
26.00	Manufacturing of VV horizontal section 1 to DFX																
27.00	Manufacturing of cold sliding sleeve (TEST) with DFX																
28.00	Manufacturing of VV sliding sleeve with DFX																
29.00	Manufacturing of cold IFS section with VV IFS section																
30.00	Manufacturing of complete IFS assembly to DFX																
31.00	Manufacturing of VV plug end section to DFX																
32.00	Manufacturing of DFX for pressure test																
33.00	DFX pressure testing																

Key points in production

- 15 Hold points
- 24 Notified points
- 31 Witness points
- 8 Review points

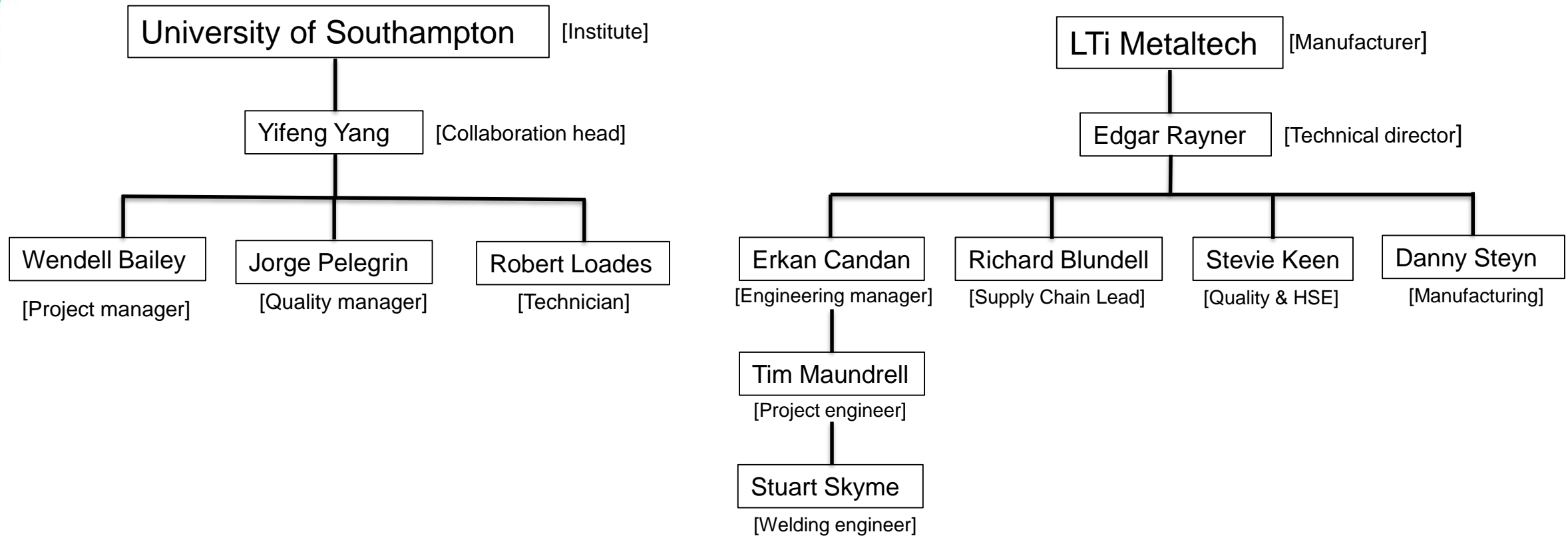
Production plan summary

DFX PRR (Proto) – 03 MAR 2020

Key milestones extracted from current production plan:

- Procurement phase (activity 0) = 8 weeks (1st Apr – 31st May)
- Manufacturing of top flange assembly (activity 1) = 8 weeks (15th Apr – 15th June)
- Manufacturing of top dome assembly (activity 3) = 10 weeks (1st May – 15th July)
- Target delivery of heaters + thermometers by CERN (activity 7) (1st May – 15th July)
- Manufacturing of mid-section assembly (activity 7) = 12 weeks (1st May – 31st July)
- Manufacturing of top dome/flange + mid-section assembly (activity 12) = 2 weeks (15th July – 31st July)
- Manufacturing of DFX vertical (activity 14) = 2 weeks (15th Sept – 30th Sept)
- Target delivery of IFS by CERN (activity 21) = (1st July – 15th July)
- Manufacturing of cold horizontal IFS section (activity 21) = 14 weeks (15th June – 30th Sept)
- Manufacturing of VV horizontal IFS section (activity 22) = 8 weeks (1st July – 15th July)
- Manufacturing of cold + VV horizontal IFS section (activity 29) = 2 week (1st Sept – 15th Sept)
- Manufacturing of horizontal sub-assemblies to DFX vertical (activities 25-31) = 4 weeks (1st Oct – 31st Oct)
- DFX full assembly pressure testing = (activity 32) 2 weeks (15th Nov – 30th Nov)

Resource



Appendix