MCBXF series production tendering

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On behalf of MCBXF CERN-CIEMAT Collaboration

Series production Kick-off Meeting, 23rd April 2021

Tendering: main guidelines

- **Funding** is provided by CERN, CDTI and CIEMAT.
- Tendering has been done in four months: we thank warmly the support from CIEMAT procurement department and CDTI.
- Contract has been awarded to **Elytt Energy**. It was signed by March 15th.
- Scope: delivery of 6 long (A) and 11 short (B) MCBXF magnets.
- Technical specification has been agreed with CERN.
- Acceptance criteria has been agreed with CERN.
- Manufacturing and inspection plan has been agreed with CERN: quality documentation, tests and hold points.
- Quality documentation will guarantee traceability. It will be uploaded at CERN servers: MTF and EDMS. Templates have been agreed with CERN.
- Drawings will be stored at EDMS (CERN), both of prototypes, series magnets and tooling (about 2000 drawings).

Parts exchange

- CERN will supply the insulated superconducting cable, the steel for the collars, the iron for the yokes, the keys for the outer dipole collars and the instrumentation of the collars.
- CERN will supply the warm magnetic measurement bench and training.
- CERN will take care of powering tests (at SM18 or FREIA).
- CIEMAT will supply the copper wedges, the end spacers and the collars (fine blanking).
- CIEMAT will make a new Call for Tender for the supply of the end spacers. It is the only pending large contract (not in the critical path).

Manufacturing and Inspection Plan

- A complete manufacturing and inspection plan is included in the technical specifications, both for the coils and for the magnet assembly.

No	ACTIVITY / OPÉRATION	APPL. STANDARDS / NORMES APPL.	APPLICABLE DOCUMENTS / DOCUMENTS APPLICABLES	REV. DOC.	INSPECTION / CONTRÔLE								NOTES / COMMENTAIRES / REPORTS
					EXECUTING ENTITY		SUPPLIER		CLIENT		3RD PARTY / SURVEILLANCE		
					Code	Signature/Date	Code	Signature/Date	Code	Signature/Date	Code	Signature/Date	
B.3	Preparation of the components		Components Traceability		N		N						Upload to EDMS *Components Traceability & Dimensional Control Reports*
C	**INNER LAYER WINDING**												
C.0	Green light to start the winding of the inner layer		Winding procedure		IH		N						
C.1	Winding of the inner layer		Winding procedure		N		H						Upload to EDMS *Winding Monitoring File* (excel)
C.2	Curing of the inner layer (including gaps filling with fiberglass)		Binding procedure		N		N						Upload to EDMS a report including: Coil Length before and after curing, mould closing gaps, thermal curing cycle, last turn profile
C.3	Electrical measurements		Binding procedure		N		N						Upload to EDMS the *Electrical Measurements Report*

Quality control: templates

- A set of templates must be filled as quality assurance: winding report, thermal cycles, electrical measurements…

Winding Monitoring Report

MCBXFB Coil number:	ICBS02 (Outer Layer)
Cable ID:	T01EC0261B
Winding direction:	Favorable
Spacers Code/Batch:	
Technicians:	
Date:	

	Spacers (nominal)	Spacers (real)	Wedge (nom. +0,1/+0,3)	Wedge (real)	Wedge w/fiberglass (real)	Fiberglass code	Filler NCS	Filler CS
03 (LJ)	798.00	797.70	**796.50**	796.70	797.55		-	-
04 (NLJ)	798.00	797.70	**796.50**	796.70	797.50		-	-
05 (LJ)	772.00	773.10	**770.50**	770.65	771.30		-	-
05 (NLJ)	772.00	772.30	**770.50**	770.65	771.30		-	-
06 (LJ)	784.00	787.80	**782.50**	782.70	783.28		1x1mm + 1x0,5mm	1x1mm + 1x0,2mm
06 (NLJ)	784.00	786.80	**782.50**	782.70	783.46		1x0,5mm	1x1mm

OUTER LAYER - NON-CONECTION SIDE (OL/NCS) — *Cumulative (positive: coil too long, negative: coil too short)* — OUTER LAYER - CONECTION SIDE (OL/CS)

NCS		Key distance <-> Mandrel end (227 mm)		Measuring gauge thickness		Total Turns Z	Nominal Dimension of the cable/spacer	abs error	Cable diff.	CS		Key distance <-> Mandrel end (227 mm)		Measuring gauge thickness		Total Turns Z	Nominal Dimension of the cable/spacer	abs error
Tension (kg)	Gain	Nominal Lower edge (Roxie Ref. Sys.)	Nominal Lower edge (MANDREL Ref.	Measured Lower edge (Z)	NCS					Tension (kg)	Gain	Nominal Lower edge (Roxie Ref. Sys.)	Nominal Lower edge (MANDREL Ref.	Measured Lower edge (Z)	CS			
		738.700675	261.299325	261.85	*1st SP*	1st SP	N/A	-0.550675	N/A			138.704675	261.295325	261.84	*1st SP*	1st SP	N/A	-0.544675
		739.662057	260.337943	260.25	Turn 1	2	0.961382	0.087943	0.638618	4,5 kg		139.666057	260.33394	260.71	Turn 1	2	0.961382	-0.376057
		740.946266	259.053734	259.36	Turn 2		1.284209	-0.306266	-0.394209			140.950605	259.049395	259.48	Turn 2		1.284548	-0.430605
		751.051093	248.948907	249.32	*2nd SP*		10.104827	-0.371093	-0.064827			151.055093	248.944907	249.23	*2nd SP*		10.104488	-0.285093
		752.089799	247.910201	248.15	Turn 3	2nd SP	1.038706	-0.239799	0.131294			152.093799	247.906201	248.04	Turn 3	2nd SP	1.038706	-0.133799
		753.277269	246.722731	247.01	Turn 4		1.18747	-0.287269	-0.04747			153.281269	246.718731	246.87	Turn 4		1.18747	-0.151269
		754.456537	245.543463	245.88	Turn 5		1.179268	-0.336537	-0.049268			154.460537	245.539463	245.69	Turn 5		1.179268	-0.150537
		755.628140	244.37186	244.75	Turn 6		1.171603	-0.37814	-0.041603			155.632140	244.36786	244.59	Turn 6		1.171603	-0.22214
		756.792601	243.207399	243.59	Turn 7		1.164461	-0.382601	-0.004461			156.796601	243.203399	243.41	Turn 7		1.164461	-0.206601
		757.950430	242.04957	242.50	Turn 8	11	1.157829	-0.45043	-0.067829	4,17kg		157.954430	242.04557	242.23	Turn 8	11	1.157829	-0.18443
		759.102121	240.897879	241.30	Turn 9		1.151691	-0.402121	0.048309			159.106121	240.893879	241.08	Turn 9		1.151691	-0.186121
		760.248159	239.751841	240.14	Turn 10		1.146038	-0.388159	0.013962			160.252159	239.747841	239.99	Turn 10		1.146038	-0.242159
		761.389019	238.610981	238.95	Turn 11		1.14086	-0.339019	0.04914			161.393019	238.606981	238.81	Turn 11		1.14086	-0.203019
		762.525166	237.474834	237.79	Turn 12		1.136147	-0.315166	0.023853			162.529166	237.470834	237.60	Turn 12		1.136147	-0.129166
		763.657054	236.342946	236.61	Turn 13		1.131888	-0.267054	0.048112			163.661054	236.338946	236.40	Turn 13		1.131888	-0.061054
		799.794882	200.205118	200.70	*3rd SP*	3rd SP	36.137828	-0.494882	-0.227828			180.827920	219.17208	219.71	*3rd SP A*	3rd SP A	17.166866	-0.53792
		800.787016	199.212984	199.50	Turn 14		0.992134	-0.287016	0.207866			181.844619	218.155381	218.63	Turn 14	1	1.016699	-0.474619
		802.031140	197.96886	198.28	Turn 15		1.244124	-0.31114	-0.024124			199.793882	200.206118	200.75	*3rd SP B*		17.949263	-0.543882
		803.263701	196.736299	197.10	Turn 16		1.232561	-0.363701	-0.052561			200.786016	199.213984	199.62	Turn 15		0.992134	-0.406016

Quality control: traceability and documentation

- Documentation to guarantee traceability and quality control will be stored at CERN servers (MTF, EDMS).

Equipment Folder : Main Info

Equipment Identifier: **HCMCBXFB001-E9000014**
Other Identifier: **MCBXFBP1d**
Description: **Dipole Orbit Corrector Q2**

Main | Made of | Equipment data | Manufacturing | Operation | Documents | History | Map

Actions : Edit | View summary

Physical

Manufacturer	CIEMAT
Resp. Technique	
Status	Manufacturing
Other Identifier	MCBXFBP1d
Parent Equipment	
Parent Slot	
Location	927/R-001
State	Good

MRC HL-WP3-MCBXF

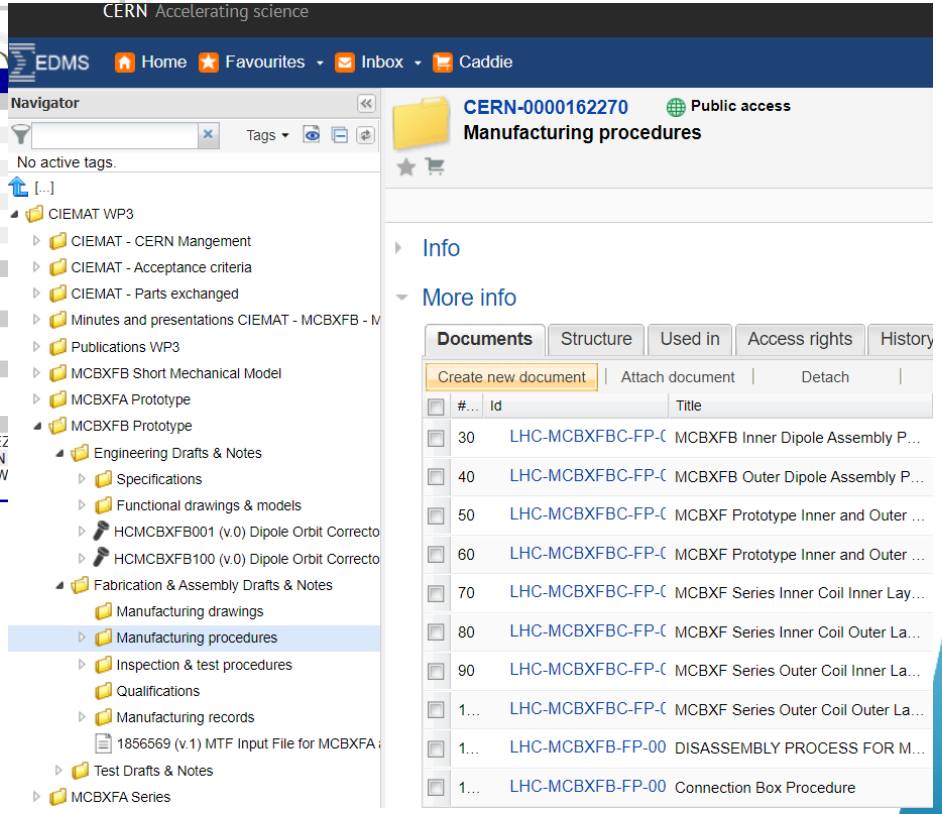
Safety
RP Classification

Comments
new shimming plan

Design
Item in ABS — Dipole Orbit Corrector Q2 PROTOTYPE 1 (ver.0)

Audit

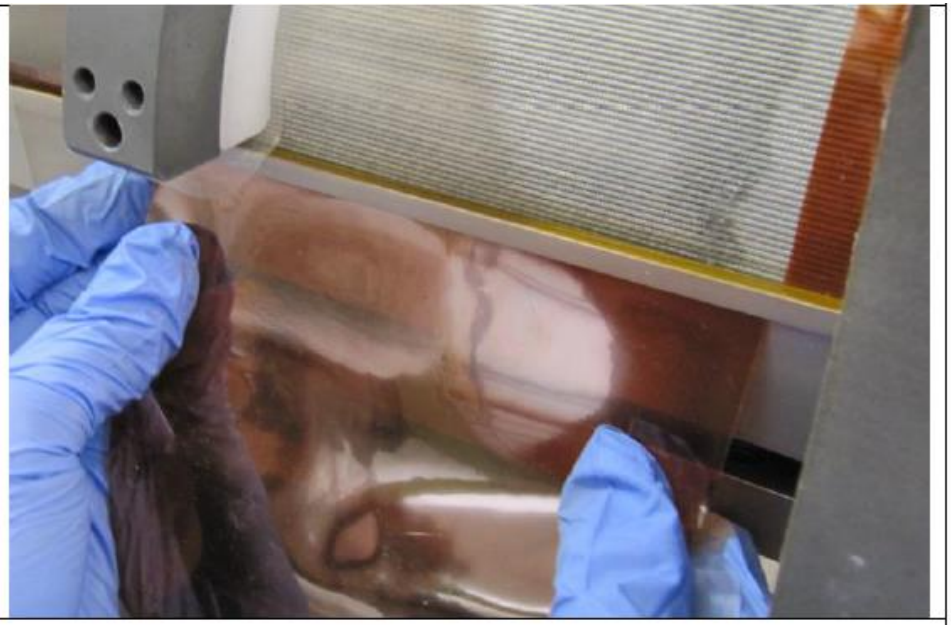
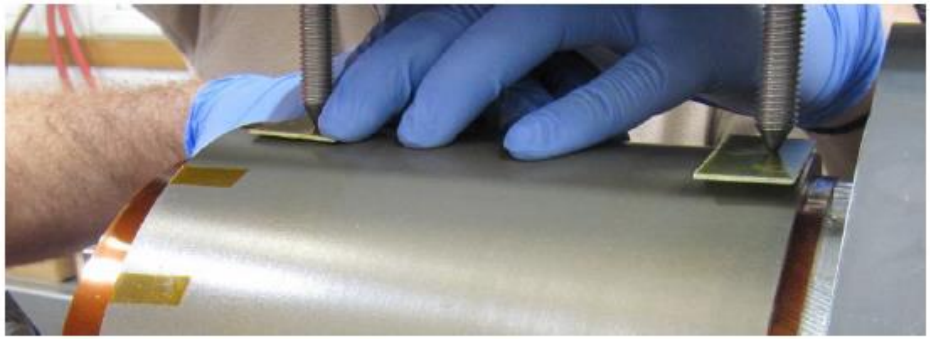
Created on	2019-07-16	by	RDIAZVEZ
Last modified on	2020-11-01	by	SMALLON
EDMS owner	RDIAZVEZ	EDMS group	HL-LHC-W



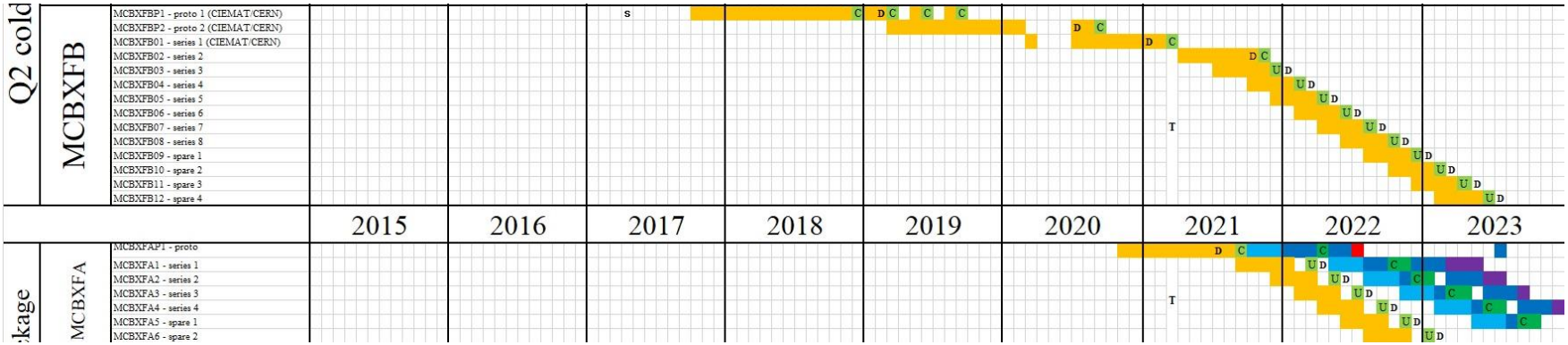
Technological transfer to industry

- An **Elytt engineer** was learning at CIEMAT during three months to prepare the offer.
- Some **Elytt technicians** have come to CIEMAT to be trained with the most delicate tasks, some of them specific for MCBXF magnets: binder, impregnation mould, assembly. They can participate in the assembly of MCBXFB01 at CERN (see J.C. Pérez talk).
- During the production of the first magnet at Elytt premises, one person from CIEMAT will be **always present** to guarantee the technological transfer.
- CIEMAT has prepared detailed **procedures** for each step of production: coil winding, binder, impregnation, assembly, parts production (ground insulation, collar packages, collaring shoes). They are uploaded to EDMS.
- There are thousands of **photos** to help know-how transfer.
- We are supporting Elytt to contact suppliers for components, tooling and materials.

Procedures: example

3.21	- Present the mid-end protection sheet (1605-16-21) to check if it fits between the end and the central protection sheets (1.5 mm gap at both sides is desirable). If it does not fit, check the NCS outer layer spacer position. If it is fine, cut a few mm of the mid-end protection sheet length.	
3.22	- Once it fits, press the spacer against the coil. Use G10 martirs and the clamping threaded studs to this end. Place one of the martirs at the inner edge of the spacer and the other just where the coil end cables reach, as showed in the picture.	

Schedule



- Schedule is very tight for the production of the first magnets: real work has already started!
- A decision needs to be made on inner dipole coil length after the powering test of MCBXFB01.

Organization to follow-up the contract

CIEMAT

- Task leader: Fernando Toral
- Contract responsible: Carla Martins
- Fabrication follow-up: Oscar Duran
- Quality control and documentation follow-up: Teresa Martínez
- Magnetic measurement support: Luis González

CERN

- HL-LHC project leader: Oliver Bruning
- HL-LHC WP3 (magnets) leader: Ezio Todesco
- Project engineer: Juan Carlos Pérez

Conclusions

- MCBXF series magnet contract has been awarded to Elytt Energy on March 15th.
- Technical specification, acceptance criteria and MIP have been agreed with CERN.
- Technological transfer from CIEMAT to Elytt Energy is being done.
- Schedule for the delivery of the first magnets is very tight: real work has already started!

Thanks for your attention