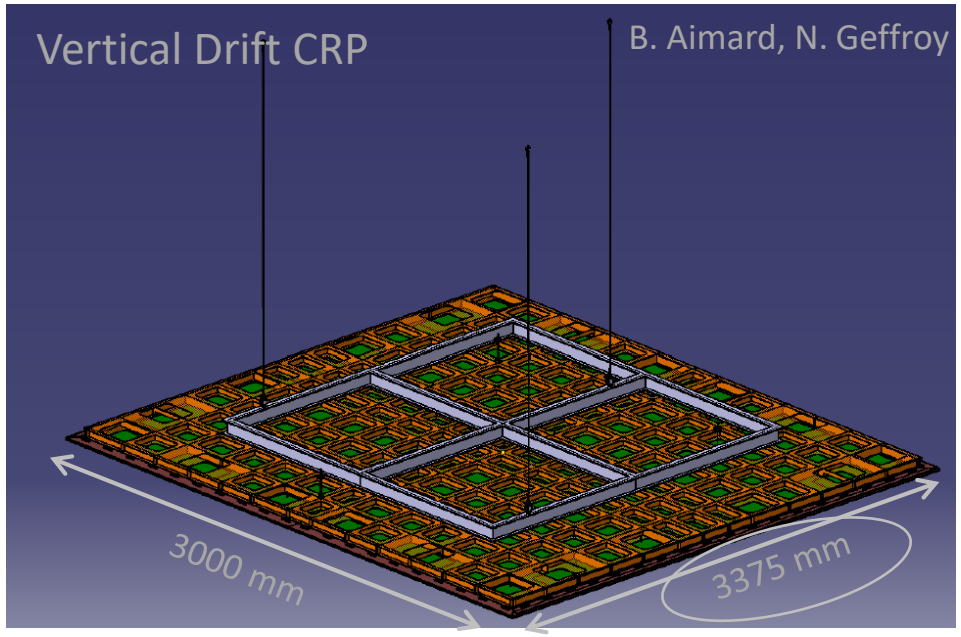
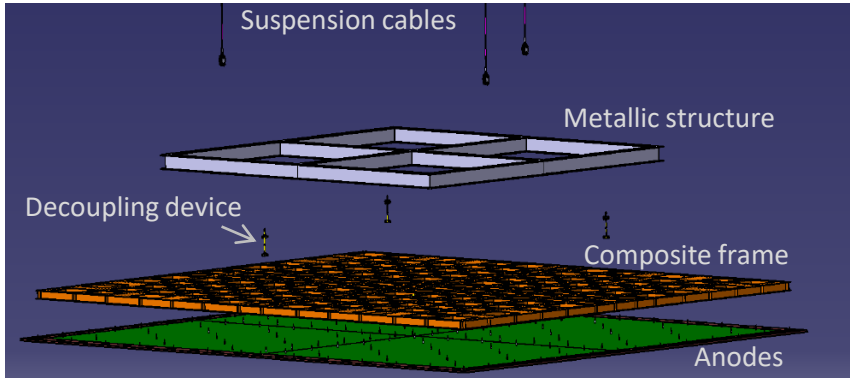
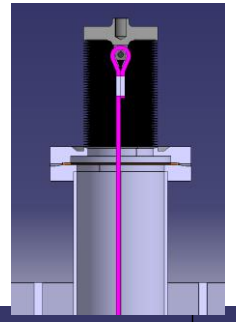
CRP consortium meeting: 17/03/2021

- Status of activities for preparing CRP of cold box tests
- Far Detector WBS
- Status of anode design and options for connecting the PCBs

Vertical Drift CRP for test in cold box



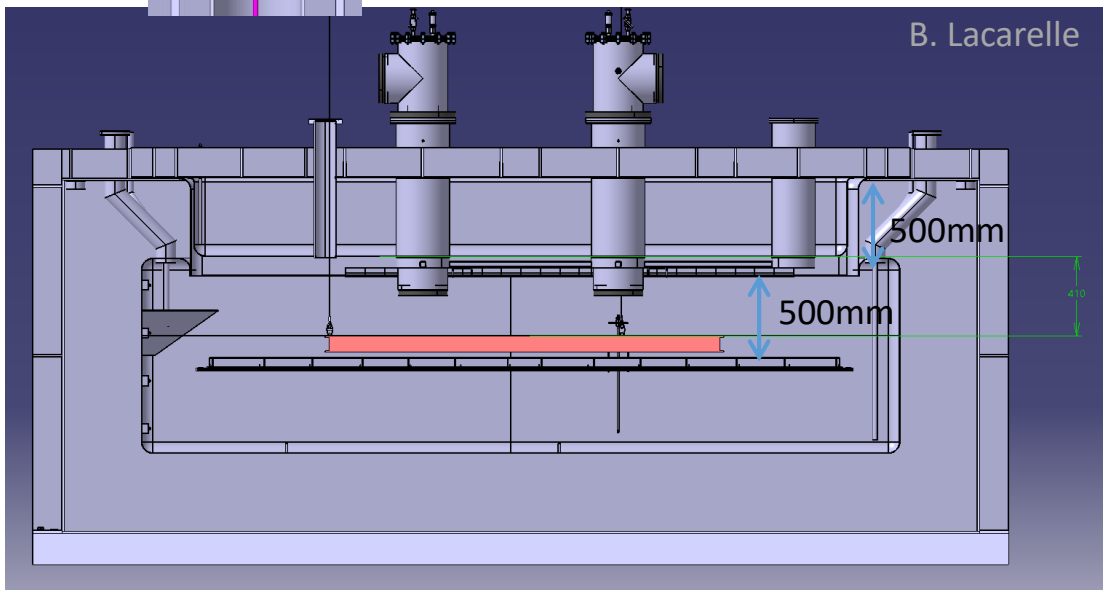


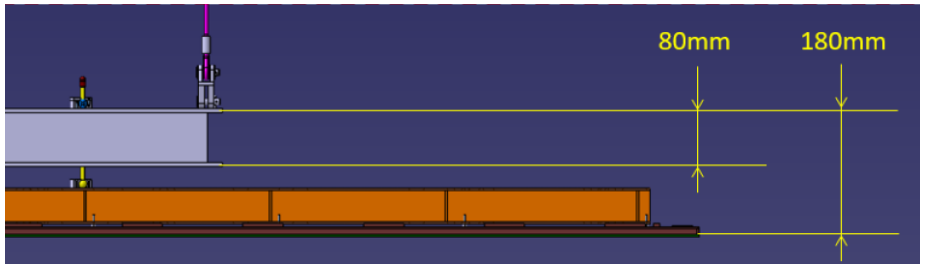


Keep original suspension system with 40mm bellows

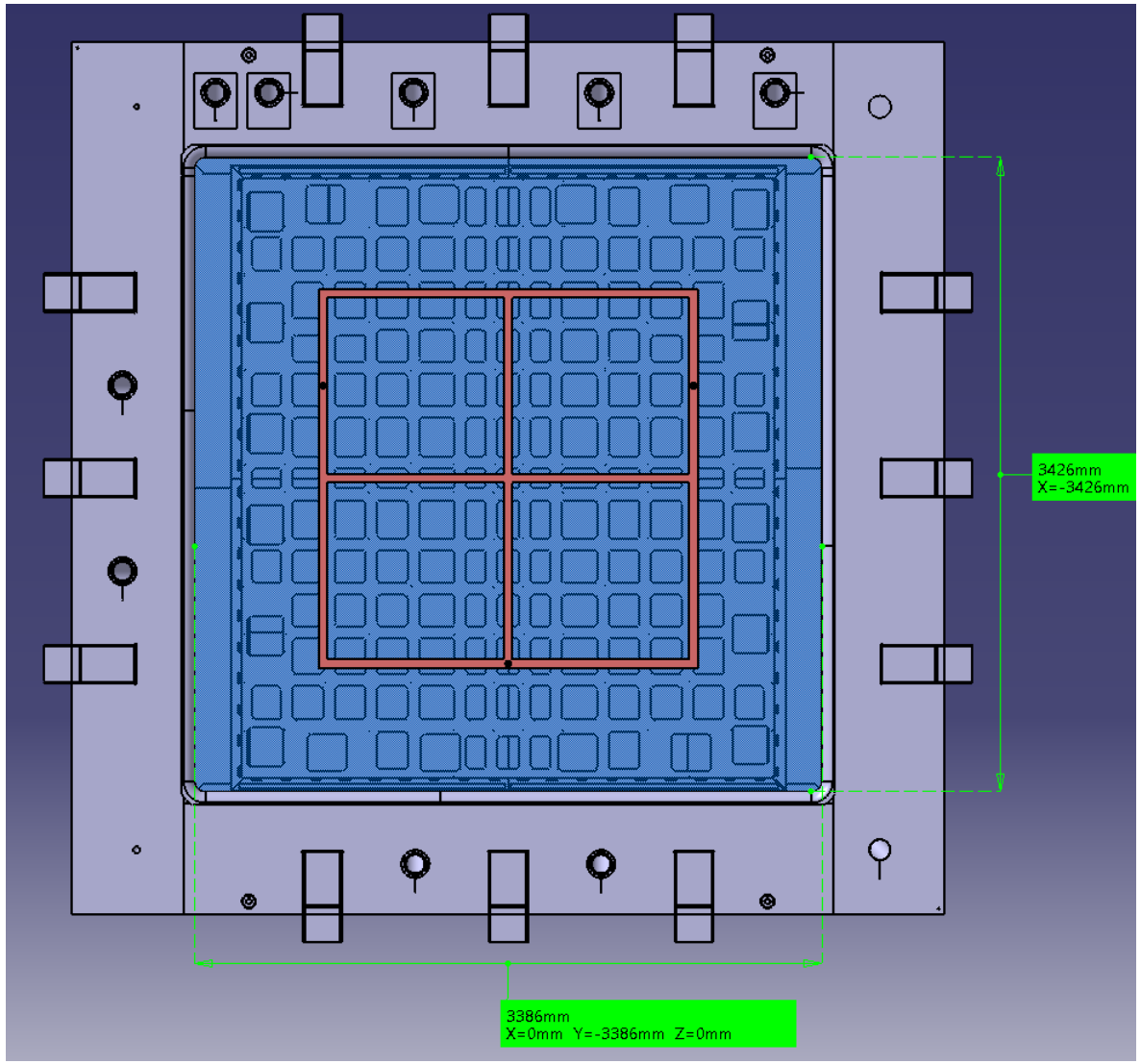
The opening of the cold box is being increased to allow vertical insertion of the CRP with no need to have an inclination of the structures

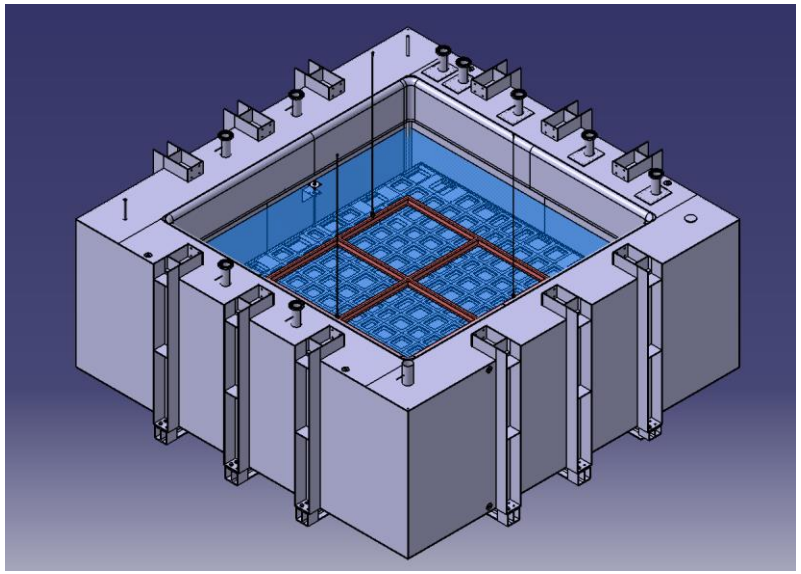
Some optimisation going on to complete with the udpated cold box model





Vertical Drift CRP for test in cold box





Goal :

centre the 3373 x 2998 mm² CRP
wrt CB opening

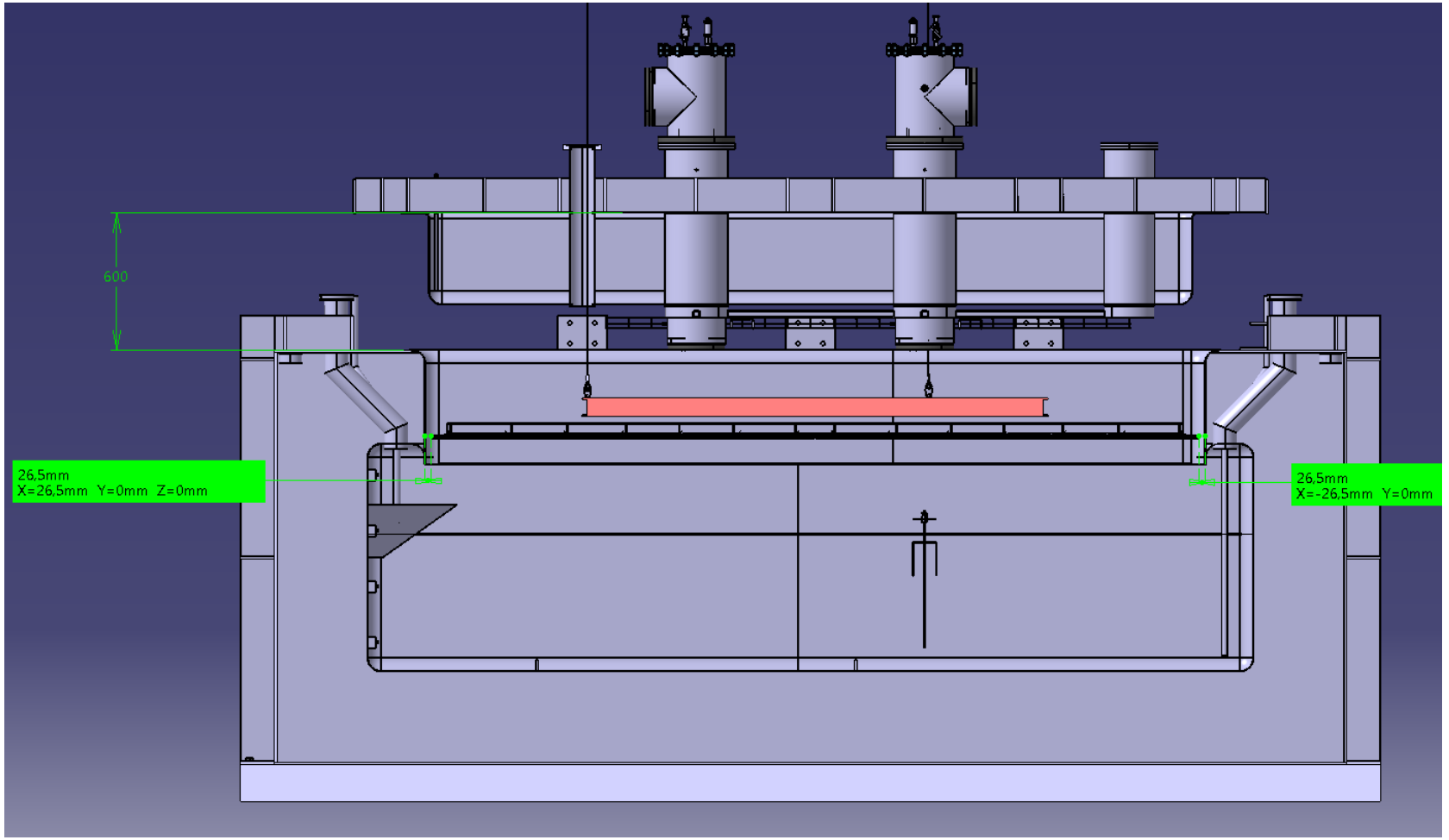
will lead to:

- 26,5mm clearance / length (3373mm)
- 194mm clearance / width (2998mm)

Vertical Drift CRP for test in cold box

3373 x 2998 mm² CRP centered wrt CB opening

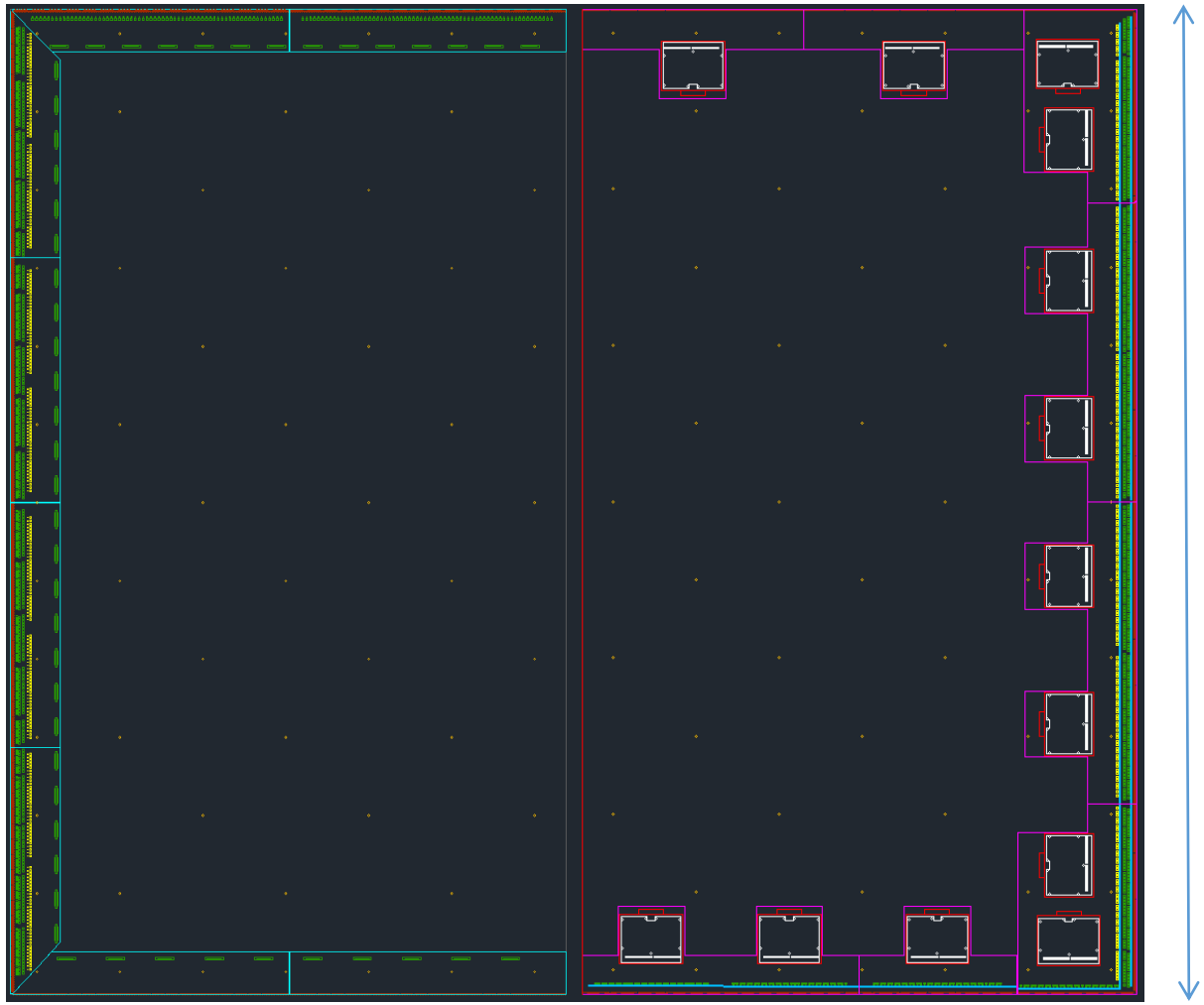
During insertion



- 26,5mm clearances / length (3373mm)

Design for the support structure

Final hole pattern « support » layer = 58 holes



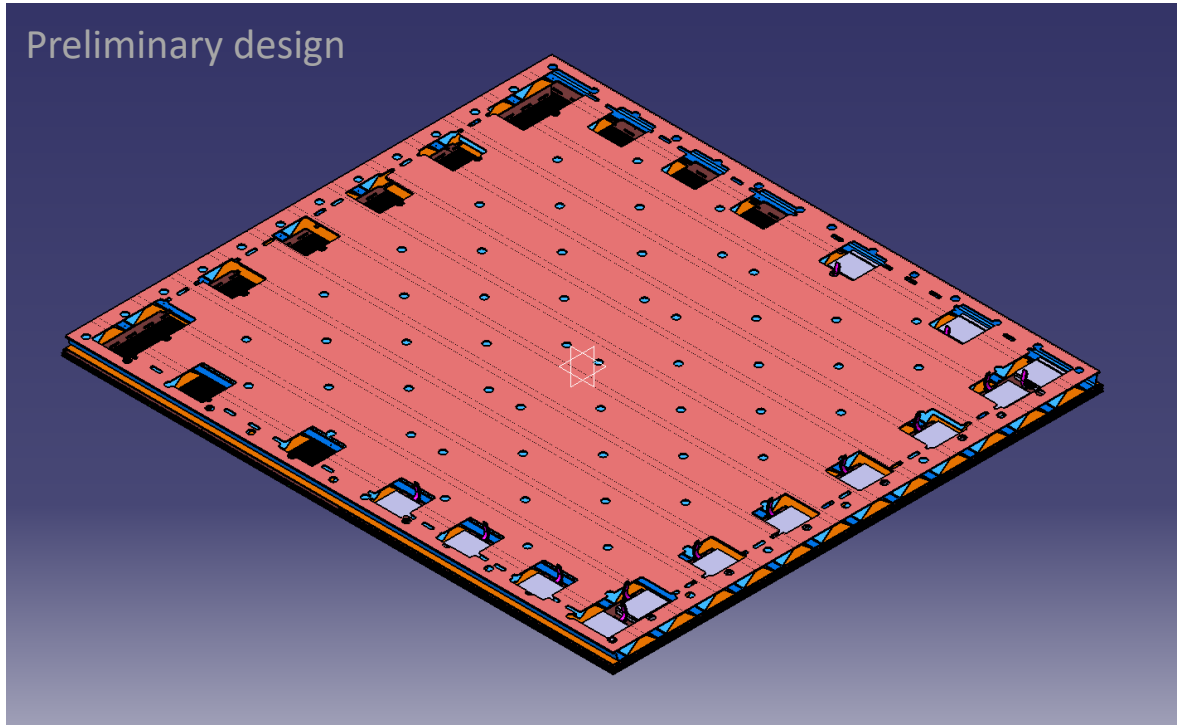
Hybrid structure:

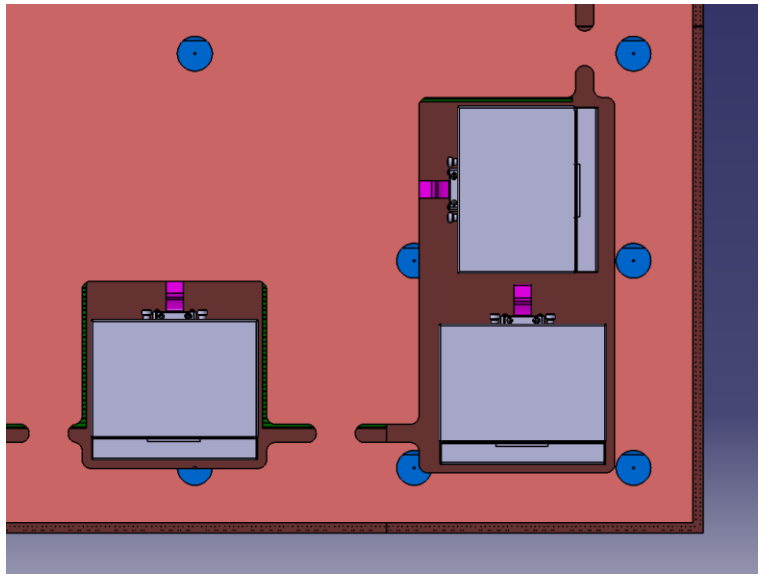
the same structure useable for both electronics (individually or mixed)

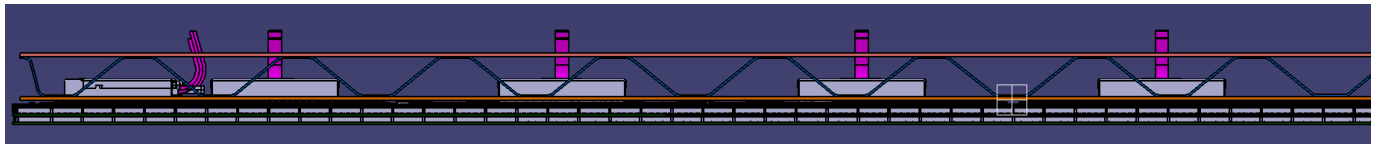
=> Openings along the sides of the frame to allow CE module connection and the connectors for top electronics

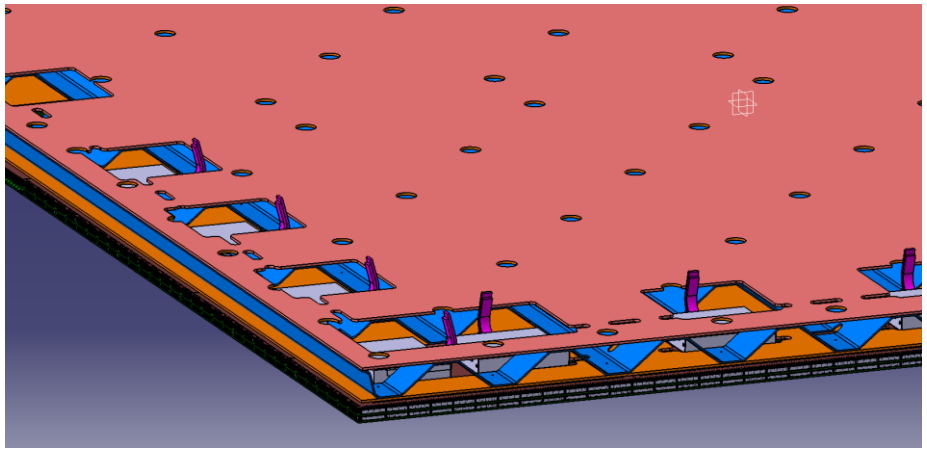
Mechanical structure: design at LAPP ongoing

Based on the 3D CAD model of the anode, adapter boards and CE box distributed last week (March 9th)









next steps :

- Deformation modelisation with all component weight and positions
- Optimise additional opening depending on the results
- Confirm the CTE of the foreseen material compatible with anode material

Dedicated discussion and meetings will be done in the coming weeks

CRP support frame design steps:

- Anode support hole pattern defined and frozen 3/03/21
- Support frame + anode material CTE measurements at Cryolab ongoing: expect results by 15/03/21
- Integration of 3D model of anode + adapter Boards + CE box (on going)
- Mechanical simulation to be done with the proper weight and component distribution

The 3D models for the CE FEMB and Boxes: use the ProtoDUNE-SP version for the time being.

CRU assembly (before the CRP assembly)

Discussion ongoing to understand how to manipulate the large PCB anodes and the needs for tooling.

=> depending on this discussion toolings may have to be designed

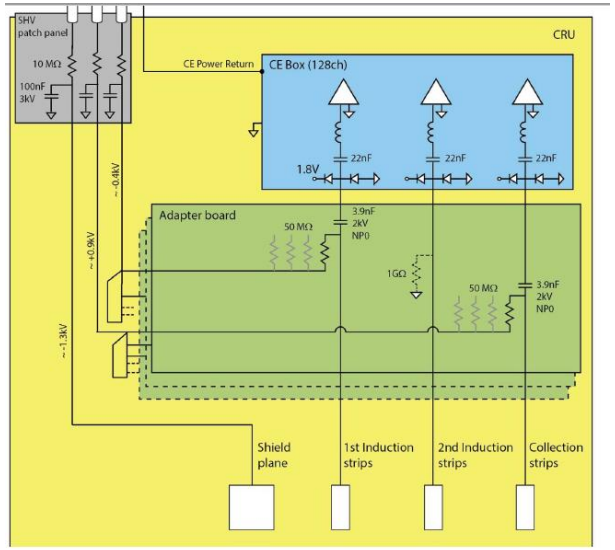
Points under study:

- Connector type, positioning and soldering (next item on the agenda)
- Anode manipulation during the CRU assembly

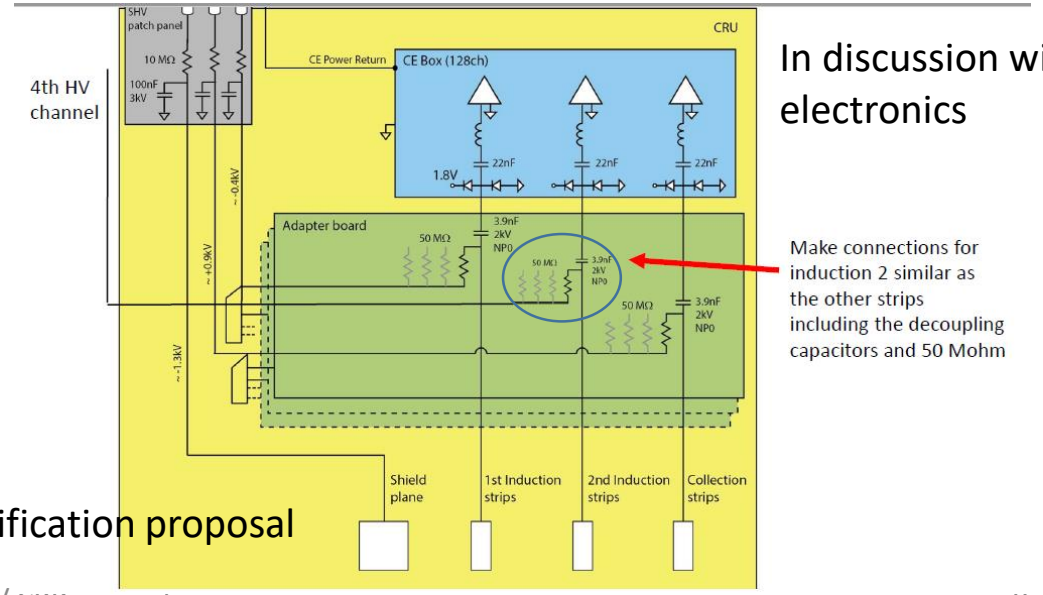
Adapter boards for the top electronics

After discussion last week it appears that some modifications are needed to treat identically induction 2 as for the 2 other strip directions.

Original schema



Modification proposal



In discussion with the top electronics

Make connections for induction 2 similar as the other strips including the decoupling capacitors and 50 Mohm

Task list and schedule for each main item:

Work started in order to go into the details and timing

- Anodes and CRUs (BNL, CERN)
- Top electronics interface (KEK, Lyon, BNL, CERN)
- Bottom electronics (BNL, FNAL, CERN)
- CRP structure components (LAPP)
- CRP assembly (from assembled CRUs to CRP) (LAPP, ...)
- CRP transport box design and production (LAPP)
- CRP transport box design and production (LAPP)
- CRP instrumentation (LPSC, CERN, ...)

Terminology

- PCB anode subpanel: perforated PCB unit produced by the company 1.7m x0.5m
- CRU layer: PCB anode layer made of 6 subpanels glued together = 1.7m x 3m
- The anode PCB with shield and induction#1 strips is called « shield layer »
- The anode PCB with induction#2 and collection strips is called « collection layer »
- a CRU is made of 1 shield layer + 1 collection layer + adapter boards

Task list for first CRP production for cold box test:

==========
Anode and CRUs (BNL, CERN)
==========

Anodes (perforated)
- design and gerber file - week of March 15
- PCB procurement - week of March 22
- PCB anode production - 6 weeks from the time of placing the order. mid April - beginning of June
- anode reception - beginning-mid of June

Connecting devices (to link the 2 PCB layers called 'shield' and 'collection' and connect the adapter boards)
- procurement - - April-May

PCB Manipulation tooling (depends on connection and assembly technics procedure)
- design - April?
- part procurement - April-May?
- reception and assembly - June?

==========
Anode and CRUs (BNL, CERN) PART 2
==========

CRU#1 shield layer
- gluing from 6 subpanels - 1 day/gluing and drying - 1 week total
- Silver connection painting - 1 day for painting and drying. 1 week total (try to parellelize with gluing) - 1 week additional in conservative estimation if we cannot parallelize with gluing
- Connector installation and soldering (depends on technical choices) - if pogo pins --> may be automated?. If manual soldering -> meeting with CERN electronics assembly workshop supervisor to know more
- Electrical test - 1-2 days

(for silver paint: assume polymerization at room temperature)

-- Dates: start mid June, finalize end of June

Manual soldering of connectors: for the 4 CRUs is 1 week

CRU#2 shield layer
- gluing from 3 subpanels - same as above
- Silver connection painting - same as above
- Connector installation and soldering (depends on technical choices) - same as above
- Electrical test - same as above

-- Dates: start beginning of July, finalize mid of July

==========
Anode and CRUs (BNL, CERN) PART 3
==========

CRU#1 collection layer
- gluing from 3 subpanels - same as above
- Silver connection painting (assume polymerization at room temperature) - same as above
- Connector installation and soldering (depends on technical choices) - same as above
- Electrical test - more channels here. 1 week of testing (induction-2 + collection)

-- Dates: assume we'll get faster with gluing and painting. Then the gained time can be used for testing.
Start mid July, finalize end of July

CRU#2 collection layer
- gluing from 3 subpanels - same as above
- Silver connection painting (assume polymerization at room temperature) - same as above
- Connector installation and soldering (depends on technical choices) - same as above
- Electrical test - 1 week

-- Dates: assume we'll get faster with gluing and painting. Then the gained time can be used for testing.
Start begining of August, finalize mid of August

==========
Anode and CRUs (BNL, CERN) PART 4
==========

CRU#1 (made of 2 PCB anode layers + adapter boards)
- mechanical assembly and connection of both layers - This is a handling process where we need to bring the two units together to attach them. Manipulating them precisely - 1-2 days. (If we need to install spacers or something like that for the CRP mechanical structure it may take 1-2 more days.)
- installation of adapter boards - 1-2 days
- control test - 1-2 days (warm noise/functionality test with electronics)
?? cold test?? – should we plan some test?

-- Dates: 1 week from mid August

CRU#2 (made of 2 PCB anode layers + adapter boards)
- mechanical assembly and connection of both layers - same as CRU#1
- installation of adapter boards - same as CRU#1
- control test - same as CRU#1
??cold-test?? - should we plan some test?

-- Dates: 1 week at the end of August

Task list for first CRP production for coldbox test:

==========

Top Electronics interface (KEK, BNL, CERN)

==========

- connector procurement
- adapter boards
  - -design
  - -part procurement (PCB + resistors + capacitors)
  - -fabrication (including connector soldering)

==========

Bottom Electronics (FNAL, BNL, CERN)

==========

- adapter boards
  - -design
  - -part procurement (PCB + resistors + capacitors)
  - -fabrication

-CE FEMB
-Power and data cables
- CE boxes
  - design
  - procurement

==========

CRP structure components (LAPP)

==========

CRP composite support structure
- material characterisation (CTE) by mid March
- concept drawing (composite vs PCB assembly) by mid March
- design (beginning of April)
- procurement (end of April)
- production (6 weeks=> mid June)

CRP metallic frame
- design (April)
- procurement (mid April)
- production (5 weeks => end of May)

CRP decoupling system
- design (mid April)
- prototype and test (end of April)
- procurement (mid May)
- production (?)

CRP suspension feedthroughs (use same below and flange as previous cold box tests)
- manual winch system design
- procurement
- production

==========

CRP transport box (LAPP, ...) (could be based on additional elements to the existing metallic frame)

==========

CRP transport box
- design
- part procurement
- assembly
- (Manutention test?)

==========

CRP instrumentation (LPSC, CERN, ...)

==========

Sensor
- design
- part procurement (sensor + Read Out electronics + cables)
- ....

==========

CRP assembly (from assembled CRUs to CRP) (LAPP, ...)

==========

CRP mounting procedure definition

CRP mounting tooling
- design
- part procurement
- reception and assembly

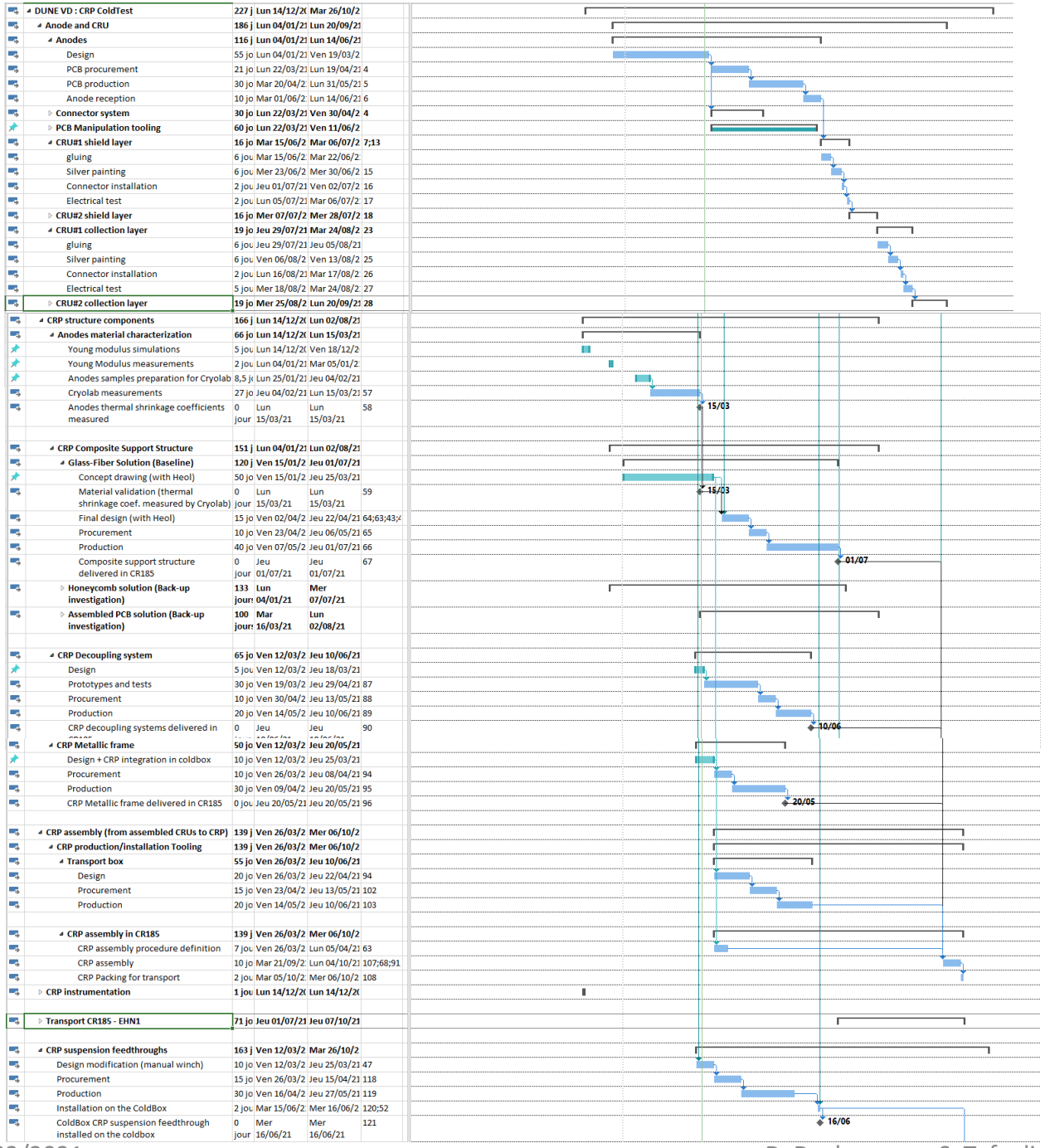
Metallic frame attachment

CRU attachment to support frame

CE module cable routing

Instrumentation (Pt/level meter..) installation and cabling

All this assembly planning has to be defined;
It depends strongly on some technical choices of anodes and CRU assembly



DUNE VD : CRP ColdTest	227 j	Lun 14/12/2(	Mar 26/10/2	
Anode and CRU	186 j	Lun 04/01/21	Lun 20/09/21	
Anodes	116 j	Lun 04/01/21	Lun 14/06/21	
Design	55 jo	Lun 04/01/21	Ven 19/03/2	
PCB procurement	21 jo	Lun 22/03/21	Lun 19/04/21	4
PCB production	30 jo	Mar 20/04/2	Lun 31/05/21	5
Anode reception	10 jo	Mar 01/06/2	Lun 14/06/21	6
Connector system	30 jo	Lun 22/03/21	Ven 30/04/2	4
PCB Manipulation tooling	60 jo	Lun 22/03/21	Ven 11/06/2	
CRU#1 shield layer	16 jo	Mar 15/06/2	Mar 06/07/2	7;13
gluing	6 jou	Mar 15/06/2	Mar 22/06/2	
Silver painting	6 jou	Mer 23/06/2	Mer 30/06/2	15
Connector installation	2 jou	Jeu 01/07/21	Ven 02/07/2	16
Electrical test	2 jou	Lun 05/07/21	Mar 06/07/2	17
CRU#2 shield layer	16 jo	Mer 07/07/2	Mer 28/07/2	18
CRU#1 collection layer	19 jo	Jeu 29/07/21	Mar 24/08/2	23
gluing	6 jou	Jeu 29/07/21	Jeu 05/08/21	
Silver painting	6 jou	Ven 06/08/2	Ven 13/08/2	25
Connector installation	2 jou	Lun 16/08/21	Mar 17/08/2	26
Electrical test	5 jou	Mer 18/08/2	Mar 24/08/2	27
CRU#2 collection layer	19 jo	Mer 25/08/2	Lun 20/09/21	28
CRP structure components	166 j	Lun 14/12/2(	Lun 02/08/21	
Anodes material characterization	66 jo	Lun 14/12/2(	Lun 15/03/21	
Young modulus simulations	5 jou	Lun 14/12/2(	Ven 18/12/2	
Young Modulus measurements	2 jou	Lun 04/01/21	Mar 05/01/2	
Anodes samples preparation for Cryolab	8,5 j	Lun 25/01/21	Jeu 04/02/21	
Cryolab measurements	27 jo	Jeu 04/02/21	Lun 15/03/21	57
Anodes thermal shrinkage coefficients measured	0 jour	Lun 15/03/21	Lun 15/03/21	58
CRP Composite Support Structure	151 j	Lun 04/01/21	Lun 02/08/21	
Glass-Fiber Solution (Baseline)	120 j	Ven 15/01/2	Jeu 01/07/21	
Concept drawing (with Heol)	50 jo	Ven 15/01/2	Jeu 25/03/21	
Material validation (thermal shrinkage coef. measured by Cryolab)	0 jour	Lun 15/03/21	Lun 15/03/21	59
Final design (with Heol)	15 jo	Ven 02/04/2	Jeu 22/04/21	64;63;43;4
Procurement	10 jo	Ven 23/04/2	Jeu 06/05/21	65
Production	40 jo	Ven 07/05/2	Jeu 01/07/21	66
Composite support structure delivered in CR185	0 jour	Jeu 01/07/21	Jeu 01/07/21	67
Honeycomb solution (Back-up investigation)	133 jour	Lun 04/01/21	Mer 07/07/21	
Assembled PCB solution (Back-up investigation)	100 jour	Mar 16/03/21	Lun 02/08/21	
CRP Decoupling system	65 jo	Ven 12/03/2	Jeu 10/06/21	
Design	5 jou	Ven 12/03/2	Jeu 18/03/21	
Prototypes and tests	30 jo	Ven 19/03/2	Jeu 29/04/21	87
Procurement	10 jo	Ven 30/04/2	Jeu 13/05/21	88
Production	20 jo	Ven 14/05/2	Jeu 10/06/21	89
CRP decoupling systems delivered in	0	Jeu	Jeu	90
CRP Metallic frame	50 jo	Ven 12/03/2	Jeu 20/05/21	
Design + CRP integration in coldbox	10 jo	Ven 12/03/2	Jeu 25/03/21	
Procurement	10 jo	Ven 26/03/2	Jeu 08/04/21	94
Production	30 jo	Ven 09/04/2	Jeu 20/05/21	95
CRP Metallic frame delivered in CR185	0 jou	Jeu 20/05/21	Jeu 20/05/21	96
CRP assembly (from assembled CRUs to CRP)	139 j	Ven 26/03/2	Mer 06/10/2	
CRP production/installation Tooling	139 j	Ven 26/03/2	Mer 06/10/2	
Transport box	55 jo	Ven 26/03/2	Jeu 10/06/21	
Design	20 jo	Ven 26/03/2	Jeu 22/04/21	94
Procurement	15 jo	Ven 23/04/2	Jeu 13/05/21	102
Production	20 jo	Ven 14/05/2	Jeu 10/06/21	103
CRP assembly in CR185	139 j	Ven 26/03/2	Mer 06/10/2	
CRP assembly procedure definition	7 jou	Ven 26/03/2	Lun 05/04/21	63
CRP assembly	10 jo	Mar 21/09/2	Lun 04/10/21	107;68;91
CRP Packing for transport	2 jou	Mar 05/10/2	Mer 06/10/2	108
CRP instrumentation	1 jou	Lun 14/12/2(	Lun 14/12/2(	
Transport CR185 - EHN1	71 jo	Jeu 01/07/21	Jeu 07/10/21	
CRP suspension feedthroughs	163 j	Ven 12/03/2	Mar 26/10/2	
Design modification (manual winch)	10 jo	Ven 12/03/2	Jeu 25/03/21	47
Procurement	15 jo	Ven 26/03/2	Jeu 15/04/21	118
Production	30 jo	Ven 16/04/2	Jeu 27/05/21	119
Installation on the ColdBox	2 jou	Mar 15/06/2	Mer 16/06/2	120;52
ColdBox CRP suspension feedthrough installed on the coldbox	0 jour	Mer 16/06/21	Mer 16/06/21	121

Task list for first CRP production for coldbox test:

First draft version of the detailed project schedule

Procedures are being refined

A preliminary version available by next week

In the mean time the WBS for the FD2 module is being developed: CRP and CRU are 2 elements

WBS Element #	WBS Element Name	Inst	Act ID	Activity Name	Simple Resource	Resources (Optional)	Labor	Non Labor	Currency	Predecessor ID	Notes	WBS Dictionary
131.02.04	Far Detector 2 (FD-2)											
131.02.04.01	FD-2 Project Management											Project Management costs for Far Detector-2 (FD-2) including M&S and travel costs for the project staff, incidental costs for reviews and project coordination.
131.02.04.02	FD-2 Charge Readout Units (CRU)											DOE, CERN and international partners: Design, prototyping, prototype testing of the PCB and adapter boards. The prototyping and design phases will be done in conjunction with US, CERN and international partners DOE: Procurement, assembly and shipment of bottom CRU to CRP assembly sites. The CRP assembly site is covered in a separate WBS. CERN, international partners: Procurement, assembly and shipment of the Top CRU to CRP assembly sites will be done in Europe.
131.02.04.02.01	CRU Management											
131.02.04.02.02	Anode PCBs											
131.02.04.02.02.01	Anode PCB design	DOE										spec and proc for connectors comes from here, then ship to CRP asly factory
			1	Anode PCB design	Scientist		100					
			2	Design validation	Scientist		40			1		
			3	gerber file preperation	Technician		20			2		
131.02.04.02.02.02	Anode PCB fabrication	DOE										
			1	collecting quotations and decide company	Scientist		40					
			2	placing the order	Scientist		10					
			3	fabrication of PCBs and drilling	M&S		4160	2000000				
131.02.04.02.02.03	Anode PCB gluing	CERN ++										
			1	gluing PCBs	Technician		640	60000				
			1	gluing PCBs	Technician		640	60000				
131.02.04.02.03	Interface cards top											
131.02.04.02.03.01	Interface cards top design	DOE										
			1	design	Scientist		40					
			2	validation	Scientist		20					
			3	gerber file preperation	Technician		10					
131.02.04.02.03.02	Interface cards top fabrication	DOE										
			1	interface card PCB production	M&S		XX					
131.02.04.02.03.03	Interface cards top assembly	CERN ++										
			1	component procurement	M&S		XX					
			2	component soldering	Technician		XX					
			2	component soldering	Technician		XX					
			3	quality checks	Scientist Uncosted - Generic Univ		40					
			3	quality checks	Scientist Uncosted - Generic Univ		40					
131.02.04.02.04	Interface cards bottom											
131.02.04.02.04.01	Interface cards bottom design	DOE										
			1	design	Scientist		40					
			2	validation	Scientist		20					
			3	gerber file preperation	Technician		10					
131.02.04.02.04.02	Interface cards bottom fabrication	DOE										
			1	interface card PCB production	M&S		XX					
131.02.04.02.04.03	Interface cards bottom assembly	DOE										
			1	component procurement	M&S		XX					
			2	component soldering	Technician		XX					
			2	component soldering	Technician		XX					
			3	quality checks	Scientist Uncosted - Generic Univ		40					
			3	quality checks	Scientist Uncosted - Generic Univ		40					
131.02.04.02.05	CRU top											
131.02.04.02.05.01	CRU Top assembly	CERN ++										
			1	preparing assembly area	Technician		200					
			2	preparing necessary handling devices and tools for assembly	Mechanical Engineer		200					
			2	preparing necessary handling devices and tools for assembly	Technician		200					
			3	Assemble 2 layers of PCB	Scientist		40					
			3	Assemble 2 layers of PCB	Technician		40					
			3	Assemble 2 layers of PCB	Scientist Uncosted - Generic Univ		40					
			4	Connecting interface boards to the Anode assembly	Scientist		40				1,2	
131.02.04.02.05.02	Ship to CRP top assembly sites	CERN ++									3	
			??	Preparation and building shipping container??								
			1	Preparation of CRU for shipping	Technician		20					
			2	Shippment	M&S							
131.02.04.02.06	CRU bottom											
131.02.04.02.06.01	CRU Bottom assembly	DOE										
			1	preparing assembly area	Technician		200					
			2	preparing necessary handling devices and tools for assembly	Mechanical Engineer		200					
			2	preparing necessary handling devices and tools for assembly	Technician		200					
			3	Assemble 2 layers of PCB	Scientist		40				1,2	
			3	Assemble 2 layers of PCB	Technician		40				1,2	
			3	Assemble 2 layers of PCB	Scientist Uncosted - Generic Univ		40				1,2	
			4	Connecting interface boards to the Anode assembly	Scientist		40				3	
131.02.04.02.06.02	Ship to CRP bottom assembly sites	DOE										
			1	Preparation of CRU for shipping	Technician		20					
			2	Shippment	M&S							
131.02.04.02.07	CRU teststands, CRU-CRP installation eqp. QC											
			1	Preparation of testing facility	Scientist		1000					
			1	Preparation of testing facility	Technician		1000					
			2	Procuring necessary hardware for test	Scientist		400					
			3	QC tests on the CRU units	Scientist		2000				1,2	
			3	QC tests on the CRU units	Scientist Uncosted - Generic Univ		2000				1,2	
131.02.04.03	FD-2 Charge Readout Plane (CRP)											
131.02.04.03.01	CRP Management											
131.02.04.03.02	Anode support structure frame top											
131.02.04.03.02.01	Design	IN2P3										
			1	Design of the composite frame	Mechanical Engineer		100					
			1	Design of the composite frame	Scientist		100					
			2	Material characteristation	Mechanical Engineer		10				1	
131.02.04.03.02.02	Part procurement	IN2P3										
			1	Do the tendering and decide	Mechanical Engineer		10					
			2	Place the order	Mechanical Engineer		10				1	
131.02.04.03.02.03	Assembly	IN2P3										
			1	Fabrication of the top CRP structure frame	M&S			800000	Eur			
131.02.04.03.02.04	Ship to CRP top assembly sites	IN2P3										
			1	prepare the transportation	Technician		10					
			2	Shipment	M&S		xxxxxx				1	
131.02.04.03.03	Anode support structure frame bottom											
131.02.04.03.03.01	Design	IN2P3										
			1	Design of the composite frame	Mechanical Engineer		100					
			1	Design of the composite frame	Scientist		100					
			2	Material characteristation	Mechanical Engineer		10				1	
131.02.04.03.03.02	Part procurement	IN2P3										

Dedicated meeting next Thursday to review the description of activities in the WBS