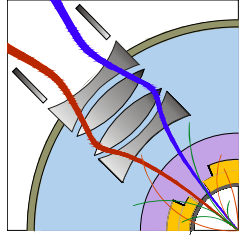


Technical agreement n 3
New SC Magnets activities

P. Fessia (G. De Rijk), D. Reynet, J.M Rifflet

EuCARD

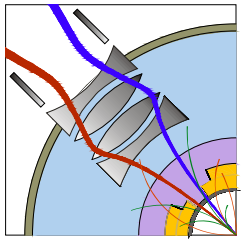
SLHC-PP 2008 • 2011 PREPARATORY PHASE
LARGE HADRON COLLIDER UPGRADE

CEA

CNRS

EuCARD

SLHC-PP 2008 • 2011 PREPARATORY PHASE
LARGE HADRON COLLIDER UPGRADE



SC HFM MAGNETS

CERN

LHC IR Upgrade - Phase I

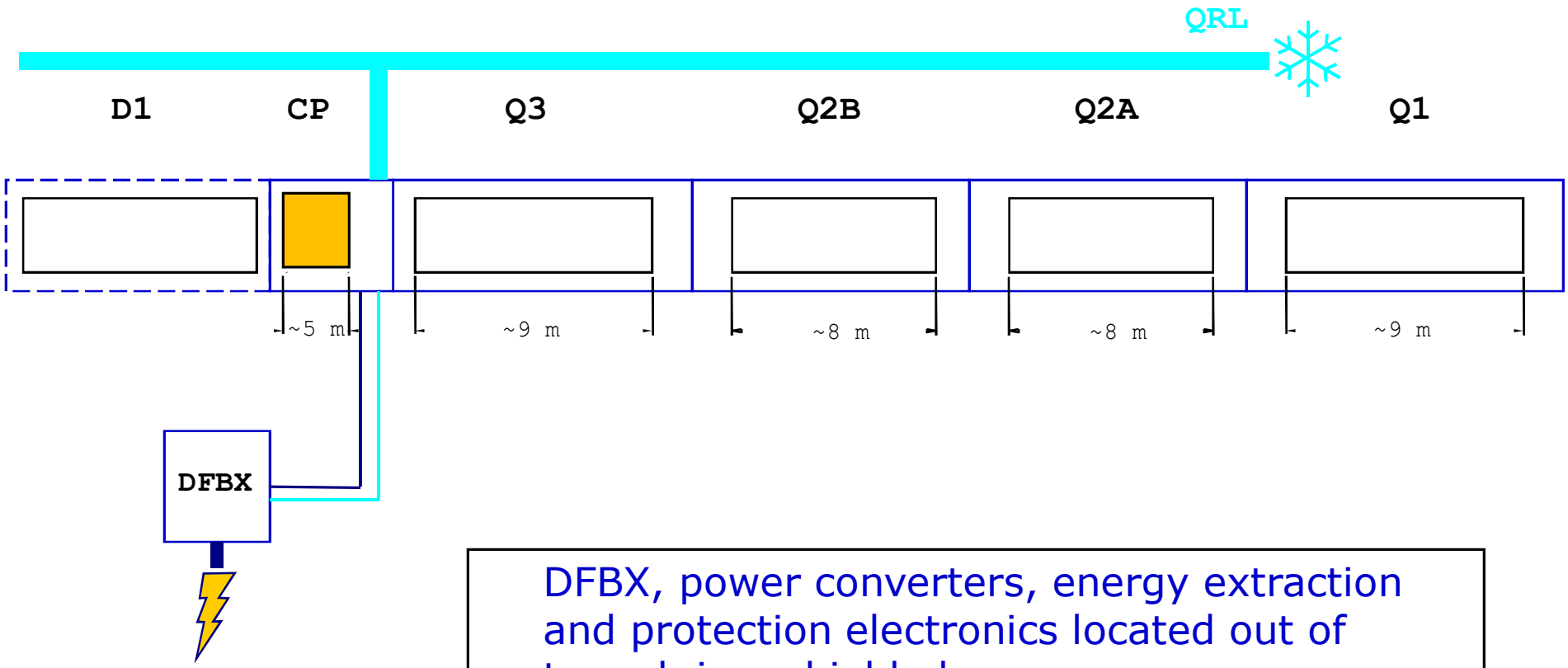
Goal of the upgrade:

Enable focusing of the beams to β^*=0.25 m in IP1 and IP5, and reliable operation of the LHC at 2 10^{34} $cm^{-2}s^{-1}$ on the horizon of the physics run in 2013.

Scope of the Project:

1. Upgrade of ATLAS and CMS interaction regions. The interfaces between the LHC and the experiments remain unchanged at $\pm$ 19 m.
2. Replace the present triplets with wide aperture quadrupoles based on the LHC dipole cables (Nb-Ti) cooled at 1.9 K.
3. Upgrade the D1 separation dipole, TAS and other beam-line equipment so as to be compatible with the inner triplet aperture.
4. The cooling capacity of the cryogenic system and other main infrastructure elements remain unchanged.
5. Modifications of other insertion magnets (e.g. D2-Q4) and introduction of other equipment in the IR to the extent of available resources.

A schematic layout



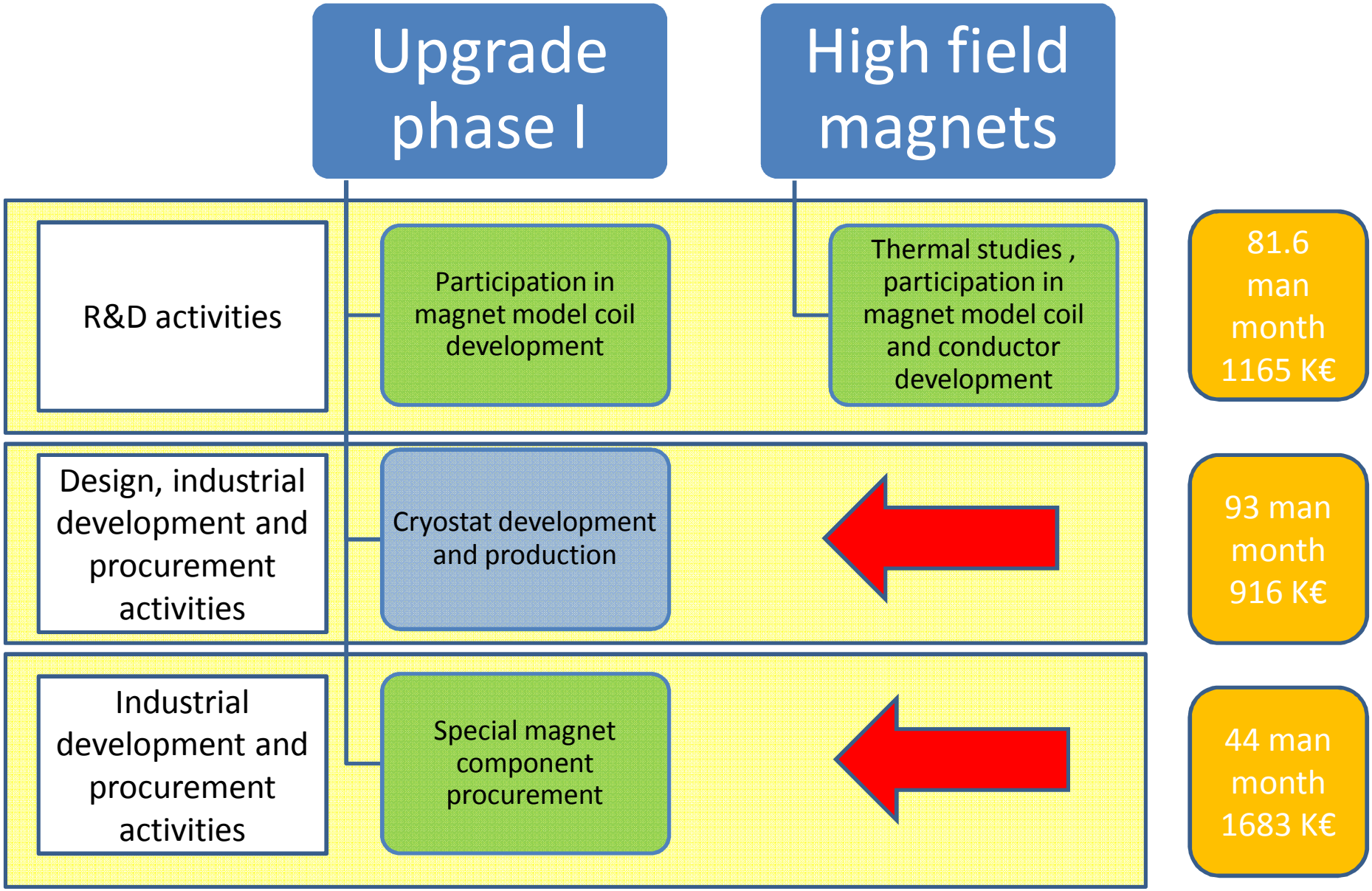
DFBX, power converters, energy extraction and protection electronics located out of tunnel, in a shielded area.

Quadrupoles powered in series at 11 kA.

All correctors powered at 600 A.

HFM the subjects covered:

- Thermal studies. High field accelerator magnets with Nb_3Sn coils need to have excellent heat removal properties to withstand the heat load induced by the particle flux originating from beam losses or the interaction points.
- Race track coils in Nb_3Sn. This is a first step to test out the Nb_3Sn coil technology before constructing larger and more costly coils.
- Coils for Fresca2 1.5 m model. To prepare for a Nb_3Sn program a cable test facility is needed that can test up to 15 T.
- Nb_3Sn strand. The conductor is the heart of a superconducting magnet, continuous development is needed to get the required conductor.


Upgrade phase I
High field magnets
R&D activities
Participation in magnet model coil development
Thermal studies , participation in magnet model coil and conductor development
81.6 man month 1165 K€
Design, industrial development and procurement activities
Cryostat development and production
93 man month 916 K€
Industrial development and procurement activities
Special magnet component procurement
44 man month 1683 K€

R&D activities

Work Packages	materiel kEUR	hommes. mois	Institut	Materiel (kEUR) 2008	2009	2010	2011	Hommes.mois 2008	2009	2010	2011
3.9 MQX1: model coils	79.00	30.4	CEA	19.00	60.00			2	9.4	19	
3.10 Thermal studies	62.10	10.5	CEA		12.40	24.80	24.90		2.5	4	4
3.11 Race track coils in Nb3Sn	93.20	10.5	CEA		24.80	46.70	21.70		2.6	5.3	2.6
3.12 Coils for Fresca 2 1.5m model	186.30	21.7	CEA		20.90	87.70	77.70		3.7	8	10
3.13 Nb3Sn strand	745.20	8.6	CEA		60.00	342.60	342.60		1.6	3	4

N.B. for the work package 3.9 other 18.6 CEA man-month and 44.000 € are foreseen as EU funded man power and finances in the frame of the SLHC-PP project .

EUCARD connection still to be accounted for.

Design, industrial development and procurement

Work Packages	materiel kEUR	hommes. mois	Institut	Materiel (kEUR) 2008	2009	2010	2011	Hommes.mois 2008	2009	2010	2011
3.1 Cryostat for 120 mm bore magnets: tooling	6.20	14	CNRS		6.20			0.8	7.5	5.7	
3.2 Cryostat for 120 mm bore magnets: prototype cryostat	67.10	36.5	CNRS		6.10	61.00		1.8	13.2	21.5	
3.3 Cryostat for 120 mm bore magnets: production series cryostats	916.10	42.5	CNRS		171.00	745.10			0	20	22.5

N.B. CNRS for the work package 3.2 other 6 man-months and 14.000 € are foreseen as EU funded man power and finances in the frame of the SLHC-PP project

Industrial development and procurement

Work Packages	materiel kEUR	hommes. mois	Institut	Materiel (kEUR) 2008	2009	2010	2011	Hommes.mois 2008	2009	2010	2011
3.4 Corrector magnets: series production	1,242.00	36	CEA			621.00	621.00			8.5	27.5
3.5 MQX1 magnets: Quench Heaters' series production	124.00	6.6	CEA			31.00	93.00			2.6	4
3.6 MQX1 magnets: fine blanking tooling for austenitic steel collars	81.00	3.5	CEA		50.00	31.00				3.5	
3.7 MQX1 magnets: fine blanking of austenitic steel collars	112.00	7.6	CEA			112.00				2.6	5
3.8 Cold bore tubes	124.00	4	CEA		31.00	93.00			1	3	

AT 3 follow up

- Every 2 month each work package shall provide an update of the logbook (agreed between the CERN and CEA-CNRS technical responsible, see next slide)
- Every 4 months parties will meet to discuss advancement and prepare CSP. I.E. Participants D. Reynet (CNRS), J. M. Rifflet (CEA), P. Fessia and G. De Rijk (CERN)+ technical contacts in function of need :
  - End of October (CNRS)
  - End of February (CERN)
  - End of June (CEA)
- Accounting of resources for activities complementary to the SLHC-PP program should take into account the resources allocated in the frame of the FP7 program
- Before end of September revise the list of the technical contacts for each WP

Log book

Work-package number	3.1	**Work-package title**	Cryostat for 120 mm bore magnets: tooling		
Reference institute	CNRS				
Time span	**Start**	**End**			
	Oct-08	Jun-10			
Allocated human resources	14 man.months		**Allocated financial resources**	6.2 K€ - 10 KCHF	

Indicative personnel profile				**Indicative financial profile (commitment)**		
	Engineer	**Technician**	**Draft man**		**K€**	**KCHF**
2008	0.8			**2008**		
2009	2.3	1	4.2	**2009**	6.2	10
2010	1.6	3.1	1	**2010**		
2011				**2011**		
Total	4.7	4.1	5.2	**Total**	6.2	10

	Engineer	**Technician**	**Draft man**		**K€**	**KCHF**
Resources employed last 2 months				**FinaNcial reoucres committed last 2 months**		0

Activity description

Status deliverables

	resources employment				**financial resources commitment**	
	Engineer	**Technician**	**Draft man**		**K€**	**KCHF**
Aug-09	**0**					
Oct-09	**0**					
Dec-09	**0**					
Feb-10	**0**					
Apr-10	**0**					
Jun-10	**0**					
Aug-10	**0**					
Oct-10	**0**					
Dec-10	**0**					
Feb-11	**0**					
Apr-11	**0**					
Jun-11	**0**					
Aug-11	**0**					
Oct-11	**0**					
Dec-11	**0**					

Program till December 2009

Work package	Activity
3.1 cryostating tooling	1) October conceptual design review 2) December 2009 production readiness review
3.2 cryostat for 120 mm bore magnets	1) September2009 Conceptual design review 2) October 2009 Production readiness review 3) December 2009 Procurements documents released
3.3 Cryostat for 120 mm bore magnets: series cryostats production	1) December 2009 Conceptual review of the corrector package and service module design. Definition of detailed delivery plan
3.4 Corrector Magnets: series production	1) December 2009 Detailed definition of the supply scope
3.8 cold bore tubes	1) October 2009 CERN issuing drawing and technical specification
3.9 MQXC model coils	1) October 2009: CERN magnet cross section
3.10 Thermal studies	1) December 2009 report on SMC coil block heat transfer
3.11 racetrack coils in Nb3Sn	1) December 2009: design report on ceramic insulated double pancake
3.13 Nb3Sn strand	1) December 2009: report on strand development

Présentation WP

WP 3.1 Outillages d'assemblage

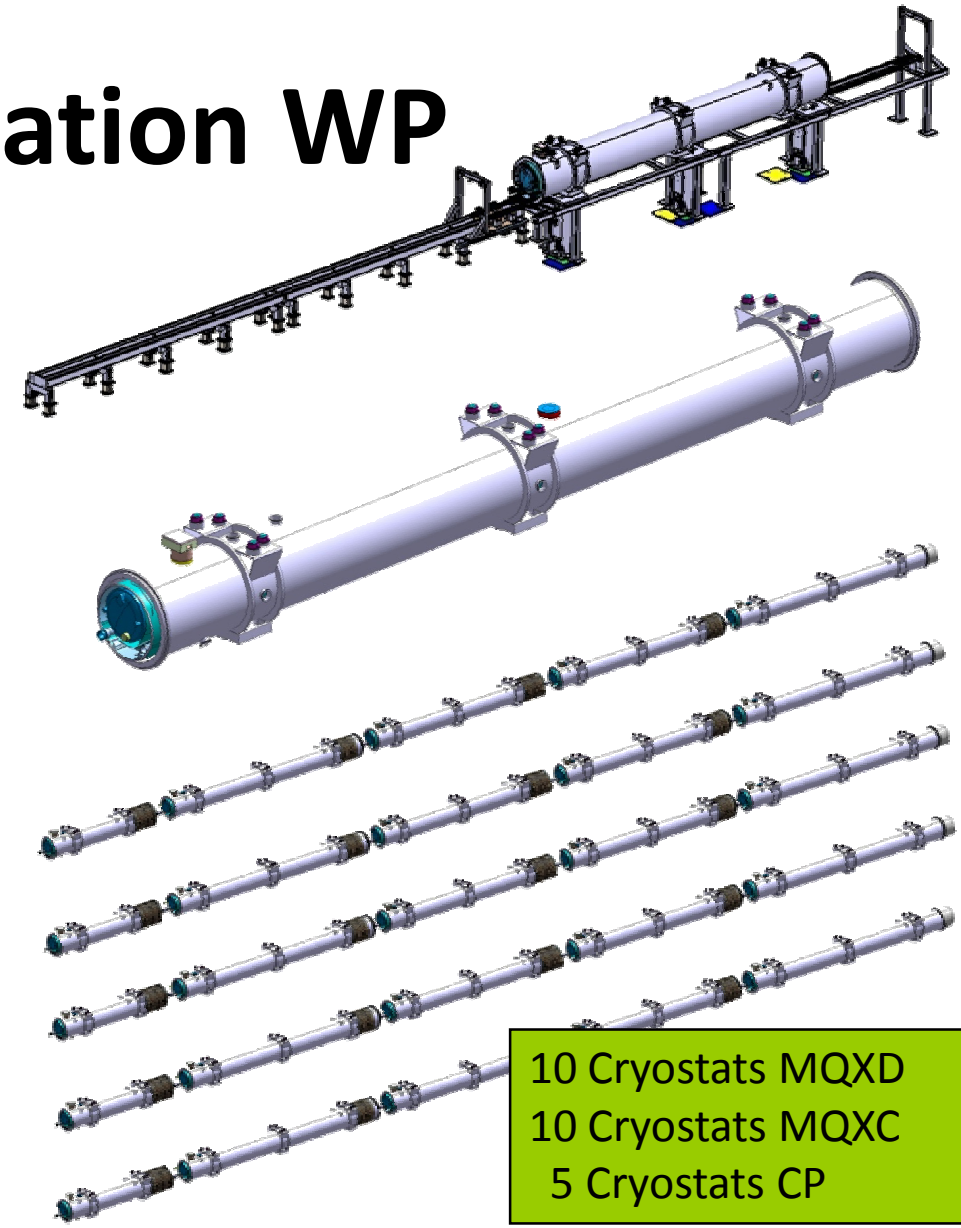
Conceptual Design Review	***Octobre 2009***
Production Readiness Review	***Novembre 2009***
Tooling installation	***Septembre 2010***

WP 3.2 Cryostat Prototype (Q1)

Conceptual Design Review	***Septembre 2009***
Production Readiness Review	***Octobre 2009***
Procurements documents released	***Novembre 2009***
Delivery of all components to CERN	***Décembre 2010***

WP 3.3 Cryostats Série

Conceptual Design Review (CP)	***Décembre 2009***
Production Readiness Review	***Janvier 2010***
Delivery of 1st Cryostat	***Décembre 2010***
Completion of Délivery	***Décembre 2011***

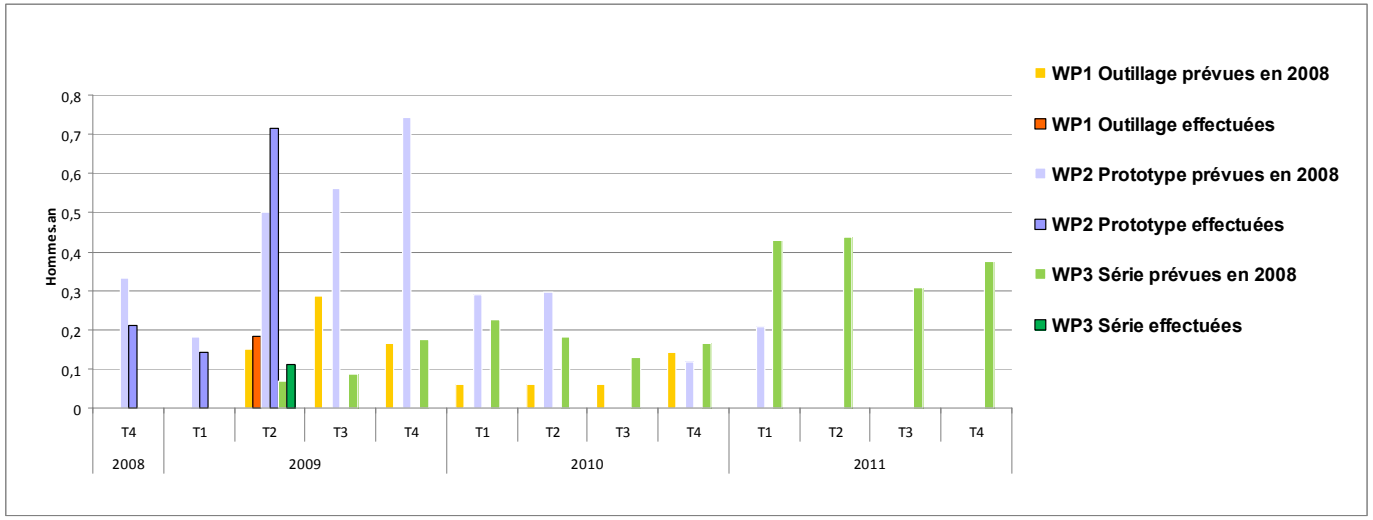


10 Cryostats MQXD
10 Cryostats MQXC
5 Cryostats CP

Ressources CNRS WP3.1, 3.2 et 3.3

		2008	2009 (homme. Mois)			
		T4	T1	T2	T3	T4
WP3.1	prévues cumulées	0	0,00	1,8	5,28	7,2
	effectuées cumulées	0	0,00	2,16		
WP3.2	prévues cumulées	3,96	6,12	12,12	18,96	27,84
	effectuées cumulées	2,52	4,2	12,84		
WP3.3	prévues cumulées	0	0,00	0,84	1,92	3,96
	effectuées cumulées	0	0,00	1,32		
WP3.1,2,3	prévues cumulées	3,96	6,12	14,88	26,04	39
	effectuées cumulées	2,52	4,2	16,32		

2 RT à l'IPN
3 RT au CERN
Missions : 3180 €



Avancement étu

- Calculs - Optimisation
- Composants - Rayonnement
- Interconnexion
- CODAP – FEM
- Dossier de Plans
- Spécifications Techniques
- Consultations

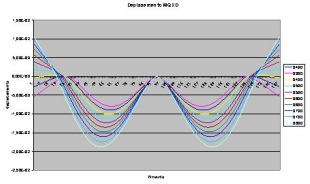
- Outillage

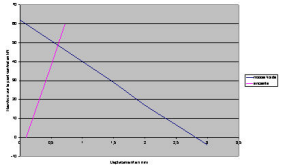
Optimisation entraxe pieds

Poids propre
- MF + EV

Masse froide MQXC :
L = 10714mm
Masse : 20500kg

Masse froide MQXD :
Longueur : 9325mm
Masse : 17500kg





f enceinte seule : 0.16mm
f enceinte + Masse froide : 1mm

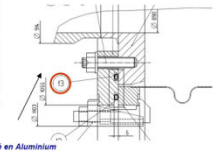
f enceinte seule : 0.1mm
f enceinte + Masse froide : 0.6mm

Joints pour le vide – Triplet upgrade

Option élastomère

Option joints métalliques

Nouvelle Conception
Bride prisonnière !!!



HNV 200 Ø=5.8
Revêtement d'étanchéité en Aluminium
Intercalaire en Inconel
Ressort en Nimonic 90 (H°)
Ø 984.2 x 995.8

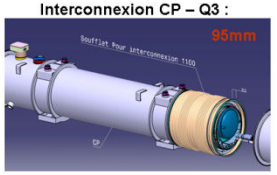
Quantité	Prix Unitaire
2	1375,70 €
30	1112,70 €

5x10⁸ Rads = 5x10⁶ Gray

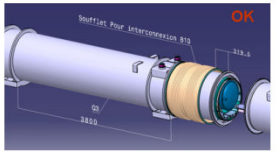
3 Joints brides interconnexion
3 Joints bouchon pied + 1 Soupape Dn200

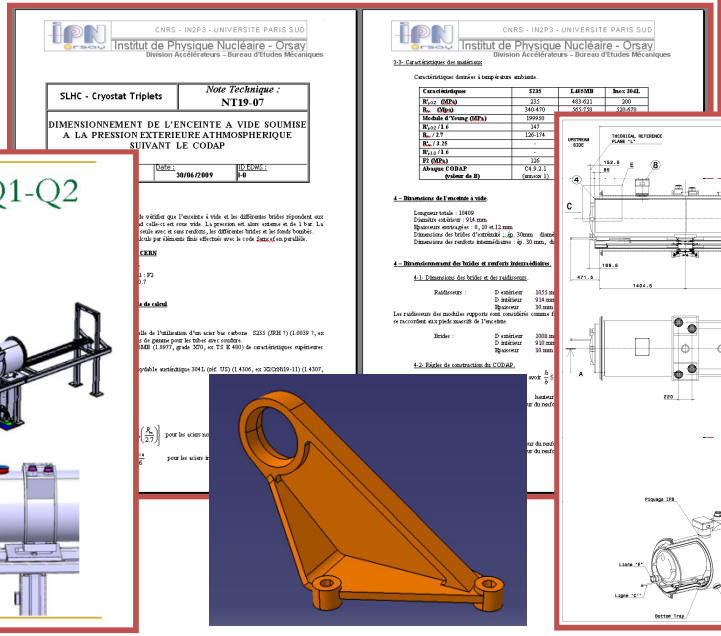
Recul Soufflet Interconnexion

Interconnexion CP – Q3 :



Interconnexion Q3 – Q2b





Outillage SSS-MS : adaptations pour Q1-Q2

- Longueurs des enceintes Q1 & Q2
  - compatible avec la longueur de la table
- Position stabilisateurs
  - compatible
  - vérifier les positions des fixations