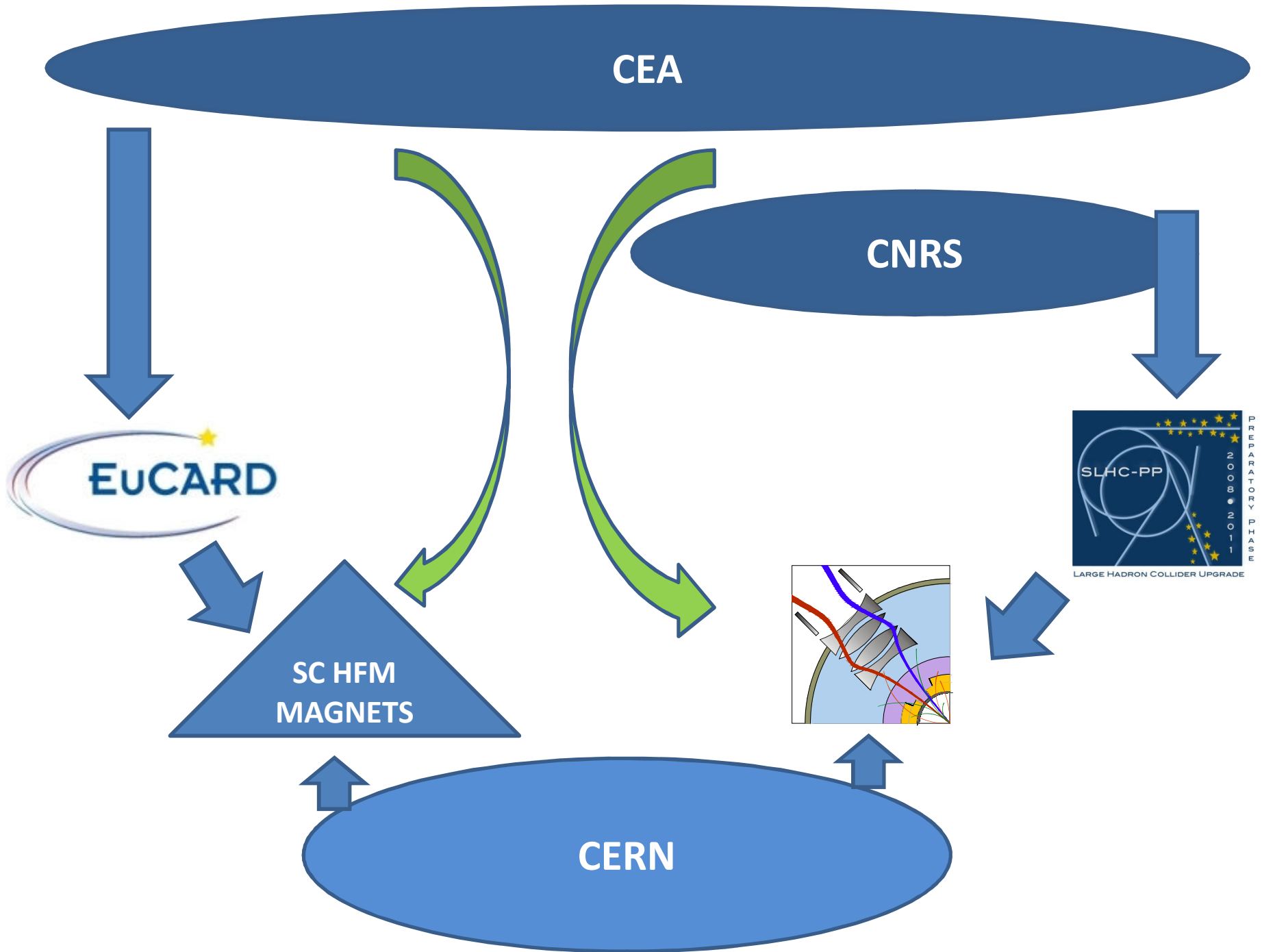


Technical agreement n 3

New SC Magnets activities

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





LHC IR Upgrade - Phase I

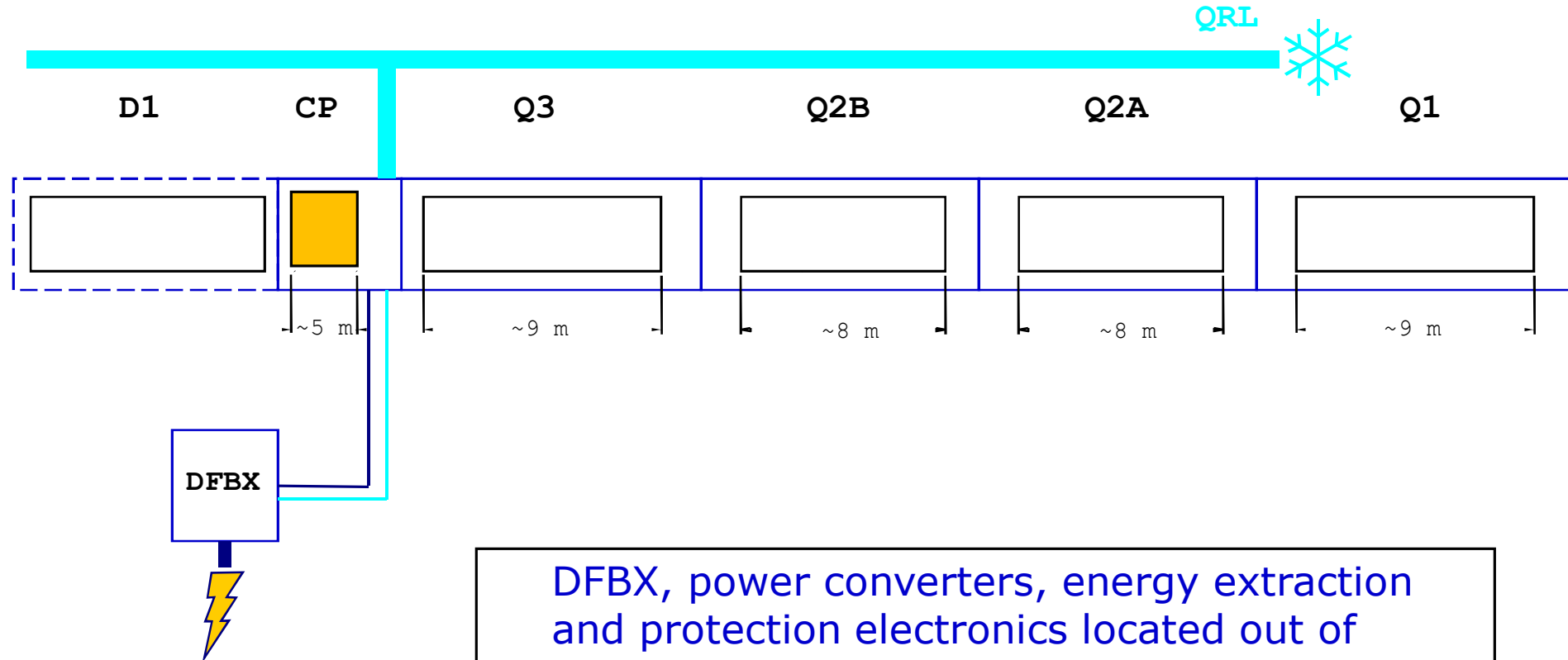
Goal of the upgrade:

Enable focusing of the beams to $\beta^*=0.25$ m in IP1 and IP5, and reliable operation of the LHC at $2 \cdot 10^{34}$ cm⁻²s⁻¹ on the horizon of the physics run in 2014.

Scope of the Project:

1. Upgrade of ATLAS and CMS interaction regions. The interfaces between the LHC and the experiments remain unchanged at ± 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 Nb₃Sn 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 Nb₃Sn. This is a first step to test out the Nb₃Sn coil technology before constructing larger and more costly coils.
- Coils for Fresca2 1.5 m model. To prepare for a Nb₃Sn program a cable test facility is needed that can test up to 15 T.
- Nb₃Sn 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

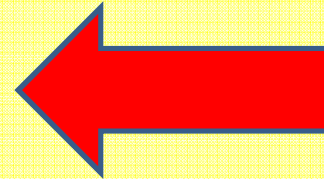
Participation in magnet model coil development

Thermal studies , participation in magnet model coil and conductor development

81.6 man month
1165 K€

Design, industrial development and procurement activities

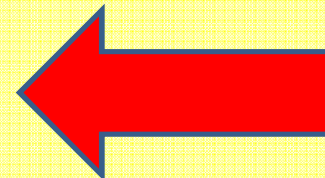
Cryostat development and production



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)				Hommes.mois			
				2008	2009	2010	2011	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)				Hommes.mois			
				2008	2009	2010	2011	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)				Hommes.mois			
				2008	2009	2010	2011	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 resources 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) September 2009 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 cryostat 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 Nb ₃ Sn	1) December 2009: design report on ceramic insulated double pancake
3.13 Nb ₃ Sn strand	1) December 2009: report on strand development

Présentation WP

WP 3.1 Outillages d'assemblage

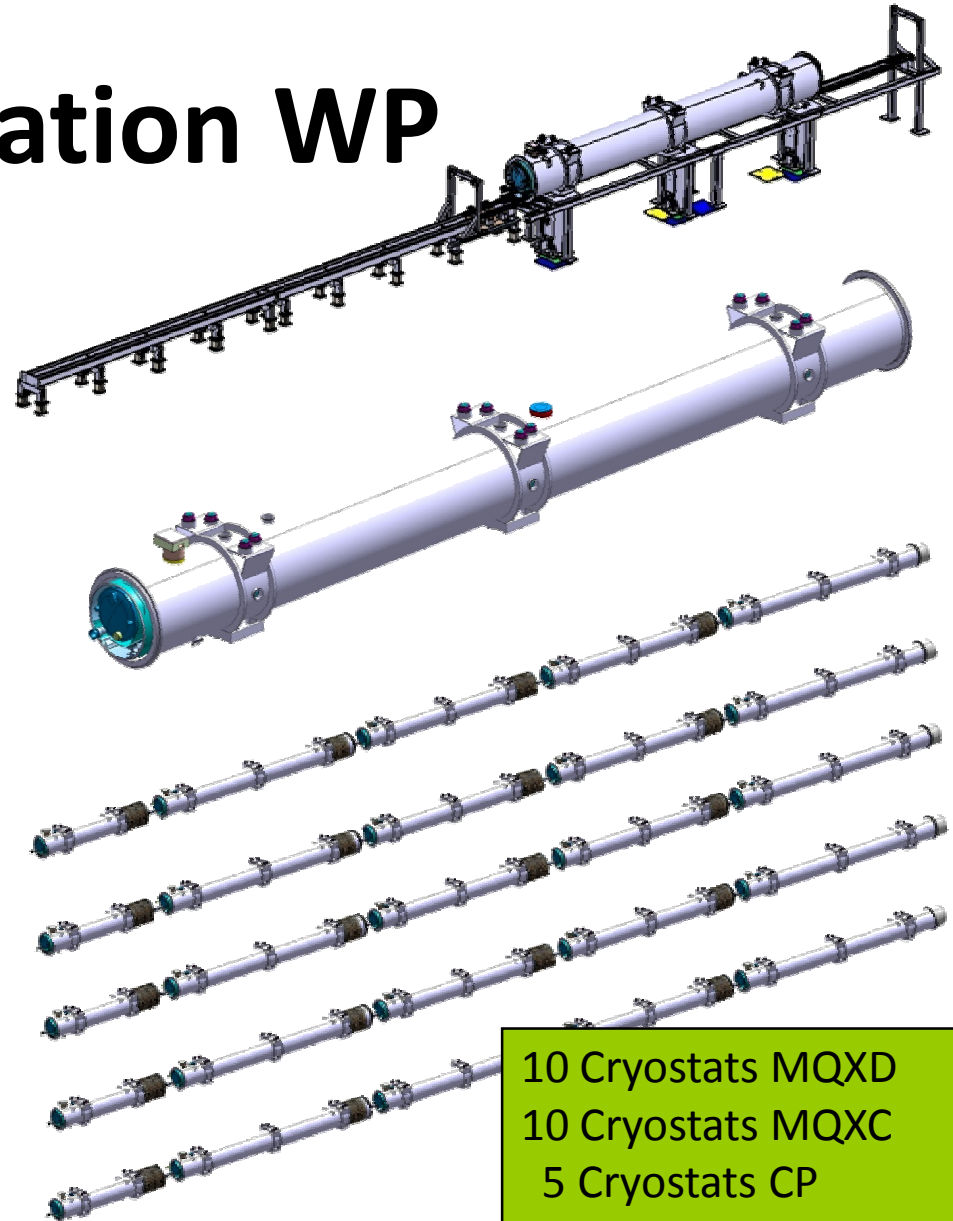
Conceptual Design Review	Octobre 2009
Production Readiness Review	Novembre 2009
Tooling installation	Septembre 2010

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 Délivry	Décembre 2011

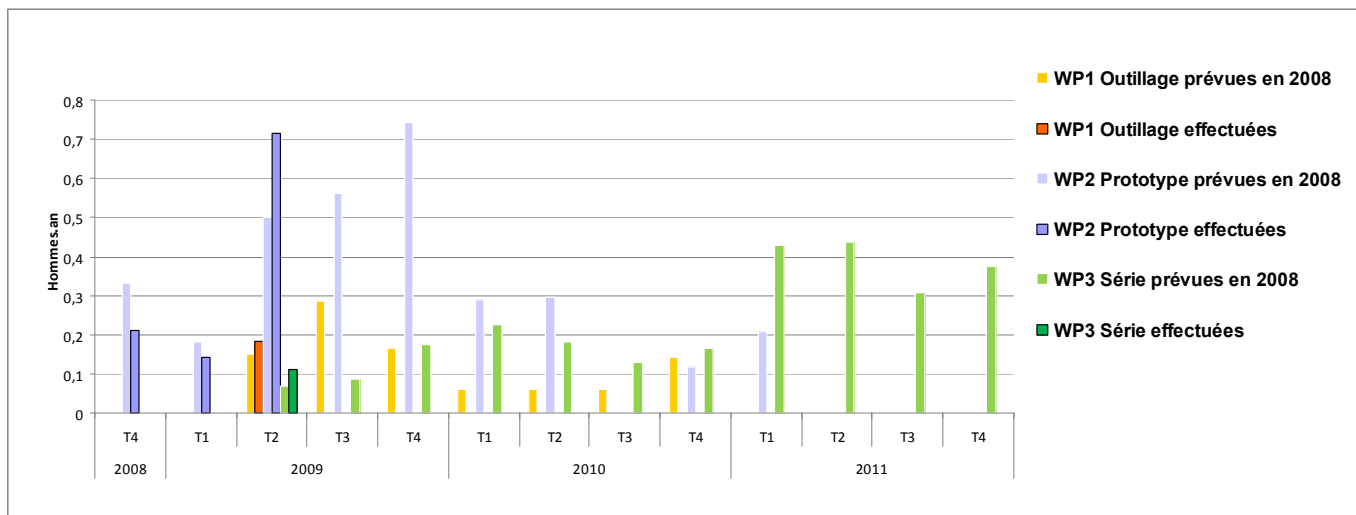


10 Cryostats MQXD
10 Cryostats MQXC
5 Cryostats CP

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 €

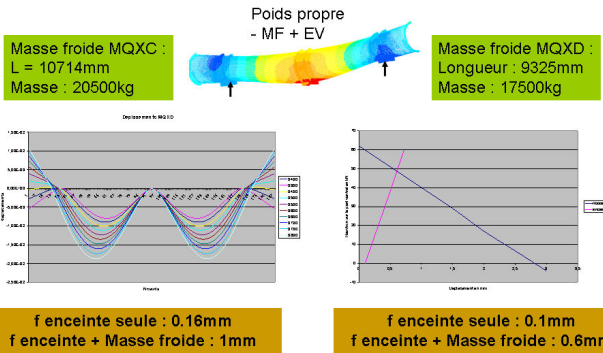


Avancement études

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

- Outillage

Optimisation entraxe pieds



Joint pour le vide – Triplet upgrade

Option élastomère

Option joints métalliques

Nouvelle Conception Brides prisonnière !!!

A. MATERIAUX		B. TENUE AUX RAYONNEMENTS (Dose par m ² et à température ambiante)	
CADASTROUC DE BASE	BOURTE	BOITE CONDUITE MAXIMALE EN RADS	
(Identification recommandée)	ENIG	Estimée par rapport aux intégrations de fraction	
CADASTROUC DE BUTADENS	ES 1401	ES	3 x 10 ⁴ à 5 x 10 ⁵
			10 ⁵

5x10⁶ Rads = 5x10⁶ Gray

Quantité	2	Prix Unitaire	1275,70 €
	30		1112,70 €

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

Recul Soufflet Interconnexion

Interconnexion CP – Q3 :

98mm

Interconnexion Q3 – Q2b

216.6 OK

CNRS - IN2P3 - UNIVERSITE PARIS SUD
Institut de Physique Nucléaire - Orsay
Division Accélérateurs - Bureau d'Etudes Mécaniques

SLHC - Cryostat Triplets

Note Technique :
NT19-07

DIMENSIONNEMENT DE L'ENCEINTE A VIDE SOUMISE A LA PRESSION EXTERIEURE ATMOSPHERIQUE SUIVANT LE CODAP

DATE :	28/06/2009	REVISION :	04
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Institut de Physique Nucléaire - Orsay
Division Accélérateurs - Bureau d'Etudes Mécaniques

1-2- Caractéristiques des matériaux

Caractéristique	S23	L4550R	Matr 304L
Yield (MPa)	235	455	205
Tens. à la rupture (MPa)	360-410	555-570	510-530
Module d'élasticité (GPa)	207	207	207
ρ (kg/m ³)	7850	7850	7930
ν	0.3	0.3	0.3
σ _{max} (MPa)	356		
σ _{max} (MPa)	452.3		
σ _{max} (MPa)	452.3		

1-3- Dimensionnement de l'enceinte à vide

Equipement n°1 : 2000 mm
Diamètre nominal : 194 mm
Epaisseur nominale : 10 mm et 12 mm
Epaisseur de l'anneau d'extrémité : 10 mm
Diamètre de l'anneau d'extrémité : 10 mm
Diamètre de l'anneau d'extrémité : 10 mm

1-4- Dimensionnement des brides et renforts intermédiaires

1-4.1- Dimensionnement des brides et des renforts

Matériaux : D max/min : 307/28 mm
D max/min : 194 mm
Epaisseur : 10 mm
Les renforts de brides respectent une condition comme il est spécifié aux points suivants.

Bride : D max/min : 300 mm
D max/min : 194 mm
Epaisseur : 10 mm

1-4.2- Règles de construction du CODAP

SECTION A-A
Echelle : 1:10

SECTION B-B
Echelle : 1:10

SECTION C-C
Echelle : 1:10

SECTION D-D
Echelle : 1:10

SECTION E-E
Echelle : 1:10

SECTION F-F
Echelle : 1:10

SECTION G-G
Echelle : 1:10

SECTION H-H
Echelle : 1:10

SECTION I-I
Echelle : 1:10

SECTION J-J
Echelle : 1:10

SECTION K-K
Echelle : 1:10

SECTION L-L
Echelle : 1:10

SECTION M-M
Echelle : 1:10

SECTION N-N
Echelle : 1:10

SECTION O-O
Echelle : 1:10

SECTION P-P
Echelle : 1:10

SECTION Q-Q
Echelle : 1:10

SECTION R-R
Echelle : 1:10

SECTION S-S
Echelle : 1:10

SECTION T-T
Echelle : 1:10

SECTION U-U
Echelle : 1:10

SECTION V-V
Echelle : 1:10

SECTION W-W
Echelle : 1:10

SECTION X-X
Echelle : 1:10

SECTION Y-Y
Echelle : 1:10

SECTION Z-Z
Echelle : 1:10

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

