

Challenges of the XFEL Cryomodule Integration and Industry Transfer

IPAC'14

Introduction

- ❑ ALSYOM overview
- ❑ Project structure
- ❑ Progress status
- ❑ Team structure
- ❑ Workshop layout
- ❑ Technical issues
- ❑ Production challenges

ALCEN Group

□ ALCEN Group

- French group created in 1988
- High technology dedicated to:
 - Defence and Security
 - Energy
 - Medical machines
 - Aeronautics
 - Large scientific equipment
- 206 million euros turnover in 2013
- About 30 subsidiaries
- 1950 employees in 2013

□ ALSYOM

- Large Scientific Instruments
 - Laser Mégajoule (nuclear simulation)
 - Laser PETAL
 - Experimental Fusion Reactor ITER
 - Particle Accelerators (XFEL)
- Defence
- Aeronautics, Space and Astronomy

ALSYOM main activities

- ❑ Program Management
- ❑ Engineering and Industrialization (in Tarbes and Mérignac)
 - **System Analysis, Mechanical, and Opto-mechanical design, Optic, Electronic, Instrumentation and Control System**
 - **Industrial Process Definition**
- ❑ Opto-mechanisms manufacturing (in Tarbes)
 - **Mechanical infrastructures with large dimensions and high accuracy**
 - **Vacuum vessels**
 - **Opto-mechanical systems with cleanliness and vacuum requirements**
- ❑ Integration and clean environment (in Tarbes, Laseris Le Barp, Saclay)
 - **Geometric characterization**
 - **Getting ISO 5 and ISO 8 cleanliness**
 - **Integration and testing**
- ❑ Mechanical structures mounting & assembly in clean environment on Customer sites

Industrial entity, unique in France, combining these domains of competences and level of performances (high accuracy, large size, ultra clean and vacuum)



Project structure

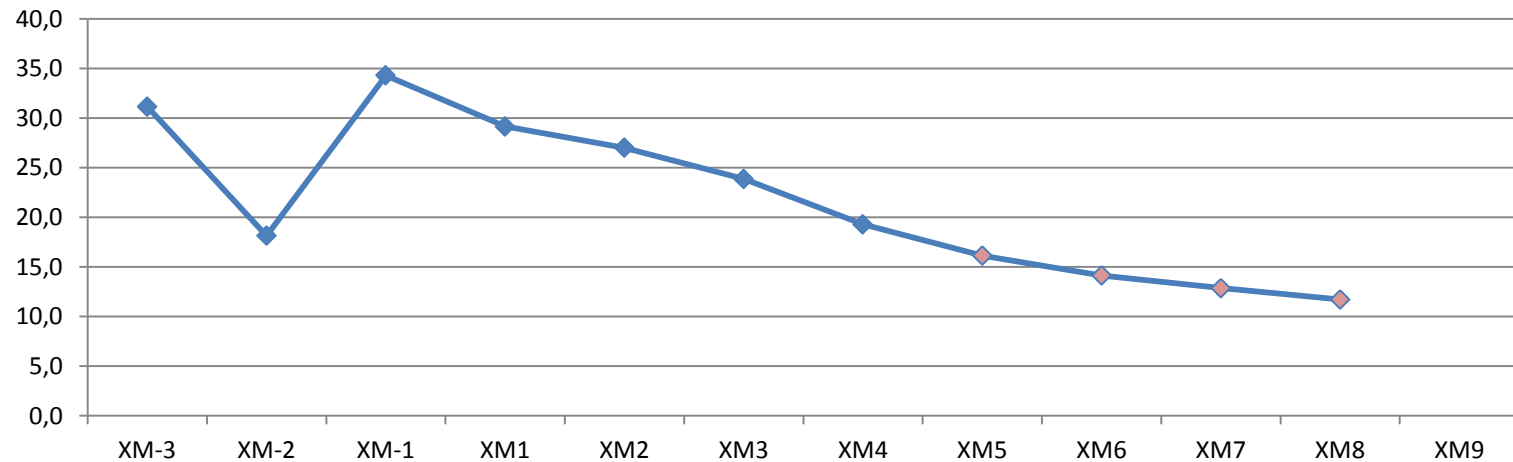
- ❑ More than 100 cryomodules to be produced
- ❑ Delivery rate : 1 module / week
- ❑ 4 phases:
 - Pre-series production
 - XM-3 : observation
 - XM-2 and XM-1 for training
 - Series production
 - From XM1 to XM7, ramp-up period
 - From XM8 up to XM100 : nominal production rate: 1 module/week

Workstation																				
WS1-CC				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
WS2-SA					1	2	3	4	5	6	7	8	9	10	11	12	13	14		
WS3-RO						1	2	3	4	5	6	7	8	9	10	11	12	13		
WS4-AL							1	2	3	4	5	6	7	8	9	10	11	12		
WS5-CA								1	2	3	4	5	6	7	8	9	10	11		
WS6-CO									1	2	3	4	5	6	7	8	9	10		
WS7-SH											1	2	3	4	5	6	7	8	9	

Progress status

- ❑ XM1, XM2, XM3, XM4 already delivered
- ❑ XM5 shipment on 06/17/2014
- ❑ XM11 coupler cold parts assembly on W25/2014

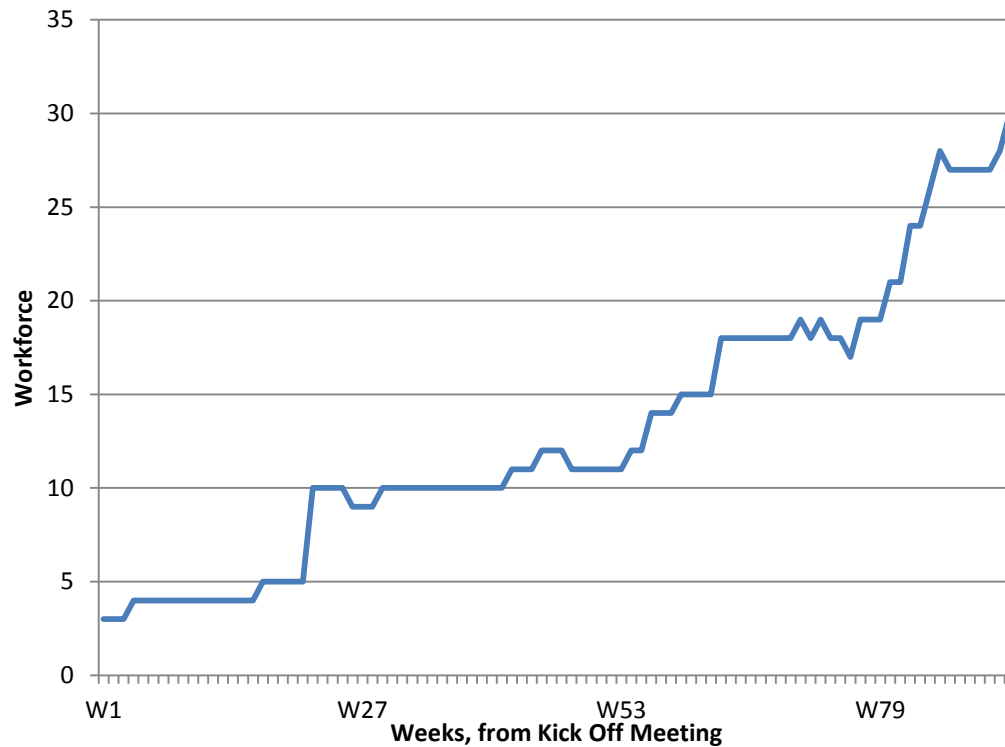
Assembly time / week



Team structure

□ 29 people including

- Management
- Support activities
- Production staff

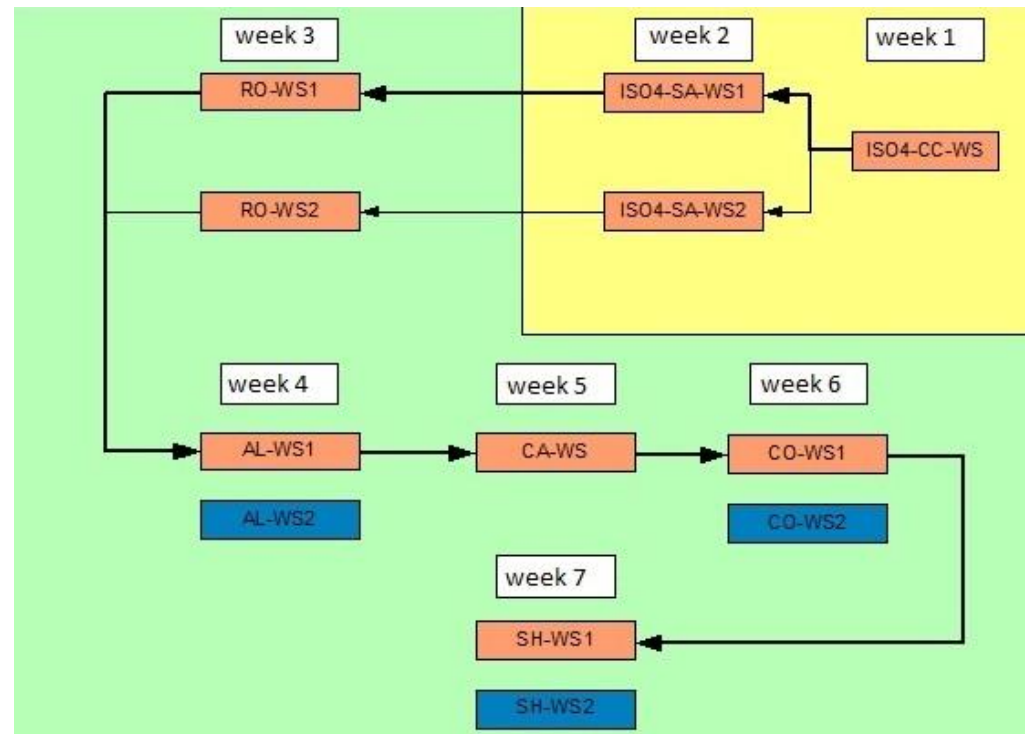


Workshop layout

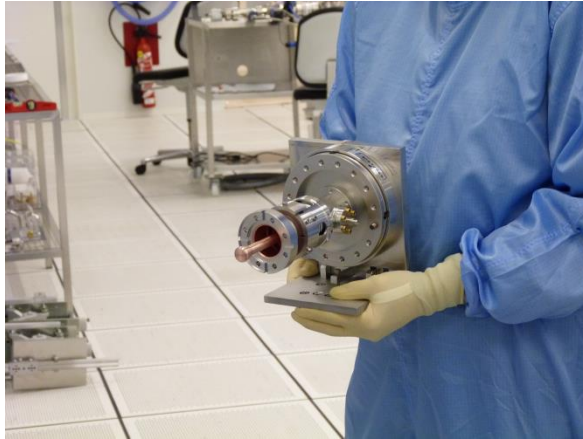
7 workstations

- WS1-CC : Coupler Cold part assembly (ISO4 clean room)
- WS2-SA : String Assembly (ISO4 clean room)
- WS3-RO : Roll-Out area
- WS4-AL : Alignment
- WS5-CA : Cantilever
- WS6-CO : Warm Coupler parts assembly
- WS7-SH: Shipment

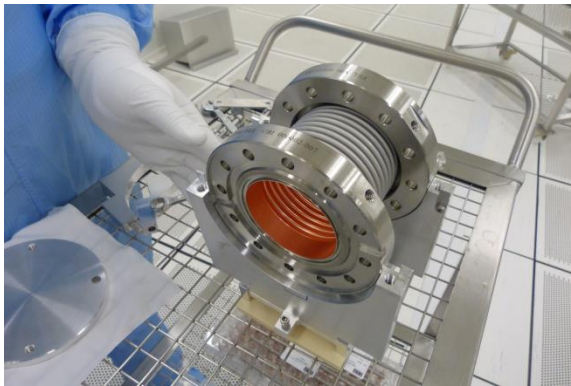
Most of workstations are doubled



Workshop layout



Cold coupler assembly



String assembly

Workshop layout



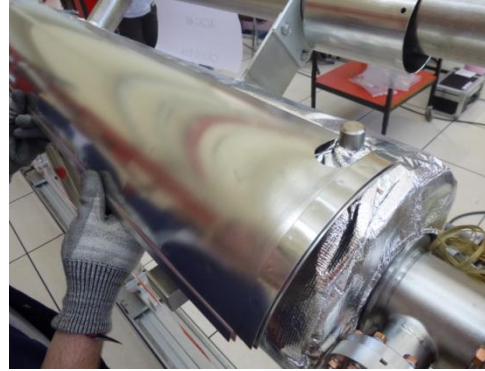
From Clean Room
to Roll-Out area



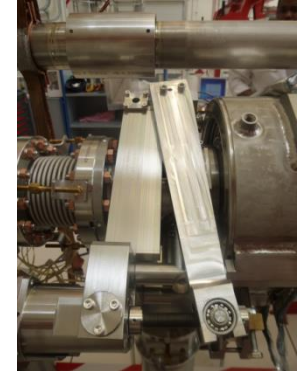
Workshop layout



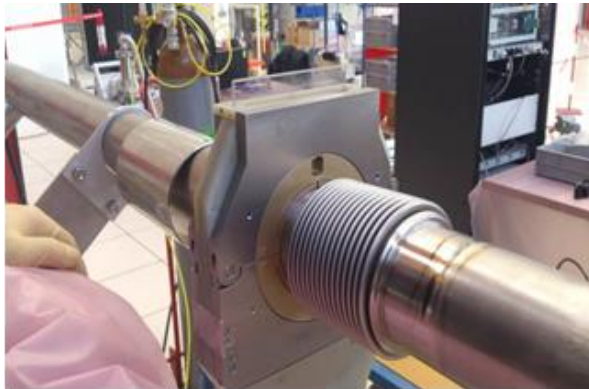
Multi-Layer Insulation



Magnetic shields



Tuner systems



Titanium bellows welding



Cold Mass transfer

Workshop layout



Alignment area



Workshop layout



Cantilever



Warm
Coupler
Assembly



Workshop layout



Transfer to shipment

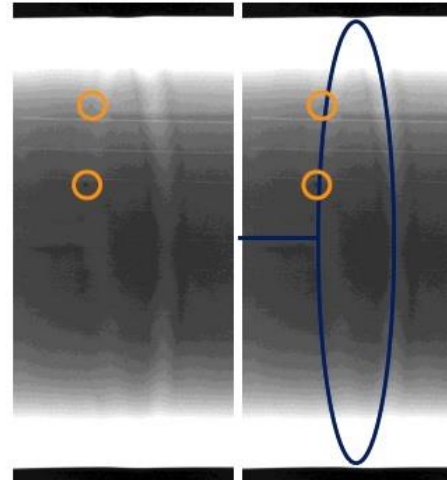


Shipment area

Technical issues

❑ XM-1 Welding

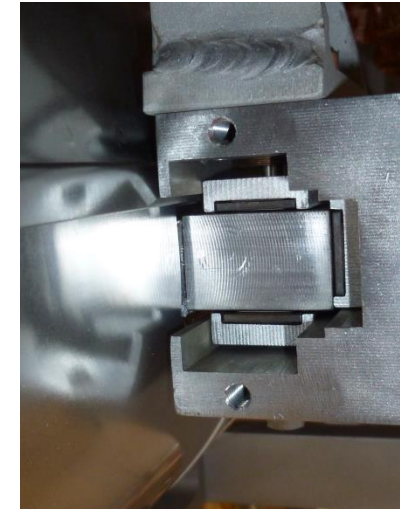
- X-Ray has shown pores in Titanium welds



X-Ray picture

❑ String and Cold Mass assembly

- Bearings tightening improvement



Bearings assembly between Cold Mass and Cavity String

❑ Couplers overheating

- Under investigation for XM-1 and XM1

Production challenges

- ❑ A powerful Data Management System (EDMS)
 - For traceability
 - For non conformities and design changes recording

The screenshot displays the ALSYOM EDMS interface. At the top, there is a navigation bar with a search field and user information (Francis Chastel). Below this is a menu bar with options like Claim, Signoff, Reassign, Flag, Comment, and More Actions... The main content area is divided into a left sidebar with 'Lists', 'Create', and 'Preferences' sections, and a central 'Current Work' section. The 'Current Work' section contains a table of assignments with columns for Pr, EDMS-ID, Name, Description, Work Status, Assignment, and Access Scheme in Use. The 'Work Status' column shows 'Approved' for all entries.

Pr	EDMS-ID	Name	Description	Work Status	Assignment	Access Scheme in Use
<input type="checkbox"/>	D00000004646091.B.1.2	PP_PT_CrNi42_0001	Documentation for penetrant testing: Quadropol Pipe connecting on 42.4 Pipe 01/42, module assembly, after welding	Approved	FYI	Project: XFEL_WP03
<input type="checkbox"/>	D00000004646091.B.1.2	PP_PT_CrNi42_0001	Documentation for penetrant testing: Quadropol Pipe connecting on 42.4 Pipe 01/42, module assembly, after welding	Approved	FYI	Project: XFEL_WP03
<input type="checkbox"/>	D00000004328131.B.1.2	WPS 033	WPS for orbital titanium welding of the 2Ph service pipe OD76.1x2.0mm	Approved	FYI	Project: XFEL_WP03
<input type="checkbox"/>	D00000003299811.C.1.2	PA_LT_PR_0003	Documentation for the He leak test between current lead and the vacuum vessel	Approved	FYI	Project: XFEL_WP03
<input type="checkbox"/>	D00000003300571.B.1.5	PA_LT_PR_0004	Documentation for the He leak test welding sleeve to vacuum vessel	Approved	FYI	Project: XFEL_WP03
<input type="checkbox"/>	D00000003284041.D.1.2	PA_LT_PR_0002	Documentation for the He leak test at the service pipe tube, warm up pipe, wiring box	Approved	FYI	Project: XFEL_WP03

Production challenges

- ❑ A traveler file
- To follow every assembly step

Traveler RO_XM6.xlsx [Partagé] - Microsoft Excel

X-FEL Traveler: Rollout_Workstation		Cryomodule reference: XM 6			Rail: OUEST			
Task #	Task Identification:	Opération:	GOM Ref:	GOM version	Beginning Date:	Operators:	Template:	
1	10-03	Ultrasonic cleaning of TiBL	Nettoyage ultrasons soufflets	NA		GOUIT F.		
2	20-01	Qpole diag box cap welding preparation	Préparation pour soudage bouchon Qpole - Soudure 01 / LW (plan 3_09_9610 / M.010)	ASS_AH_206	1			
3	20-02	Qpole diag box cap welding 01/LW	Soudage du bouchon du Qpole - Soudure 01 / LW (plan 3_09_9610 / M.010)	WPS-IN-CC-001 Prod	B		DESY Welding Plan Ref D*4170481	
4	20-03	Qpole diag box cap welding 01/LW visual inspection	Contrôle visuel du bouchon Qpole 01/LW	PA_VT_Lip-welds_0001	Rev.A		PP_VT_Lip-welds_0001	
5	10-01	Qpole diag box electrical test	Test électrique de la boîte diagnostic du Qpole Unit	TST_AH_166	2.1	23/04/2014	MARQUES D.	Template_QR_ET_XMn_CLC_XCLxxx
6	20-05	Service pipe cutting	Préparation pour soudage du "service pipe Qpole"	ASS_AH_183	3	23/04/2014	GREGOIRE J. VALLET K. FILLION S.	
7	20-06	Welding of 42,4mm test piece	Soudage d'un tube témoin 42,4mm	ASS_AH_91	3	23/04/2014	GREGOIRE J. VALLET K.	DESY Welding Plan Ref D*4170481
8	20-07	Welding of Qpole service pipe	Soudage du tube 42,4mm pour soudure 01/42 (plan 1_11_9610_M_009)	ASS_AH_91	3	23/04/2014	GREGOIRE J. VALLET K.	DESY Welding Plan Ref D*4170481
9	20-08	Qpole 42,4mm welding 01/42 visual inspection	Contrôle visuel de la soudure Qpole 42,4mm (01/42)	PA_VT_CrNi42_0001	Rev.D			PP_VT_CrNi42_0001
10	20-09	Service pipe Ti-bellow welding preparation 01/76	Préparation pour soudage du soufflet Ti sur cavité position 8 - Soudure 01/76 (plan 1_11_9610_M_009)	ASS_AH_207	1	22/04/2014	MARQUES D.	DESY Welding Plan Ref D*4170481
11	20-10	Service pipe Ti-bellow welding preparation 02/76	Préparation pour soudage du soufflet Ti sur cavité position 8 - Soudure 02/76 (plan 1_11_9610_M_009)	ASS_AH_185	3	22/04/2014	MARQUES D.	
		Service pipe Ti-bellow welding	Préparation pour soudage du soufflet Ti sur cavité					

Ctrl of STR | Welding | T* & Magn. Shields | Tuner | Copper Braids, 70K shells & T* | Cold Mass & 4k shells | BreakPoint & Cold Mass rising

Prêt | FR | 12:47 | 17/06/2014

Production challenges

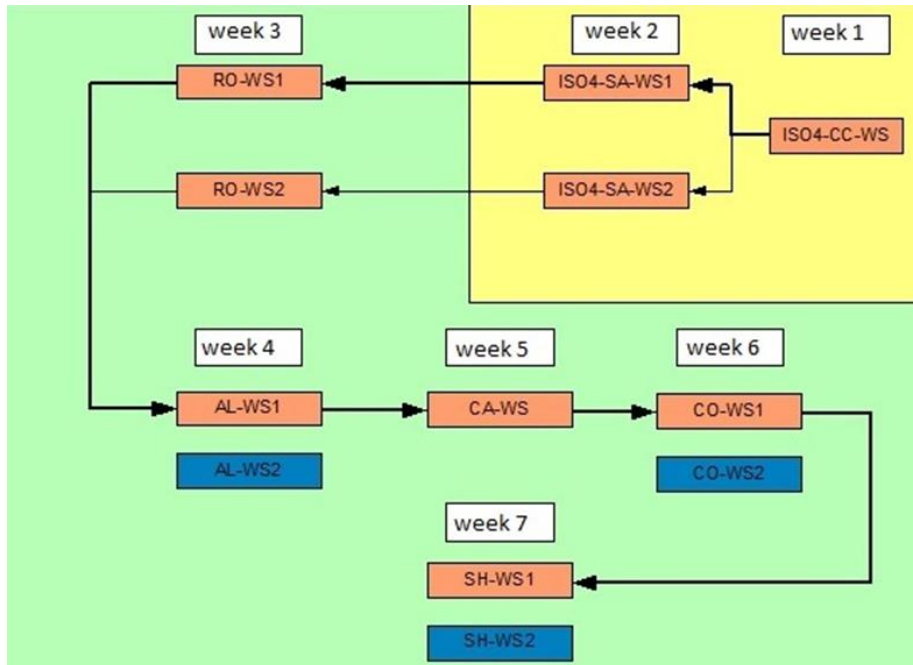
- ❑ Assembly steps monitoring
- ❑ Workload balance
- ❑ Lifting and handling operations



Aluminium thermal shields welding

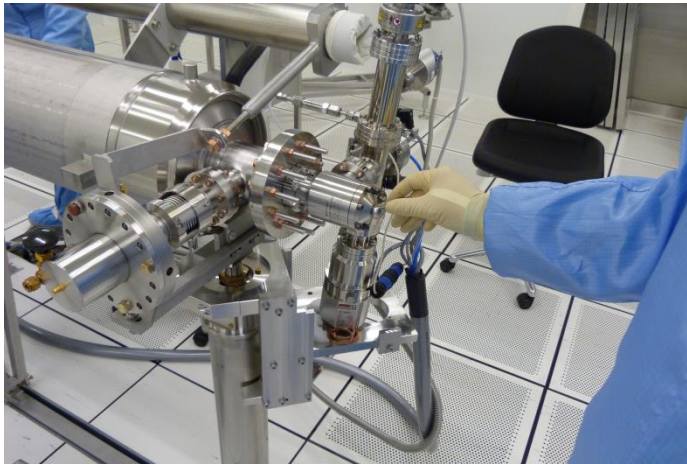
Production challenges

Roll-Out and clean room coordination



Further improvements

- A new string assembly method has been proposed
 - No more pumping and venting units needed



THANK YOU FOR YOUR ATTENTION