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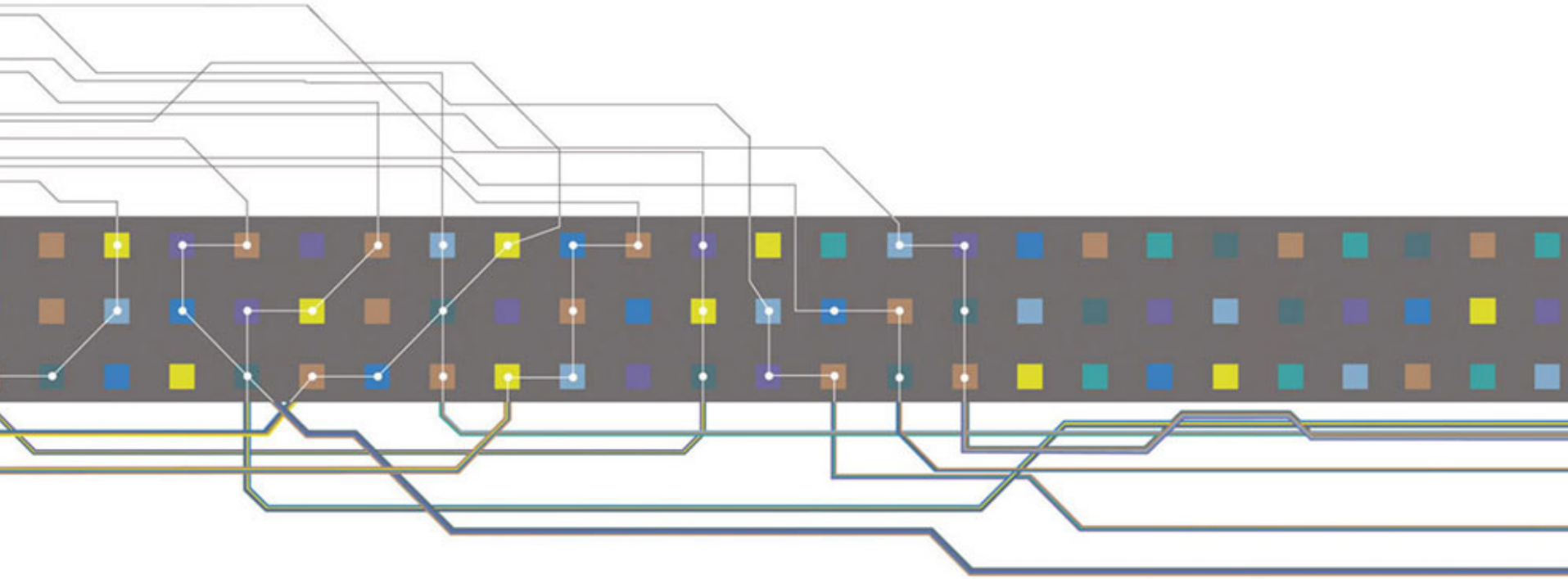


Preliminary Industrialisation Studies of XFEL Cryomodules

C. Liguoro, J.P. Brasile (Thales)
J. Caseiro, P. Heine (Phoebe),
S. Berry, S. Chel, A. Daël, C. Madec and O. Napoly (Cea-Saclay)

Agenda

1. THALES & THALES Communication/UCT/DIS
2. XFEL EPI: Preliminary Industrialisation Study
3. XFEL CEA Saclay Infrastructures
4. XFEL production challenges
   - Quality and discrepancy management
   - Data and Configuration management
   - The short lead-time of production

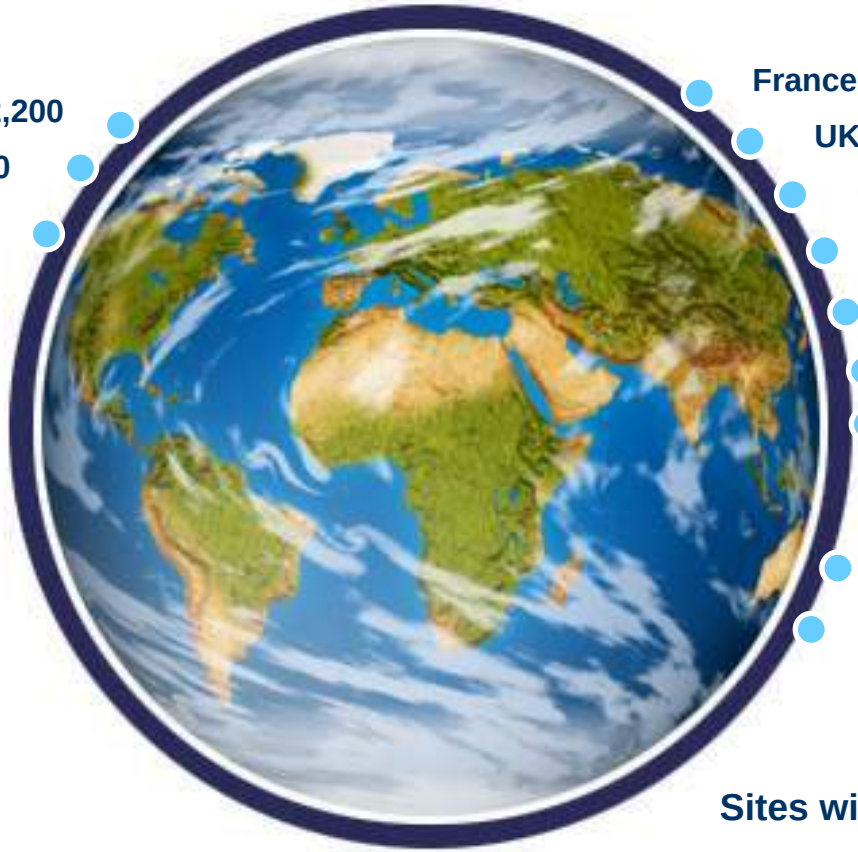
Thales & Thales Communication/UCT/DIS

- Three core businesses
  - Aerospace & Space
  - Defence
  - Security

NOTA: the scope of this presentation is limited to THALES Communication insolvent in XFEL

Thales & Thales Communication/UCT/DIS

- A Worldwide Group
  - 68,000 employees worldwide
  - Presence in 50 countries



USA: 2,200

Canada: 1,200

Brazil and rest of Latin America: 660

France: 34,300

UK: 8,200

Germany: 4,500

Spain: 2,100

Italy: 2,600

Netherlands: 2,000

Belgium: 950

Australia: 3,600

Korea: 1,370

Sites with more than 950 employees

Thales & Thales Communication/UCT/DIS

- R&D at Thales totals €2.2bn (18% of revenues)
- 25,000 researchers on cutting-edge technologies
- 300 inventions per year
- Over 15,000 patents
- Over 30 cooperation agreements with universities and public research laboratories in Europe, the United States and Asia

Innovation and technological excellence

Thales & Thales Communication/UCT/DIS

Department DIS (Durcissement – Instrumentation – Sécurité)

- Hardening
  - EMC (electromagnetic compatibility)/ EMI
  - NEMP
  - TREE (Transient Radiation Effects on Electronics)
  - Lightning protections
- Instrumentation
  - Development and production of captor
    - From 30 MHz to 4 GHz & 500 V/m to 10 kV/m
    - From 10 kHz à 2.5 GHz & 0.5 V/m à 1 kV/m
  - Pulse power generator
- Safety

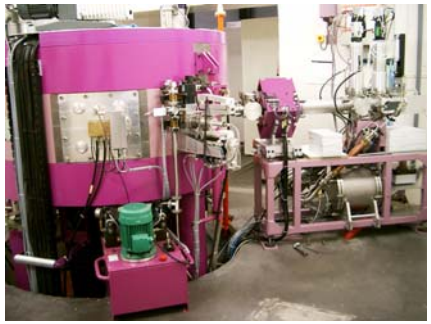
Remarque: The presentation today deal only with Thales departement DIS involvement in XFEL project.

Example of DIS department developments and realisation

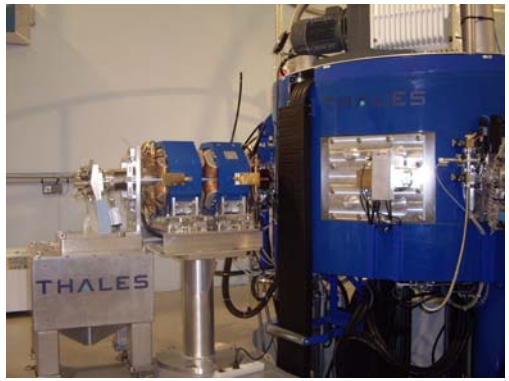
Linac Soleil pre-injector (France) : 100MeV

Synchrotron Alba pre-injector (Spain) 100MeV

Cyclotron: 7 & 15 MeV



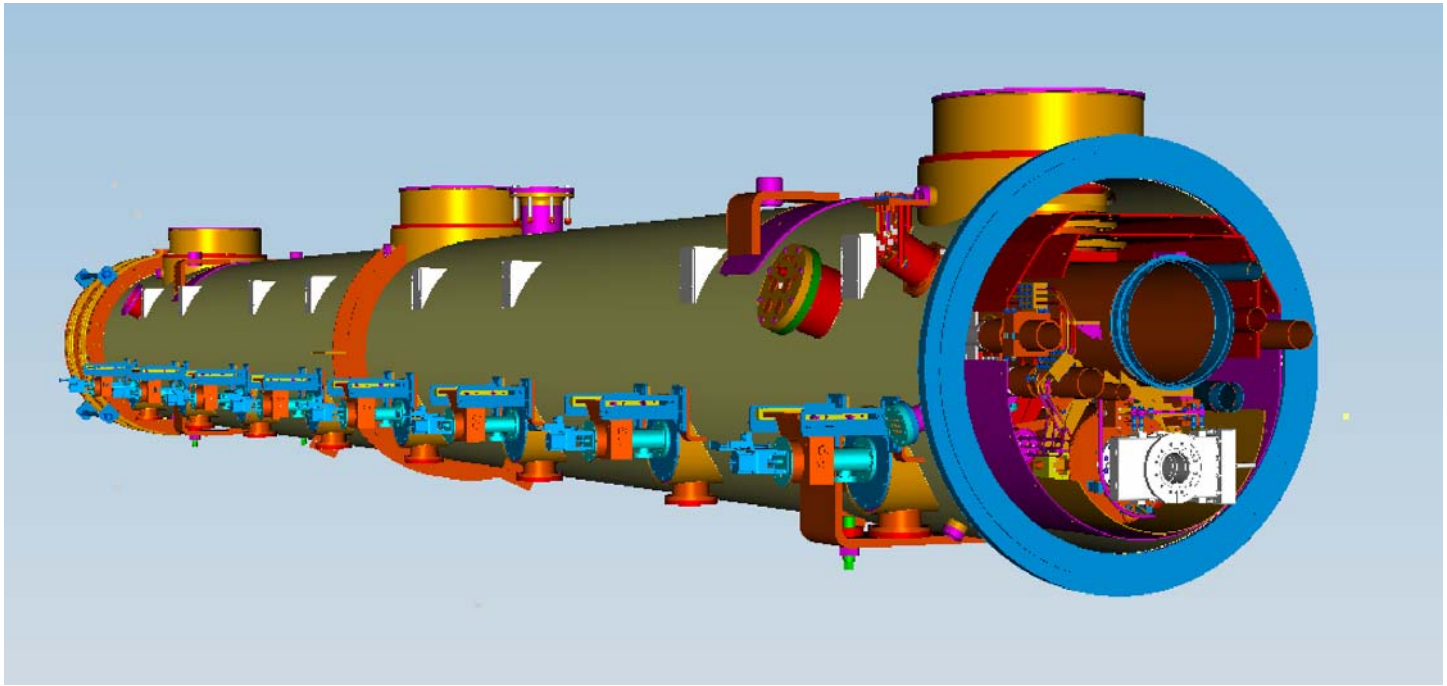
Cyclopharma Clermont-Ferrand



Pulse power generator: 100 GW

XFEL EPI: preliminary industrialisation study

Thales was contracted by CEA for preparing an industrialization study for the XFEL cryomodules assembly in the site of Saclay (France)



Our aim is to add to the CEA technical knowledge
our industrial know how capabilities

XFEL EPI: preliminary industrialisation study

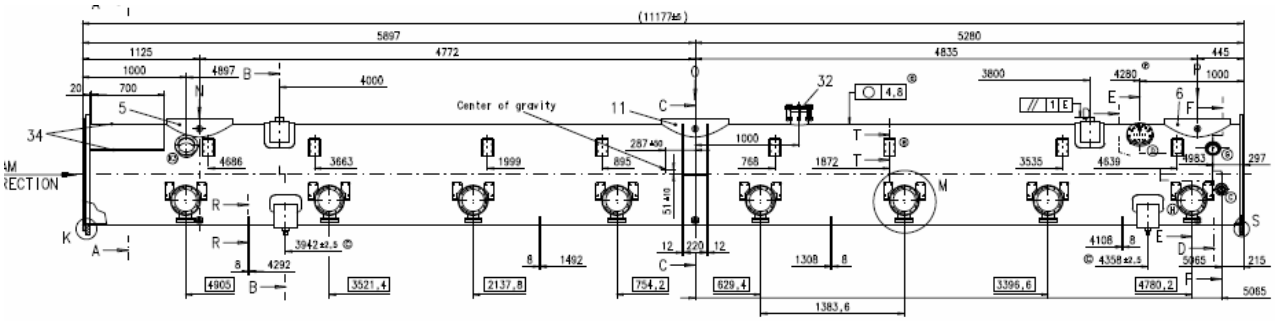
The production organisation has to achieve the following objectives:

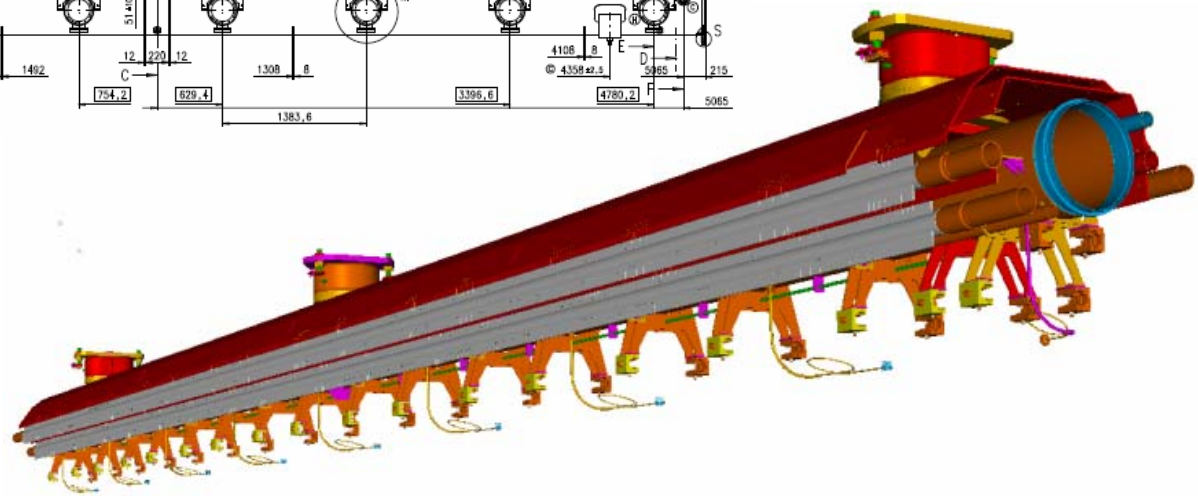
- Assembly of one cavity string (8 cavities) per week
- Delivery of one cryomodule per week
- A Global production of 100+3 cryomodules with:
  - A ramp up with 3 pre-series
  - A traceability of each part of the module and safe data management,
  - Some partial electrical measurement
  - Leak checks and measurements of critical quotes
  - The respect of ISO14001 (environmental standard) procedure

XFEL EPI: preliminary industrialisation study

First steps are under way.

- Thales is manufacturing one Cold mass and one vacuum vessel prototype for DESY (delivery before Christmas)





- During 2008 Preliminary Study for Industrial cryomodules integration and test at CEA Saclay site (EPI)

XFEL EPI: preliminary industrialisation study

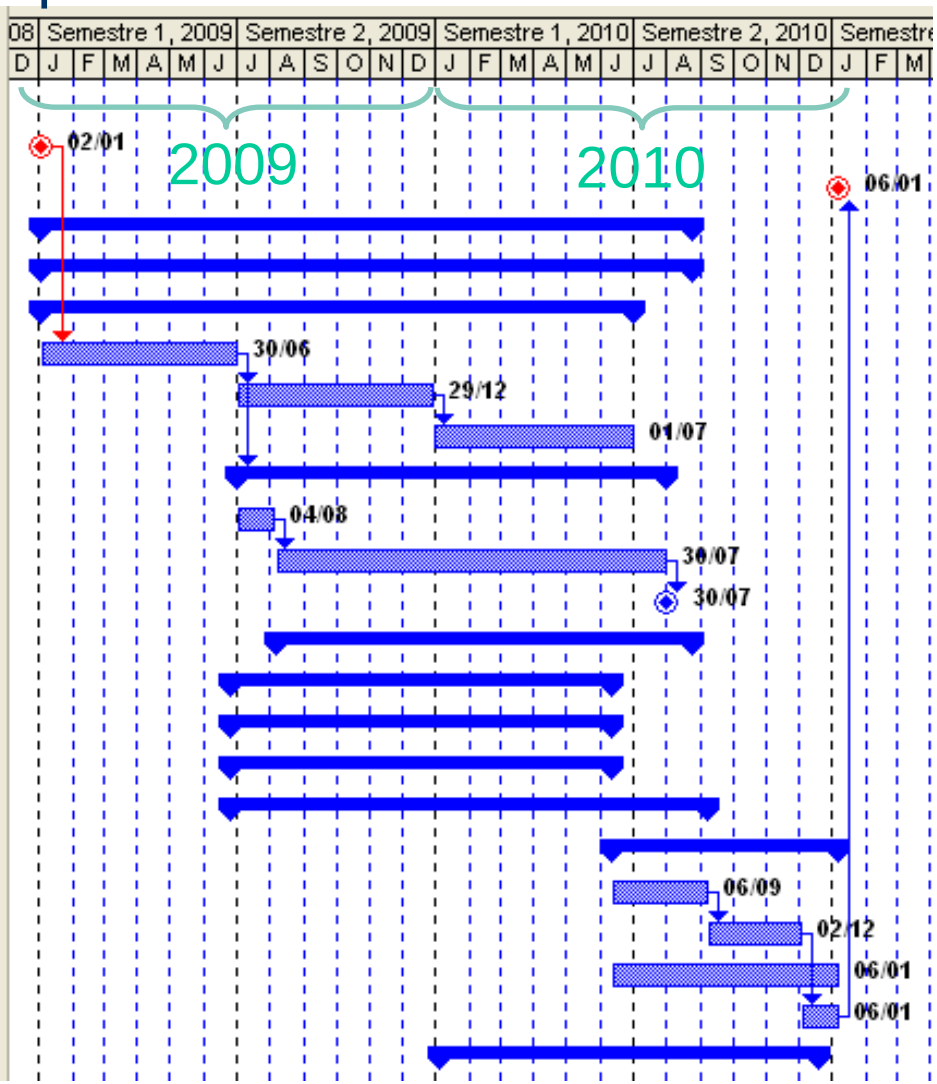
Before starting the series production:

- Further Steps to achieve to be ready for a full production during 2011&2012:
  - ERP order (computer assisted production management software)
  - Study, built and install the necessary tools.
  - Quality, Safety and Environment plan & procedures
  - FMEA (failure mode effect analyses) during the ramp up
  - Take part into the prototype assembly at DESY (spring 2009)
  - Recruit & train the production teams
  - Update of the production files

XFEL EPI: preliminary industrialisation study

Before starting the series production

Index WBS	Nom de la tâche
1	**Production initialization**
2	T0
3	T1 Start of the serie production
4	**Facitities preparation**
4.1	**Tools realisation**
4.1.1	**Cart**
4.1.1.1	Study
4.1.1.2	realisation
4.1.1.3	Validation & qualification of the cart
4.1.2	**Cantilever**
4.1.2.1	definition files modifications
4.1.2.2	Realisation
4.1.2.3	Acceptation in CEA facitiy
4.1.3	**Other Tools**
4.2	**Work station installation**
4.3	**ERP choice and installation**
4.4	**Quality / ISO14001 / Safety**
5	**definition of the worker and constitution of the t**
6	**3 preseries cryomodules: ramp-up**
6.1	First shif training
6.2	Second shift training
6.3	FMEA
6.4	Up date of the fabrication files
7	**Order of the sub systems and pieces**

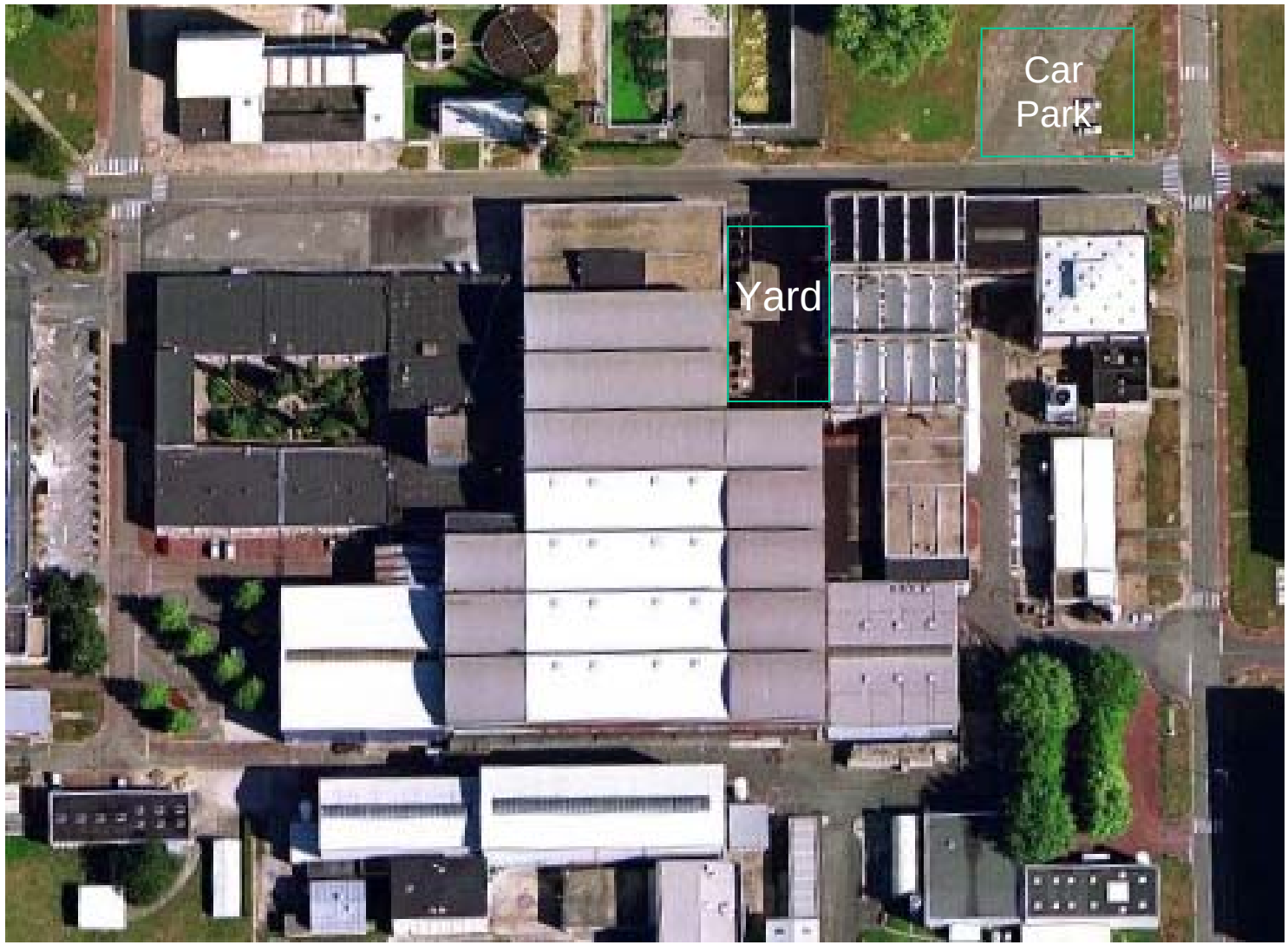


XFEL EPI: preliminary industrialisation study

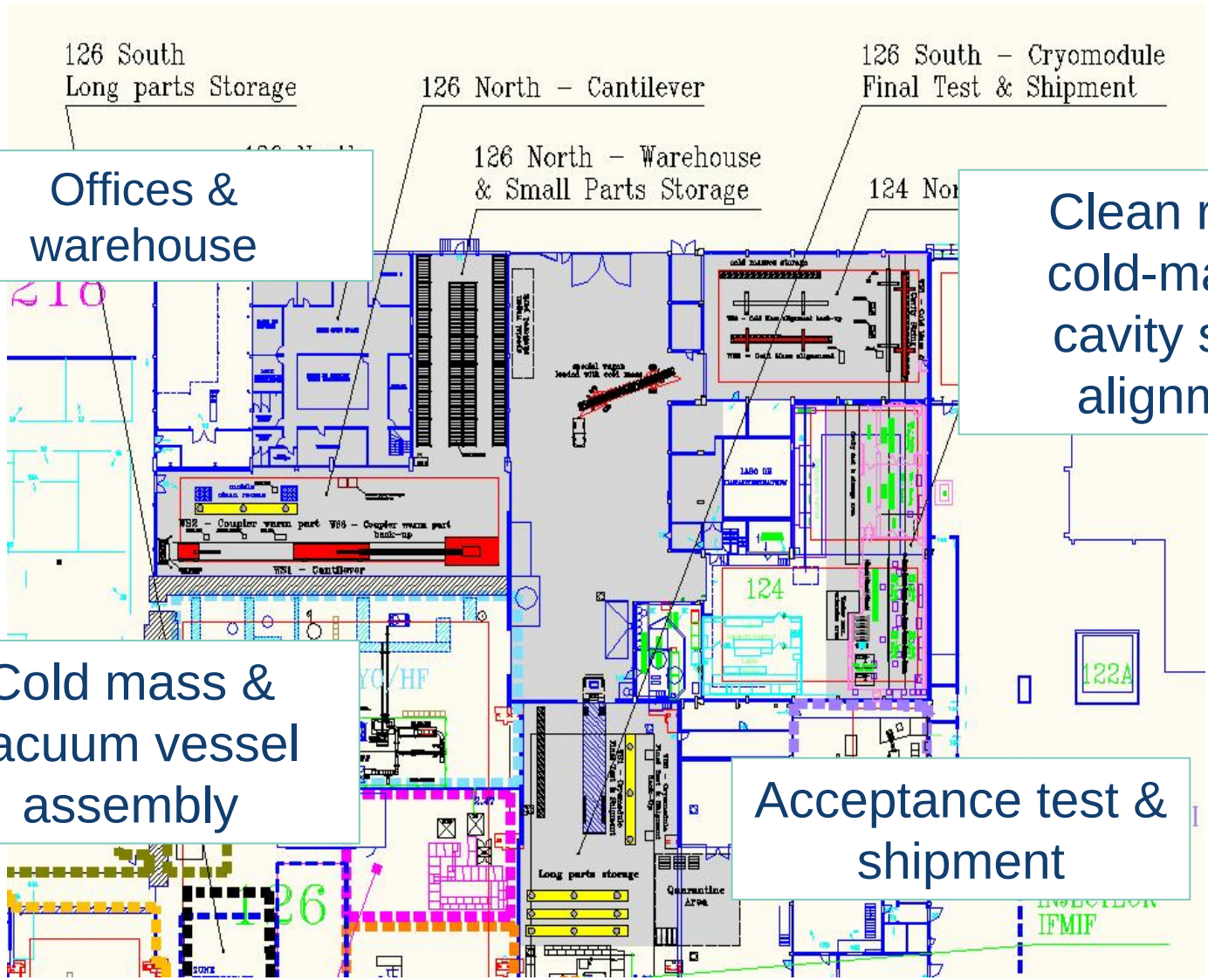
The pre-industrialisation (EPI) objectives are:

- To define the infrastructure
- To establish the Fabrication files
- To list and define the tools
- To analyze the main risks
  - Infrastructure, manpower, utilities, test equipments, tooling, training, etc…
- To estimate the full cost

XFEL CEA Saclay Infrastructure Plans



XFEL CEA Saclay Infrastructure Plans



Offices & warehouse

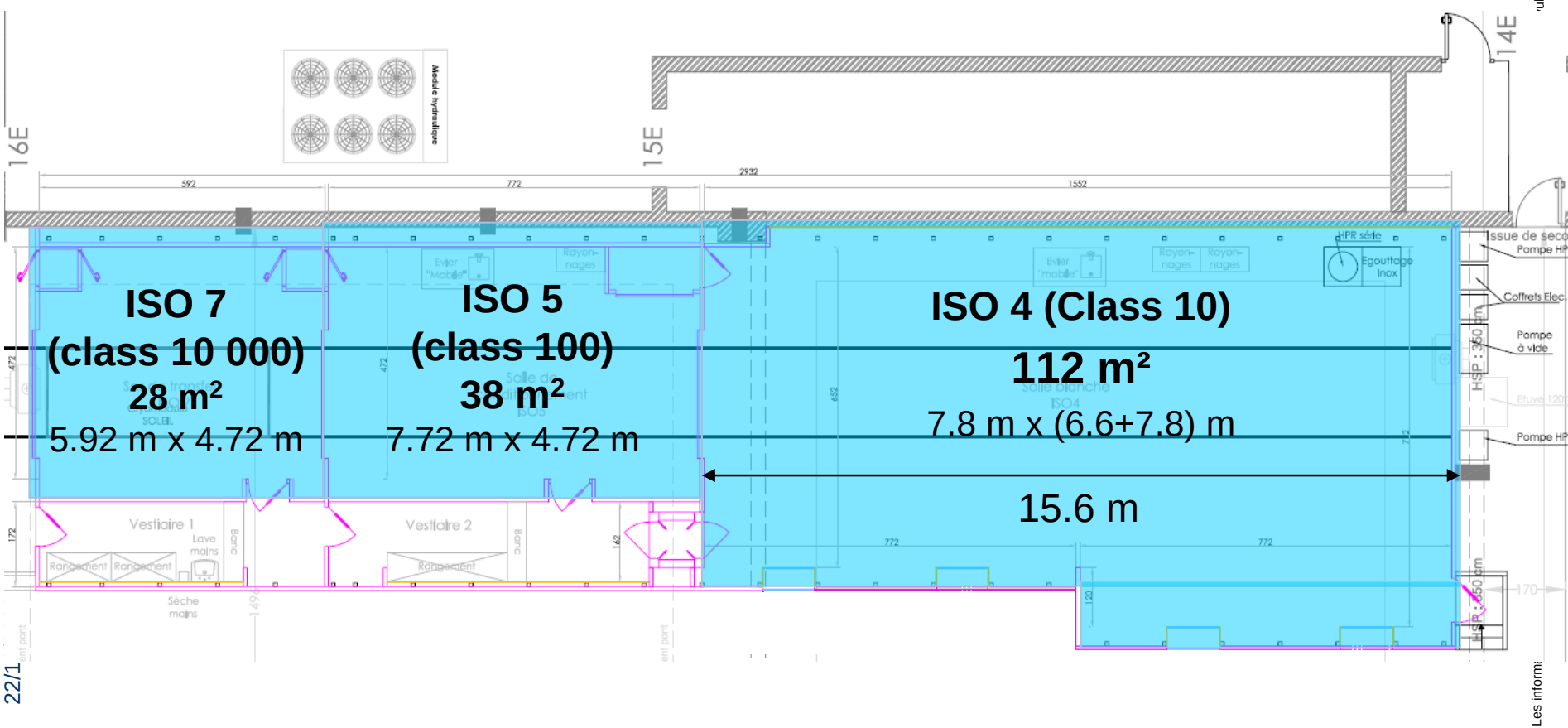
Clean room, cold-mass & cavity string alignment

Cold mass & vacuum vessel assembly

Acceptance test & shipment

XFEL CEA Saclay Infrastructure Plans

Clean room : mostly designed by CEA and ‘Faure Ingénierie’, construction starts, ready for operation by mid-2009



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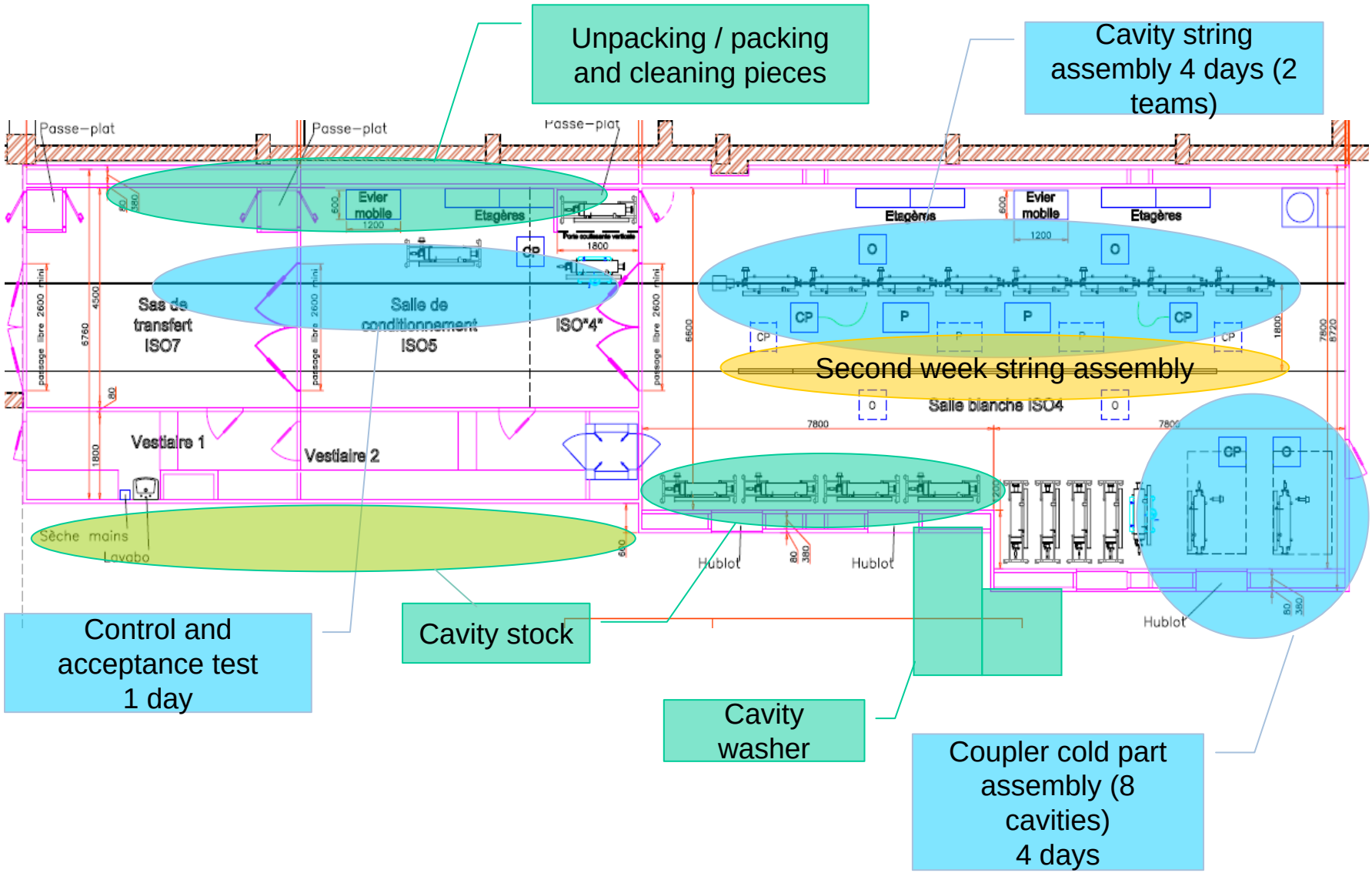
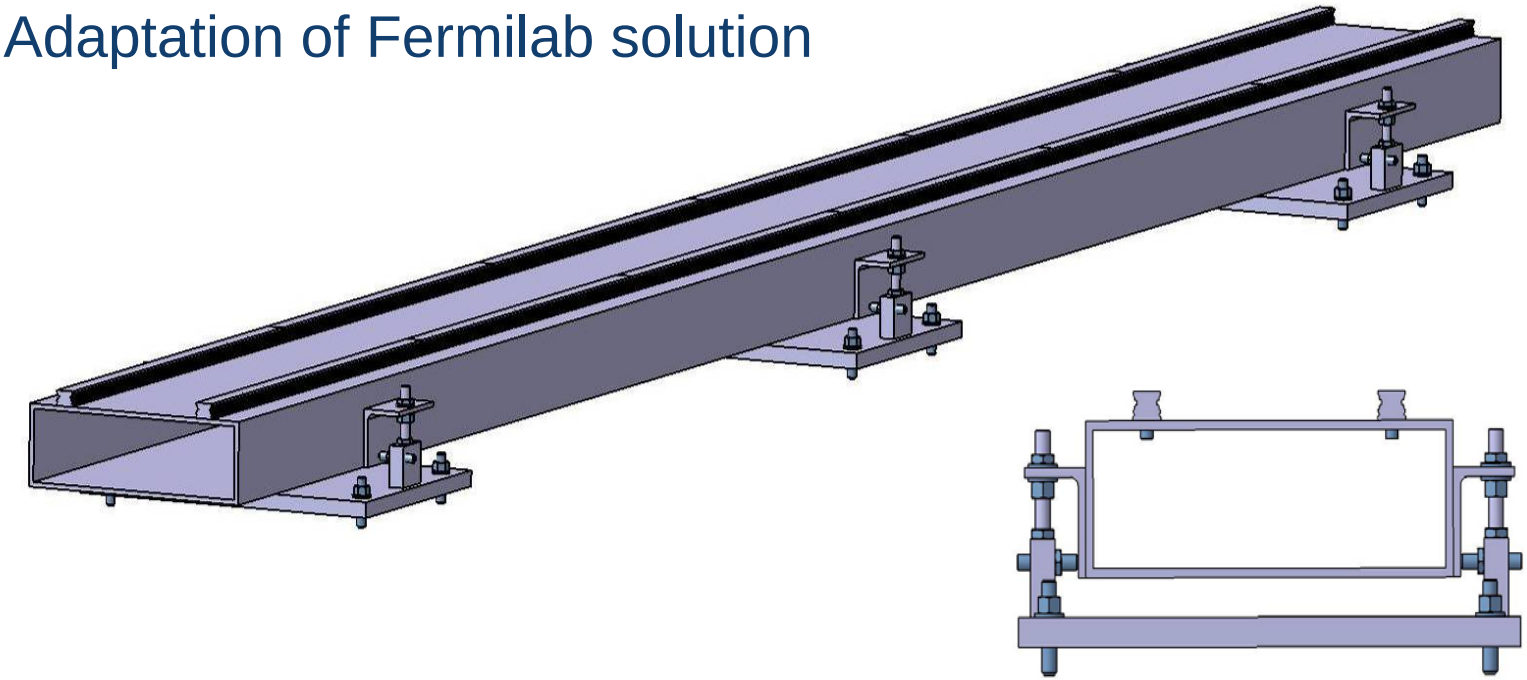
XFEL CEA Saclay Infrastructure Plans



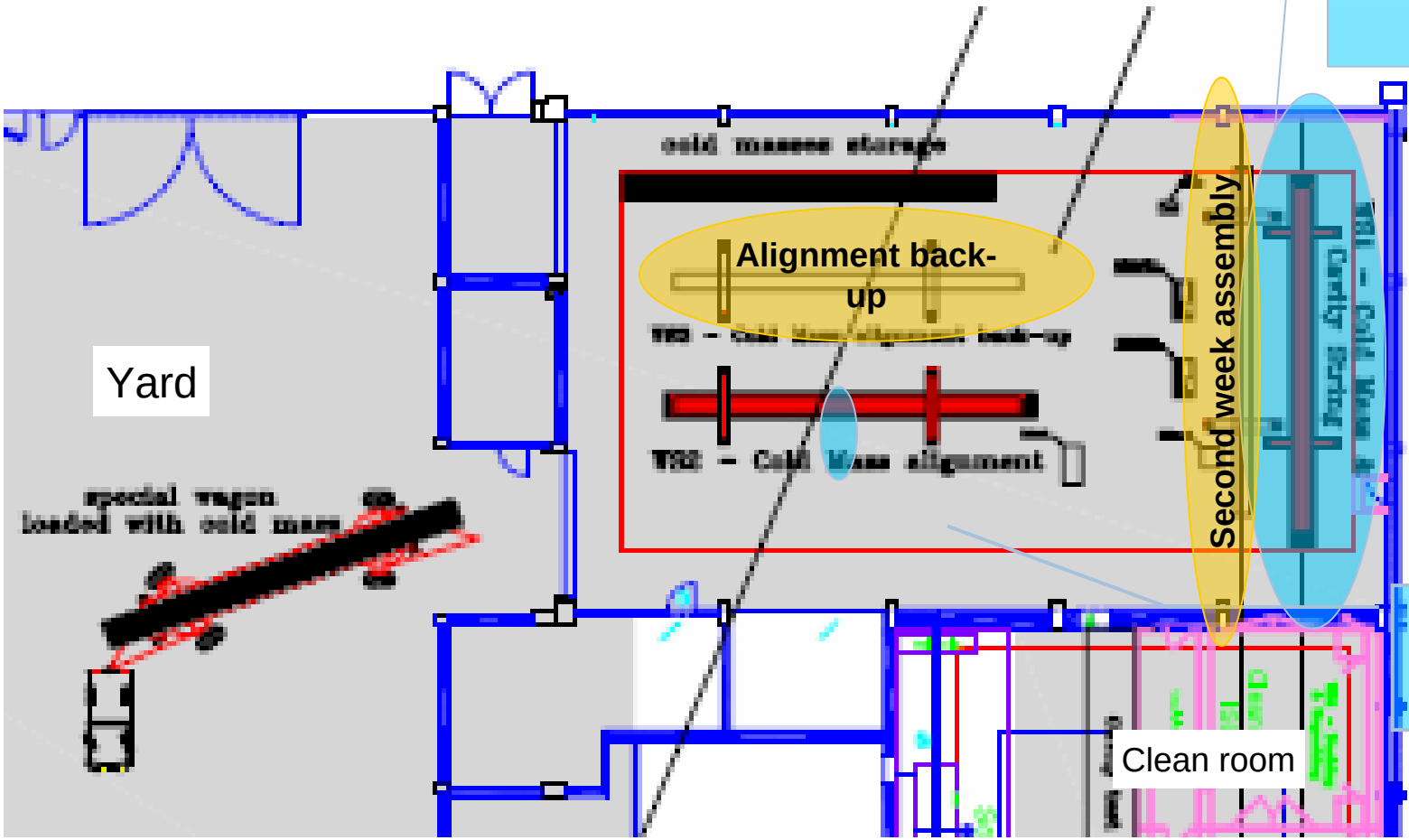
Importance of Rail system choice for cavity string assembly and motion:

- Adaptation of Fermilab solution

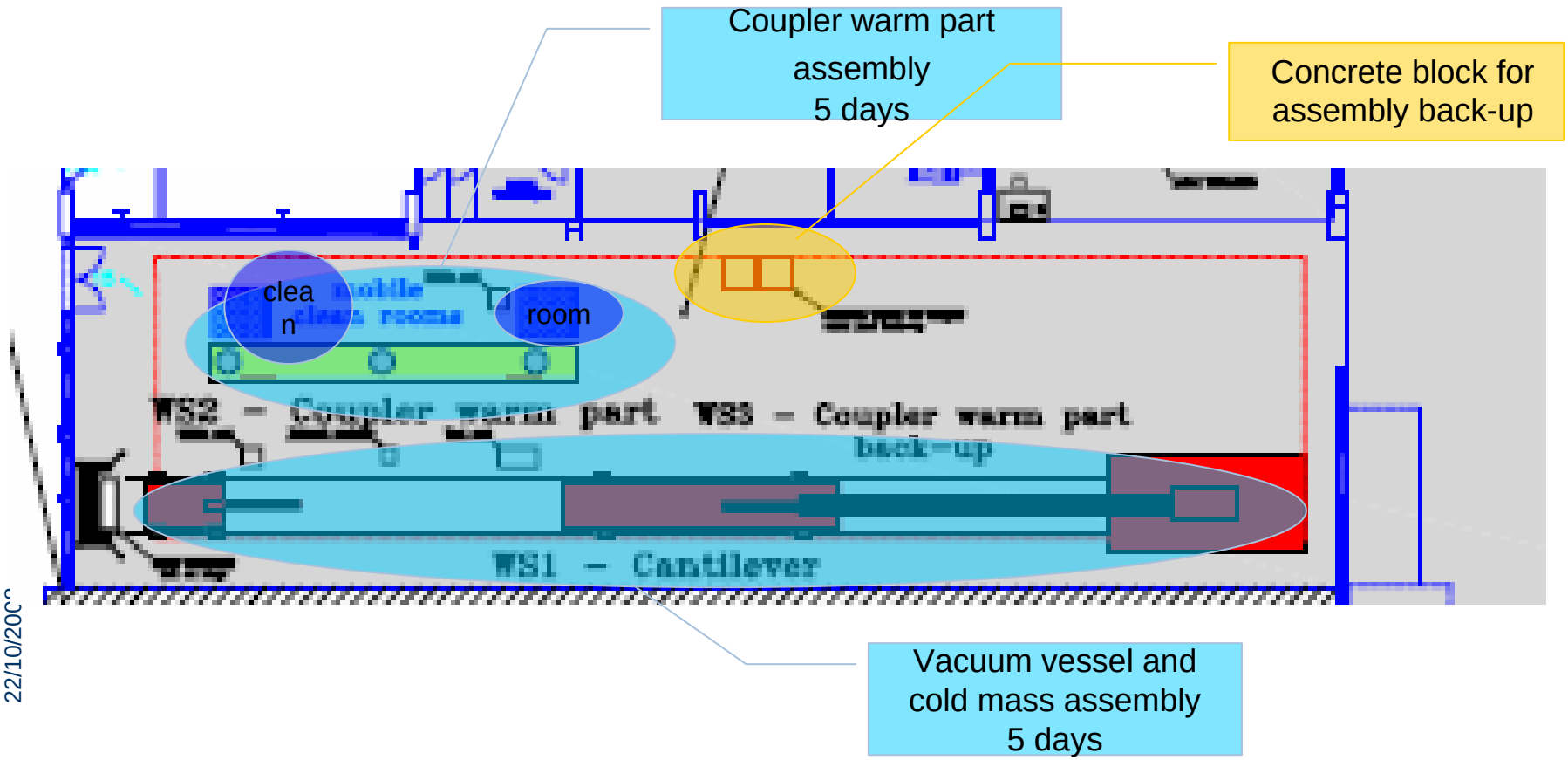


Objectives:
To ensure a good relative alignment of cavities before assembly

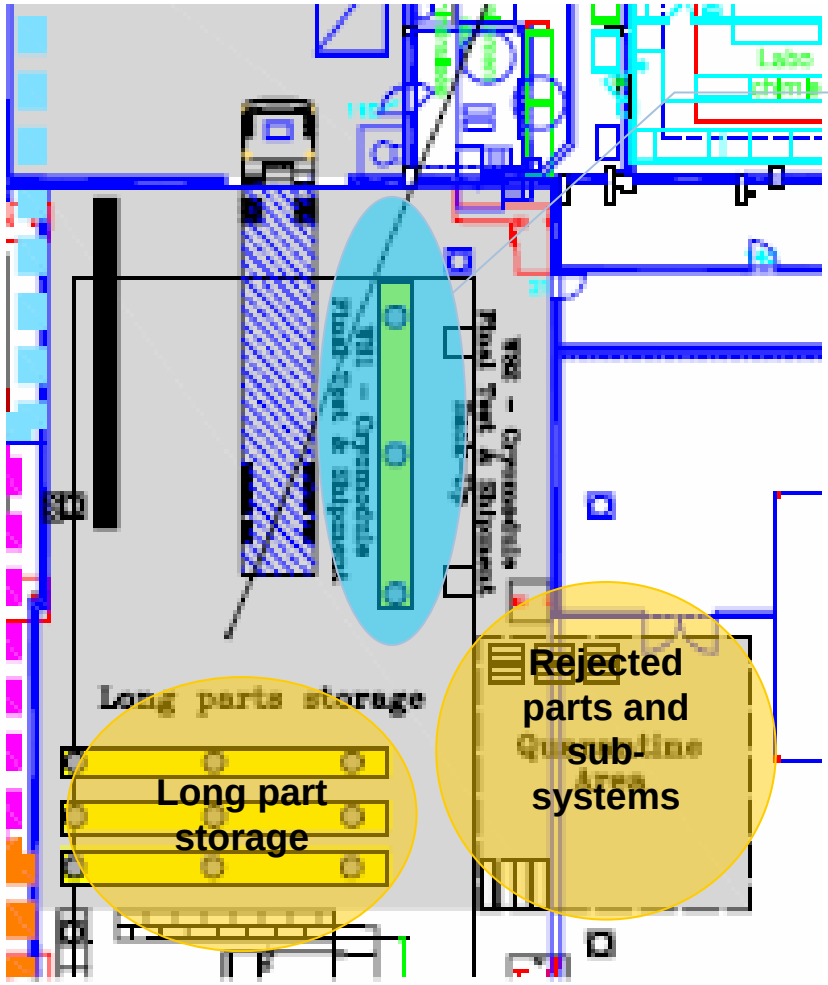
Cavity string and Cold mass assembly



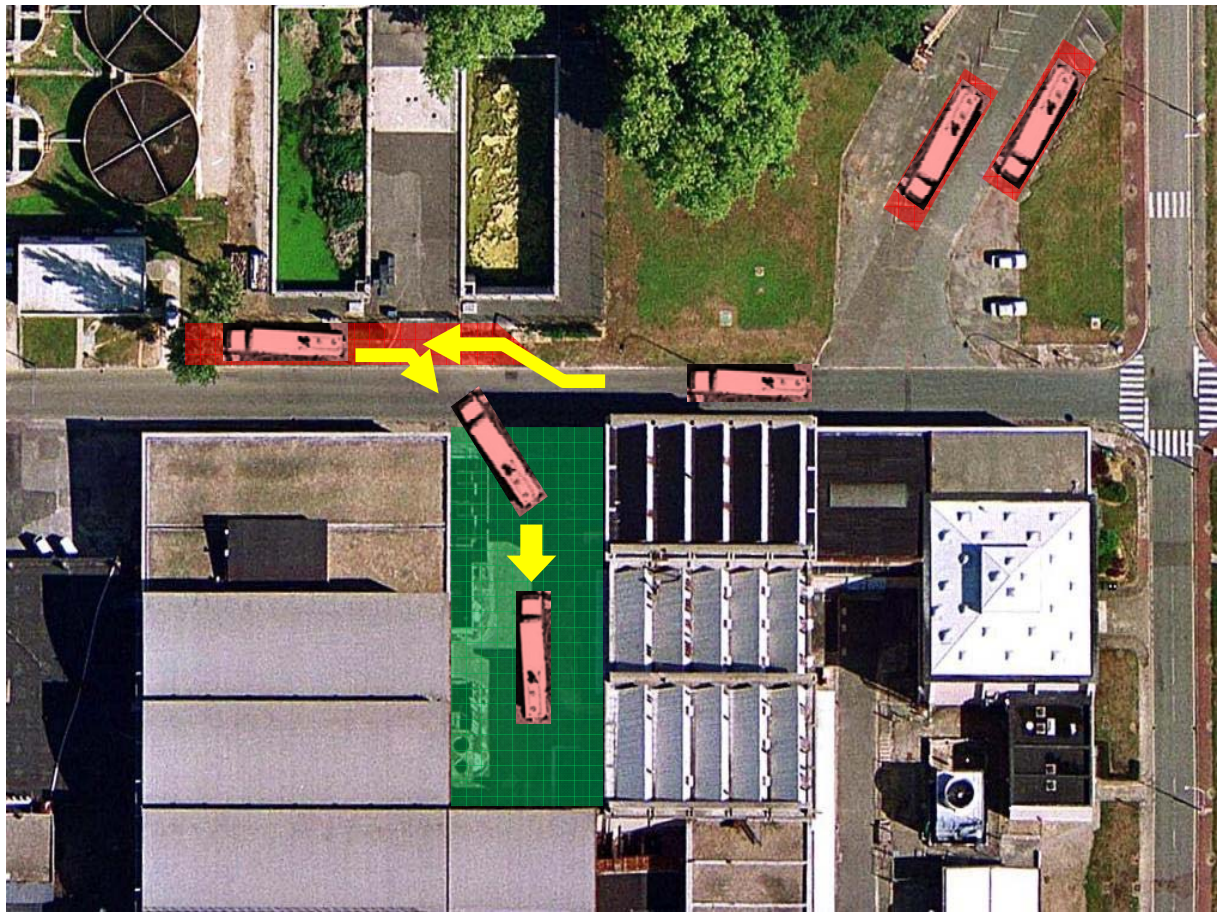
Vacuum vessel and cold mass assembly



Final test and shipment



Yard

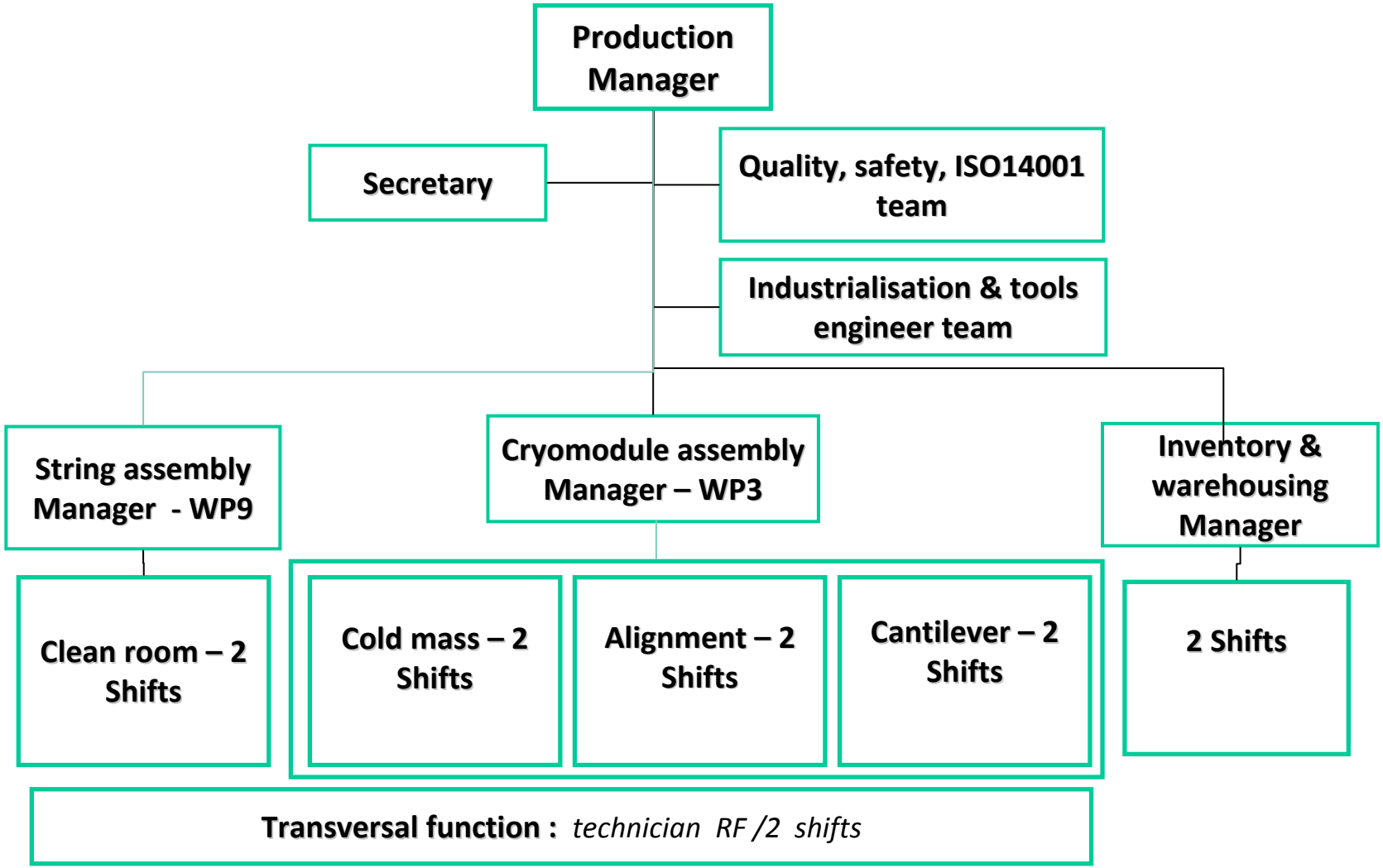


XFEL production challenge

Our risk analyses lead to following issue of XFEL module assembly:

- The difficulty to identify and fix a discrepancy
  - Target: a zero default production
  - ➢ The importance of the Quality Plan & Procedure.
  - ➢ Well trained team
- Assembly of critical sub-systems coming from different places with a configuration to manage.
  - Many data to exchange
  - Rigorous configuration management
  - ➢ Importance of the ERP
- The short lead time of production
  - A cryomodule to deliver per week
  - ➢ 2 Shifts organisation

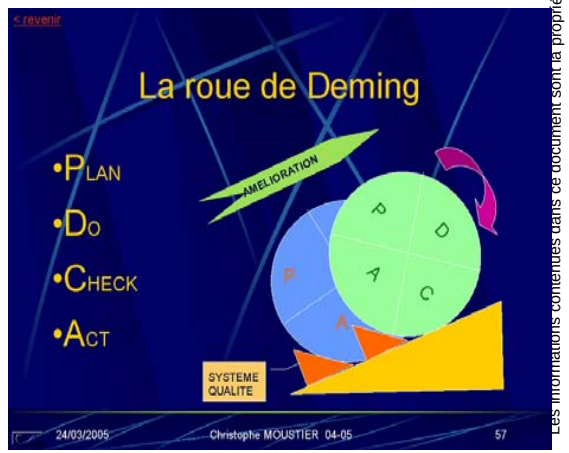
XFEL production challenge



XFEL production challenge

A Key job: Quality / Safety and ISO 14001 Manager:

- Start working one year before the production
- Use the DESY experience and FMEA to define
  - The Production check lists
  - The “traveller” (document describing the life of the module during its production)
  - Define the quality/safety and environment Plans
- Validate the controls and quality procedures during the ramp-up
- Organise:
  - Acceptance test of the string cavity
  - Acceptance test of cryomodules
- Implement continuous improvement methods during the production
  - Define discrepancy and qualities indicators
  - Organise weekly continuous improvement meeting



XFEL production challenge

Teams organisation and training:

- Special training on Quality, controls and continuous improvement methods
  - To insure a independent quality controls at each step of the production, the controls team must be different from the assembly team
- Training continuous improvement methods
  - Regular participation of the teams to continuous improvement meetings
- A slow ramp up to validate production files and finalize the FMEA studies
- A special attention on manpower turn over and new member training

Importance of the experience of DESY to teach the team during the pre-series

Roles of the ERP:

- To archive:
  - The incoming information (delivery bills, sub contractor proposals, CoC…)
  - The project documentations:
    - Fabrication files, blank check list, quality plan…
    - Acceptance documents and check list
    - Minutes of meetings
  - The outgoing documents (orders, delivery bills, …)
- To manage the warehouse:
  - Inventory (stock) control
  - Preparation informations…
- To organise the configuration management
  - Of the modules
  - Of the documents :

XFEL production challenge

- To manage the production:
  - Give information on the state of the production for each module and on each work stations
  - Archive check-lists
  - Archive « traveller »
- To edit indicator on
  - Production status
  - The controls status of each modules or cavity string
  - Stock status
  - Cost status
  - Discrepancy status…
- To be interfaced with EDMS (DESY database) for other work package information

Objective Zero paper

XFEL production challenge

The lead-time of production sets a timing for each workstations:

- The movement of the module from a workstation to the next one has to be done the same day
- The work organisation has to be conform to the CEA labour and security rules

- EPI study limits: the time indicated in the production files are coming from different documents and presentations analyse and will need to be validate by observation of a modules assembly.

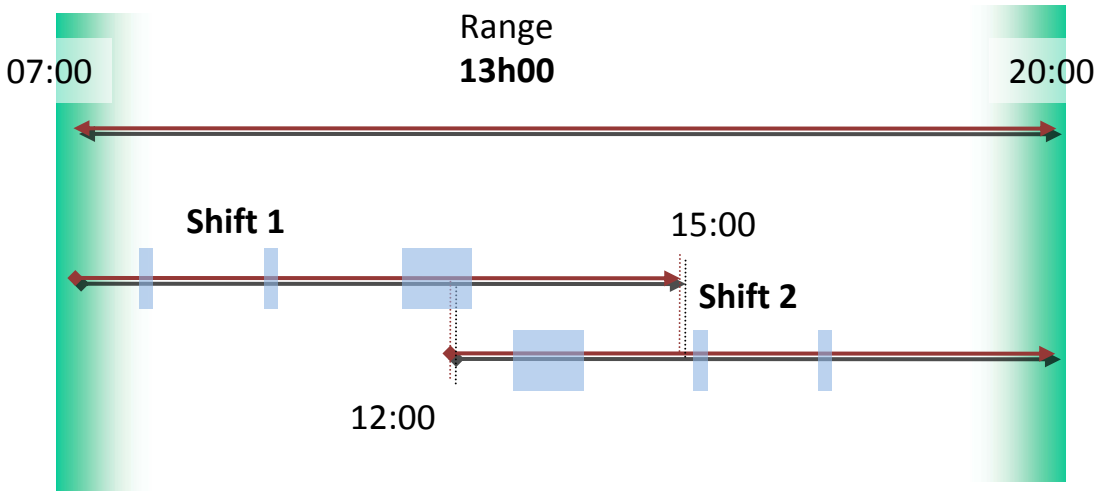
Conclusion of the assembly time analysis:

- 5 days of 7 hours even with two teams working on each end of the module, is not enough for some workstations

➢ Two shift organisation

Shift organisation

- Range of work 13 h per day
- Effective work 14h per day with 7h per shift



Conclusion

The EPI studies will be finished in 2 months.

The EPI study:

- confirms the feasibility of using CEA Saclay has a production site
- gives clues to organise the work during the next two years.
- provides a preliminary production files & associated plans
- will prepare the production risk analyses.