SPIRAL2 PROJECT:
INTEGRATION OF THE ACCELERATOR PROCESSES,
CONSTRUCTION OF THE BUILDINGS
AND PROCESS CONNECTIONS
OUTLINE

- Introduction
- Definition of the needs and preliminary design
- Implementation studies
- Building construction
- Process connections
- Conclusion
SPIRAL2 is one of the ESFRI list projects (45 most important EU research infrastructure projects).
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The SPIRAL2 facility

SPIRAL2 Project

Phase 1

Existing GANIL facility

Introduction
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The SPIRAL2 facility

Phase 1

Phase 2
RIB Production Cave

SPIRAL2 Project

constructed

Existing GANIL facility

Introduction
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**Introduction**

**Phase 1**
- DESIR Facility low energy RIB (constructed)

**Phase 1+**
- DESIR Facility low energy RIB

**Phase 2**
- RIB Production Cave (postponed)

**The SPIRAL2 facility**
SPIRAL2 is one of the ESFRI list projects (45 most important EU research infrastructure projects)

**Introduction**

Phase 1
- DESIR Facility low energy RIB

Phase 1+:
- In design
- Existing GANIL facility

Phase 2
- Postponed
- RIB Production Cave

SPIRAL2 Project

The SPIRAL2 facility
1) Baseline Configuration of the processes

For the accelerator:
- Heavy ion source (A/q=6) and RFQ - optional upgrade
- LEBT lines
- RFQ (MEBT line)
- ECRIS (A/q=3, 1mA)
- ECRIS (d^+, H^+, He, 5mA)
- QWR 88MHz (\(\beta = 0.07\))
- SC Linac
- QWR 88MHz (\(\beta = 0.12\))
- Neutron For Science
- d^+ : 20 MeV/n
  HI : 14.5 MeV/n
- RIBs production

For NFS:
- NFS 8520

For S3:
- S3
2) Implementation of the SPIRAL2 Product Breakdown Structure (PBS)

- Mixed with geographical structure (for ex : by beam line section) and with technical structure (by trade for ex : electricity supply)

- 6 levels

- Representation of the project organization, the budget, the documentary structure...

- provide codification for equipments and for plans
Definition of the needs and preliminary design

3) Getting all the required conventional facilities for each equipment

- Electrical power
- Water cooling
- Compressed air
- Thermic air dissipation
- Heat load
- Weight, size
- Power distribution
- Fluid distribution
- Climatization
- Handling
- Civil engineering

Building contractor responsibility

Equipment design:

- Heat load
- Cables
3) Getting all the required conventional facilities for each equipment

- Electrical power
- Water cooling
- Compressed air
- Thermic air dissipation
- Heat load
- Weight, size
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Building contractor responsibility
- Power distribution
- Fluid distribution
- Climatization
- Handling
- Civil engineering
- Fire sectorization definition

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Definition of the needs and preliminary design

3) Getting all the required conventional facilities for each equipment

- Equipment design
  - Electrical power
  - Water cooling
  - Compressed air
  - Thermic air dissipation
  - Heat load
  - Weight, size
  - Cables
  - Power distribution
  - Fluid distribution
  - Climatization
  - Handling
  - Civil engineering
  - Building contractor responsibility

fire sectorization definition
Definition of the needs and preliminary design

4) Data collection with EXCEL files elaborated from PBS

5) Generation of synthesis data in order to define building Interfaces for each room and for each work package

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**Base**: for the building preliminary design and secondly for writing the work package call for tenders (building and process connections)
Definition of the needs and preliminary design

Decision to design the entire project with 3D tools (high degree of complexity of the processes and very high level of the integration including connecting pipes and cables trays).

3D model of the building design with SolidWorks

3D model of the processes design with CATIA

guarantee our ability to install, set up and maintain the equipments.

3D modelization of the facility with SolidWorks tool
Beam axis is -8 m
Implementation studies

3D synthesis operation

The integration and synthesis process consisted in:

- Positioning equipments into the building and providing these equipments with all services and connections necessary for their functioning.
- Ensuring the spatial coherence for all equipment in respect of the architectural constraints and technical capacities, for both exploitation and maintenance.

Organization:

For each firm: same software, same graphics rules and same modelization structure (by building level and by block).

The synthesis process was carried out synchronizing nine companies, the building prime contractor, the assistant and the SPIRAL 2 project team, day after day over a twelve months period (March 2011 to March 2012).

*it was a challenge!*
Implementation studies

Organization of 3D synthesis operation

Synthesis Cell for Process and connections Work Packages

Global synthesis by SP2 Team

Database

Synthesis Cell for Buildings Work Packages

WP1 WP2 WP3 WP4

WP20 WP30 WP40 WP50 WP60 WP70 WP80

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Implementation studies

3D models for the injector block level -2

Building WP: Civil engineering
Implementation studies

Building WP: Civil engineering

Building WP: water cooling system and non nuclear ventilation

Building WP: cranes

Building WP: nuclear ventilation

Process WP: electrical connections

Processes

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20
Compilation of all 3D models

Implementation studies
Implementation studies

Interference checking in the block
Implementation studies

The synthesis process has provided:

- A 3D high definition global integration without spatial interference
- The size and position of more than 1,000 reservations (reinforcement needed to realize the concrete floors and walls)
- The position of ground pin connections (good electromagnetic compatibility → high beam quality)
Building construction

Buildings:
- Height: +8.80 m; Depth: -9.50 m
- 4 levels
- ~100 rooms
- 7200 m²

Surface area:
- Width = 80 m; Length = 133 m

The key dates of the building construction are:
- Construction permit: October 2010
- Excavation start: January 2011
- Pouring of first concrete: September 2011
- First process installation: November 2012
- Building handover: October 2014
- Processes connection handover: April 2015
Status of building construction: Mai 2011
Status of building construction: Mai 2012
In October 2014, 14,000 m³ of concrete were poured with 2200 T steel reinforcement (280,000 hours for civil engineering)
Status of building construction: October 2014
Process connections

Four work packages directly managed by the SPIRAL 2 team have been contracted to realize this “connecting work”:

- One fluid work package for the water cooling connections and air connections (700 valves).
- One RF power distribution work package to distribute the 600 kW@88 MHz (for accelerator cavities) through 1,200 m of coaxial lines (broadcast).
Process connections

- Two electrical work packages to install 10,000 m of cable trays, 400,000 m of cables, more than 20,000 connectors and the electrical distribution cabinets.
Process connections

- Two electrical work packages to install 10,000 m of cable trays, 400,000 m of cables, more than 20,000 connectors and the electrical distribution cabinets.

Default rate before correction < 1% : 😊
Conclusions

- the buildings are now constructed,
- the main part of the cables and connections are installed,
- the injector is under tests and the superconducting LINAC is now being installed.
Conclusions

For the integration, synthesis, construction and set up of a complex facility such as SPIRAL 2 our main feedback concerns the followings:

1. The Contractors underestimated the complexity and the number of connections required by our processes.

2. The data collection and synthesis is an enormous task (a lot of time and resources). Spreadsheet files is not appropriate. A database seems much more adapted.

3. For a large facility, a detailed 3D modelization with a high level of integration is required.
   - Risks were minimized (spatial interference, difficulties of assembly and maintenance).
   - It’s a powerful tool to design and construct buildings and infrastructures, and then, to control the execution (potential tool to operate).
4. 3D model file sizes are enormous and global assemblies are often difficult to visualize. Simpler model in particular for the processes are required.

5. The goal is reached:

Such as designed = Such as built

or

3D = Reality
Thank you for your attention

On behalf the team of the SPIRAL2 integration cell and the whole SPIRAL2 project team