AMICI WP5 INDUSTRIALIZATION

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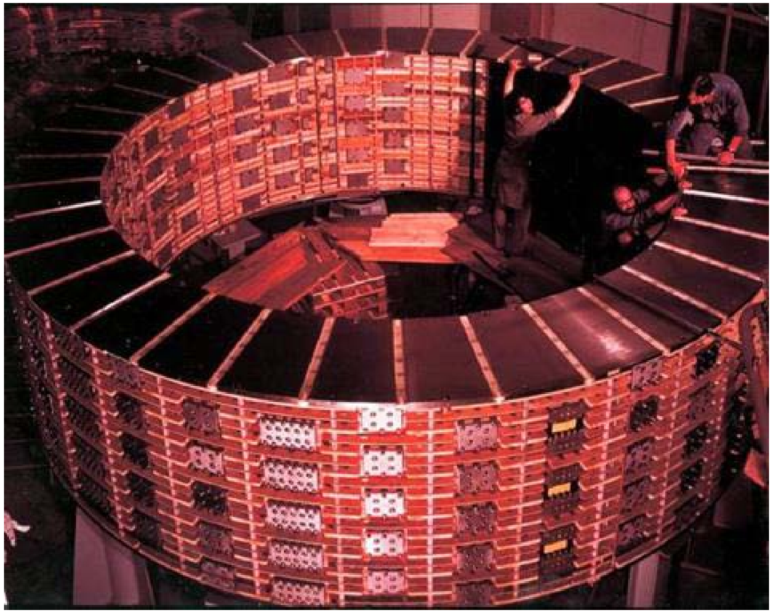


BEBC developed at CERN in the seventies → About 20 years later

OUTLINE

1) Objectives of WP5
2) Tasks

T5.1 Professional training and apprenticeship

T5.2 Harmonization- Material and Component Reference

T5.3 Harmonization - Cryogenic Safety Procedures

T5.4 Requirements and conditions for developing prototypes with the industry

3) Organization of the work

I will mainly report on the presentations and discussions held yesterday at the WP5 Workshop

OBJECTIVES

- The overall goal of this Work Package is to sensitize and train the industrial companies in the needs, the knowledge (know-how), the techniques, the methods and the quality standards involved in the accelerator and superconducting magnet technologies developed in the Research Institutes.

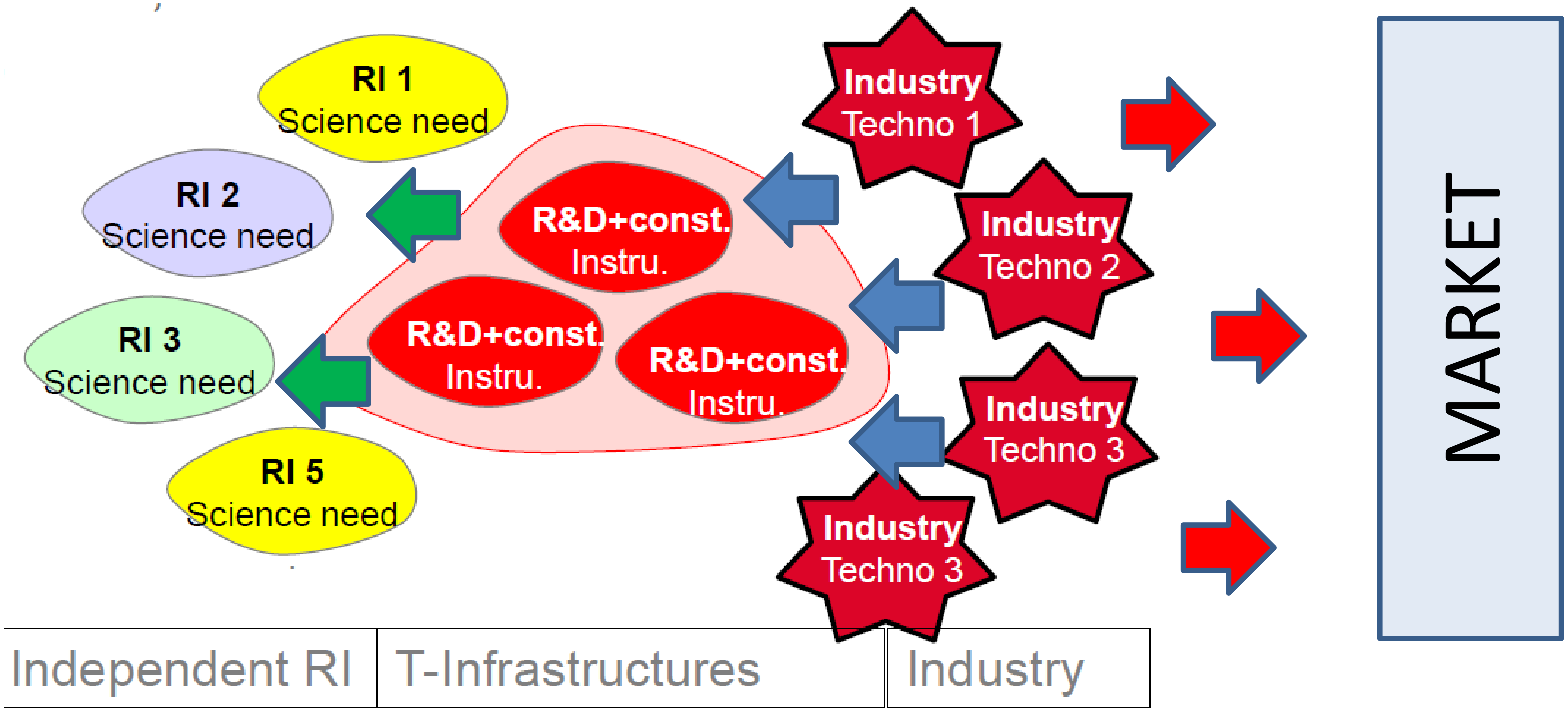
- We should allow the industries to be able to develop and construct, also independently, accelerators (or components of accelerators) and sc magnets for research projects (industrialization) and, possibly, applications beyond RI interests (innovation) and to placing European Industries in position to participate in the construction of new Research Infrastructures in Europe and worldwide.

WP5 Industrialization

Industry for Research's benefit

- Professional training and appendiceship
- Harmonization (Materials – Cryogenic Safety)
- Prototyping in industry

In the end industry also benefits for their own new product development (i.e. innovation → WP5←→ WP4)



T5.1 Professional training and apprenticeship

TL Stéphan Berry (CEA) - Other participants DESY, INFN

This task aims at promoting professional skills training and cross improvement between research laboratories and industry by profiting from the excellent scientific and technical environment provided by their Technological Infrastructures, and eventually proposing a development plan for generalizing such a program across European Technological Infrastructures. In this way, personnel may bring technical and scientific knowledge as well as approaches to the R&D work, which are not available within the hosting party.

A) Training and apprenticeship in TI

B) Training and apprenticeship in industry

From presentation of S.Berry

A) Training and apprenticeship in TI

- Defining the conditions (where, how, how long)…

setting the basis for an apprenticeship program (what)

where professional technicians and young engineers

from relevant industrial partners (who is eligible)

would be trained by hands-on fabrication, assembly or test of accelerator and magnet equipment and by exercising key techniques (examples next slide)

- To facilitate this program, the **certification of the Training Courses** provided by scientific laboratories towards Industry will be addressed and supported.

Presentation of S.Berry

Definition of training courses on key techniques (examples)

Key techniques	Hands-on work	Hosted by *(TI)*	Duration *(in hours)*	Certificate name *(tbd)*
Ultra-high vacuum and cleanliness	Single cell preparation for cold RF test			
Eddy-currents Scaning	Niobium sheet analysis			
RF engineering	Cavity tuning			
RF engineering and Cryogenic	Perfom a cold RF test of the cavity			
SC coil winding and electrical connections	…			

Presentation of S.Berry

B) Training and apprenticeship in industry

- The engagement in industrial R&D activities and in services to the industry aimed at innovating their products and processes would benefit from the secondments of researchers and technical personnel within the companies themselves. Seconded personnel may obtain a more direct and a deeper understanding of the problem being worked, including initially overlooked requirements, constraints and potentialities and conversely they may acquire knowledge and be trained to new techniques, equipment and methodologies.

Presentation of S.Berry

Open questions

- We need to collect all past experiences of AMICI participants and other networks
- Which Industrial Partner is eligible to Training Courses ?
- Does it break the call for tender rules?
- Which tools to track the technician or engineer certifications?

From presentation of S.Berry

T5.4 Prototyping

T5.4 Requirements and conditions for developing prototypes in the industry

TL Paolo Michelato INFN - Other participants CNRS

Define requirements and conditions for prototype development in industry with the idea that taking a leading role in the construction of prototypes for the TI, can represent for industry a very effective way to acquire firsthand knowledge of cutting-edge technologies and to provide feedback on engineering aspects that are important for the latter-stage industrialization process

T5.4 Prototyping - Scenarios

Two scenarios should be taken into considerations.

1) The **industry** develops prototypes **in the facilities of the TI** in **close collaboration** with TI personnel.

2) The **industry** develops prototypes **in their facilities** taking advantage of **existing tool** or other technical infrastructure **not available in the TI.**

In both scenarios the prototype development could contribute in **taking active large tooling or facilities developed for past projects** and marginally or not involved at all after the project conclusion.

Presentation of P.Michelato

Industries develops prototypes at the TI / RI (1/3)

Advantages for Industry

a) Gain more money
b) Knowledge growing
c) Access to first hand and extremely high quality know how
d) Access to already available high cost tooling / technologies not available in the industry due to high cost / high risk in buying and doing investment, in particular for small and medium-sized enterprises
e) Limited economical investment / low risk
f) More updated perception of future possible markets (general and accelerator fields)
g) …

Presentation of P.Michelato

Industries develops prototypes at the TI / RI (2/3)

Advantages for RI / TI

a) More qualified manpower
b) Gain experience from industry (project management)
c) Gain money (?)
d) Technological transfer to the industry for future project
e) Use / maintain live high cost tooling / plants that are not often used or developed for past projects

Potential risk / complication for industry

a) Risk for RI / TI founding availability / reliability
b) Complicated procedure for buying / call for tender (public buying)
c) Co-working
d) Not direct / personal management of TI / RI personnel
e) Scheduling must be agreed with TI / RI, could be not fully under industry control

Presentation of P.Michelato

Industries develops prototypes at the TI / RI (3/3)

Potential risk / complication for RI / TI

a) Risk for founding availability / reliability of the company (?bankrupt)
b) Company personnel working in the RI / TI: safety, etc
c) What happens at the end of activities about goods, tools, etc…
d) More difficult to manage for RI/ TI that have a distributed structure.

Legal and formal framework? Agreements (MoU, Contracts), Fund management, Cost sharing, Patents, Responsibilities, Safety, etc,

Presentation of P.Michelato

T5.2 Harmonization- Material and Component Reference

TL Sebastien Bousson CNRS - Other participants DESY, IFJ-PAN

Establishing the basis for a common knowledge, background and use among TIs and related laboratories and industries of raw materials in relation to material and components involved in accelerator and large SC magnets.

Comment: T5.2 (and T5.3), by putting in collaboration the TI and industry, is a sort of practical test bed for AMICI

Main ideas and outcome

From presentation of S.Bousson & M.Fouaidy

Main idea:

- Accelerator performances are based not only on accelerator systems design but also on material or component choice and specifications.
- Data and characteristics of these are not easy to find in papers and knowledge sharing is more commonly done with private communications.
- Even on raw materials, non-standard use in an accelerator environment (radiation, cold temperature…) add difficulties to find corresponding data.

Main outcome:

Create a reference database for material/component used in accelerators (accelerating structures, magnets, diagnostics, ancillaries…) and start to fill it with relevant data.

Open questions

From presentation of S.Bousson & M.Fouaidy

Questions linked to implementation of the database:

- **Who has access ?** Amici contributors in the beginning, and then everybody who is requesting to have access ?
- **Who has grants to implement datas ?** Reference persons per Lab/company ?
- **Who is validating the data entered ?**

To take into account for the database implementation

- **Datas are not only numbers.** *But also tables, curves, datasheet, pictures, scientific articles, …*
- **Database sustainability ?** *Who is monitoring that datas entered are still "up-to-date"* **?**

What is in

From presentation of S.Bousson & M.Fouaidy

What the database should include

1. MATERIAL

- Raw material, as used to fabricate accelerator systems
- Material as used during processing/preparation

2. COMPONENT

- ancillaries, as used to implement accelerator systems
- Instruments as used in accelerators ? *Specially when they are very specific*

1. Physical characteristics
2. Chemical characteristics
3. Economical properties (information)
4. References

Distribution of work

From presentation of S.Bousson & M.Fouaidy

- **Database skeleton : CNRS lead institute**
- **Software choice / IT work : IFJ PAN lead institute**
- **All AMICI participants: contributing to enter first sets of datas**

- **Other AMICI contributors (labs, industries) are welcome to advice, participate and actively contribute !**

T5.3 Harmonization- Cryogenic Safety Procedures

TL Steffen Grohmann KIT- Other participants CEA, CERN

Standardisation of safety procedures in particular in the domain of cryogenic equipment. The search for a standardization of practices, the possibility to produce realistic and scaled validation tests will lead to make future projects easier, safer and cheaper. Under the EU regulations, this task will organize exchange of knowledge and procedures, with the goal to develop a common methodology used by labs and industrials for the design and fabrication of cryogenic equipment.

What it is expected: General harmonised guidelines for the safety of cryogenic equipment

Working areas: Organising and coordinating a working group at the European Committee for Standardization (CEN), where additional experts from Universities, research labs and industry will participate

Outline of S.Grohmann presentation

- Introduction – Relevant existing standards
- Motivation – What is special in LHe cryostats?
- Status of the European standardization project
- Objectives within WP5.3 of the AMICI project

From presentation of S.Grohman

Rupture of a 70 L liquid nitrogen

Accident in a laboratory (09/2005)

From presentation of S.Grohman

Liquid helium cryostats

- Nomenclature
  - Cryostat ≠ storage vessel/container!
  - LHe cryostats involve **active components** such as superconducting magnets and cavities, heaters, pumps, valves etc.
- LHe cryostat conditions **not covered** by other standards
  - Staging of multiple safety levels, e.g. for quench recovery
  - Large stored energies, loss of insulating vacuum, thermal acoustic oscillations, electric arcs
  - Rates of pressure raise (out of scope wrt. EN ISO 4126-10)
  - Two-phase flow (discharge functions out of scope wrt. EN ISO 4126-10)
  - Incompatible design constraints (e.g. 3 % rule for inlet piping pressure drop; 0.6 m rule for heat load)
  - Helium recovery and discharge in confined spaces
  - …

From presentation of S.Grohman

European standardisation project

Satellite meeting at European Cryogenics Days 2015 (Grenoble)

- Agreement to advance a **European standardisation process**
- Baseline documents: Translations of DIN SPEC 4683 and CEA documents, CERN standards + any other contribution

Aim of the European standard

- **Collect**, **structure** and **harmonize** state-of-the-art **rules**, **procedures** and **know-how** from labs, institutes and companies in Europe
- Provide a **comprehensive overview** on all major aspects of **safe design and operation** of liquid helium cryostats
- **Solve conflicts** with other standards by the indication of **alternative options**
- Provide the **first multi-national standard** on safety of LHe cryostats for our community

Establishment of a **new working group** at CEN/TC 268 –
Cryogenic vessels and specific hydrogen technologies applications

From presentation of S.Grohman

What is beyond

From presentation of S.Grohman

"Beyond the actual state-of-the art, T5.3 will **collect and assess** available **modelling codes**, which are able to consider and analyse the **process dynamics** of cryogenic incidents. In addition, the task will **define the scope of future experiments and model developments** required to consolidate and evolve the proposed common methodologies. This concern specifically the **experimental basis** required **for the implementation of dynamic models** in a common standard, as well as performance data of pressure relief devices under cryogenic conditions."

WP5 Deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D5.1	Definition of the possible structure and content of a database for materials and components	6 - CNRS	Report	Public	26
D5.2	Final report on the required conditions for apprenticeships program in TI	1 - CEA	Report	Public	28
D5.3	General harmonised guidelines for the safety of cryogenic equipment	10 - KIT	Report	Public	28
D5.4	Final report on the required conditions for apprenticeships program in industries	4 - INFN	Report	Public	30
D5.5	Final report on conditions for developing prototypes in industry	4 - INFN	Report	Public	30

Relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS18	List of safety scenarios in liquid helium cryostats	10 - KIT	12	M5.1 - List of safety scenarios in liquid helium cryostats (M12)
MS19	Preliminary report on the required conditions for apprenticeships program in TI	1 - CEA	16	M5.2 - Preliminary report on the required conditions for apprenticeships program in TI (M16)
MS20	Preliminary report on the required conditions for apprenticeships program in industries	1 - CEA	18	M5.3 - Preliminary report on the required conditions for apprenticeships program in industries (M18)
MS21	Preliminary conclusions of the working group on prototyping issues	4 - INFN	24	M5.4 - Preliminary conclusions of the working group on prototyping issues (M24)

WP5 Organization –Meetings

- Deliverables under TL responsibility

- Regular video- meetings among WP5 coordinator and TL for checking the status of activities (3 per year).

- WP5 workshops before the annuals AMICI meetings

- Task meetings (Under task organization)
- Task workshop?

- Inter-task meetings if necessary also with other WPs
  (see next slide)

Points emerged during the discussion

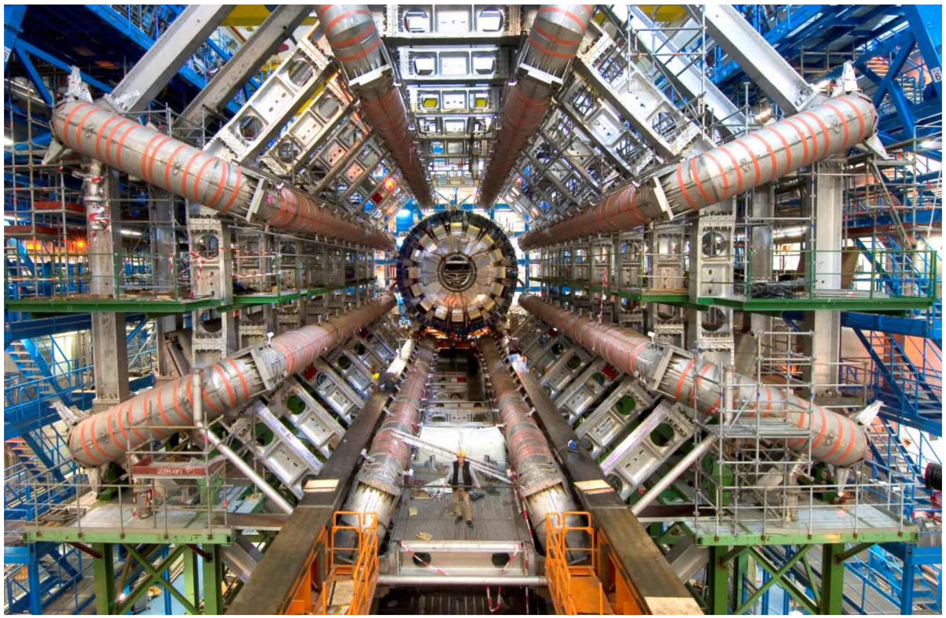
- Importance of Amici-Industry Day (AID) for T5.1 and T5.4 Soon after AID, T5.1, T5.4 tasks of WP4 and T1.2 could have a dedicated meeting for coordinating the efforts towards the involved industry.

- Activities on harmonization should evolve in future towards (EU) projects

- Understand/Clarify the legal and formal framework: Agreements (MoU, Contracts), Fund management, Cost sharing, Patents, Responsibilities, Safety, …

- How making attractive the TI-Industry collaboration (for both TI and Industry)

Thank you for the attention



ATLAS magnet. SC coils developed with industry (B0) and built in the industry