Management and Controls of In-Kind Contributions to the European XFEL facility

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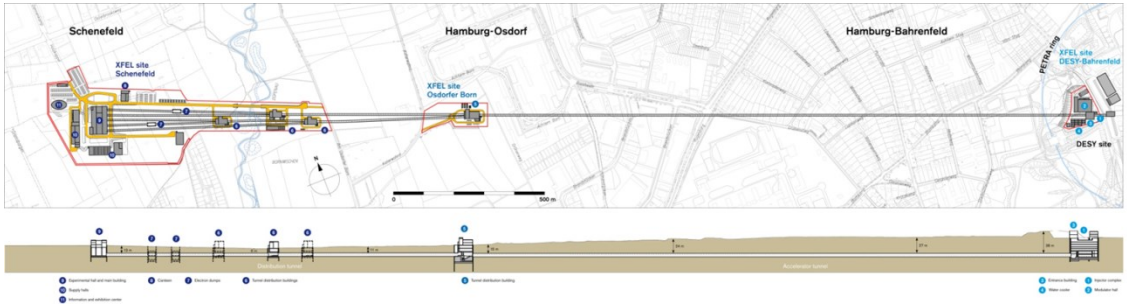
Main facts about the project

- The European XFEL Facility in Hamburg is an applied research facility
  - Generation of X-ray flashes: 27 000/s
  - Superconducting linear accelerator for electrons (energy level 17.5 GeV)
  - 3.4 km long machine in 5.8 km underground tunnels
  - 3 sites above ground and 5 experimental stations (3 in the start-up)

- Construction :
  - Cost 1.2 B€ (2005)
  - 12 countries participate in the construction through 21 institutes
  - 48 Work Packages
  - 78 in-kind contributions
  - Lifetime 20 years 2016-2036



5,8 km of tunnels

Removing the cutter head ø 5.3m

Breakthrough at beam switchyard

End of underground construction was celebrated in June 2013

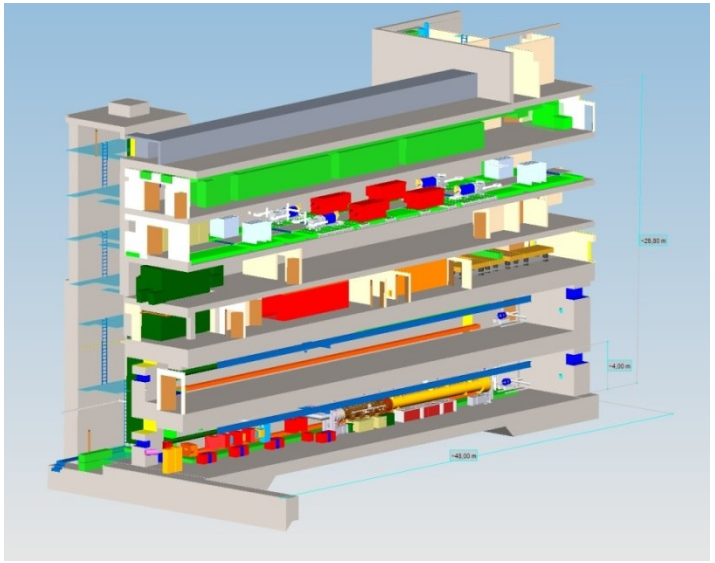
Main tunnel is 2 km long

Floor laying

Utilities installed in accelerator tunnel

Vehicle for cryomodule transport

Underground Injector building



Underground injector building: 7 levels, 38m deep

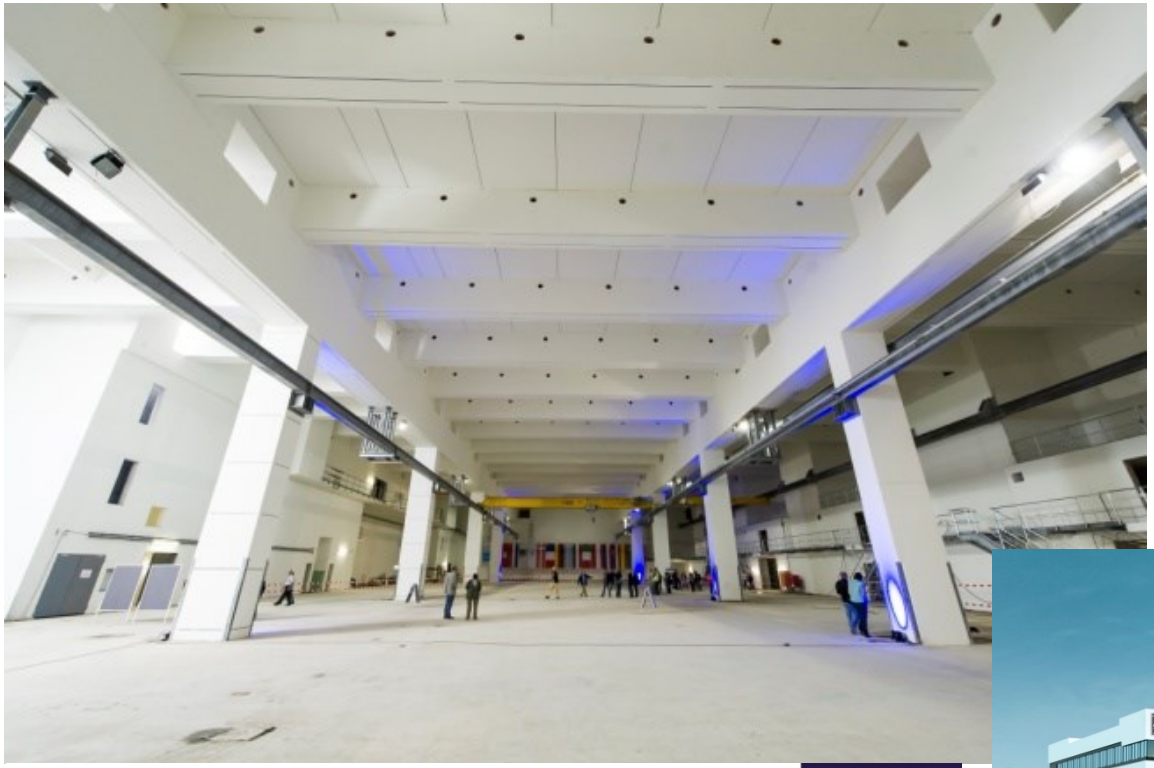
Oct. 2009

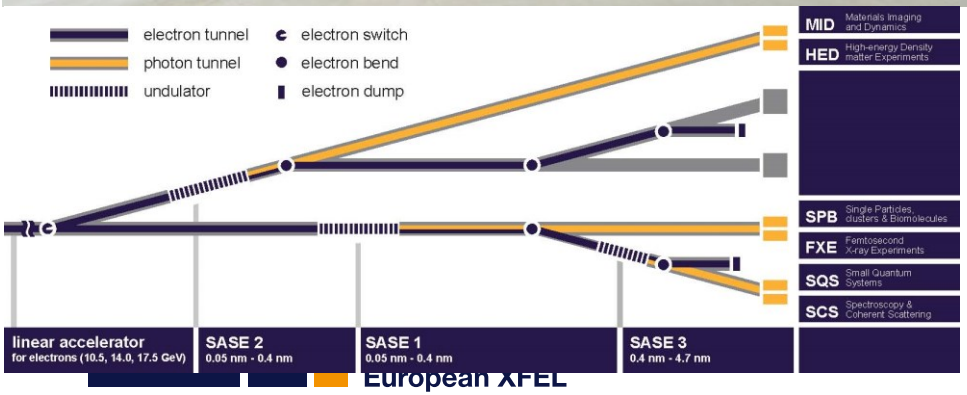
RF power components

Electron gun

Main shaft

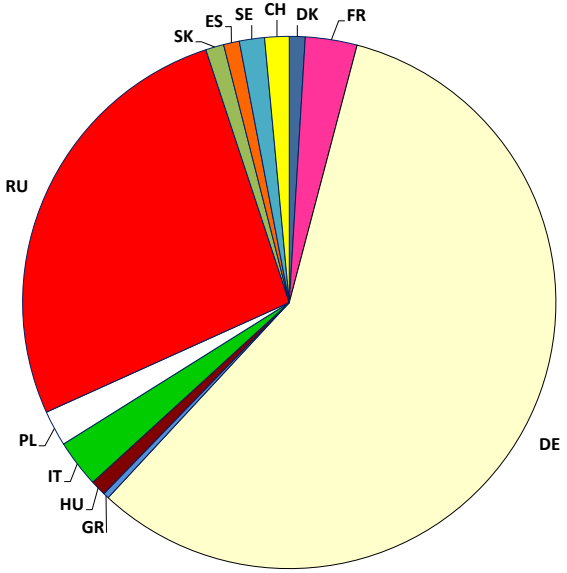
Experimental Hall: 90 m x 50 m (height 14 m)



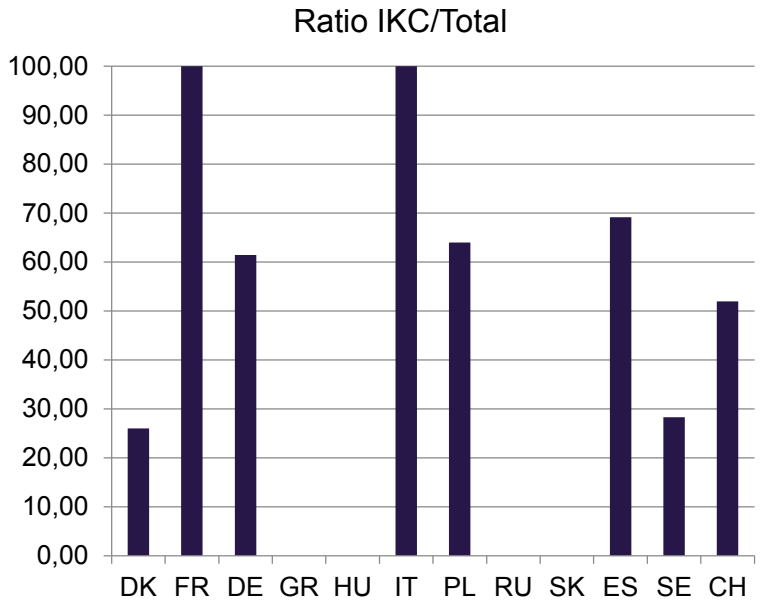


Labs and offices building are above experimental hall (move in 2016)

12 countries contribute to the European XFEL Facility

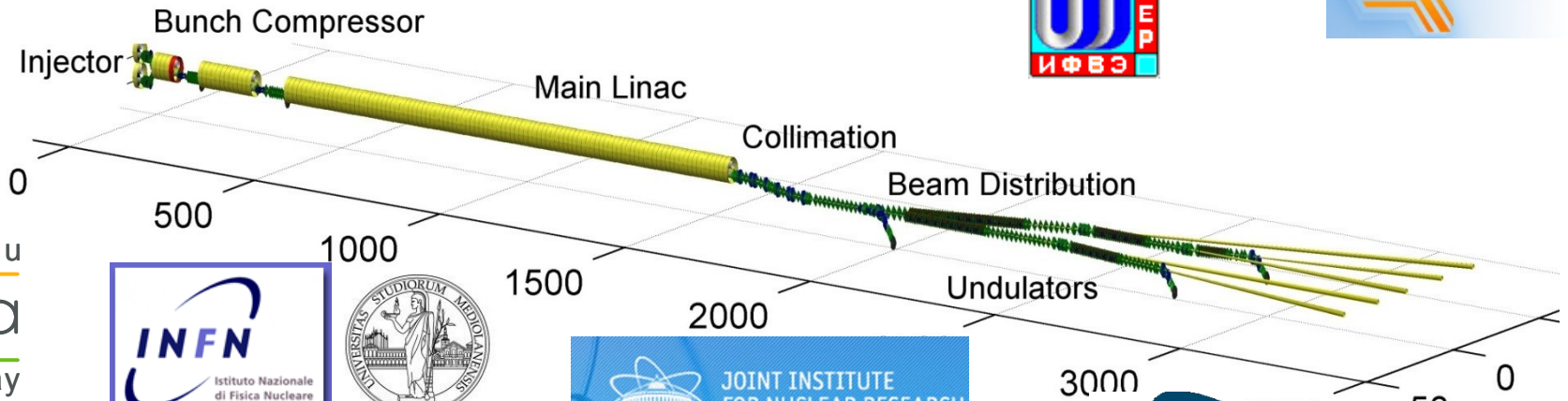


Distribution of total contributions



Each country contributes either in cash, in-kind, or both to the construction phase.

Institutes contributing in-kind to the construction



Overview of in-kind contributions

9 Countries
21 Institutes
78 IKCs
683 Milestones
585 M€ (2005)

Efforts by IKC Office →

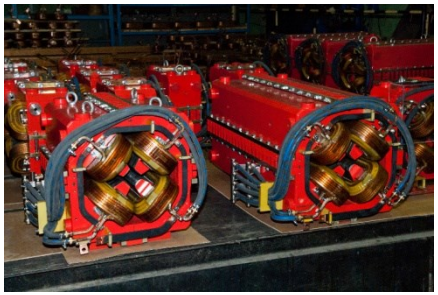
- Prepare agreements
- Implement changes
- Validate milestones
- Follow-up and control
- Verify achievements

Status end 2017

- all IKCs allocated
- 416 Milestones completed
- 22 IKCs completed
- We are collecting all the documentation to consider completed the delivery

Main components delivered

- Super-conducting cavities: 800
- Cryostats: 100
- Warm magnets: 715
- Cold magnets: 100



Objectives of in-kind contributions for the construction phase

- Budget of the European XFEL Facility:
  - In-Kind contributions ~ 50%
  - Cash ~ 50%

- Reasons why IKCs are an attractive solution:

- For the contributing institute:
  - Implementing and developing its know-how
  - Local development
  - Image and reputation

- For the project:
  - Delegation of responsibilities (technical, management)
  - Delegation of risks (technical, costs)
  - Delegation of resources

Drawbacks of in-kind contributions

- For the contributing institute :
  - Technical risks
  - Manufacturing risks
  - Risk of not achieving expected performance
  - Financial risks
  - Human risks: loss of competences
  - Risk of change of strategy by funding agency
- For the project:
  - Follow-up and control especially in safety and technical aspects can be more demanding than expected
    - ► For project groups and
    - ► For IKC office
- Other risks appear:
  - Failure to deliver on schedule, in quality and according to national safety standards
  - Assistance may require unforeseen effort

Work Packages in the construction phase

WPG1 Linac	WPG1 Linac	WPG2 Accelerator Subsystems	WPG4 Control & Operation	WPG5 Infrastructure	WPG3 Photon Beam System	WPG3 Photon Beam System	WPG6 Sites & Buildings
WP01 RF System *Stefan Choroba*	WP07 Freq. Tuners *L. Lilje / A. Bosotti*	WP12 Warm magnet *Bernward Krause*	WP28 Acc Control Sys. *Kay Rehlich*	WP10 AMTF *Bernd Petersen*	WP71 Undulators *Joachim Pflüger*	WP74 X-Ray diagnostics *Jan Grünert*	WP31 Sites & Civil Cons *H-J Christ*
WP02 Low Level RF *Holger Schlarb*	WP08 Cold vacuum *Lutz Lilje*	WP14 Injector *Klaus Flöttmann*	WP29 Operab. & Reliab *NN*	WP13 Cryogenics *Bernd Petersen*	WP72 Ph. Fields Simul. *Gianluca Geloni*	WP75 Detector Dev. *Markus Kuster*	WP41 Site Lot 1 *H-J Christ*
WP03 Acc. Modules *O. Napoli / K. Jensch*	WP09 Cav. String Assy. *B. Visentin A. Matheisen*	WP15 Bunch compress. *Torsten Limberg*	WP35 Radiation Safety *Norbert Tesch*	WP32 Survey & Align. *Johannes Prenting*	WP73 X-Ray Optics & Tr *Harald Sinn*	WP76 DAQ & Control *Chris.Youngmann*	WP42 Site Lot 2 *H-J Christ*
WP04 SC Cavities *W. Singer P. Michelato*	WP11 Cold Magnets *HD Brück / F. Toral*	WP16 Lattice *Winfried Decking*	WP36 General Safety *Andreas Hoppe*	WP33 Tunnel Installation *Norbert Meyners*	WP78 Optical lasers *Max Lederer*	WP81 FXE Instr. *Christian Bressler*	WP43 Site Lot 3 *H-J Christ*
WP05 Power Couplers *W. Kaabi / WD Möller*	WP46 3.9 GHz System *E. Vogel / P. Pierini*	WP17 St. e-b diagn. *Dirk Nölle*	WP38 Pers. Interlock *Brunhilde Racky*	WP34 Utilities *J-P. Jensen*	WP79 Sample Environ. *Joachim Schulz*	WP82 HED Instr. *NN*	WP44 Site Engineering *H-J Christ*
WP06 HOM Couplers *J. Sekutowicz / E. Plawski*		WP18 Spec. e-b diagn. *Christopher Gerth*	WP39 EMC *Herbert Kapitza*	WP40 Info & Proc. Supp *Lars Hagge*	WP85 SQS Instr. *Michael Meyer*	WP83 MID Instr. *Anders Madsen*	WP45 AMTF Hall *H-J Christ*
DK FR IT PL RU ES SE CH		WP19 Warm vacuum *Sven Lederer*			WP86 SCS Instr. *Andreas Scherz*	WP84 SPB Instr. *Adrian Mancuso*	
		WP20 Beam Dumps *Norbert Tesch*					
		WP21 FEL Concepts *Mikhail Yurkov*					

Tasks of the IKC controlling office

- Assistance to the project management and to the administration:
  - Follow-up of the technical progress at the various in-kind contributions
  - Reporting to the management and associated committees
  - Organize meetings of the In-Kind Review Committee
  - Inform the controlling and finance group
- Close cooperation with the project teams in:
  - Preparation of the technical part of IKC agreement
  - Enforcement of engineering and safety standards and national safety regulations
  - Traceability of parts
  - Documentation
  - Technical validation of achievements at milestones
  - Acceptance tests

Tasks of the IKC controlling office

- Assistance to the contributing Institute:
  - Preparation of the contract (IKC Agreement)
  - Preparation of quality plan
  - Provision of safety standards and national safety requirements
  - Validation of the achievements
  - Solving difficulties: procurements, delays, etc..
  - Maintain close relationship

Process of an IKC in the construction phase

Input
Extent of contribution
Value
Specifications
Interfaces
Schedule
Standards & QA requirements

Agreement and Technical Annex

Allocation by the XFEL Council

AFC financial recommendation

IKRC technical recommendation

XFEL technical groups

EoI by institute

Work
- Management
- Engineering
- Production
- QA control
- Tests
- Shipment
- Assistance

Resources
- Manpower
- Factory, halls
- Machines & equipment
- Offices
- Budget

Contributor's responsibility

Output
- Hardware
- Services
- Manpower
- Software
- Documents

Project team
- Acceptance tests
- Integration and machine risk assessment of complete set up
- Commissioning

Interaction with the contributor

- Assist him from the beginning:
  - How to present his contribution (IKRC Committee)
  - How to prepare the documents (financial agreement and technical annex)
- Assist him during the work
  - Procurements
  - Follow-up
  - Quality assurance
  - Milestones validation
- Assist him at the end
  - Final acceptance
  - Final notification, appraisal
- Treat him as a project partner but: the contributor must be controlled !!!
  - Monitor closely his progress with respect to plan
  - Make regular on-site visits
  - Control the documentation and traceability of parts

IKC follow-up: Validation of Milestone's achievement

- The progress of a contribution is monitored through specific contractual milestones detailed in the agreement:
  - Milestone name, date expected, validation criteria
- About 580 milestones cover all IKCs of European XFEL

For each milestone,

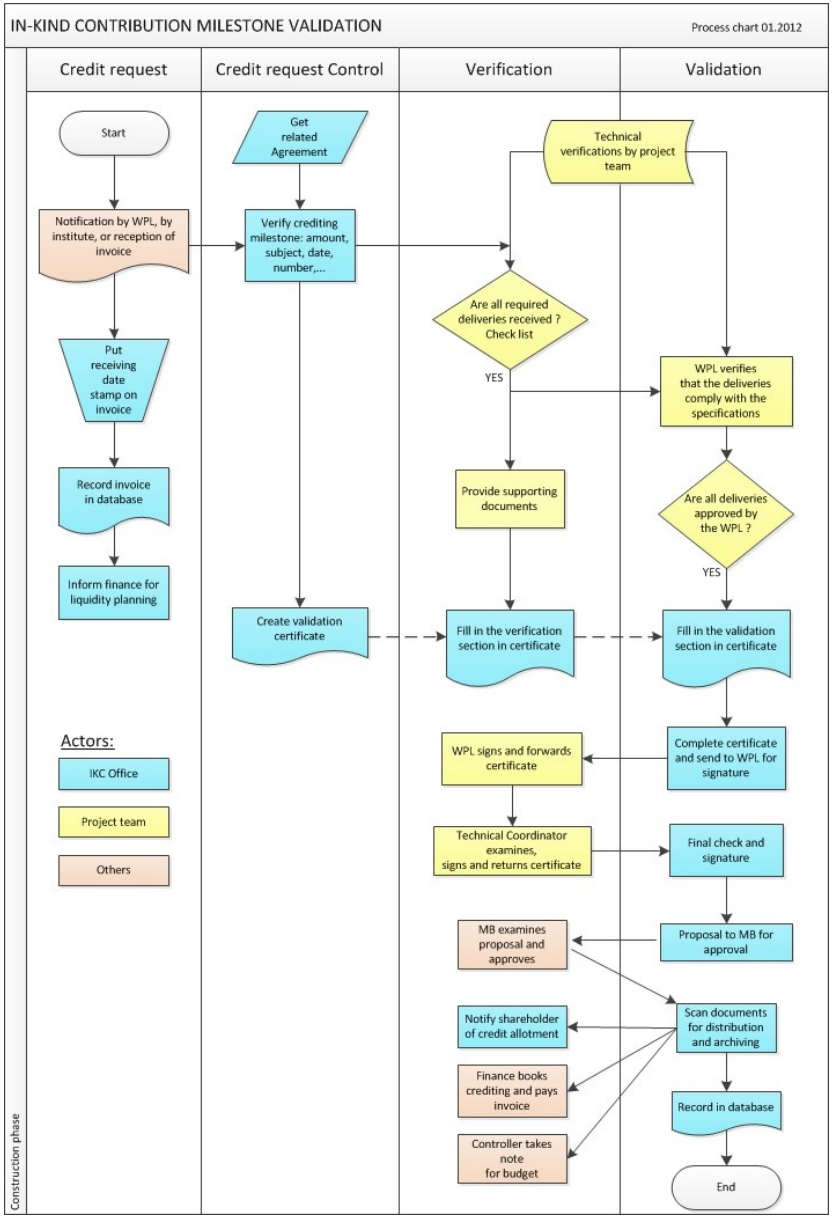
when corresponding task is completed:

- Institute or project team → notifies IKC Office
- IKC Office prepares specific certificate
- Project team → evaluates the deliveries / criteria:
  - Documents
  - Test reports
  - Equipment

  → gives his approval of satisfactory achievement
- IKC Office:

  → presents for signatures the certificate to validate the milestone

  → notifies the shareholder and accounts credit of value



IKC follow-up: Certificate of Validation (example)

European XFEL

Certificate of validation of IKC milestone Phase 4 PL05 for WP10

European XFEL GmbH, Albert-Einstein-Ring 19, 22761 Hamburg, Germany

Contributing Institute:	**Henryk Niewodniczanski Institute of Nuclear Physics Polish Academy of Sciences ("IFJ-PAN")** ul. Radzikowskiego 152, 31-342, Kraków, Poland		
Shareholder	**NCBJ Swierk**	**Poland**	
Contract	**PL05**	**Tests of cavities and cryomodules in the AMTF Hall**	
Project leaders	Andrzej Kotarba		
Work package and responsible person	**WP10 – AMTF** Bernd Petersen	**WPG5** Markus Hüning	
Reference document	IKC Agreement European XFEL – IPJ - IFJ-PAN for WP10 of 16 December 2010 Technical Annex 10-2 to ACA DESY-IFJ-PAN for WP10 of 16 December 2010		

Terms of references

Value of the IKC	9 368 309 € (in 2005 prices) for Option B			- Art. 5.1 of the agreement - Letter of notification of Option B (12 July 2011)
Milestone	**Phase 4:** 1st cavities batch tested			Art. 5.3 of the agreement and letter of notification dated 21/12/2011
Expected date	October 2013			
Crediting allotment	1 125 000 €	Ownership transfer	Yes	

Verification operations		**Dates**
Verification steps	Test procedures documented and approved.	
Detail of verification	Re_ FW_ IFJ PAN milestones4.pdf; 320cavitiesreports.pdf; TUIOC01_TALK_AMTF_Swierblewski.pdf; Linac14_THPP021_poster.pdf	
Completeness of verification	Verification complete: all requested items and documents are delivered	
Verified by: Name and signature	B. Petersen	26.9.14

Validation involves the approval and signatures by:

- Technical team
- Technical coordinator
- IKC Office
- Administrative Director of European XFEL GmbH

Management Board gives a formal approval
Shareholder's account is credited
Shareholder is notified
Supporting documentation is uploaded in database

Validation operations		**Dates**
Validation	WPL approves of the test procedures.	
Completeness of validation	All validation steps were completed.	
Validation by: Name and signature	B. Petersen	26.9.14

Approval by the Accelerator Consortium Coordinator

Approved by	H. Weise	
Signature and date		24/9/14

Conclusions

Milestone	Milestone Phase 4 is validated	
Crediting allotment	The amount of 1 125 000 € can be credited to NCBJ.	
Approval by the IKC Coordinator	Milestone Phase 4 is completed according to criteria	30/9/14
Date and signature by the Administrative Director	The Management Board approves of the crediting to NCBJ.	21/10/2014

Specific issues of in-kind contributions

Coordination of several different actors in space and time needs a big effort:

- Technical difficulties:
  - Different environment (procedures, language, CAD software, units…)
  - Different standards (technical and safety)
  - Different raw materials (same quality ?)
  - Different style of management
  - Follow-up is difficult
- Financial:
  - Budget is in current prices, but IKCs are in 2005 prices
  - Controller takes note of completed IKC milestones
  - Custom taxes for equipment coming from outside EU

Specific issues of in-kind contributions

Coordination of several different actors in space and time needs a big effort:

- Logistics:
  - Transports
  - On-time delivery and temporary storage
  - Installation must fit with global integration plan

- Legislation:
  - National regulations are different
  - Procurement rules can be different

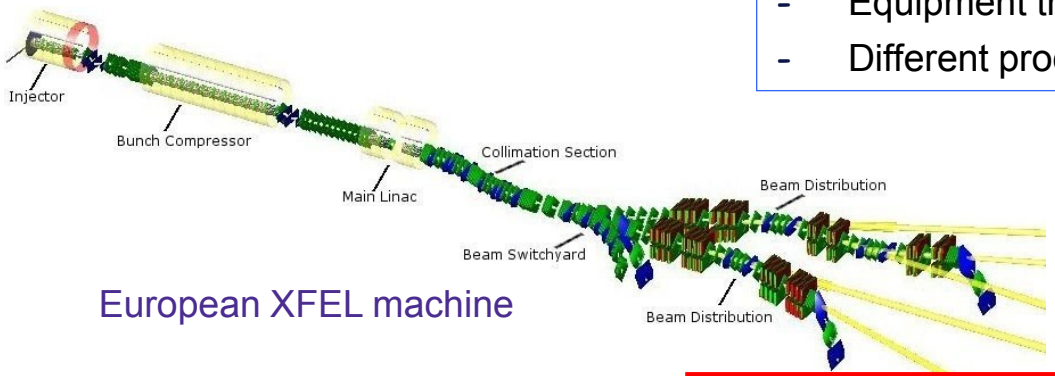
Quality management issues

48 WPs

9 Countries

21 Institutes

78 IKCs
- Many interfaces
- Materials of different origins
- Different ways of work
- Equipment transported from Europe and Asia
- Different processes of acceptance



European XFEL machine

- Common rules of good practice are necessary !
- Quality management must be implemented

Examples of difficulties encountered (Design and manufacturing)

- Difficulties of detailed design underestimated
  - Very often the effort or time necessary for detailed design by contributor is underestimated critical delays
  - Solution: spend more time in the evaluation of design effort (external reviewers, expert panel…)
- Approval by project is too long
  - Too many stakeholders delay approval of design by contributor (subjects with many interfaces) resulting that manufacturing is delayed due pending approvals
  - Solution: Set up approval process in a way to avoid delays
- Raw material or special component specified in IKC contract is not available at the contributor
  - Look for local equivalent, or
  - Buy the material or component and send it to the contributing institute (shift from IKC to cash)
- Loss of competences (example: qualified welders) , or failure to produce equipment
  - IKC must be re-allocated to another actor, or
  - Equipment must be contracted to industry

Examples of difficulties encountered (Schedule and quality)

Delayed achievements

- Contributor does not deliver on-time hence delay of whole project
  - Preventive actions:
    - ► Define precise responsibilities (agreements and internal provisions)
    - ► Close follow-up and reporting
    - ► Risk analysis (think of plan B in case of high risk)
  - Corrective actions:
    - ► Provide assistance to the contributor to find a solution
    - ► Decide on an alternative

Default in quality

- Equipment delivered does not satisfy the specified performance and safety standard
  - Preventive actions:
    - ► Design review before start of production
    - ► Close follow-up and reporting
    - ► Risk analysis
  - Corrective action:
    - ► Provide assistance to the contributor to find a solution

Top 10 Dos and Don'ts

Do

- Consider contributor as project partner
- Define precisely what is expected
- Define specific goals of achievements
- Share important project info
- Define precisely acceptance criteria
- Visit regularly contributors
- Provide assistance in solving difficulties
- Plan the unexpected (risk analysis)
- Verify completeness of documentation
- Appraise value of accomplishments

Don't

- Change requirements repeatedly
- Underestimate difficulties of design
- Develop conflictual relationship
- Let a contributor work without a signed agreement
- Consider contributor as a vendor
- Discredit contributor's know-how
- Hide important project info
- Ignore help request or warning signals of problem
- Believe or accept anything without verifying
- Delay unduly acceptance of achievements

Conclusions

- Management and control of IKCs need significant efforts (technical, safety & administration)
- Precise processes must be established before start
- Define precise responsibilities, deliverables, and criteria of acceptance for each IKC
- Contributors must be treated as project partners (share info, reviews, dialogue)
- Be prepared, think of the unexpected
- IKCs management involve all groups in the project including the advise of safety engineers