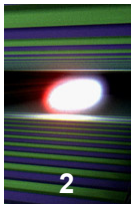
In-Kind Contributions to the European XFEL Facility

Management and control of IKCs

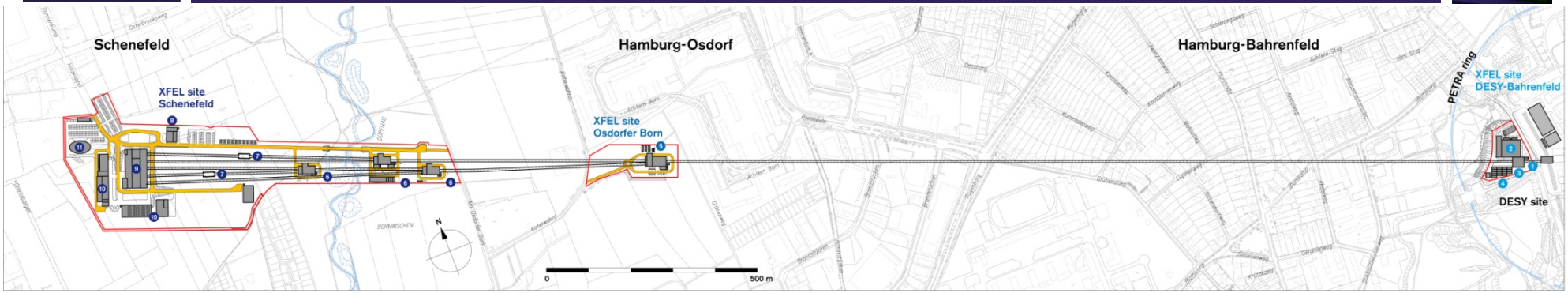
Serge Prat – IKC Coordinator at European XFEL Company

Overview



- Short overview of the European XFEL project
- Place of IKCs in the construction phase
- IKCs management
- IKC follow-up:
  - Milestones validation
  - Specific issues
- Quality management in IKCs and risk analysis
- Examples of difficulties encountered
- Conclusions

Main facts about the project



The European XFEL Facility in Hamburg is an applied research facility

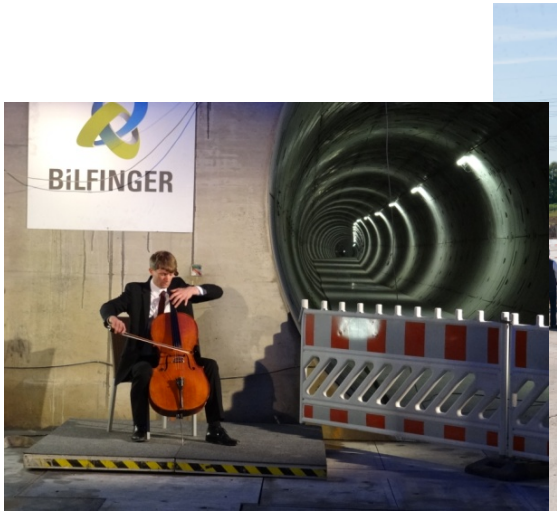
- Generation of X-ray flashes: 27 000/s
- Superconducting linear accelerator for electrons (energy level 17.5 GeV)
- 3.4 km long machine in 5.8 km underground tunnels
- 3 sites above ground and 5 experimental stations (3 in the start-up)

- **Construction** :
- Cost 1.15 B€ (2005) or 1.43 B€ (2013)
- 12 countries participate in the construction through 21 institutes
- 48 Work Packages
- 76 in-kind contributions
- Lifetime 20 years 2016-2036

5,8 km of tunnels

Breakthrough at beam switchyard

Removing the
cutter head ø 5.3m



End of underground construction was celebrated in June 2013

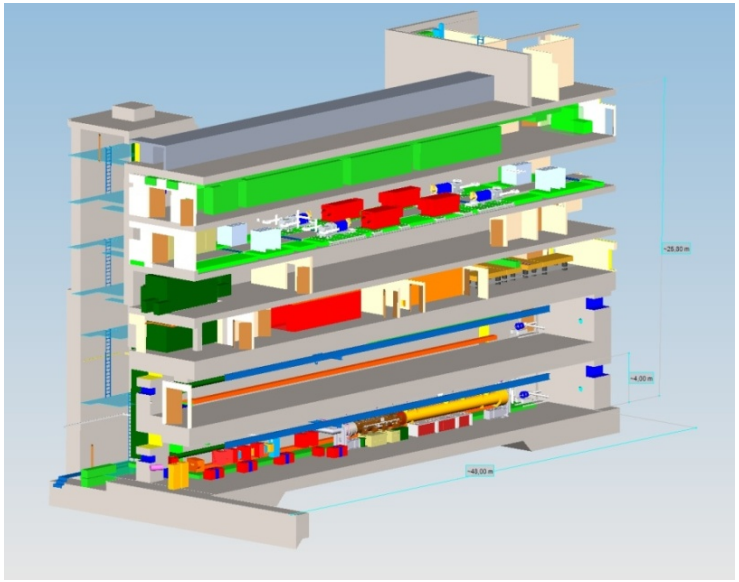
Main tunnel is 2 km long

Floor laying

Utilities installed in accelerator tunnel

Vehicle for cryomodule transport

Underground Injector building



Underground injector building: 7 levels, 38m deep

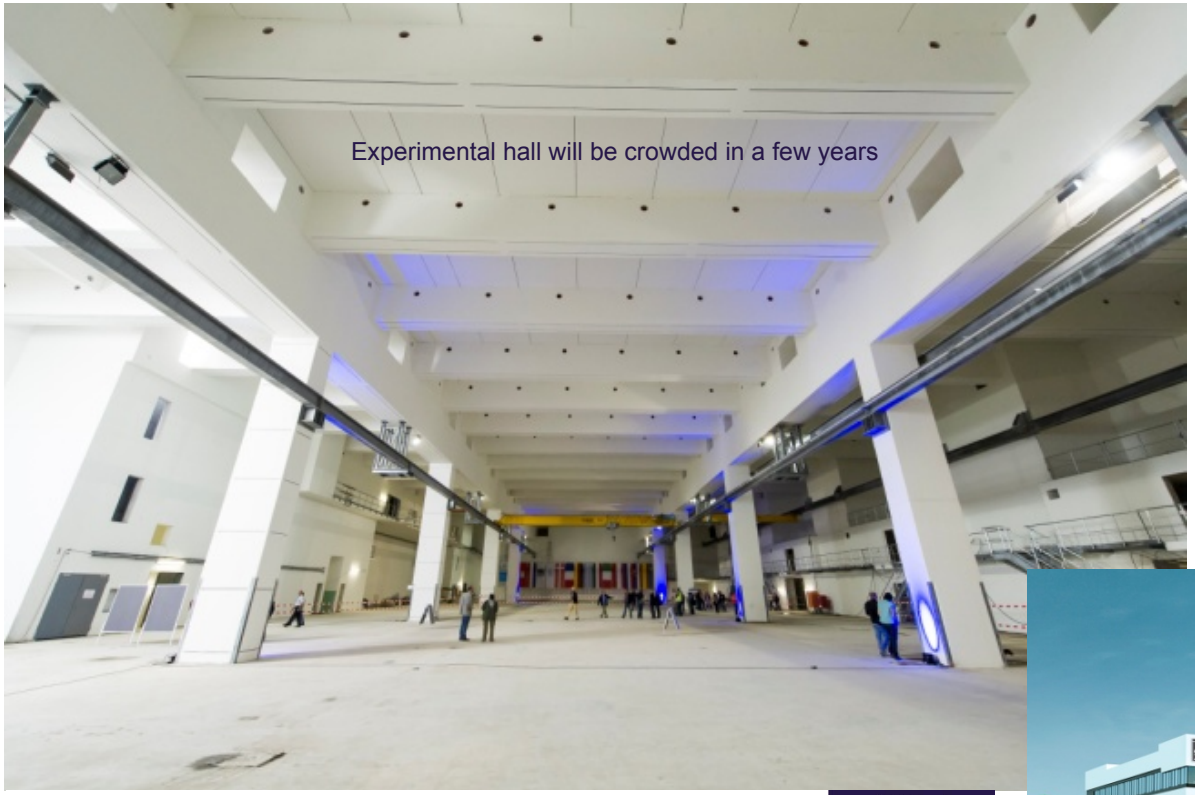
Oct. 2009

RF power components

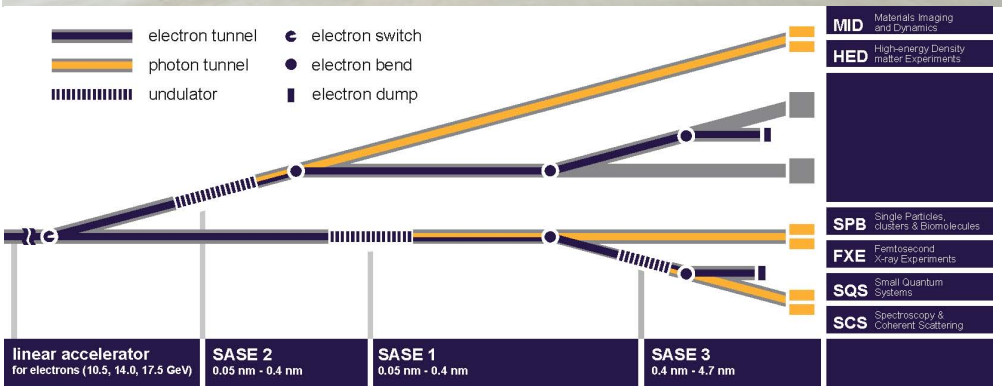
Electron gun

Main shaft

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

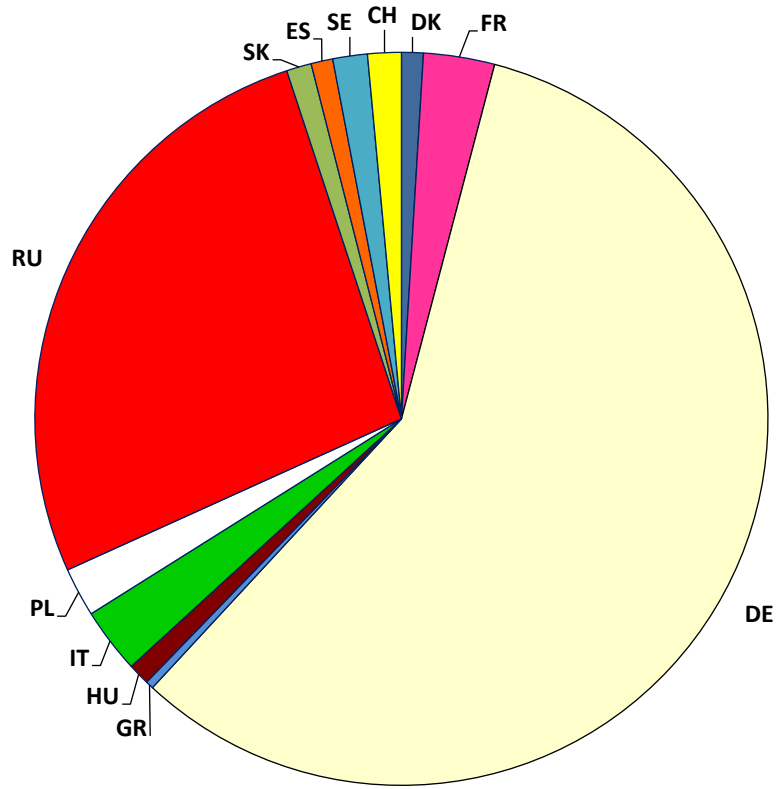


Experimental hall will be crowded in a few years



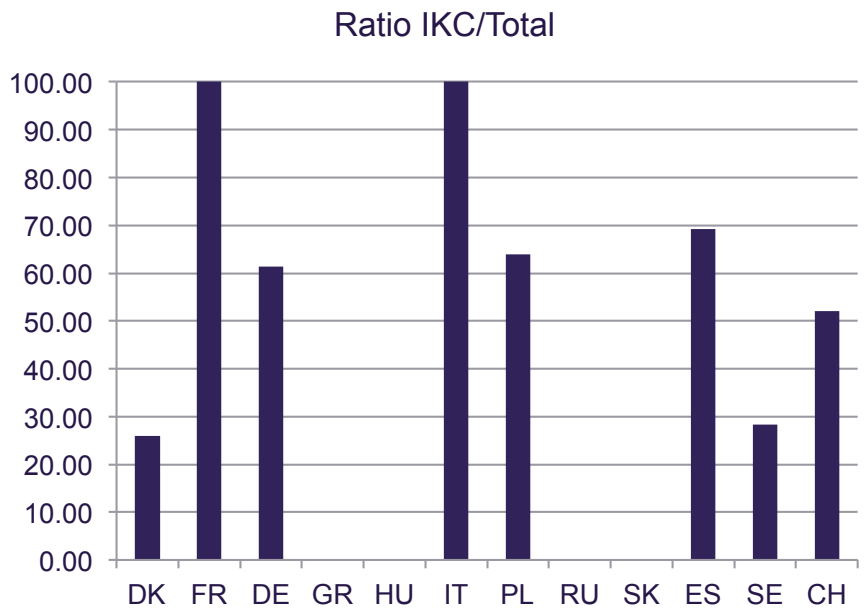
Labs and offices building will be built above experimental hall (2014-2015)

12 countries contribute to the European XFEL Facility

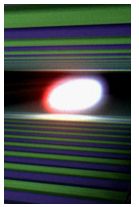


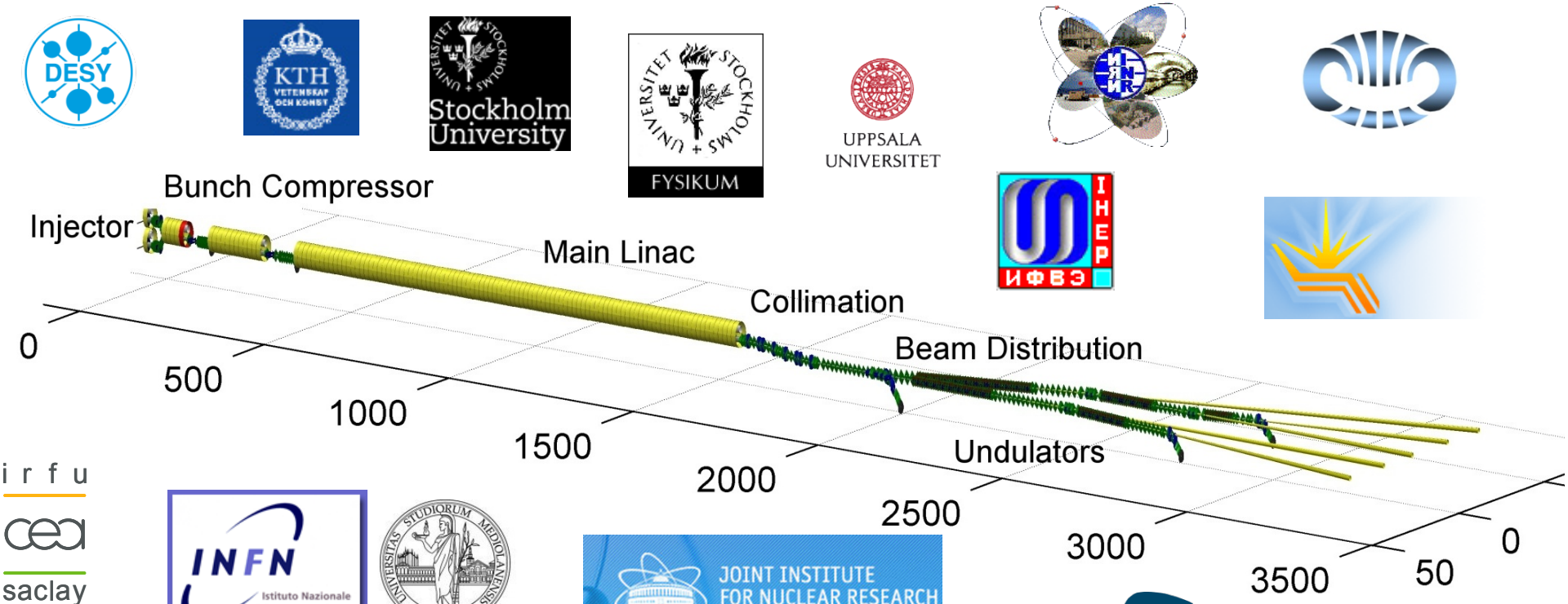
Distribution of total contributions

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



Institutes contributing in-kind to the construction





DESY

KTH VETENSKAP OCH KONST

Stockholm University

FYSIKUM

UPPSALA UNIVERSITET

ИФВЭ

irfu cea saclay

INFN Istituto Nazionale di Fisica Nucleare

JOINT INSTITUTE FOR NUCLEAR RESEARCH

PAUL SCHERRER INSTITUT PSI

cnrs dépasser les frontières

In2p3

Wrocław University of Technology

MINISTERIO DE EDUCACIÓN Y CIENCIA

Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

DTU Technical University of Denmark

Overview of in-kind contributions end 2013

- 9 Countries
- 21 Institutes
- 76 IKCs
- 580 Milestones
- 560 M€ (2005)

Efforts by IKC Office →

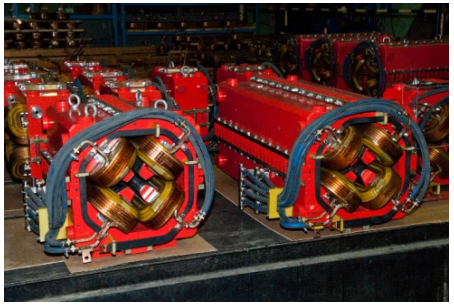
- Prepare agreements
- Implement changes
- Validate milestones
- Follow-up and control
- Verify achievements

Status end 2013

- 67 IKCs allocated
- 188 Milestones completed
- 3 IKCs completed
- Project delay, but already many components delivered

Main components delivered

- Super-conducting cavities: 213/800
- Cryostats: 47/100
- Warm magnets: 383/715
- Cold magnets: 65/100



Objectives of in-kind contributions for the construction phase

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

- <u>Reasons why IKCs are an attractive solution:</u>
  - For the contributing institute:
    - Implementing and developing its know-how
    - Participation of national industries
    - Image and reputation
  - For the project:
    - Delegation of responsibilities (technical, management)
    - Delegation of risks (technical, costs)

Drawbacks of in-kind contributions

But

- Drawbacks of IKCs

  - 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:
    - Technical follow-up and control can be more demanding than expected
      - For project groups
      - For IKC office
    - Other risks appear:
      - Failure to deliver on schedule, in quality
      - 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*
		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*					

DK FR IT PL RU ES SE CH

Tasks of the IKC controlling office

1 – 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 controller and finance group

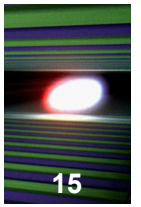
2 – Close cooperation with the project teams in:

- Preparation of the technical part of IKC agreement
- Enforcement of engineering standards and safety rules
- Traceability of parts
- Documentation
- Technical validation of achievements at milestones
- Acceptance tests

3 – Assistance to the contributing Institute:

- Preparation of the contract (IKC Agreement)
- Preparation of quality plan
- Validation of the achievements
- Solving difficulties: procurements, delays, etc..
- Maintain close relationship

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

- **Yes, 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,

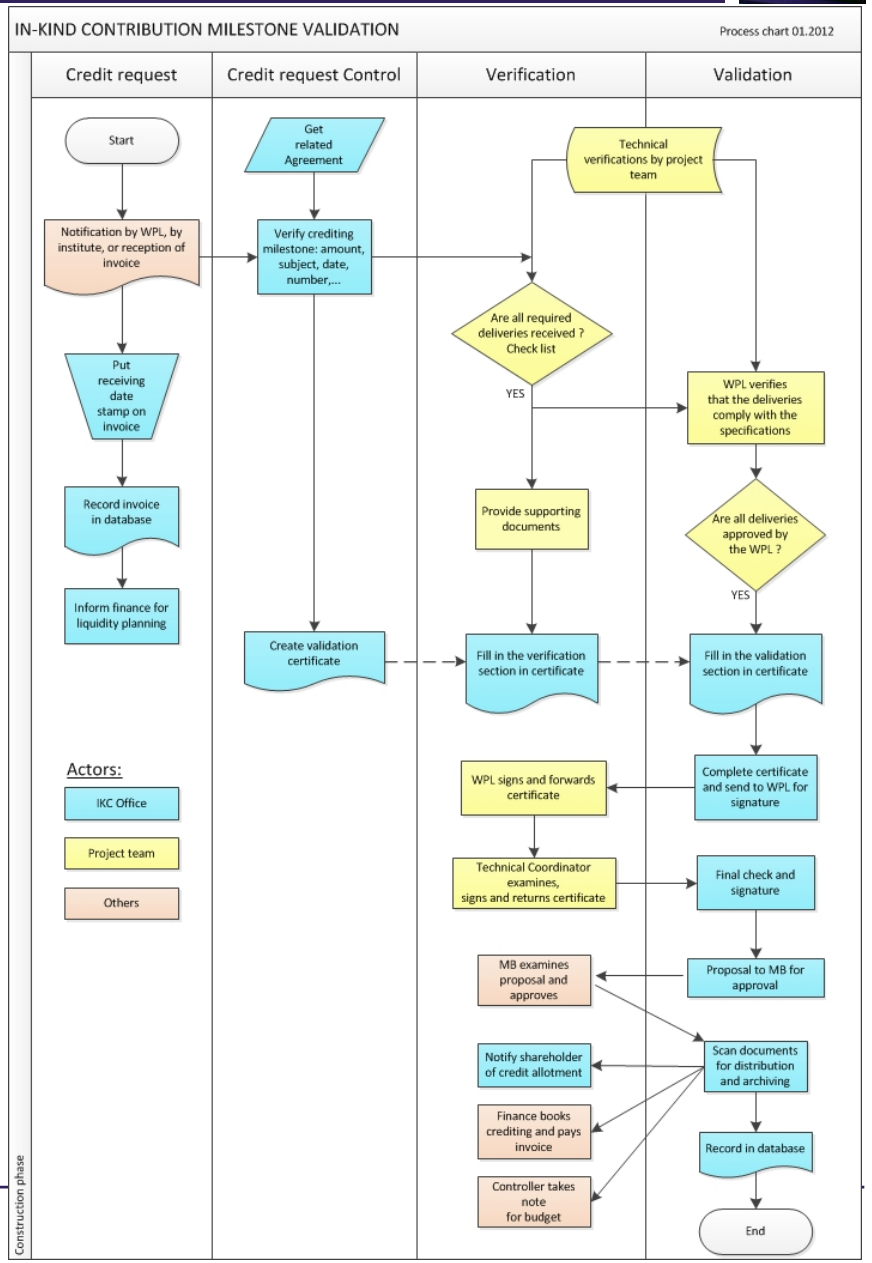
when corresponding task is completed:

- 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 milestone Phase 2
IKC SE03

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

Contributing institute:	**Uppsala University (UU)** P.O. Box 256, SE-751 05 Uppsala, SWEDEN		
Shareholder	**Swedish Research Council (VR)**	**Sweden**	
IKC No & name	**SE03**	Laser heater system for the injector	
Work package and responsible person	**WPL14** Klaus Flöttmann	**Partner institute:** Volker Ziemann	**WPGL:** W. Decking /T. Limberg
Reference documents	IKC Agreement European XFEL – VR for WP14 dated 18 May 2010 Technical Annex 14-1 to the ACA dated 19 July 2010		

Terms of references

Value of the IKC	850 000 € (in 2005 prices)			Art. 6.1 of the Agreement
Milestone	**Phase 2**: Final Design			- Art. 6.2 of the Agreement - Art 2.2 of the TA 14-1
Expected date	Q1 2012	Ownership transfer	**N. A.**	
Crediting allotment	170 000 €			

Validation operations		**Dates**
Validation criteria	Milestone M7: TDR completed	
Verification steps	Documentation for M4 to M7 of the TA 14-1 delivered	
Validation steps	The WPL confirms acceptance of the documentation for TA 14-1 milestones M4 to M7 (with reference to email from UU of 12 Sept 2013, attached) and confirms that Phase 2 is reached and validated. SE03 M2 UU V Ziemann_ IKC milesto	
Completeness of validation steps	All validation steps are completed All required items were delivered. • M4 of TA14-1: Undulator tender specifications • M5 of TA14-1: Contract UH2012/8 with Kyma S.r.L. for the supply of undulator for the XFEL laser heater • M6 of TA 14-1: Specification of conceptual design and minutes of relevant meetings • M7 of TA 14-1: Specification of conceptual design for the IR laser routing system lh_undulator_tender_v6.pdf · Avtal Kyma SRL.pdf · 2012-04-18 Minutes DESY Meeting Mathia · 2012-04-26 Specification of conce · IR-Laser_System_Design.pdf	
Validation by: Signature and date	Klaus Flöttmann 17.9.13	

- Validation involves the approval and signatures by:
  - Technical team
  - Technical coordinator
  - IKC Office
  - Administrative Director
- Management Board gives a formal approval
- Shareholder's account is credited
- Shareholder is notified
- Supporting documentation is uploaded in database

Approval by the Accelerator Consortium Coordinator

Approved by Signature and date	Hans Weise	4/9/13

Conclusions

Milestone	Phase 2 is validated.	
Crediting allotment	The amount of 170 000 € can be credited to VR.	
Approval by the IKC coordinator	Milestone is completed according to criteria.	18.09.2013
MB decision: Signature and date	The Management Board approves the crediting of 170 000 € to VR.	10.10.2013

IKC follow-up: Milestones database

- Excel table of all contractual milestones:
  - represents the up-to-date status of achievements
  - Allows to control the milestones:
    - At achieved milestones: link to certificates of validation and associated documents
      - At delayed milestones: send a reminder to responsible person

Country	Institute	IKC No	Group	IKC Name	WP	WPL	IKC value (2005) €	Milestones	Milestone name	Validation criteria	Allotment value (2005) €	Date planned	Date of validation	Date of notification to shareholder	Delay (days)	Delay of non-validated milestones (days)	Late ?	Completed milestones	Remaining milestones	Number of delayed	% Progress indicator
PL	WUT	PL04	AC	Cryogenic transfer line XATL1 and Two vertical test stands and accessories	10	B. Petersen	2,115,550	M1	Manufacturing drawings of XATL1	Drawings approved by DESY and certified by TUV	125,000	28/02/2011	02/12/2011	07/12/2011	274	0		1	0	0	17
PL	WUT	PL04	AC		10	B. Petersen		M2	Delivery & installation of XATL1	All XATL1 modules delivered and installed successfully	625,000	30/11/2011			188	188	late	0	1	1	17
PL	WUT	PL04	AC		10	B. Petersen		M3	Acceptance of XATL1	Final acceptance approved by ACC	165,550	31/12/2012			0	0		0	1	0	17

Specific issues of in-kind contributions

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

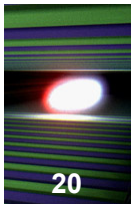
- Technical difficulties:
  - Different environment (procedures, language, CAD software, units…)
  - Different standards
  - Different raw materials (same quality ?)
  - Different style of management
  - Follow-up is difficult

- 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

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

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

Intellectual property in in-kind contributions



How to deal with IP must be precisely defined in the agreement:

- Free exchange of knowledge between parties
  - Background
  - Foreground
- Confidentiality agreement
- Rights
  - Background remains property of inventor
  - Right for the project to use, adapt, and reproduce all foreground
- Publications
  - Flexibility
  - Acknowledge the collaboration
- Inventions

Finance and controlling aspects of IKCs

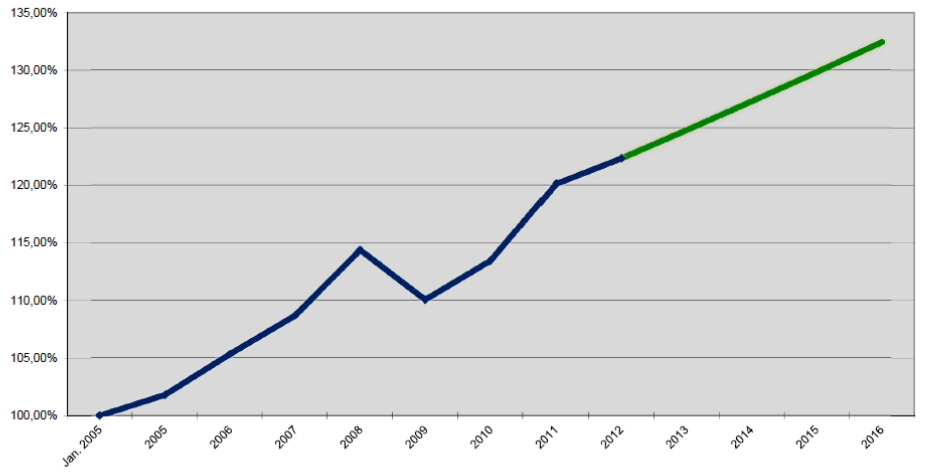
- **At milestones achievements**
  - All milestones achievements are reported by the IKC Office (see procedure)
  - For each completed milestone the accrued value is notified to the shareholder
  - Delivery of a single tangible object implies the transfer of ownership
  - Delivery of prototypes or intangible objects (like design drawings, reports and documents) do not imply the transfer of ownership
  - Transfer of ownership of the complete IKC is effective after final acceptance

- **Calculation of 2005 value from current value**

By Council decision, producer price index for manufactured products EU27, published by EUROSTAT, must be used to deflate cash contributions and all types of expenditures to the 2005 price level.

- Index changes every month → yearly updates of balance sheet must be made

updated: 14.03.2013	EUROSTAT Industry producer prices index for manufacturing, domestic market, EU27, based on empirical data								change of weights 2012	Extrapolated data (+2 % p.y.)			
	Jan 05	2005	2006	2007	2008	2009	2010	2011	2012*	2013	2014	2015	2016
PPI updated March 2013	100,00%	101,80%	105,34%	108,68%	114,37%	110,06%	113,43%	120,14%	122,34%	124,79%	127,29%	129,83%	132,43%



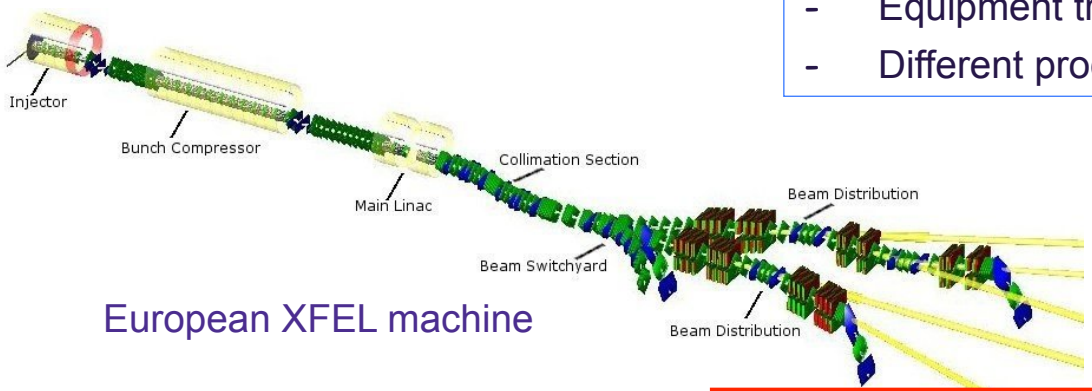
Quality management issues

48 WPs

9 Countries

21 Institutes

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



European XFEL machine

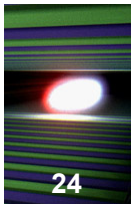
- Common rules of good practice are necessary !
- Quality management must be implemented

Quality Management tasks

Assistance to be provided to each IKC Contributor on practical issues:

- Provide procedures, tools and guidelines for quality assurance
- Help on:
  - Quality plan
  - Risks analysis
  - Project reviews
  - Evaluation of suppliers
- Inspection plan for final acceptance
- Enforce identification & traceability to:
  - Preserve manufacturing history
  - Keep the memory of knowledge, design, tests, performance, during lifecycle 20 years
  - Identify root causes of malfunction
  - Track maintenance history
  - Facilitate inventory and store administrative data
- Management of non conformances
- Conduct audits when necessary

QA support (1): Standards, directives and guidelines



- ISO Standards on specific subjects
  - Materials
  - Screws, bolts, fasteners
  - Drawings, tolerances
  - Tests

- European Directives

There are 21 EC Directives providing for CE marking,
but there are only few important ones which apply to XFEL components:

  - 2004/108 Electromagnetic compatibility
  - 2006/95 Low voltage equipment
  - 2006/42 Machinery
  - 2004/22 Measuring instruments
  - 97/23 Pressure equipment
  - 2002/95 Restriction of use of certain hazardous substances
  - + some Dir. Buildings, infrastructure, elevators, utilities

- CERN Guidelines on material
  - Stainless steel
  - Copper

- DESY Guidelines
  - UHV
  - Cleaning

QA support (2): Quality Plan & Risk analysis

- Assist contributor in preparing the quality plan
  - → Follow guideline ISO 10005

- Assist contributor in performing risk analysis
  - Identification of feared events in all phases of IKC and sorting by category
    - Risks concerning the environment
    - Scientific and technical risks
    - Risks concerning the production in industry
    - Human and organizational risks
  - Risks analysis → evaluation of the probability of a hazardous event and of the severity of its impact (consequence) on the project
    - Establish the “risk register”
    - Follow-up
  - Risks mitigation
    - Reducing severity, probability or impact

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
  - ➢ To avoid this: 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) → manufacturing is delayed pending approval
  - ➢ 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 (Cost)

- **Case of over-specifying tolerances**
  - Very tight geometrical tolerances are specified (although not justified) by the project
    → leads to unexpected high price of manufacturing
    - Include a review of tolerances in the design review (functional analysis)
      The "best" is not right!

- **Case of exceptional cost increase**
  - Very high increase of material cost (copper, steel…) since date of cost book
    - Procedure for exceptional cost increase:
      - Panel of experts analyses the case & reports to Council
      - Council decides on higher value of IKC

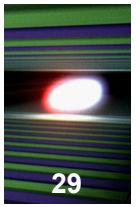
- **Case of wrong cost estimate in cost book**
  - It is found that the cost estimate of a specific equipment made in 2005 was wrong, and the contributor does not (cannot) take the cost overrun in charge
    - Case is brought to the Council for discussion among shareholders and decision
  - At European XFEL a funding shortfall was discovered in 2011, and 3 main shareholders decided to increase their cash contribution to the project by 145 M€

Examples of difficulties encountered (Schedule and quality)

- **Delayed achievements**
  - Contributor does not deliver on-time → 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
    - 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



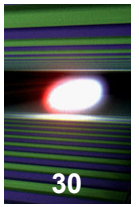
Do

1. Consider contributor as project partner
2. Define precisely what is expected
3. Define specific goals of achievements
4. Share important project info
5. Define precisely acceptance criteria
6. Visit regularly contributors
7. Provide assistance in solving difficulties
8. Plan the unexpected (risk analysis)
9. Verify completeness of documentation
10. Appraise value of accomplishments

Don't

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

Conclusions



- **Management and control of IKCs need significant efforts (technical & 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**

Thanks to HEPTech and ESS for organizing this workshop

Thank you for your attention !