FRONT PAGE

PROJECT PERIODIC REPORT

Grant Agreement number: 206711

Project acronym: ILC-HIGRADE

Project title: International Linear Collider and High Gradient Superconducting RF-Cavities

Funding Scheme: Combination of CP & CSA

Date of latest version of Annex I against which the assessment will be made:

Periodic report: 1st ☐ 2nd ☐ 3rd ☒ 4th ☐

Period covered: from 1.2.2010 to 31.1.2011

Name, title and organisation of the scientific representative of the project's coordinator:

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Declaration by the scientific representative of the project coordinator[1]

I, as scientific representative of the coordinator[1] of this project and in line with the obligations as stated in Article II.2.3 of the Grant Agreement declare that:

- The attached periodic report represents an accurate description of the work carried out in this project for this reporting period;
- The project (tick as appropriate):
  - ☐ has fully achieved its objectives and technical goals for the period;
  - ☒ has achieved most of its objectives and technical goals for the period with relatively minor deviations[1];
  - ☐ has failed to achieve critical objectives and/or is not at all on schedule[2].
- The public website is up to date, if applicable.
- To my best knowledge, the financial statements which are being submitted as part of this report are in line with the actual work carried out and are consistent with the report on the resources used for the project (section 6) and if applicable with the certificate on financial statement.
- All beneficiaries, in particular non-profit public bodies, secondary and higher education establishments, research organisations and SMEs, have declared to have verified their legal status. Any changes have been reported under section 5 (Project Management) in accordance with Article II.3.f of the Grant Agreement.

Name of scientific representative of the Coordinator[1]: Dr. Eckhard Elsen

Date: ....11/ 7 / 2011

Signature of scientific representative of the Coordinator[1]: ....

[1] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.
[2] If either of these boxes is ticked, the report should reflect these and any remedial actions taken.

Table of contents

1 *Project objectives for the period*

The two overriding objectives of the Preparatory Phase Project ILC-HiGrade continue to be: to ensure that with the release of the Technical Design Report in 2012 the crucial R&D has been carried out to allow the project to be constructed within the internationally agreed cost envelope and to establish all necessary structures and technical capabilities to ensure that the ILC can be brought to governments for submission for approval in 2012 and that the site choice has been technically prepared.

The participating institutes of ILC-HiGrade have engaged in this respect and have formed the backbone of European activities in these areas.

On the technical side a key issue for ILC-HiGrade is the delivery of the superconducting RF cavities and establishment of the good performance. The tendering has been carried out and respective order of the cavities has been placed during 2010. The delivery is currently foreseen to start for late 2011 and is likely to continue well into 2012. In the meantime the consortium has used existing cavities to practise the diagnostics tools, several of them newly developed, and to prepare for the rapid and comprehensive analysis of the cavities once they are delivered. The description of this preparatory work constitutes the major body of this work and notably considerable progress has been made in building and establishing the technical tools for quality assessment.

Considerable progress has been made in detailing governance models for the ILC, an effort that Europe is currently leading, a development that is owed to the collaborative model for High-Energy Physics that is prevalent in Europe.

The ILC-HiGrade work packages in detail are:

	Activity
WP1:	Management of the Consortium
WP2:	Integration and optimisation of the European contribution within the global GDE organisation as the ILC project moves through the GDE Technical Design Phases
WP3:	Ensure that the characteristics and importance of the ILC, and its place within the world of science and research, is widely disseminated to the peoples of the European Union, and their governments
WP4:	Investigate features and develop possible schemes of governance for the ILC, exploiting expertise of CERN (LHC) and DESY (HERA) in international projects
WP5:	Prepare and investigate possible European sites for ILC construction
WP6:	Investigate and monitor the production process that yields high-gradient cavities with high yield. Establish the process in industry
WP7:	Optimisation of the coupler conditioning at reduced cost
WP8:	Demonstrate suitability of tuner design in tests. Establish a cost-effective tuner production

2 *Work progress and achievements during the period*

The activities of the past reporting period are described for each work package.

2.1 WP2 – Coordination of European GDE Activity

Work package number	WP2		**Start date or starting event:**				1
Work package title	Coordination of European GDE Activity						
Activity type	COORD						
Participant id	1	3	6				
Person-months per beneficiary	12	6	4.04				

As reported in previous Annual Reports, the European GDE activity is completely integrated into the global organisation. The organisation of the GDE (Figure 1) remains unchanged and continues to work well. Key European personnel are summarised in Table 1, and represents no change from the last 2009/2010 Report.

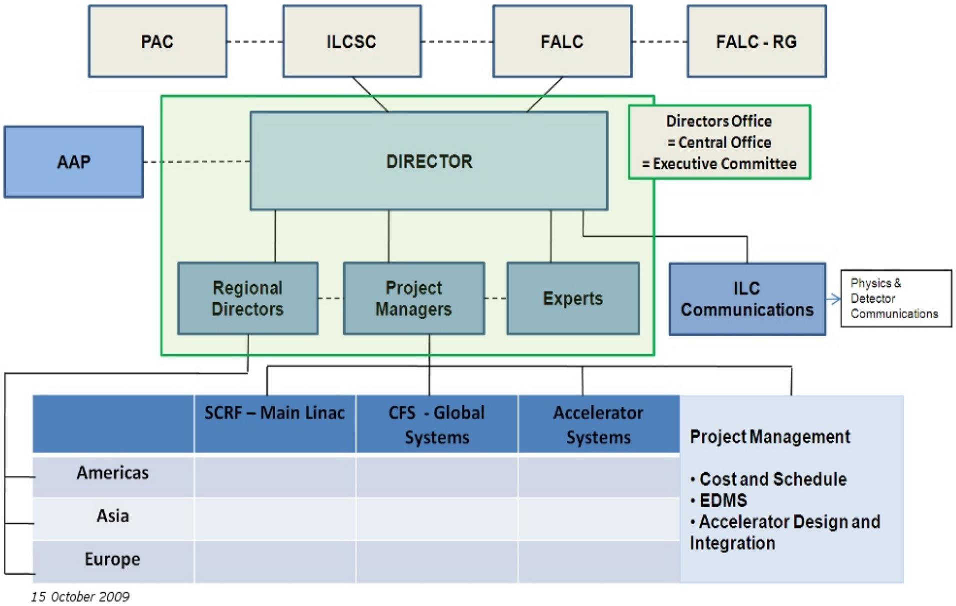

Figure 1 Structure of the GDE management. The boxes at the top correspond to bodies to whom the GDE in one sense or another reports. The blue box defines the Director's office, which in equivalent to the EC defined in the text. The AAP is the Accelerator Advisor Panel, a body that reports to the EC and which can be charged to carry out specific reviews of any area of GDE activity. The ILC communicators contain representative of each from each region and are responsible for public outreach. The Project Managers' Office is responsible for delivering the R&D programme defined by the EC.

Calendar year 2010 saw the completion of Phase 1 of the Technical Design Phase of the GDE. The year focused on technical details of the ILC re-baseline, and achieving a consensus with all stakeholders (including the physics and detector community). In addition to face-to-face workshops (several in Europe hosted in part by the European GDE, see Table 2), the work was carried out using remote conferencing, which has now become an indispensible tool for the GDE. B. Foster presented progress on the ILC and the activities of ILC-HiGrade to the European Committee for Future Accelerators, ECFA, at its plenary meeting in Frascati in July 2010.

Person	Institute	GDE Role
Prof. Brian Foster	Oxford University	GDE European Regional Director
Dr. Nicholas Walker	DESY	Project Manager for Accelerator Systems
Prof. Eckhard Elsen	DESY	Chair Accelerator Advisory Panel (AAP)
Dr. Wilhelm Bialowons	DESY	Assistant Project Manager for Conventional Facilities and Siting, and Global Systems.

Table 1 Senior European GDE members

Of specific interest to Europe is the strengthening of the collaboration between the GDE and the CLIC collaboration centred at CERN. Again, the European GDE together with ILC-HiGrade have been centrally involved. The first joint ILC-CLIC workshop was held in Geneva, Switzerland, in October 2010 and saw almost 500 participants. It has been agreed that there will now be one joint workshop each year, which will further bring together the two linear collider groups. In addition to the plans for joint workshops, a special GDE-CLIC working group on 'Joint Issues' has been working to address key problems involved in establishing a linear collider project. ILC-HiGrade coordinator E. Elsen is a member of this group.

One area where ILC-HiGrade directly contributes is in industrialisation of the superconducting radio-frequency technology. The GDE has begun ramping up industrial contacts worldwide with a view to producing a globally distributed mass-production model and cost estimate for the approximately 15,000 cavities required. ILC-HiGrade, together with its links to the European XFEL production, will continue to provide a central coordinating role in this important issue for the remaining period of the project.

The ILC Project Advisory Committee (PAC) regularly reviews the activities of the GDE. The PAC has been installed by ILCSC and reports to ILCSC. The PAC met twice during the reporting period. The minutes of these meetings constitute milestones in the development of the ILC project towards realization and are available with this report.

The list of ILC meeting directly relevant to the coordination of the ILC activities in Europe is given in Table 2.

Meeting	Venue and Date	Purpose and Programme
GDE Accelerator Advisory Panel Review	Oxford University 6.-8.01.2010	Independent review of the proposed ILC baseline design modifications to be used for the Technical Design Report. http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=4253
ECFA Plenary Meeting	Frascati National Laboratory, Italy 1.-2.07.2010	Plenary report to the European Committee on Future Accelerators on ILC progress and activities on ILC-HiGrade
IWLC'10	Geneva, CH 18.-22.10.2010	Joint ILC-CLIC workshop. https://espace.cern.ch/LC2010/default.aspx
7th GDE Positron Source collaboration meeting	DESY, Hamburg, Germany 15.-16.07.2010	ILC positron source R&D and design workshop. http://indico.desy.de/conferenceDisplay.py?confId=3061
Workshop on Linac Operation with long bunch-trains.	DESY, Hamburg, Germany 22.-24.07.2010	Review of progress on ILC linac operation studies at the FLASH facility at DESY. https://indico.desy.de/conferenceDisplay.py?confId=2576

Table 2 Meetings related to the coordination of the European Activities of the GDE

2.2 WP3 – Dissemination and Outreach

Work package number	WP3	**Start date or starting event:**		1		
Work package title	Dissemination and Outreach					
Activity type	COORD					
Participant id	1	4	5	6			
Person-months per beneficiary	-	5.21	14.9	0.68			

A summary of the dissemination and outreach activities and links can be found at the ILC-HiGrade webpage http://www.ilc-higrade.eu/e10/e38725/.

Cooperation and communication strategies developed over the last years have truly paid off in the year 2010. One of the central messages of future projects, like the ILC, as well as for most other projects and strategies in particle physics around the world, is that results from the LHC will determine which project will eventually be approved. Communication experts from many international labs and institutes are systematically connected in communication networks and collaborations, and many work on both the LHC and on future projects at the same time, including the European ILC communicators. In 2010, the year that brought the first real data from the LHC, a major particle physics conference bundled results and plans from current and future projects and attracted a lot of media attention, made possible by synergies and supportive cooperation between the people responsible for communication. Fun projects like the Particle Physics Photowalk also underlined the connected nature of the field.

2.2.1 Introduction

The core of European ILC communication is a team of two communication specialists with combined physics and journalistic backgrounds, who work in close collaboration with one American and two Asian colleagues, the scientific ILC community and a wider network of particle physics communication specialists from around the world. Ever since its formation six years ago, the international ILC communications team has had very active communication and outreach activities, producing publications and brochures aimed at an international audience. These publications were mainly produced in English. To complement this work, the European team considers it essential to develop European-specific communications tools and translate the existing ones, into the main languages of the member states of the EU: German, French, Italian, Spanish and Russian.

Although the ILC is a global project and should be promoted as one, the communicators also consider it important to deliver further specific messages to selected audiences in Europe. The work is based on a strategic ILC European communication plan for the four years of the ILC-HiGrade project, which was approved by the ILC European Outreach Advisory Subgroup (chaired by B. Foster). Our strategies are both internal in that our activities aim to strengthen the ILC collaboration as an international endeavour, and external, by developing tools to present the ILC to European governments and funding agencies and reaching out to the larger scientific community and key political representatives, always following the ultimate goal of building the ILC. This is illustrated by a number of concrete actions taken this past year.

2.2.2 Press

The ILC communicators continue to handle incoming press requests and promote the ILC when talking to journalists in different contexts. Particle and accelerator physics are enjoying a raised profile thanks to the news from the Large Hadron Collider (LHC) at CERN, but the focus is still very much on the LHC.

High-energy physics was moved into the spotlight this year, with the first collisions of the LHC taking place on 30 March 2010. The media activity organised by CERN for the event, ‘First Physics’, consisted of a live webcast coordinated from the CERN Control Centre and linking to the control rooms of the four major experiments. Key events in the day were also made available live to broadcasters around the world via the European Broadcasting Union. A press centre was established at CERN, and journalists attending were all given the opportunity to visit one or more of the experiments’ control rooms.

Both European ILC communicators where involved in the national and international coordination of the major media event organised by CERN. At CERN alone, 110 journalists from 69 media in 18 countries were accredited to witness the live event. Press events were organised in many European states. The coverage of this particular day was tremendously large, with 2200 news items published on the same day.

Another major event for the physics community and press was the International Conference on High Energy Physics (ICHEP2010), which took place in Paris in July 2010. From the LHC, through neutrinos to dark matter, the very latest results of high-energy physics experiments were unveiled during the largest series of international conferences on particle physics in the world. Both European communicators were involved in the coordination and preparation of all outreach and press events during the conference. An international press conference was held in 26 July 2010, in the presence of CERN director general, KEK director general, HEPAP chair and ICHEP2010 chair. The topic of the ICHEP press conference was the announcement latest results from current high-energy experiment followed by an outlook for the future of high-energy physics, including of course the ILC project. More than 60 media came to interview physicists that week and the press conference triggered hundreds of media items, including about 20 quoting the ILC from such media as *Agence France Presse*, *Der Spiegel*, *Le Figaro*, *BBC News*, *New Scientist* or *the Independent*.

View most of ILC-related press cuttings on the ILC websites

- in 2010: http://www.linearcollider.org/about/Press/In-the-news/2010
- in 2011: http://www.linearcollider.org/about/Press/In-the-news/2011

In the year 2010, attention for particle physics and colliders has grown immensely, and the ILC project is clearly benefiting from this popularisation of the field. Particle physics is no longer confined to science pages and specialised magazines, but has found its way into culture sections and everyday language. The synergies created by communication networks and the fact the European ILC communicators worked on these many opportunities to promote the ILC, explaining its concept and goals, cannot be underestimated. The challenge for ILC and particle physics communication in general now is to maintain and increase the current level of interest.

2.2.3 Translation of the main ILC publications

Several documents originally issued in English have been translated and been made available

- A companion document, a glossy 40-page brochure *The International Linear Collider – Gateway to the Quantum Universe*, to the rather technical four-volume *ILC Reference Design Report*, was produced in 2007 by the ILC communicators as core part of a committee representing the whole ILC community. In 2008 the WP3 coordinators coordinated and edited the French, German, Italian, Russian and Spanish versions of this document. These documents are now available on the ILC website and can be retrieved from http://www.linearcollider.org/cms/?pid=1000446

- Commissioned by the Funding Agencies for Large Colliders (FALC), *The International Linear Collider – Gateway to Technology* is a four-page outreach brochure that aims to describe possible industrial, socio-economic transfers and the wider societal implications of the ILC project. It is based on a FALC report entitled "Technology Benefits Deriving from the International Linear Collider". The European communicators worked with their Asian colleagues to write and realise this document, in close collaboration with, for the European aspects, the European Industry Forum for Accelerators with SCRF Technology (EIFast). It was produced in 2009, and in 2010, the WP3 coordinators coordinated and edited the French, German, Italian, Russian and Spanish versions of this document. These documents are now available on the ILC website http://www.linearcollider.org/about/Publications/Gateway_to_Technology.

Both translated publications were printed and first distributed at the International Workshop on Linear Colliders 2010 meeting at CERN on October 2010.

2.2.4 ILC Weekly Newsletter NewsLine

Since August 2005, the birth of the Global Design Effort (GDE), the ILC communicators have published the electronic newsletter *ILC NewsLine* every week. The communicators are responsible for the content of the ILC website's public face, and tasks include updating it regularly with new news clippings, current and attractive images of R&D and other milestones. ILC NewsLine presently counts 2193 subscribers (a roughly stable number of readers since last year). We estimate the number of European subscribers to be about 31 % of the total.

This year, 150 articles were published in ILC NewsLine, 20 of those written by one of the three WP3 coordinators. Thirty-seven articles on European R&D, milestones and scientific milestones were published, mainly on the ILC, but also some about related projects. Indeed, in Europe, it is particularly important to connect the ILC to other projects in particle physics, like the Large Hadron Collider at CERN, the European X-Ray Free-Electron Laser Project (XFEL) at DESY or the Compact Linear Collider (CLIC) Study. In particular, the first high-energy collisions and first results of the LHC this year were a huge opportunity to tap the public and media interest in particle physics at an unprecedentedly high level. In ILC NewsLine, 16 articles related to LHC were published in 2010. The European communicators also devoted 18 articles and photos in total to XFEL and CLIC projects and one article specifically on ILC-HiGrade.

The 'ILC Blogs" section of *ILC NewLine* reports on relevant blogs around the world related to particle physics and the ILC. One blogger from Europe is presently writing in *Quantum Diaries (*http://www.quantumdiaries.org/).

Four thematic issues of *ILC NewsLine* were released in 2010. The topics were the *LHC first high-energy collisions*, *women in science*, *high-energy physics future machines and projects* and *ILC cavities*.

Specific links:

- ILC NewsLine's current issue: http://www.linearcollider.org/newsline
- ILC NewsLine archive: http://www.linearcollider.org/newsline/archive/index.html

- ILC NewsLine special issues archive: http://www.linearcollider.org/about/Publications/ILC-NewsLine

2.2.5 New linearcollider.org website

The central communication tool for the ILC, its website www.linearcollider.org, was almost completely rewritten and restructured during the year 2009, and was launched 18 February 2010. It now has a much more extensive section with general information about the ILC, clearly marked section for collaborators on the GDE, on the detectors and for the general public. Its news content is much higher with frequently changing features highlighting various aspects of ILC life, including European projects and milestones like those of ILC-HiGrade. On average, about 10,000 unique visitors per month visit it.

2.2.6 Particle Physics Photowalk

On August 7, 2010, more than 200 amateur photographers from around the world had the rare opportunity to experience state-of-the-art accelerators and detectors in all of their complexity and beauty as part of the first Particle Physics Photowalk organised through the InterAction collaboration in five laboratories including DESY in Germany. One of the European communicators was involved in the preparation and coordination of the German event and the event at CERN. A nice anecdote is that Japan's local winner featured French ILC scientists working at the Accelerator Test Facility (ATF) at KEK, one of the ILC test infrastructure in Asia.

2.2.7 Deliverables

During this period the deliverable 3.2 of this WorkPackage has been fully completed. The "Gateway to the Quantum Universe" and "Gateway to the Technology", ILC's main brochures, are now available in print in several European languages, namely English, French, German, Spanish, Italian and Russian. They can be obtained from the web-page www.linearcollider.org/gateway. Printed copies are available upon request.

2.3 WP4 – Governance

Work package number	WP4		**Start date or starting event:**			1	
Work package title	Governance						
Activity type	SUPP						
Participant id	1	3	4	5	6		
Person-months per beneficiary	-	4.4	-	10.1	2.20		

As remarked in last year's report, ILC-HiGrade planned to draw together proposals for the funding and governance of the International Linear Collider and present them to funding agencies and the community in the summer of 2010. This was achieved and the various steps taken are summarised in the report below.

Because the ILC is a truly international project, its structure must reflect its nature. Thus input to the question of governance is necessary from all three major participating continents: Asia, the Americas, and Europe. This requirement is reflected in the structure we have set up to study the governance question and which is illustrated in Figure 2.

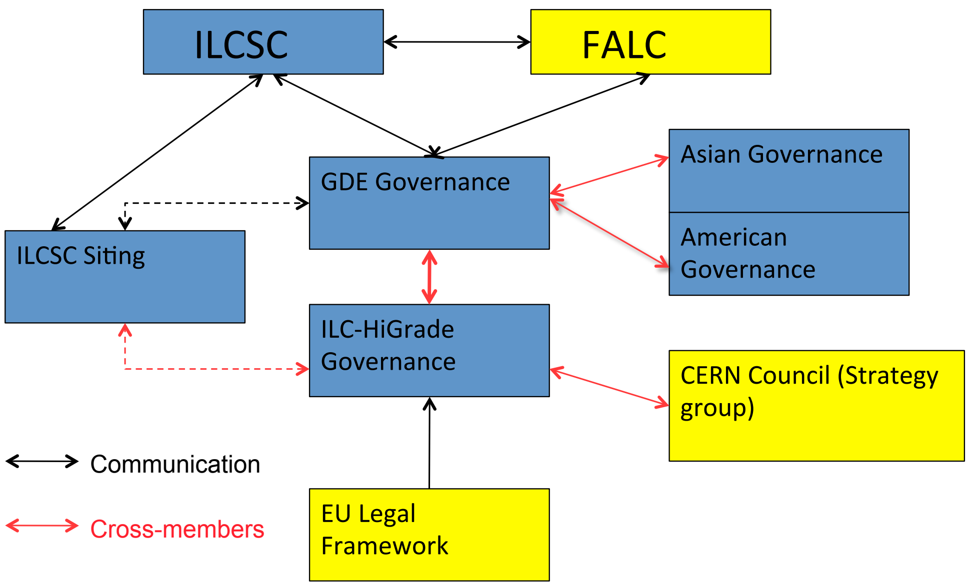

Figure 2 Structure of the governance activity in the ILC. The blue-shaded boxes represent committees set up inside the high-energy physics community. Those surrounded by the light-blue shaded box are currently not active. Note that since the last Annual Report, the American Governance group has constituted itself and has become active. Yellow boxes represent committees external to the particle physic community. Back arrows represent communication paths, while red arrows represent cross-membership between committees.

In Figure 2, FALC is the acronym for Funding Agencies for Large Colliders, a body which meets typically twice per year and contains representatives from most major funding authorities with an interest in particle physics. CERN Council represents the smaller European countries, while France, Germany, Italy and the UK have their own representatives. This body is currently chaired on a *pro tempore* basis by Walter Davidson of the Canadian National Research Council. The CERN Council is custodian not only of the affairs of the European Laboratory for Particle Physics, CERN, but also sets the European Strategy for particle physics, which, after wide consultation among the European particle physics community, feeds directly into the ESFRI roadmap. The process to begin the procedure to draw up a new European Strategy for particle physics is now beginning, with the aim of producing a new document by the end of 2012. ILC-HiGrade, through its leading individuals, is in an excellent position to have influential input into this new strategy.

The internal particle physics structures are controlled directly or indirectly by the International Committee for Future Accelerators, which is an organ of the C11 Commission for Particles and Fields of the International Union of Pure and Applied Physics, IUPAP, itself an organ of UNESCO. ICFA is currently chaired by Atsuto Suzuki, Director-General of KEK, the Japanese National Laboratory for Particle Physics. It contains representatives of each of the three regions as well as the heads of the major international laboratories, for example the Director-General of CERN is an *ex-officio* member. It meets twice yearly and sets overall policy for the world particle physics community. Although it has no executive authority, its influence is large.

The International Linear Collider Steering Committee, ILCSC, is charged by ICFA with overseeing the activity towards realising the International Linear Collider. The current chair is Jonathan Bagger, a distinguished theoretician from Johns Hopkins University in the USA. Each of the three regions has ex-officio representation. From Europe this includes the Chair of the ELCSC, the European Linear Collider Steering Committee. The current chair, Tatsuya Nakada, is the Chair of the European Committee for Future Accelerators, ECFA, which is an organ of CERN Council. The ELCSC typically meets twice per year, just before the meetings of ILCSC.

The ILCSC siting group is a subgroup of the ILCSC and is discussing mechanisms and procedures to establish the preferred site for the ILC. Its composition is currently under discussion; the chair is A. Suzuki.

The other two bodies in Figure 2 are both chaired by the European Director of the Global Design Effort for the ILC, Brian Foster. They maintain close contact with each other and hold common meetings. The GDE Governance group contains representatives of all three regions and is a subset of the Executive Committee of the GDE. Membership of this Governance groups is: Brian Foster (chair), Barry Barish (Director, GDE), Mike Harrison (Americas Regional Director, GDE), Ewan Paterson (Integration Scientist, GDE) and Sakue Yamada, (ILC Research Director).

The ILC-HiGrade working group is the main organ to produce the deliverables of the WP4 work package. It is chaired by Brian Foster, European Director of the Global Design Effort, and consists of the following members: Jean-Pierre Delahaye, Deputy European Director, GDE; Umberto Dosselli, Deputy Director, INFN; Eckhard Elsen, Scientific Coordinator of ILC-HiGrade; Francois Richard, former director of LAL, Orsay, France; Steinar Stapnes, previously Secretary of the Strategy Group of the CERN Council and now Linear Collider Studies Leader at CERN; Joachim Mnich, DESY Director for High-Energy Physics; and Guy Wormser, immediate former director of LAL, Orsay.

The GDE and ILC-HiGrade working groups are well coordinated by virtue of their common chair, their minutes are circulated to all members and they hold joint meetings.

The major output of this year's work has been the production of an interim governance report. This was agreed by both the European and World Governance groups and had significant input from the other regional governance working groups. The major conclusions, which are backed up by the *pro formas* produced over the last 18 months and discussed in last year's report, are listed below.

- *ILC should be set up as an international treaty organization similar to ITER, taking advantage of zero VAT rating and similar privileges.*
- *ILC should have a strong Council as the ultimate governance body. Council delegates should be of sufficient standing to make decisions in a timely fashion. The ILC should have a Director General and a Directorate, proposed for Council ratification by the DG. The DG should have significant delegated authority from the Council, allowing him or her to act decisively without continual need to refer back to Council.*
- *Each Council member state*[3] *should have two official delegates and a maximum of two advisors. One of the two delegates should be a particle physicist. There should be the option, every few years, of Ministerial Council Meetings in which delegates are the relevant government minister.*
- *Council should decide questions not of a financial nature by simple majority; financial questions should be decided by a qualified majority voting decided by a majority of financial contributions plus a majority of individual member states.*
- *The ILC agreement should be fixed term – a construction period of ~9 years plus 20 years of operation; it should be extendable by agreement of Council in periods of 5 years. Withdrawal would not be allowed until a minimum of 10 years after the agreement comes into force and then only after 1 full year after notice of withdrawal.*
- *The ILC construction project should be based on a Work Breakdown Structure (WBS) system. In-kind contributions will be likely to form the majority of contributions to the project's infrastructure. An agreed register of WBS items should be set up and a committee constituted to consider bids for WBS items from member states. Value engineering should be used in defining the "value" of each WBS item. There should be an adequate Common Fund (of at least 20%) in order to give management enough flexibility. There should be no strict "juste retour".*
- *If and when needed, the Council should have the authority to call on a central contingency budget with a maximum of 10% of the total project cost and to allocate it as appropriate. Increases in costs to produce a WBS item smaller than 25% or some other agreed ceiling in cash should be borne by the country with responsibility for that item; they are recommended to have appropriate internal contingency. It is important to avoid double counting between the central contingency and a country's internal contingency in arriving at the overall project costing. If costs for a WBS item increase beyond the agreed ceiling, the case could be referred to and considered by a standing Board and either referred back to the submitting country or referred to Council for release of central contingency, as appropriate.*

[3] The definition of a "member state" should be as flexible as possible and include groupings of nations represented by a coordinating body, for example CERN or JINR.

- *Exhaustion of the central contingency should lead to appropriate descoping of the project to be decided by management with Council's agreement.*
- *Running costs should be evaluated at the time of setting up the organization and a suitable algorithm agreed to. A commonly chosen algorithm is that running costs should be distributed roughly proportional to capital contributions.*
- *Decommissioning should be the responsibility of the state that provided that WBS item; the Host State should have residual responsibility.*

It is emphasised in the report that there are often several possible solutions to each of these points; the choices made here seemed to the Governance working groups to be the best, but generally speaking others could be made to work. These conclusions were presented both to the funding authorities and to the particle physics community in a variety of meetings. These included the European Committee for Future Accelerators Plenary meeting in July 2010 in Frascati, FALC at its meeting at CERN in June 2010 and at the International Conference of High Energy Physics (ICHEP) at a well attended parallel session in Paris in July 2010. Comments were received and will be incorporated into future work. B. Foster also attended the final meeting of the OECD Global Science Forum on Large International Infrastructures in Bologna in October 2010. He had contributed to the discussions leading up to the final report and was invited to the session as an international expert. The conclusions of the OECD activity agree very well in general terms with those of ILC-HiGrade. The write-up of B. Foster's talk published in the proceedings of the Paris ICHEP conference[4] forms the official version of the interim report of the ILC-HiGrade WP4, i.e. deliverable 4.3. "Governance of the International Linear Collider Project".

The recently proposed ERIC legal framework is a very important initiative for research infrastructure development in the EU. Ideas from it have been influential in the development of our recommendations.

Since the mandate of both the ILC Global Design Effort and the ILCSC terminate in 2012, intensive discussions are under way to decide on what should replace these organisations. Recognising the limited remaining mandate for the ILCSC, Professor Bagger has had his term as Chair extended until the end of 2012. Leaders of ILC-HiGrade are heavily involved in these discussions, which will shape the future of linear collider activity in the world.

The next phase of the work of WP4 will be to put the recommendations of the interim report into the wider context of a Project Implementation Plan (PIP). Members of the ILC-HiGrade governance activity and the wider GDE committee on governance are the leaders of this effort, which will form one of the most important parts of the Technical Design Report of the ILC, to be published at the end of 2012.

[4] B. Foster et al., "Governance of the International Linear Collider Project", Proceedings of Science (ICHEP 2010) 516, http://pos.sissa.it/archive/conferences/120/516/ICHEP%202010_516.pdf

2.4 WP5 – ILC Siting in Europe

Work package number	WP5	**Start date or starting event:**					1
Work package title	ILC Siting in Europe						
Activity type	SUPP						
Participant id	1	3	4				
Person-months per beneficiary	12.00	6.0	0.44				

The purpose of this Work Package is the preparation and the investigation of possible European sites for the construction of the International Linear Collider. The work in the past period had concentrated on the investigation of potential sites in Europe and the adaption and optimization of the tunnel design to the different sites in the framework of the GDE activities.

A priori seven different tunnel configurations can be envisaged: single and twin shallow or deep tunnels with service buildings located only at the shafts, cut-and-cover construction for all or only for the service buildings or a gallery for the services at the surface. One deep site with a twin tunnel near CERN at Geneva has been considered. This is the only European site discussed already in the Reference Design Report (RDR) of the International Linear Collider. Another possibility is a near-surface solution as it has been chosen for the European XFEL project in Hamburg, which is currently under construction. A proposal for a site near Hamburg had been developed for the Linear Collider project TESLA. The advantage of this design lies in the cost savings, particularly for a single tunnel layout. For the RDR a twin tunnel solution has been considered. A second European sample site near DESY in Hamburg is developed for the International Linear Collider. This site is significantly different from the RDR sites. The route is in a populated area thus the services can only be located at the shafts and the tunnel lies in water saturated soft ground and has to be reinforced with watertight concrete blocks. In addition, the Joint Institute for Nuclear Research has also proposed a shallow tunnel soft-ground site in the neighbourhood of Dubna in the Moscow region of the Russian Federation. Here a single tunnel solution is also possible similar to the DESY site but most of the infrastructure can be installed along the accelerator at the surface. This scheme holds promise of an additional saving for the ILC Conventional Facilities cost, which currently constitute the largest fraction of the total costs.

For the reporting period the work concentrated on the single tunnel design and the site selection criteria. A single tunnel design similar to the European XFEL solution in Hamburg has been developed for the European as well as for America's site. The major differences to the European XFEL design are the installation of the accelerator at the floor instead of the tunnel crown and the use of a klystron cluster scheme. The klystrons for the European XFEL will be installed together with the pulse transformer in the accelerator tunnel. A new scheme has been developed for the International Linear Collider. The klystrons will be installed in surface halls together with the modulators and pulse transformers. Cylindrical over-moded waveguides transport the RF power into the tunnel. One disadvantage of this scheme is the shorter spacing between vertical shafts. Now the maximum distance of the service halls is defined by the maximum power, which can be transported trough the waveguides into the accelerator tunnel. The number of the shafts is roughly twice the number assumed in the RDR, where the maximum pressure drop in the Helium gas return pipe limited the distance. Nevertheless the transition to a single tunnel design for the ILC is a major milestone for reducing the cost. The impact of the changes has been discussed in a First Baseline Assessment Workshop at KEK in Tsukuba. At the end a proposal was written, reviewed by the Change Control Board and accepted by the Project director. The safety issues have been investigated extensively since that time and it was concluded that it is possible to operate a single-tunnel configuration that will meet safety standards around the world. The availability has also been studied with a simulation program that used data from existing accelerators to establish the parameters and again it was concluded that good availability could be achieved in a single-tunnel configuration. Additionally early November 2010, four members of the Global Design Effort Conventional Facilities and Siting group and two guests from Japanese industry visited DESY in Hamburg, Germany, for two days. They wanted to find out more about the current state of the European X-ray Free Electron Laser (European XFEL) civil construction and to get information about other relevant projects like DESY's FLASH accelerator.

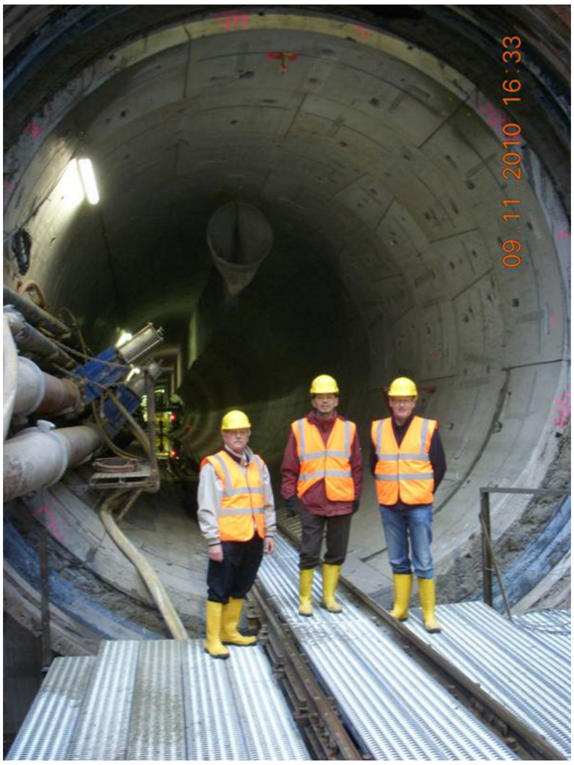

Figure 3: The three regional leaders from the civil facilities and siting (CFS) group after visiting the European XFEL tunnel boring machine in front of the tunnel mouth. The piping for the bentonite can be seen on the left. Image: John Osborne.

The team also witnessed how one can construct shallow tunnels and underground buildings in water-saturated soil, what the design of a single accelerator tunnel could look like and how the installation of the components could be handled.

In the past period the development of the site selection criteria for the site selection process was started. The criteria are divided into:

- Site impacts on Critical Science Parameters
- Scientific and Institutional Support Base
- Land Acquisition
- Environmental Impacts
- Construction Cost Impacts
- Operational Cost Impacts
- Environment, Safety and Health Issues
- Regional Infrastructure Support

- Risk Factors

Figure 4 shows some details of the site selection criteria. The ambient noise and the floor get also more important for other future accelerator projects. The Paul Scherrer Institute at Villigen in Switzerland plans a new normal conducting Free Electron Laser. The SwissFEL project was supported in the investigation of the ground vibration measurements of a potential site.

Reference Design Regional Sample Sites **European Region**

Conventional Facilities Site Considerations - December 2010

Purpose of this procedure is to develop suitable criteria to assess candidate site and to identify appropriate sample regional site for preparation of the International Linear Collider (ILC) Reference Design Report.

1 Site impacts on Critical Science Parameters

Description: This sub-heading will evaluate site-specific factors that affect critical science parameters.

Consideration: The site should permit the highest level of research productivity and overall effectiveness at a reasonable cost of construction and operation and with a

1A Configuration (Physical Dimensions and Layout)

The topography and geology of a site strongly influences machine configuration, tunnel alignment, tunnel depth, tunnel access and penetrations as well as the flexibility for design optimization options.

.1	Usable Length and Width	"economical" length maxi 42 Km, width 5 Km on average
.2	Flexibility for Adjustment of Alignment	
.a	Adaptable to Laser Straight	Yes
.b	Adaptable to Earth Curvature	Yes
.3	Depth of Tunnel	Depending on length and profile, 20 to 100 m
.4	Depth of Interaction Halls	90 m, possibly more
.5	Accessibility to Tunnels	10 No 12 m diameter shafts, plus one 15 m diameter shaft for exp cavern

1B Performance (Vibration and Stability none

Micro-seismic ground motion and cultural noise (man-made vibrations) may affect the operations of the beamline apparatus. To minimize impact upon beam position, the ILC beam line should be oriented to minimize ground waves at a given site. A quiet site which has low levels of micro-seismicity and cultural noise will avoid the need for passive or active damping systems to achieve required stability during operation.

.1	Natural Vibration/Noise Sources	class 1B for France (low)
.a	Geologic Dynamic Properties	none
.b	Seismic	two
.c	Maximum Acceleration	
.d	Grand Vibration	
.e	Volcanoes	none
.f	Rivers	
.g	Hot Springs	yes, distance 1 to 5 Km from ILC tunnel
.2	Cultural Vibration/Noise Sources	yes, on 1/3 of layout
.a	Active Railway	none
.b	Main Highway	International airport, distance 4 Km from
.c	Active Quarries	
.d	Other Major Man Made Activities	

Figure 4: Summary of details of the site selection criteria

Table 3 summarizes all Web meetings and Table 4 all face-to-face meetings where amongst other subjects the site development was discussed. The subject of the Project Management Meetings rotates between the Main Linac and Super Conducting Radio Frequency, the Accelerator Systems and Technical Areas, the Conventional Facilities and Siting and Global Systems and the Accelerator Design and Integration. The references are a collection of the Civil Facilities and Siting presentations during the last year. Additionally the participation of the Work Package 5 members in Cost and Site Review committees are listed. The respective meeting numbers in the InDiCo calendar (ilcagenda.linearcollider.org) are referenced.

InDiCo	Meeting	Frequency
	TDP CFS Meeting	Weekly every Tuesday
	TDP Project Management Meeting:	Weekly every Wednesday
4423, 4479, 4516, 4582, 4616, 4671, 4725, 4764, 4799, 4857, 4890, 4934, 4974	Main Linac and Super Conducting Radio Frequency	
4452, 4535, 4581, 4642, 4694, 4745, 4822, 4863, 4915, 5000	Accelerator Systems and Technical Areas	
4497, 4531, 4585, 4629, 4688, 4739, 4815, 4868, 4911, 4963	Conventional Facilities and Siting and Global Systems	
4418, 4559, 4615, 4624, 4625, 4750, 4789, 4823, 4885, 4922, 4961, 4962	Accelerator Design and Integration	
85902[5],	CLIC-ILC Cost and Schedule Meeting	Several times in the period

Table 3 ILC TDP phone and web meetings

InDiCo	Meeting	Location	Date
4408	ILC-HiGrade Scientific and Annual Meeting	CERN, Geneva	February 25, 2010
4466 4175	2010 Linear Collider Workshop (LCWS10) and International Linear Collider Meeting (ILC2010)	Beijing, China	March 26 to 30, 2010
4613	Asian Single Tunnel Design Review – Study of the ILC Conventional Facility in Mountain Regions	KEK, Tsukuba	June 1 and 2, 2010
4696	CFS Area System Workshop 1	STFC, Daresbury	July 12 and 13, 2010
4697	CFS Area System Workshop 2	SLAC, Menlo Park	August 2 to 4, 2010
4593	First Baseline Assessment Workshop	KEK, Tsukuba	September 7 to 10, 2010
4507	International Workshop on Linear Colliders IWLC 2010	Geneva, Switzerland	October 18 to 22, 2010
	GDE Conventional Facilities and Siting Meeting	DESY, Hamburg	November 8 and 9, 2010
4828	ILC-HiGrade 3rd Scientific Workshop	DESY, Hamburg	November 22, 2010
4612	Second Baseline Assessment Workshop	SLAC, Menlo Park	January 18 to 22, 2011

Table 4 Face-to-face ILC-HiGrade and GDE meetings

[5] indico.cern.ch

The deliverables for this work package constitute the site study of the previous reporting period (deliverable 5.1) and the report on the site selection process (deliverable 5.2). While most of the technical ingredients determining the contents of the latter report have been collected and in part presented the final report has been delayed to allow the strategic developments of the site selection to terminate.

References:

- ILC Global Design Effort and World Wide Study, *International Linear Collider Reference Design Report, Volume 3: Accelerator, Chapter 4: Conventional Facilities and Siting and Chapter 5: Sample Sites*, August 2007.
- Wilhelm Bialowons and John Andrew Osborne, *WP 5 ILC Siting in Europe Work Package Report*, ILC-HiGrade Scientific and Annual Meeting (4408), CERN, Geneva, February 25, 2010.
- Wilhelm Bialowons and John Andrew Osborne, *Site Selection Criteria for European ILC Site*, ILC-HiGrade-Report-2010-003, to be published.
- Wilhelm Bialowons, John Andrew Osborne and Grigori Shirkov, *Siting Study for European ILC Sites*, ILC-HiGrade-Report-2010-004, March 31, 2010.
- Yulian Budagov et al, *Dubna Site Investigation - An Evaluation of a Proposed Site for the International Linear Collider near Dubna, Moscow Region, Russia*, ILC-REPORT-2010-026 and ILC-HiGrade-Report-2010-008, November 18, 2010.
- Wilhelm Bialowons and John Andrew Osborne, *WP 5 ILC Siting in Europe Work Package Report*, ILC-HiGrade 3rd Scientific Workshop (4828), DESY, Hamburg, November 22, 2010.
- Wilhelm Bialowons, *Getting a vision of tunnels, Report from the visit of the ILC civil facilities and siting group to the European XFEL and FLASH at DESY in Hamburg*, ILC NewsLine, December 16, 2010.
- Rafael Abela et al, *Ambient Noise Measurements at the Potential SwissFEL Site East, Paul Scherrer Institut PSI*, Villigen, Switzerland, unpublished.

Review Committees:

- *Asian Single Tunnel Design Review – Study of the ILC Conventional Facility in Mountain Regions* (4613), KEK, Tsukuba, Japan, June 1 and 2, 2010.
- *Peer Review of the CLIC Conceptual Design Report Value Estimate*, CERN, Geneva, postponed to 2012.
- *SuperB Site Advisory Committee*, INFN Istituto Nazionale di Fisica, Rome, Italy, 2011.

2.5 WP6 – High gradient cavities

Work package number	WP6	Start date or starting event:				1
Work package title	Cavities					
Activity type	RTD					
Participant id	1	2				
Person-months per beneficiary	38.2	8.94				

This work package concentrates on ascertaining a high yield of superconducting cavities that perform at a high gradient under industrial production conditions. High-gradient cavities have been produced in the laboratory with gradients well above 30 MV/m. The manufacturing process of such cavities is thus sufficiently understood to yield high performance cavities. This statement is also well supported by the observed increase of cavity performance worldwide. To achieve a high yield in the industrial mass production process thus necessitates high reproducibility of the manufacturing process and stringent quality assessment. ILC-HiGrade addresses particularly this aspect.

Several preparatory steps have been taken to improve the reproducibility of the production and to assess the properties of the cavities. The principles are meanwhile well established and will be exercised in the production of the cavities for ILC-HiGrade once they become available. ILC-HiGrade has continued to exercise the methods on new and existing cavities available from the FLASH upgrade at DESY and for the preparation of the European XFEL.

Likewise the Saclay infrastructures for cavity string assembly in the clean room and for the complete sequence of cryomodule assembly have now become fully operational. It will be intensively used in the coming years for assembly of cryomodules for the European XFEL. Currently it is being exercised and until mid-2012 for the first prototype cryomodules (known as PXFEL2 and PXFEL3) and to train the teams in charge of assembly and to qualify the large and specific tools. The schedule of this industrial assembly operation covers the years 2012 to 2014. The good progress in the commissioning of the large infrastructures is encouraging. To retain flexibility in the production process and to limit any performance impact in the cryomodules and in particular of the high-performance cavities for the ILC CEA-Saclay is preparing the infrastructure for High Pressure Rinsing (HPR) and for electropolishing, as further detailed below.

2.5.1 Towards Automated Optical Inspection Algorithms

The high-resolution camera system originally developed at KEK and Kyoto University, Japan continued to be used in exploring the inner surface of cavities in much detail. The high-resolution camera and the improved LED-based illumination (LEDs) of the observed area constitute the main workhorse for these investigations.

Some 50 cavities have been inspected, often repeatedly to monitor e.g. the effects of particular surface treatments. A vast amount of images has been recorded manually and is available for visual inspection and serves as a sample repository for development of scanning algorithms. The recording process is time consuming and labour intensive and so is the interpretation of the picture obtained.

Figure 5 shows as a reminder the example of a cavity surface section from the earlier report that gave indications of a surface feature before the chemical treatment. The structure is more pronounced after bulk material removal during the electro-polishing step. After final treatment of the cavity the defect is clearly visible with the camera system. Under RF test a quench is observed.

a)

b)

c)

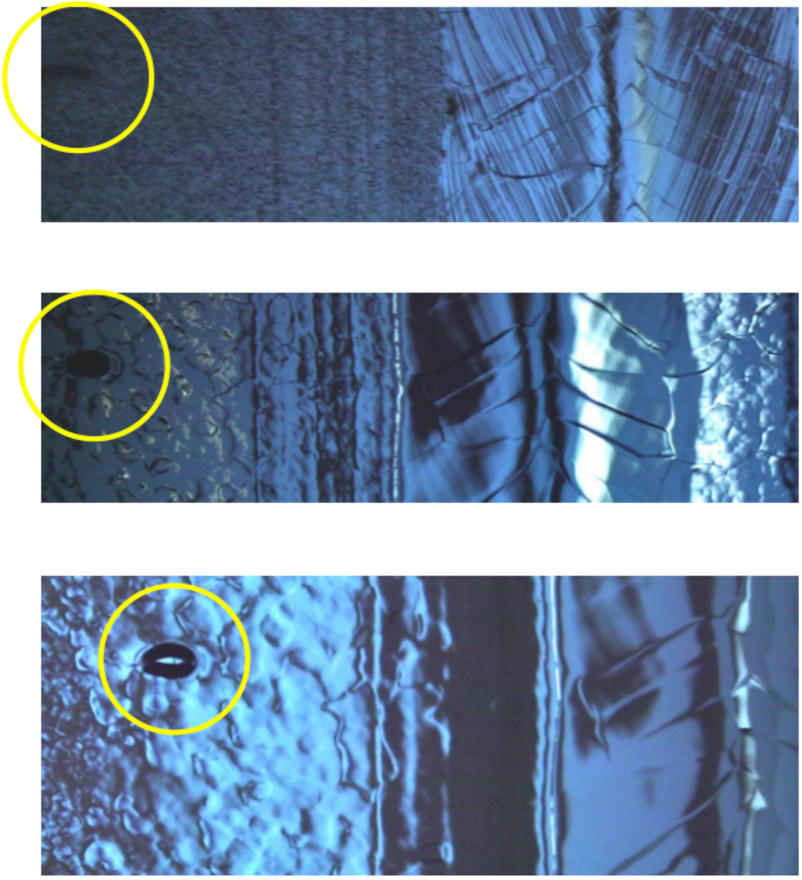

Figure 5 A surface defect (inside yellow circle) that could be traced through all stages of the preparation: a) before surface treatment, b) after bulk surface removal and c) after final treatment and RF-test. The size of the defect is ~0.5 mm.

In this reporting period intense work has started on developing software algorithms that automatically scan the recorded pictures and characterise the features. The goal of this algorithm is two-fold: The automatic feature recognition will characterize the surface in a quantifiable manner. The size and extent of features detected, their frequency and location inside the cavity contribute to understanding the features of the cavities. They will effectively monitor the production process. All ILC-HiGrade cavities will be subjected to this examination and moreover many of the cavities manufactured for the European XFEL will be subjected to the same examination. The other aspect of the automatic image processing is to detect defects such as shown in Figure 5.

Although this development is still in its initial phase some encouraging results have been obtained. Figure 6 shows the example of a cavity image near the welding seam that has been pre-processed. The image has been turned into a black and white so that the main lines and areas can be readily detected and characterized. The figures of merit are the number of such lines, the size and angle of enclosed objects etc.

This activity is in progress and continues to be refined. It is expected to significantly assist the cavity quality control.

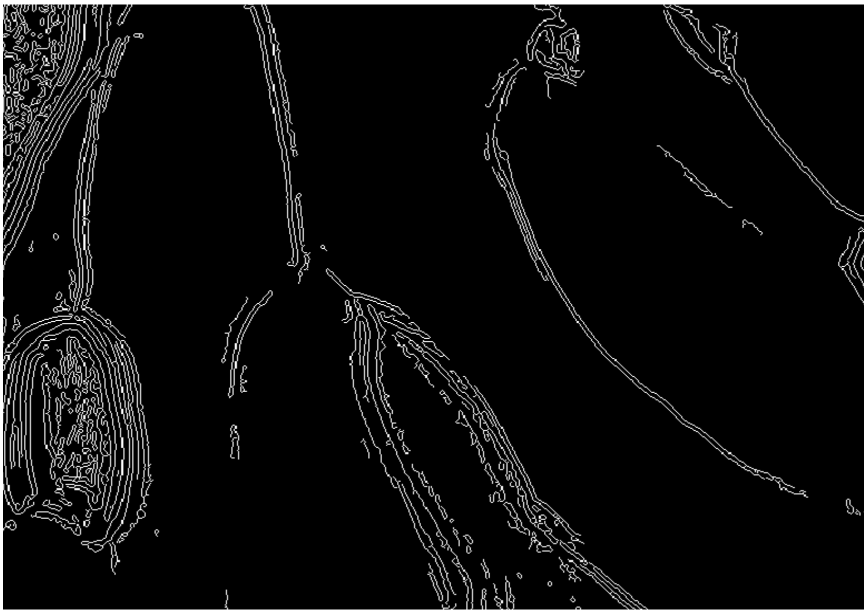

Figure 6 Example of a surface image that has been simplified to black and white and allows for recognition of the main lines and enclosed areas.

2.5.2 Automatic image recording – OBACHT

The work to complete the "robot" for automatic picture acquisition has continued over the reporting period. The Optical Bench for Automated Cavity inspection with High resolution on short Timescales (OBACHT) is again displayed as a 3d-model in Figure 7. It consists of a stiff bench that carries the drive for a linear motor. The motor moves the cavity over the camera. The camera itself can be rotated by a separate drive. An optical guide system monitors the alignment of the camera so that it will not inadvertently touch the delicate inner surface of the cavity.

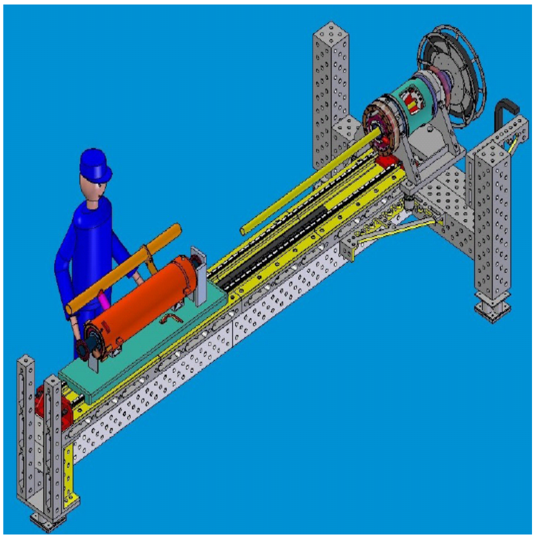

Figure 7 3d-model of the OBACHT setup for automated cavity inspection.

In the meantime most of the components for the construction of the optical scanner have been delivered and an appreciable fraction of the robot has been constructed. Figure 8 gives an early impression of the status of the construction in September 2010. The linear drive system will hold the cavities that slide over the camera, which is held inside a rotatable rod. The rigidity of the setup is necessary to reduce vibrations of the setup.

The setup will be completed during summer 2011.

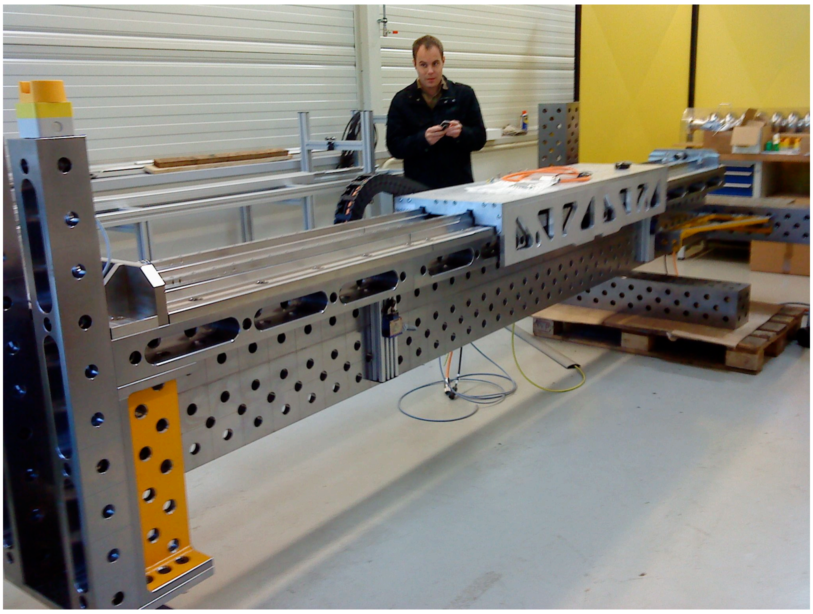

Figure 8 The OBACHT linear drive system mounted on its frame

2.5.3 Transport of Cavities – Vertical test insert

Since the cavities will be transported several times between remote testing stations in Saclay and DESY it is important that the transport of the cavities introduce the minimum stress to the cavities themselves.

ILC-HiGrade has developed a transport frame for the cavities that has been reported on in earlier periods. This work thus has been successfully concluded.

2.5.4 Second Sound System

Quench of the superconducting cavity is one effect that reduces the operational gradients. Such quenches occur when a surface structure or defect generates an excessive magnetic field that exceeds the critical field for the superconducting state. The quench induces a local heat injection that propagates through the Nb wall into the surrounding helium bath. A small amount of heat is sufficient to cause a phase transition from He II to He I. The phase transition propagates with a velocity of some 20 m/s through the helium – the so-called second sound. Similar to sound waves and a microphone these phase transitions can be capacitively recorded using oscillating superleak transducers (OST).

This effect is being exploited to locate the position of a quench without harnessing each individual cavity cell with a resistor grid, as is conventionally done. Currently the so-called vertical test stand is being equipped with individual OSTs to verify the performance of the method. An example of a detected quench is shown in Figure 9, which displays the delayed signals recorded at the OSTs following the quench itself. The quench is signalled by the sudden change in reflected power. This programme thus aids to diagnose the cavity gradient limitations for mass-produced cavities and the XFEL series production is a welcome additional testing ground. The resolution of the quench location is at the level of a few millimetres.

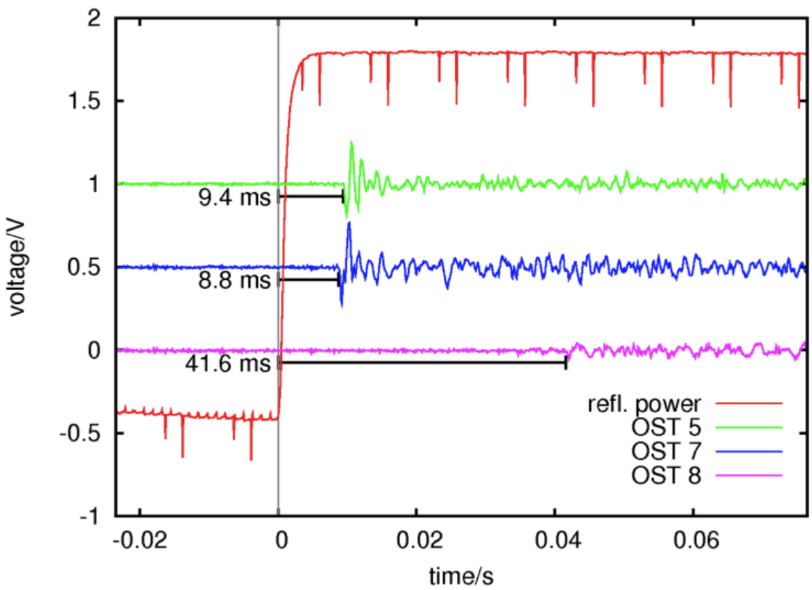

Figure 9 The signal of second sound recorded on three OSTs following a quench that is signalled by the change in reflected power.

Second sound detectors have also been introduced at CEA, where first measurements have been carried out on single cell cavities.

2.5.5 High-Pressure Rinsing

A High Pressure Rinse (HPR) is an important step that is exercised after almost every activity on the cavity surface. Operations on the cavity inside typically take place in the clean room. It is hence important to have the HPR station inside the clean area to limit any dust exposure of the cavity surface. Study and fabrication of such an HPR station fitting the Saclay clean room is well advanced. This equipment should be become available at Saclay in June 2011. A sketch of the setup is shown in Figure 10.

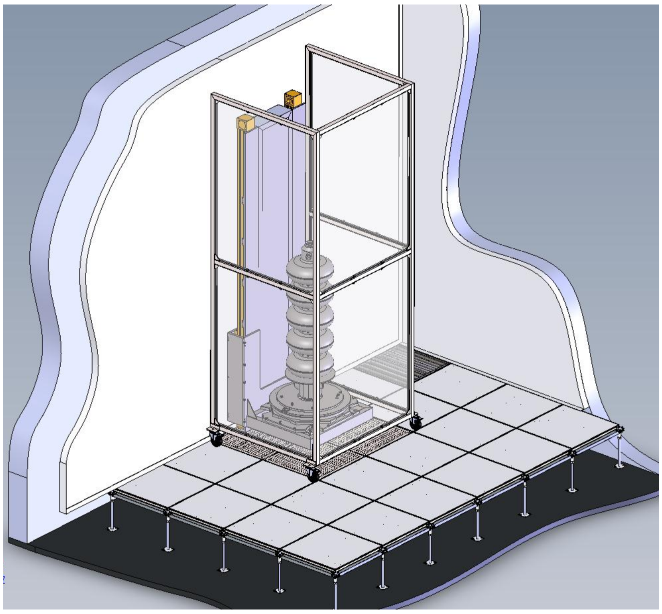

Figure 10 Sketch of the HPR station, which is under construction at CEA-Saclay

2.5.6 Vertical EP

At CEA-Saclay a system for *vertical* electropolishing (EP) of cavities continues to be developed. This system would simplify the critical surface treatment process of electropolishing for superconducting niobium cavities. So far, most systems rely on a "horizontal" EP (cavity is placed horizontally), which necessitates a mechanical rotation of the cavity. The disadvantage of the setup is mechanical complexity over a system where the cavity is held vertically. In addition a vertical system allows for simpler draining of the process liquids. An initial design has been produced and is further evaluated (c.f. Figure 11). The system components are expected for delivery in June 2011.

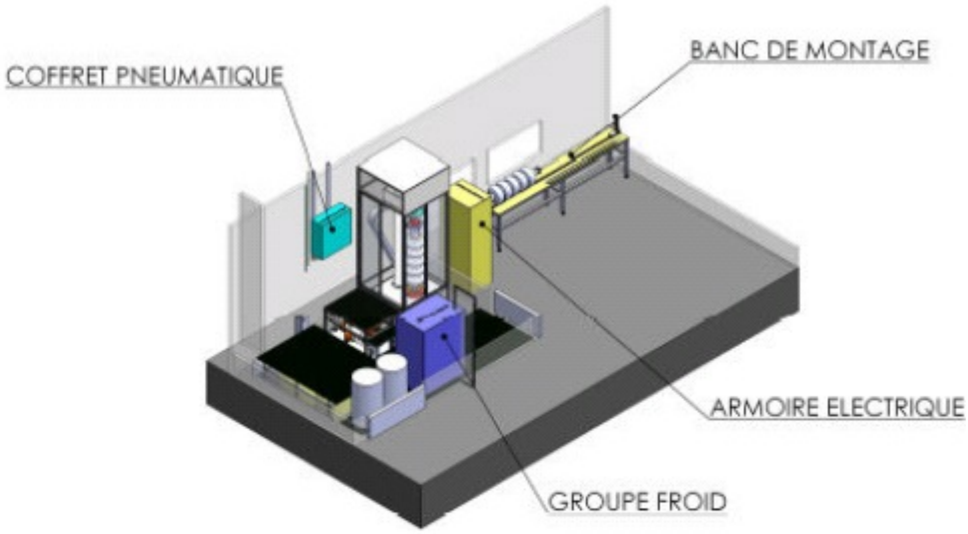

Figure 11 A sketch of the vertical EP facility currently being planned at CEA Saclay.

2.5.7 Working Group Meetings

The working group held regular meetings.

Meeting	Location	Frequency
Cavity Meeting	Phone Meeting (DESY)	weekly on Wednesdays

Table 5: Regular Meetings of Work Package 6

2.6 WP7 – RF couplers

Work package number	WP7	Start date or starting event:				1
Work package title	Couplers					
Activity type	RTD					
Participant id	4					
Person-months per beneficiary	1.29					

The high-power input couplers for the cavities transfer the RF-power from the waveguide system into the cavity. They provide the transition between warm exterior and cold interior of the cavity. Since the power loads vary through the couplers of a cryomodule they have to be adjustable and hence constitute a delicate piece of the SRF equipment and consequently of the cost.

Considerable work has been invested in identifying methods of simplifying and improving the layout of the couplers. Improvement work also addresses the reliability of the couplers during operation.

2.6.1 Design and Manufacture

The design of the optimized coupler is shown in Figure 12. The design of the coupler is the result of years of development that started in the TESLA collaboration and led to the so-called TTF3 couplers. Changes were introduced into the mechanical design following the series of tests and affected motor design, the dimensioning of components and the selection of materials. Some bellows were removed and simplified. The contacts with companies were particular useful to give early feedback on the prototype construction.

These couplers were thoroughly tested and served as the basis for the optimization of the couplers. The design is common for the European XFEL and the ILC-HiGrade cavities.

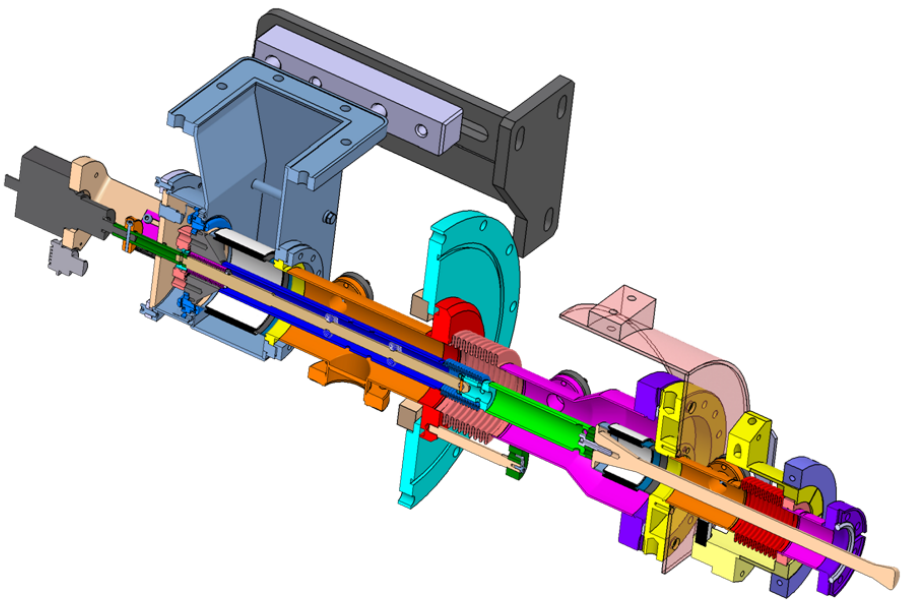

Figure 12: The layout of the high power RF-coupler foreseen for the ILC-HiGrade cavities.

With the design fixed it became possible to launch the call for tender. A common call for the couplers for the European XFEL and for the ILC-HiGrade ensures optimized cost, as was planned for the ILC-HiGrade programme. Moreover, the goal of ILC-HiGrade is to arrive at maximum gradient for industrially produced cavities including the couplers.

The call for tender has been placed in June 2010. After selecting the proper industrial company the contract was finally awarded in September 2010. The delivery of the 24 couplers for ILC-HiGrade is expected for end of 2011.

2.6.2 Coupler conditioning at LAL-Orsay

The produced couplers have to undergo a cumbersome *burn-in* procedure, during which the coupler is slowly *conditioned*. Tests at LAL had shown that the procedure could be dramatically shortened in an automatic set-up, as has been the topic of the last report.

The installation of the new infrastructure enabling the test of the mass-produced couplers is shown in the 3-D model in Figure 13. The main order for components have been placed during the year and the delivery is foreseen for March 2011. Enough time will remain to commission the test and conditioning stations before the produced couplers arrive. Overall the station should become operational during the year 2011.

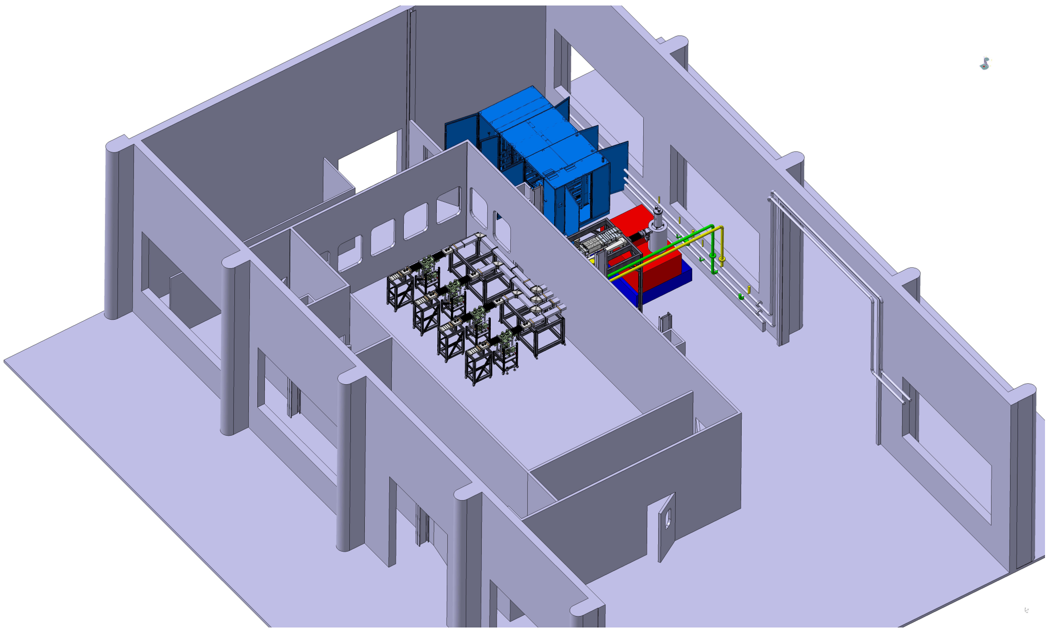

Figure 13: A 3D model of the future conditioning hall and bench

Detailed impressions of the activities in the hall can be seen in Figure 14 together with the components arriving. Figure 14 also indicates the detailed schedule of installation of the testing site. Both RF-station and conditioning room will be ready by March 2011.

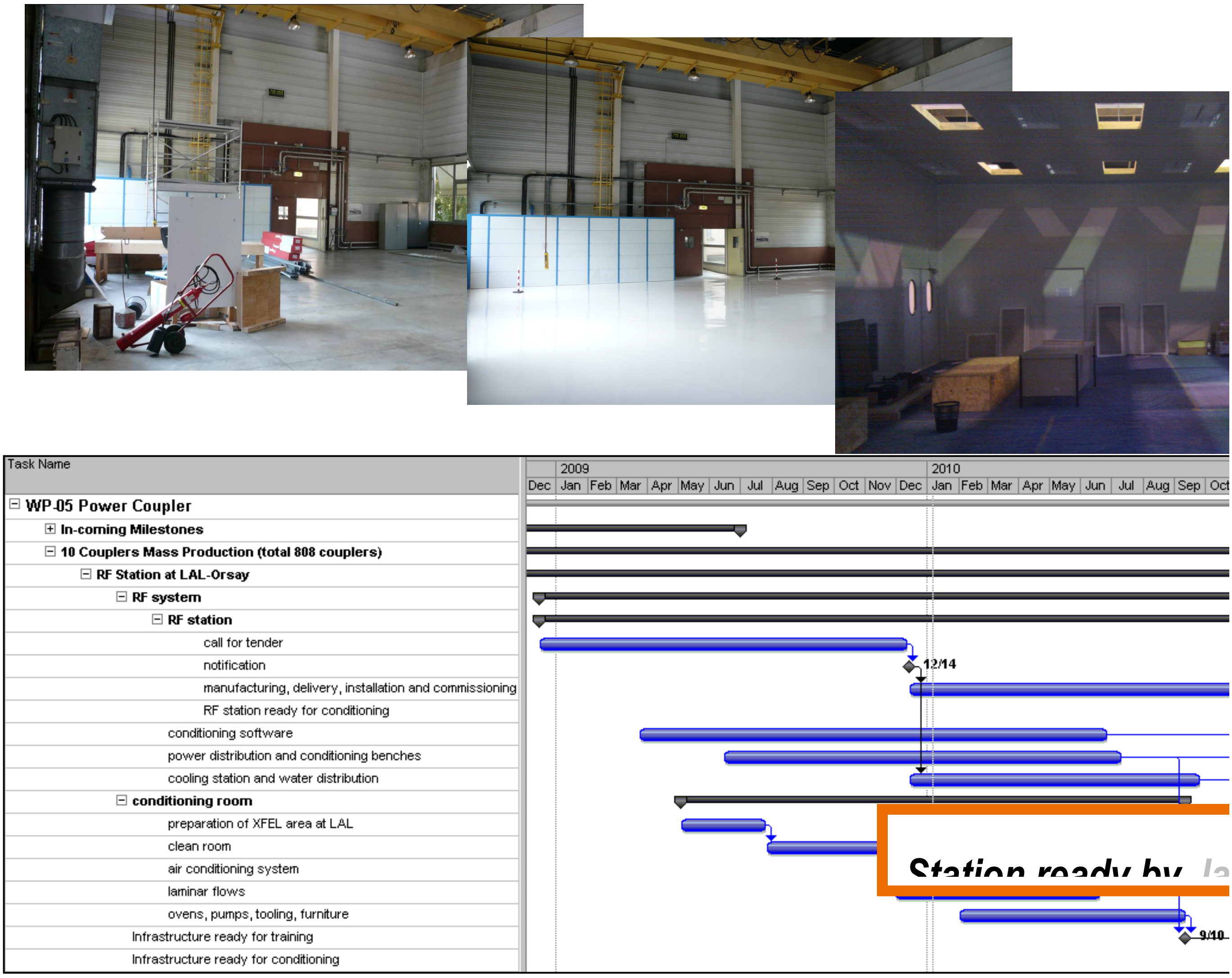

Figure 14: Site and schedule of the future conditioning bench

To speed up overall production time by a factor of four the couplers will be conditioned in parallel. Such a setup necessitates an elaborate RF-network that is depicted in Figure 15. The capacity is expandable: instead of the currently foreseen four coupler pairs that will be tested in parallel the system could be extended to process eight pairs. The processing time of a coupler is typically a week.

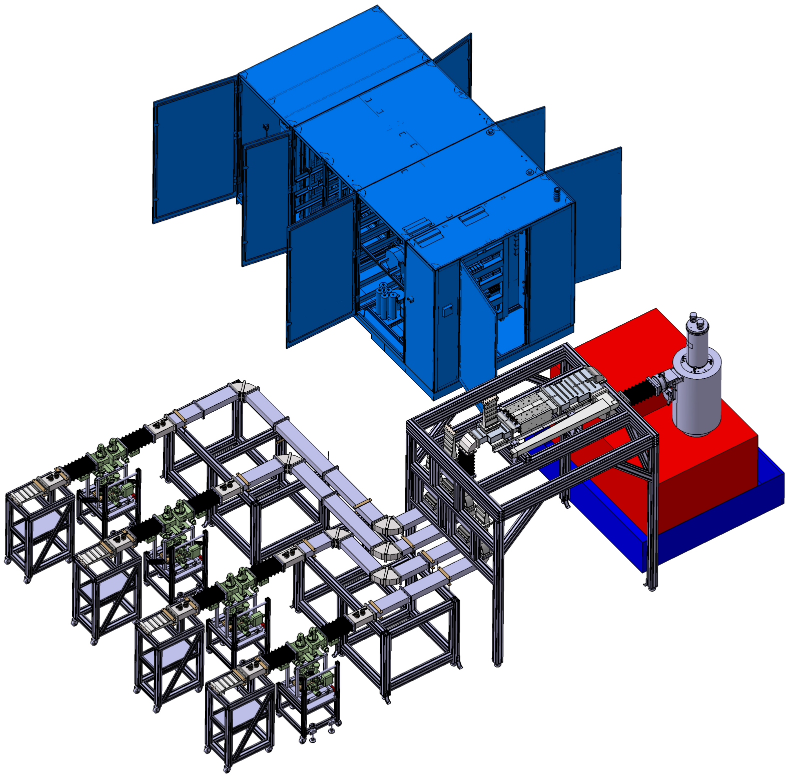

Figure 15: The planned RF network for the four coupler-conditioning stations

Figure 16 shows the new RF-source at LAL-Orsay that will drive the coupler conditioning tests.

Figure 16: New RF source at LAL-Orsay

The overall detailed schedule is shown in Figure 17. Following successful test of the pre-series of the couplers the production of the 24 ILC-HiGrade couplers is foreseen for July 2011 and the delivery planned for October 2011. Conditioning will last until November 2011 so that the couplers become available by the end of 2011 and are eventually ready for insertion into the cavities.

Consequently the ILC-HiGrade deliverable 7.2, coupler fabrication, foreseen for month 36, is delayed.

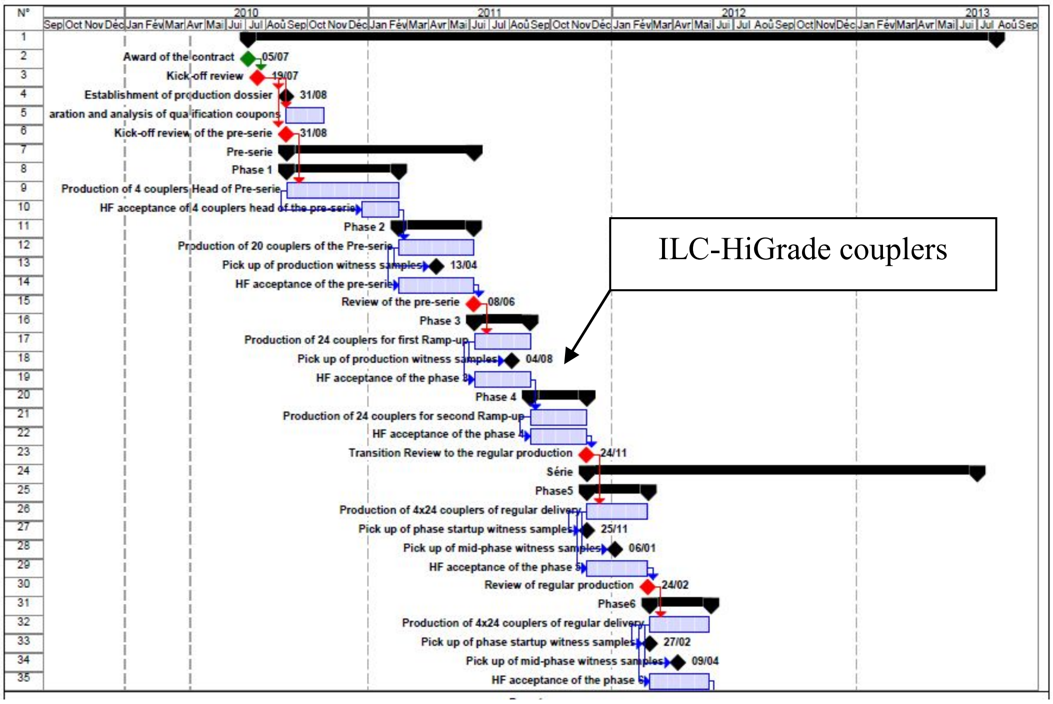

Figure 17: ILC & XFEL coupler production and conditioning schedule

2.7 WP8 – Cavity tuners

Work package number	WP8	**Start date or starting event:**				1
Work package title	Tuners					
Activity type	RTD					
Participant id	5					
Person-months per beneficiary	8.0					

In the time frame considered in this report, significant results have been achieved in the demonstration of feasibility of tuner designs in dedicated tests. A cost-effective tuner production model can be established, a task that represent the final goal of this work package.

2.7.1 Tuner production

2.7.1.1 Overview of tuner purchasing and manufacturing

The international collaborations, in which the LASA group is involved, mostly with Fermilab (US) and KEK (Japan), have been the initial test bench for the production of the revised design Blade Tuner. In fact this new Blade Tuner model has been chosen to equip the second cryomodule (CM2) of the ILCTA_NML facility at Fermilab. For this purpose a total of eight tuner units have been initially ordered and produced. This set of eight units have been manufactured by Ettore Zanon S.p.A. (Italy) and delivered to LASA by July 2008.

Then, in March 2009, two additional units have been manufactured within the collaboration with Fermilab in order to equip the cryomodule C of the S1-Global project in KEK, Japan.

An accurate process of validation has been carried out for the ten units produced so far. It includes both a visual and dimensional check for all components and an experimental test procedure at room temperature, based on a special ad-hoc single cell test facility realized at LASA laboratory. Results for all the produced units are here presented. The ten units series has been entirely tested and results confirmed to be well in agreement with expectations, both in terms of homogeneity of produced units and in terms of correspondence with FEM predictions.

2.7.1.2 Status of further productions

The production of the first set of 10 new Blade Tuners for the projects at Fermilab and KEK has been a rich and fruitful experience and the incoming ILC-HiGrade production will take full advantage.

As of today, a first ILC-HiGrade Blade Tuner set composed of 6 units has been purchased from the same manufacturer (E. Zanon) and delivered by summer 2010.

This first ILC-HiGrade set is the result of several and intense interactions with the manufacturer that have been conducted starting at the end of 2009. The aim has been to thoroughly analyse the manufacturing procedure adopted for the first set and optimize it as much as possible. This joint activity positively concluded with a significant impact on the Blade Tuner unit cost as well as improvement on the quality of the final product.

This has been achieved with a deep review of major tuner manufacturing issues:

- Machining procedure for the Blade Tuner semi-rings, including acceptance test at the manufacturer to verify the correct shape.
- Handling/packing of the blades before welding them to the tuner rings, in order to simplify the mounting and save time.
- Review of the explicit tolerances in the tuner drawings: few new critical ones have been added and other ones, being redundant, have been removed.

Quality acceptance check of these recently produced units has been positive, further details will come from the operational tests at room temperature for each unit. These measurements are currently still on-going, if proven to be effective this will be a major step forward, especially within the ILC-HiGrade WP8.

A new order is now ready to be placed for a new set of ILC-HiGrade tuners. This will fulfil the goal of the working package with the production of 18 new units: purchasing, delivery and room temperature acceptance tests will be reported within the fourth year of the ILC-HiGrade program.

2.7.2 Blade Tuner installations and on-going projects

2.7.2.1 CM2 at Fermilab

The second cryomodule for the ILC-TA facility at Fermilab, also named CM2, will be fully equipped with Blade Tuners. These will be the first cavity units specifically designed for Blade Tuner, including a new helium tank design, new magnetic shielding and MLI wrapping. A joint activity has been conducted during the past two years by Fermilab and LASA groups to address these issues and define a consistent and robust cavity unit design.

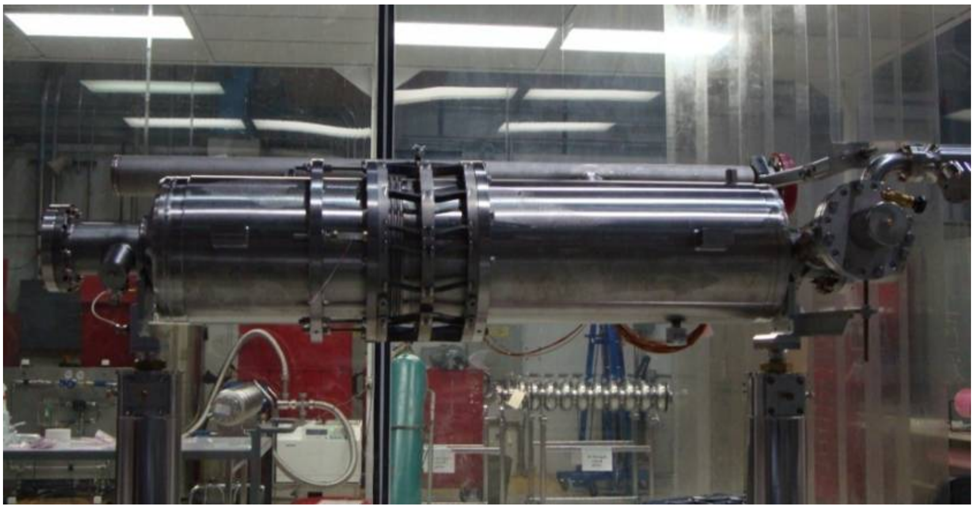

Figure 18: A complete cavity unit at FNAL with Blade Tuner installed

As of today the requirement of Blade Tuner units package for CM2 has been fulfilled, eight units have been delivered to FNAL.

At the moment of writing, within years 2010-2011 a total of 10 cavities have been integrated within the special helium tank, equipped with Blade Tuner and horizontally cold tested. Static and dynamic tuning capabilities have been tested successfully and each cavity has been operated at the nominal frequency with active piezo compensation in HTS.

Comprehensive overview of results and analyses of collected data will be first published at the coming PAC2011 conference.

2.7.3 S1-Global at KEK

The S1-Global project at KEK (Japan) aims at the demonstration of effective cryomodule operations at the ILC goal gradient. This result has been addressed by two demonstration cryomodules that will also provide on line comparison of different cavity and cold tuning solutions: a step toward the concept of plug-compatibility.

Cryomodule C of the S1-Global project is designed as a four cavity vessel with an unique mixed configuration, not only cavities from different manufacturer are installed but also two different cold tuning systems within the same cold string.

Namely the module is composed of:

- Cavity number 1 from AES company (US), equipped with Blade Tuner
- Cavity number 2 from Accel company (Germany), now RI, equipped with Blade Tuner
- Cavities number 3 and 4 from E. Zanon company (Italy), equipped with the tuners of the European XFEL

Two complete Blade Tuner units had been shipped and delivered to KEK by the end of 2009. The complete installation of all four tuning systems on the cold string took place on February 2010. A joint group composed by experts from INFN, FNAL and KEK took charge of all operations.

During tuner installation some minor problems emerged and have been further analysed; globally the cold string installation experience has been positive.

In July 2010 the cold test of installed tuning systems took place, once more a joint group composed by experts from INFN, FNAL and KEK took charge of it.

Figure 19: the joint INFN, FNAL and KEK team during tuners installation (Feb. 2010) and cold test (Jul. 2010)

Low power cw conditions have been set in both modules and this allowed the direct evaluation of both motor and piezo units performance. A direct comparison was also possible among the different tuning systems installed.

Static tuning capabilities of Blade Tuner units confirmed expectations, achieving about 600 kHz tuning range with Hz/step resolution level and more than 2.5 kHz piezo static tuning range. A dynamic analysis has been also possible, through the studying of cavity tune response to a pulsed piezo signal, as shown in Figure 20.

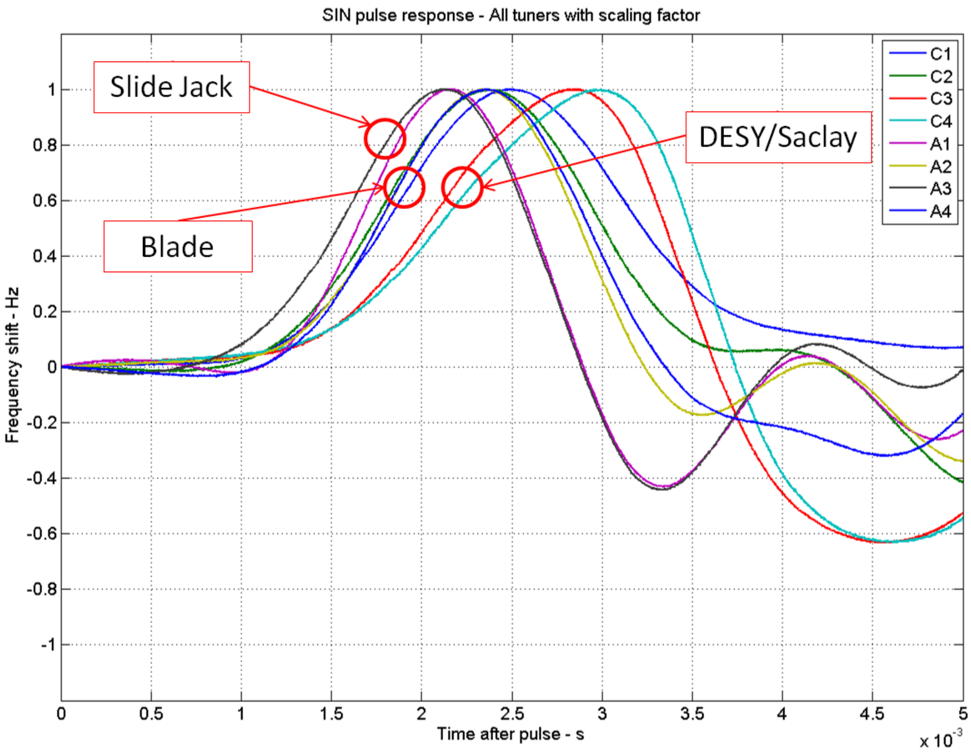

Figure 20: Direct comparison of different tuner response to a pulsed piezo signal

Moreover, during high power cold test, Lorentz force detuning (LFD) compensation capabilities have been analysed. Results have been extremely positive and the entire dynamic detuning exhibited by the Blade Tuner cavities has been compensated to Hz-level.

This successful result has been achieved with both the two piezo control system tested in S1-Global, one developed by FNAL and the other by KEK. These two systems made use of two different compensating schemes, the first one is adaptive while the other one exploits a very simple input pulse. LFD compensation was successful with both systems. Results from KEK system tests on a Blade Tuner cavity are shown in Figure 21.

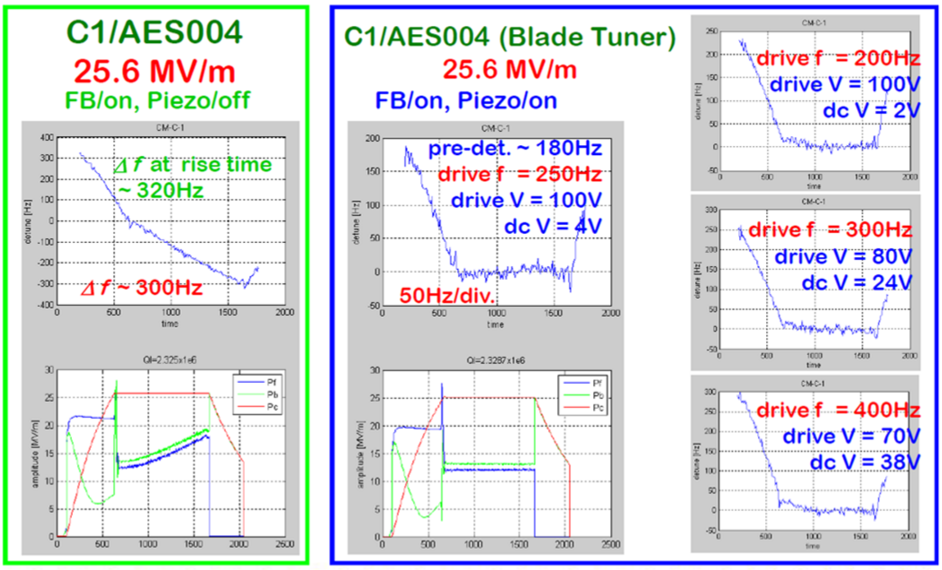

Figure 21: successful LFD compensation with ILC Blade Tuner on a S1-Global module C cavity (green without, blue with piezo)

Globally, the ILC Blade Tuner installed on the S1-Global cryomodule proved to be able to accomplish its main goals:

- Statically tune the cavity with proper resolution to the target frequency
- Achieve pulsed operation at maximum gradient with an active compensation of LFD up to tens of Hz-level residual detuning.
- Demonstrate to grant enough performance margins in LFD compensation in view of ILC-level target gradients.

Failures emerged in some components, though some of these tuners could be recovered later on. Details have still to be investigated but it is expected that both the technical novelties present in some elements and the lack of experience on a module string could have played a major role (INFN/FNAL systems are installed on a string here for the first time).

S1-Global cryomodule has been positively concluded at beginning of 2011, dismounting of the two cryomodule and investigation of observed issues is foreseen after summer 2011 and will be reported within the fourth year of ILC-HiGrade.

2.7.4 Summary Tuner

After the intensive activity with Blade Tuner prototypes performed since 2008, we successfully initiated the production and the experimental validation of the new Blade Tuner devices, with revised and optimized design in view of the ILC.

A large amount of data and information are already available concerning tuner manufacturing as well as experimental characterizations both at room temperature and at cold.

In addition a large database of cold test sessions, collected among the different facilities involved in the global ILC collaboration, has been collected. Comprehensive results overview and analyses are expected to be soon available for publishing and will be reported in the fourth ILC-HiGrade year.

3 Project management

Work package number	WP1	Start date or starting event:				1
Work package title	Coordination of European GDE Activity					
Activity type	MGT					
Participant id	1					
Person-months per beneficiary	12					

3.1 Organisation of the Consortium

Overall the work inside the consortium proceeded smoothly. The individual activities in the work packages have been described in the preceding chapters.

The 3rd Scientific Workshop was held at DESY, Hamburg, Germany on November 22, 2010. The meeting evaluated the progress on the understanding of the performance of superconducting RF cavities. With the tooling prepared the progress is impressive and the consortium starts to be prepared for the delivery of the cavities and the testing. The workshop was also used to discuss the schedule for the actual delivery of cavities and related components. Delays in tendering and ordering that have occurred since the start of the project present a challenge to complete the testing during the duration of the project. – Nonetheless the performance test is an integral part of the ILC-HiGrade programme and will be accomplished amongst the project partners.

The progress of realisation of the ILC is also a relevant aspect of the project. The ILC-HiGrade activities have been fundamental in Europe for advancing the project. The governance document is a testimony to that work.

Overall there were numerous scientific exchanges amongst the partners. An overview of the bigger conferences, workshops and meetings is given in Table 6.

3.2 Reporting

The Coordinator, who was in contact with the respective partners, initiated the reporting process. The financial statements were received and entered into the FORCE tool. Given the respective spending profiles formal audits were only necessary for one partner, namely DESY. Several partners submitted financial adjustments to previous reporting periods; an adjustment submitted by CERN referred to the first year, which had been audited in the previous reporting period.

During the reporting period the financial reports of the second period could be concluded. Some delays had been incurred mostly because of the uncertainties in the presentation of productive hours. In the end the uncertainties in the actual requirements of the reporting could be settled and the funds were received at the Coordinator and subsequently distributed to the partners.

3.3 Use of ILC-HiGrade webpage

The ILC-HiGrade webpage continues to be used as a tool for communication. Most of the activities are described in the Outreach Work package 4. They refer to the open-access pages of the web pages. Some of the webpages, notably affecting governance issues, find themselves on webpages with restricted access. These issues are not yet disclosed since they are in a developing stage. Results and conclusions of those meetings that are interesting for a wider audience are made accessible to everyone.

The agenda of the respective ILC-HiGrade meetings uses the indico.cern.ch system, which allows for convenient upload of the presentations.

3.4 ILC-HiGrade embedded in European Infrastructure Discussion

ILC-HiGrade entered the ESFRI-list of Research Infrastructures via the CERN Council Strategy document that represents the European strategy for particle physics. For the development of the ILC project it is thus important to follow the strategic decision of CERN Council concerning its future plans. With the LHC operational and physics results emerging decisions on the future of the field will be taken. The formal process will be launched during 2011, the final update of the strategy document is due end 2012. ILC-HiGrade is well embedded into this process as is being evidenced by the participation in various bodies below. It is also important that the Secretary of the Strategy Group of CERN Council continues to take part in the meetings concerning the development of Governance Structures for the International Linear Collider.

3.4.1 ECFA

ECFA, the European Committee for Future Accelerators, is the representation of users of accelerator projects in Europe. It regularly pays visits to the countries participating in High Energy Physics and reports on the involvement of these countries. ECFA discusses future accelerator projects. The European GDE director and Work Package 4 coordinator, B. Foster, made regular presentations at the ECFA meetings and ILC-HiGrade was well represented.

3.4.2 Other Global Projects

ILC-HiGrade maintained the contacts to other large Research Infrastructures. The report of Work Package 4 indicates the assessment of Governance structures for cognate projects.

3.4.3 Initiatives of the European Commission

The initiative of building European Research Infrastructures, defining their operational status and regulating the participation of foreign institutes is thus very important. The release of the ERIC framework is the prominent example for a European approach. It comprises amongst other the assessment of tax regulations. However, for the ILC, this European framework has to be expanded into a global framework. This is a challenge that needs to be addressed on a broader scale.

The European Commission has organised two meetings in Brussels to foster the exchange of experience and best practices between the various Preparatory Phase Projects of the ESFRI-list. ILC-HiGrade has taken part in both of these European Research Infrastructure (ERI) meetings. ILC-HiGrade has also taken part in the discussion of the formation of a cluster of Preparatory Phase Projects, which led to the proposal CRISP, in which the ILC partakes.

3.5 Meetings organised or attended

The list of meetings that are of relevance for the consortium as a whole is summarized in Table 6.

These meetings are of global scientific nature, address the key technological questions of the project, development of the governance aspects or the wider science and political framework in which the consortium develops.

Meeting	Venue and Date	Purpose
International Linear Collider Workshop 2010, LCWS10 and ILC10	Beijing, China, 26.3.-30.3.2010	Main meeting on the technical status of the ILC and the physics programme for Linear Colliders
TESLA Technology Collaboration (TTC) Meeting	Fermilab, Illinois, USA, 19.-23.4.2010	Review of superconducting RF-acceleration worldwide
ILC PAC	Valencia, Spain, 12.-13.5.2010	ILC Project Advisory Committee
ERI Discussion	Brussels, Belgium, 27.5.2010	Discussion of cluster of PP projects
ERI Workshop	Brussels, Belgium, 28.5.2010	Exchange of experience between PP projects
87th Plenary ECFA	Frascati, 1.-2.7.2010	Presentation of the Linear Collider in particular of the Governance model
35th International Conference on High Energy Physics (ICHEP2010)	Paris, France, 22.-28.7.2010	Conference on Particle Physics and various meetings on governance and GDE matters
First Baseline Assessment Workshop (BAW-1)	KEK, Tsukuba, Japan, 7.-10.9.2010	Assessment of the Design Options for the ILC: single tunnel and gradient
International Workshop on Linear Colliders IWLC2010	Geneva, Switzerland, 18.-22.10.2010	Joint CLIC ILC Workshop on the advancement of Linear Colliders
PAC Review	Eugene, Oregon, USA, 11.-12.11.2010	ILC Project Advisory Committee
3rd Scientific Meeting	DESY, 22.11.2010	Presentation of the results of ILC-HiGrade
3rd Annual Meeting	DESY, 22.11.2010	Brief discussion on the development of the project and the evolution of ILC-HiGrade
ERI Workshop	Brussels, 15.12.2011	Exchange of experience between PP projects
Second Baseline Assessment Workshop (BAW-2)	SLAC, Stanford, USA, 18.-21.1.2011	Reduced beam Parameter set and positron source location

Table 6: Meeting of relevance for the ILC-HiGrade consortium as a whole