R&D Plan: ‘Engineering Design’ Phase
- presentation to Saclay / Orsay

Marc Ross, Akira Yamamoto, Nick Walker

EDR Project Managers
GDE

ED Activity basis

- Minimal centralized funding
  - **Most funding has strong institutional bias**
    - FP7 and US-ART are exceptions
  - **ED Progress relies on programs that benefit both ILC and institution**
- Coordination and communication
  - **Take advantage of pre-existing programs**
  - **Devise and describe mutually beneficial activities; up to a point**
  - **(must know what these are)**
- A global project requires a transparent, open decision process
  - **in-kind basis**
  - **Document: ‘ILC Project Management Plan for the Engineering Design Phase’**

Goal:

- An ILC Project plan with a cost estimate
  - **Not to exceed RDR cost**
  - **Completed mid 2010 (Paris meeting)**
    - (Now planning response to US/UK budget cuts)
- Based on technology developed for TESLA
  - **First Priority – support development of Baseline (RDR '07 → EDR '10)**
  - **But EDR includes and promotes longer term development which addresses**
    - Cost
    - Performance
  - **Development must be *planned* (and reviewed)**

EDR Organization

- Three Project Managers
- 15 Technical Areas
  - **Focus on cost-drivers (SCRF and Civil)**
  - **Inter-area boundaries not fully assigned**
- Group Leadership with technical basis and regional balance
  - **And global responsibility**
- Boards for oversight (both internal and external - MAC)

R&D Priorities

- Superconducting RF High Gradient R&D
  - **Cavity fabrication and processing**
  - **Up to vertical test**
  - **Determine process recipe and yield**
- Conventional Facilities Design / Value Engineering
  - **Cost reduction / overall design optimization**
- Accelerator beam tests
  - **Electron Cloud (CESR)**
  - **Beam Delivery (ATF/ATF2)**
  - **SCRF Linac high current operation (TTF, STF, ILCTA-NML)**
- Development of cryomodule cost and plan
  - **Based on the concepts of 'plug-compatibility' and 'single design plan'**

Purpose of visit

- We (ILC EDR Project Managers) are deeply pleased with the prospect of Saclay / Orsay involvement in ILC EDR work
- We thank you for your invitation to visit and discuss
  - **(Apologies Marc could not come)**
- Today's presentation is strongly focused on SRF (cryomodule and cavity) issues
  - **This has been the focus of our recent discussion**
  - **Please do not interpret this focus as a comment on non-SRF work now underway at Saclay / Orsay**
  - **Or as an indication that your participation would not be welcome in other EDR aspects**

Background:

- 25.05.07 informal meeting (Nick, Guy, Olivier, mcr)
  - **Suggested roles: Coupler, CM design (Orsay); BDS (Saclay)**
- 18.09.07 Video meeting presentation covering ED Activity (appended)
  - **Request to PM to strengthen role in SRF production; esp. coupler and CM**
  - **Consistent with XFEL role**
- ILC PM pledge to visit and discuss Saclay / Orsay role in ED Phase
  - **(In this context Saclay/Orsay = CEA/IN2P3)**
  - **ED Phase plans developed 06-07 / 2007**
    - Before XFEL IK partnership plans developed

Since 18.09:

- ‘Management Plan’ released
  - **(ALCPG07)**
- Preliminary ‘R&D Plan’ distributed to FALC/RG + ILCSC
  - **(05.12)**
  - **Details for top priority R&D items**
  - **Shows global participation (now to be amended!)**
- ‘Living Document’ – planning for ‘release 2’ underway
  - **Release 2 will expand key CM issues; of interest today**
  - **(for ED Phase: CM does NOT include coupler)**

CM Plan

From EU:

- Request and invite Saclay / Orsay engineering participation
  – **(Also INFN and DESY)**
  – **Who?**
- Basic plan:
  1. **Develop 'modular' concept**
  2. **Develop 'interface' specification document**
  3. **Implement selection process between alternate sub-components**
  4. **Consensus on 'single 'global' CM design for costing and production planning**

Primary EDR CM Deliverable:

- "Development of a modular, or plug compatible, design concept to allow flexibility in construction planning. Specifically, plug compatible conditions to interface to other system/component should be well established to prepare for cryomodule manufacturing in industries in multiple regions."

- The EDR must include a global consensus-basis CM concept

Strategy

- Strategic comments (Carlo; 2007.12.05):
  - **1: The final scope of the WP on Cryomodule should be to produce *a fully documented* and *engineered* cryomodule design that can be considered as the *baseline* for the ILC. Regional differences should be accepted if equivalent and plug compatible. In case of a solution that turn out being superior in terms of cost and performance the 3 regions should accept this solution as a common reference.**
    - (Italics/highlight from mcr)
    - (‘a fully documented’ ≡ a *single* fully document)

Strategy – comments from Carlo

- 2: Alternatives should be treated in a way that does no disturb the main stream. In particular each alternative before being pursued and eventually integrated should be presented through a fully consistent document that indicates the foreseen advantages
- 3: The problem of documentation and standards is a sensitive one and strongly regional dependent. (ownership of documentation, interpretation of standards).

Work Packages

- Link deliverables to institutions
- Foundation of EDR plan

- How are these devised?
  - **Drafted by Technical Area Group Leaders (e.g):**
    - Cavity Production / Integration - Hayano
    - Cryomodule - Ohuchi/Carter
    - Main Linac Integration - Adolphsen
    - Cryogenics - Peterson
- Should respect institutional capabilities / interests and regional balance
- Work sharing coordinated by Project Managers

NJW2

Cryomodule Team

Cryomodules		
Americas	US	ANL, FNAL, Jlab, SLAC
Asia	India Japan	BARC, IUAC, RRCAT, TIFR, U. Delhi, VECC KEK
Europe	 France Germany Italy	CERN Saclay DESY INFN

- IHEP?
- (reminder- coupler work listed elsewhere)

Slide 14

NJW2 Although the next page shows a table of the WPs, I think a graphic indicating the WPs for all the SRF area would be useful.

Especially as this will indicate where the Coupler WP is.

I will work on one tomorrow. If you like it you can use it.
Nicholas Walker, 1/8/2008

CM work packages

ID	title	description
1.3.1.	Standardization	Establish basic design parameters, plug compatible interface conditions, and high-pressure gas code (regulation) issues,
1.3.2.	Cooling pipe configuration	Calculation of pressure drops, definition of the maximum pressure, cooling procedure, new piping on the module transverse cross section.
1.3.3.	5-K shield	Calculation of thermal-balance with or w/o 5 K-shield Trade-off with cryogenics operation cost.
1.3.4.	Quadrupole Assembly	Quadrupole location, support, installation procedure, alignment, vibration, current leads,
1.3.5.	Assembly Process	Study of Assembly procedure, fixtures, facilities, Study of inter-connect procedure,
1.3.6.	Engineering design with CAD	Systematic engineering design using 2D/3D CAD, R&D for technically critical components such as Ti-SUS junction, vacuum components, etc.
1.3.7.	Systematic performance evaluation	Establish performance testing process, procedures and define the test facility role during the mass production stage
1.3.8.	Transportation	Seek transportable cryomodule (region to region) Investigate transportation down to the tunnel through vertical shaft, with inclination (to save shaft size).
1.3.9.	Cost/Industrialization	Cost estimate based on BCD, and Industrialization effort (mass production and reducing the cost)

CM Plan – Crude Timeline

The timeline shown on this slide is tentative and has not been approved by the GDE and involved institutions. Due in part to recent funding actions.

- Resource Centers:
  - **KEK, Fermilab, Saclay, DESY, INFN, India, IHEP(?)**
  - **Fermilab participation USFY08 minimal**
    - Limited to 'synergy' with 3.9GHz TTF/Flash project and other 'generic' studies (?)
    - USFY09 under discussion (will know more in ~ 5 months)
  - **Proposal:**
    - Interface document 2008
    - Component selection 2009 ←evaluation / community basis
    - Design & test 2010
    - Costing & test 2011
- For review until next GDE meeting, 03.03.2008

CM Plan - Modularity

- Critical list is short:
  - **Cavity**
  - **Coupler**
  - **Tuner**
    - Fast
    - Slow
  - **(Each one, individually, technically in the 'Cavity / Integration' Technical Area Group**
  - **Also have cold mass, magnet, BPM, etc.**
- See ALCPG07 material:
    - http://ilcagenda.linearcollider.org/materialDisplay.py?contribId=256&sessionId=43&materialId=0&confId=1556
    - http://ilcagenda.linearcollider.org/getFile.py/access?contribId=256&sessionId=43&resId=0&materialId=slides&confId=1556

CM/Cavity 'selection' items

- One common design for costing purpose
- Choose:
  - **Cavity**
  - **Coupler**
  - **Tuner**
  - **Interface**
- Coupler example:
  - **Diameter? (60mm?)**
  - **Tunable? (cost)**
  - **HV Bias? (cost)**
  - **Interlock / Diagnostics? (cost)**
  - **?**
- Orsay cost study (due 03.2008 ?)

Cavity Integration WP:

- Similar aim: Develop a common, consensus-basis, for a cost and production model
- A separate Technical Area for cavity processing

ID	Title	description
1.2.1.	Tuner	Development of slow tuner for resonance stabilization and fast tuner for Lorentz detuning compensation
1.2.2.	Input Coupler	Development of coupler designs, including evaluation of fixed/variable coupling, port diameter, heat load, etc.
1.2.3.	Magnetic Shield	Determination and test of magnetic shielding method, inside/outside He-vessel.
1.2.4.	He-Vessel	Vessel material, bi-metallic junctions, Pressure Vessel regulation, and alignment method.
1.2.5.	Integration/Test	system integration into cryomodule and performance test
1.2.6.	Cost & Industrialization	Cost estimate and pre-industrialization value engineering

Cavity Integration

- 'C' → WP Coordination
- WP Coordination is primarily an individual, not an institutional responsibility
- Representatives from Saclay from Orsay are tentatively listed as shown → Is this ok?

		FNAL	JLAB	SLAC	LAL/Orsay	Saclay	DESY	IHEP	Raja Ramana Centre	KEK
1.1	**Cavity Processing**						GL			
1.1.1	Gradient performance	♦	♦				C	♦	♦	♦
1.1.2	Fabrication Specification	♦					C			♦
1.1.3	Process Specification	♦					C			♦
1.1.4	Cavity Design Specification	♦					C			♦
1.2	**Cavity Production and Integration**									GL
1.2.1	Tuner NJW5	♦				C				♦
1.2.2	Input Coupler	♦		♦	C					♦
1.2.3	Magnetic Shield	♦								C
1.2.4	He- Vessel	C								♦
1.2.5	Integration / Test	♦								C
1.2.6	Cost & Industrialization	C								♦

Slide 20

NJW5 I always forget to ask about this. I am suprised that Saclay is coordinating the tuner. I think this is much more likely a role that Carlo (INFN) will want to do. For the XFEL, Saclay effectively said it was not interested in the tuner.

Nicholas Walker, 1/8/2008

Concluding Remarks

- Saclay / Orsay collaboration extremely welcome
  - **adding strength to the ILC European Region and the GDE in general**
  - **continuing and strengthening the long history of French collaboration in the SRF linear collider**
    - (TTF, TESLA, now ILC)
- Recognise that the XFEL Project is the corner-stone of the European contribution to ILC
  - **and the important and expanding role of Saclay / Orsay in the linac construction.**
- Experience in BDS and Positron Source is also noted and appreciated
  - **however these are lower – but nonetheless important – priorities.**
- ED Phase Management key interest is in the SRF
  - **Identified priorities: Gradient, Cryomodule Design**
- What can XFEL (and therefore Saclay / Orsay) contribute directly to the ILC during the ILC ED phase?
  - **Indirect contribution is obvious**
  - **Important to define during this meeting**

XFEL and the ILC

- XFEL is recognized as a mature baseline technology
  - **A fundamentally European technology**
- Mass production information will be critical input
  - **Design for manufacture**
  - **Feedback from industry**
  - **Cost information !**
- Mass production of 101 XFEL Cryomodules represents a major "dataset" for ILC that is unmatched in the other regions.
  - **The ILC must maximize the benefit**
- Importance to ILC goes beyond ED Phase
  - **Mass production infrastructures at Saclay / Orsay together with gained in-house expertise and experience will form a corner-stone for any European in-kind contribution to the ILC**
- The GDE will give (and take!) credit for all the excellent XFEL SRF linac work
  - **Despite potential design differences.**

XFEL and the ILC (2)

- For the ILC ED Phase, we must understand the *process* in an international context
  - **Interaction of Saclay / Orsay groups (together with DESY and INFN) with equivalent groups around the World working on ILC**
    - KEK, FNAL,..
  - **Understanding roles and responsibilities, given the constraints of the XFEL construction commitments**
- XFEL is where we are today, but we must push harder for the ILC
  - **Gradient**
  - **Cost-driven design (further cost reductions)**
- Impact of in-kind contributions and distributed manufacture must be taken into account
  - **Regional variants in CM design – "Plug Compatibility"**
  - **Evolving designs to make best (cost effective) use of innovative ideas**
- Need to understand how strongly XFEL-based groups will interact and contribute to evolving ILC R&D across the GDE
  - **Some flexibility is desirable**

Four Critical Points for Discussion Today and Tomorrow

- Communication
  - **How to communicate and transfer critical XFEL production experience to the global ILC activity**
- Participation
  - **How to actively participate in the global design evolution of the ILC cryomodule (responsibility), while maintaining the XFEL commitment.**
- Planning
  - **How to help plan for ILC-like scale mass-production, including expected design evolution and regional variants**
    - The ILC cryomodule *will* be an evolution from the XFEL cryomodule
- Costing
  - **Providing invaluable input into the ILC cost models**
  - **Helping to produce 'Project Implementation' models for a future in-kind based ILC construction project.**