Management and Coordination for the ILC Technical Design Phase

presented by Marc Ross - for the ILC Project Managers:

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Based on:
'ILC Research and Development Plan for the Technical Design Phase'
Published June 2008
and
'ILC Project Management Plan for the Engineering Design (ED) Phase'
Published October 2007

3 main aims:

- **In order to achieve our goals we must:**

1) ensure that the internal momentum of the GDE continues to grow and that the tasks the GDE sets itself allow scope for the enthusiasm and commitment of the *international ILC community* to continue to grow;

2) produce the *technical information* required and agreed by the contracting governments as necessary to proceed to approval of the project implement design, preparation for procurement

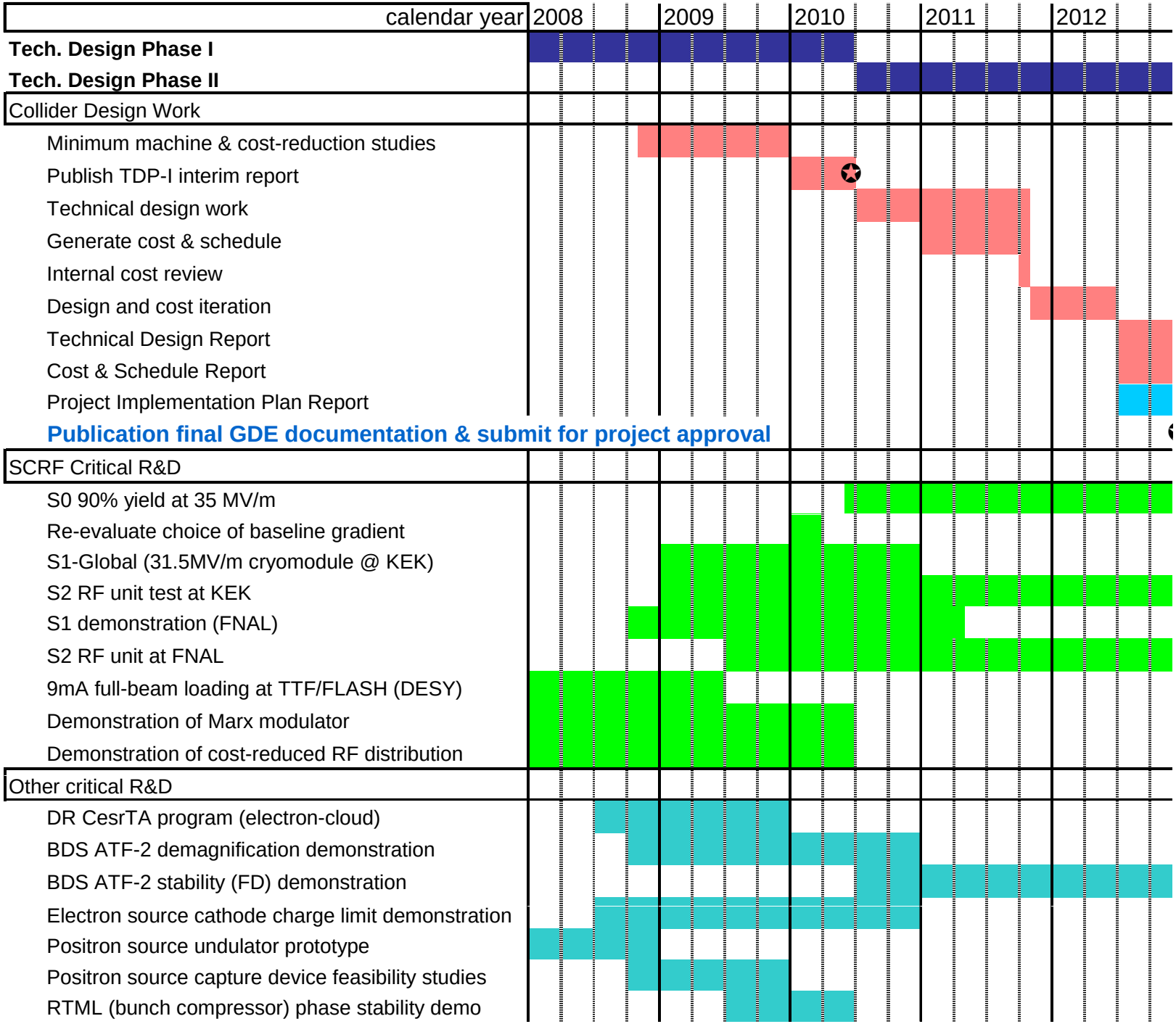
3) coordinate the *world-wide R&D programme* to give the optimum return on the investment of the contracting governments.

Goal for Technical Design Phase:

- **The Technical Design (TD) Phase of the ILC Global Design Effort will produce a technical design of the ILC in sufficient detail that project approval from all involved governments can be sought.**

- **The TD phase will culminate with the publication of a Technical Design Report (TDR) in 2012.**

TDP Schedule – 2008 to 2012



Technical Design Report (TDR):

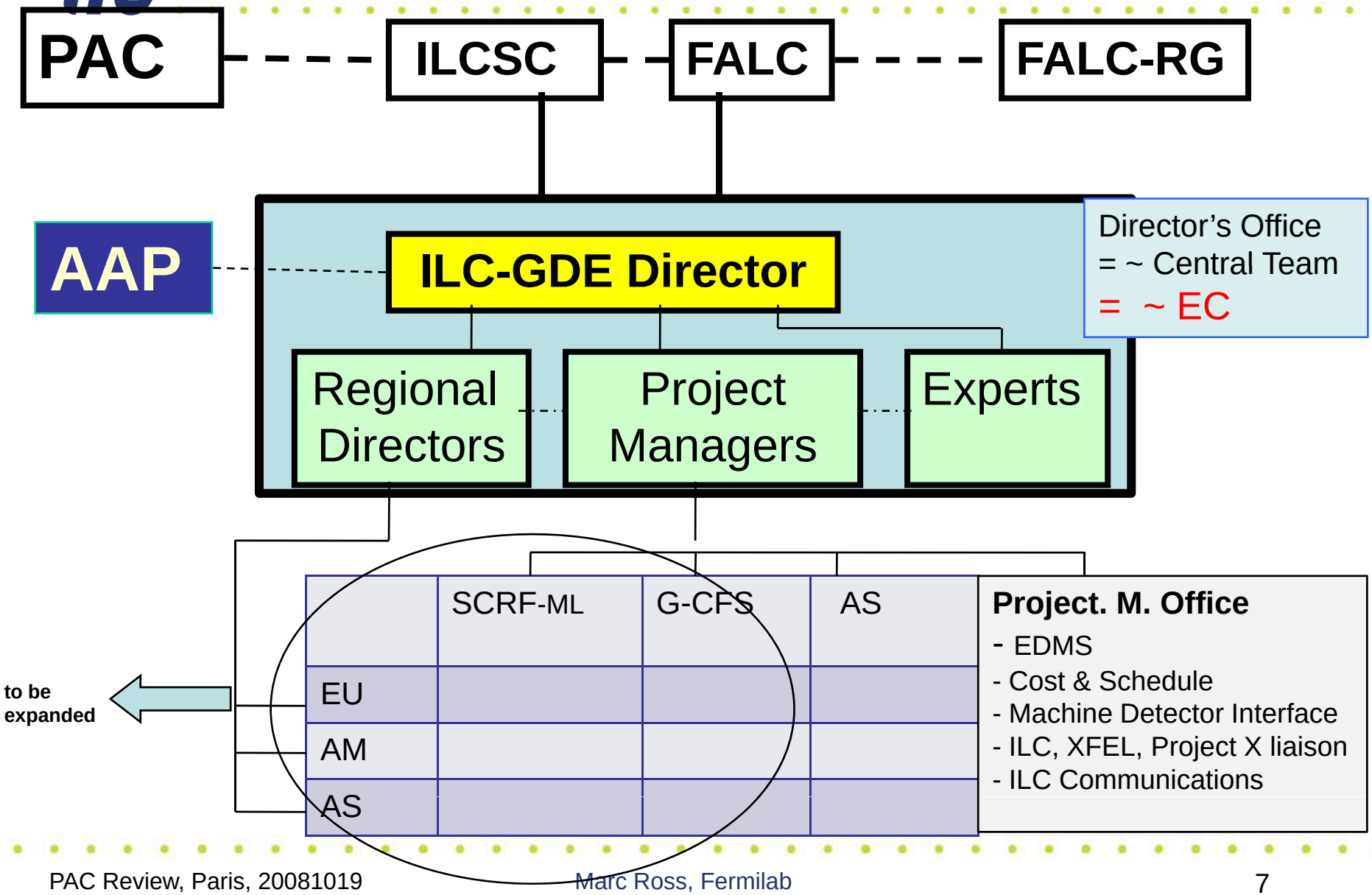
- **The key elements of the TDR will be:**
  - • A complete and updated technical description of the ILC in sufficient detail to justify the associated VALUE estimate.
  - • Results from critical R&D programmes and test facilities which either demonstrate or support the choice of key parameters in the machine design.
  - • One or more models for a Project Implementation Plan, including scenarios for globally distributed mass-production of high-technology components as “in-kind” contributions.
  - • An updated and robust VALUE estimate and construction schedule consistent with the scope of the machine and the proposed Project Implementation Plan.
- **The report will also indicate the scope and associated risk of the remaining engineering work that must be done before project construction can begin.**

Basis for our activity:

- TD Phase R & D is coordinated by the TD Phase Project Management Organization.
- The effort is subdivided into fifteen functional Technical Area Groups grouped into three Technical Areas
  - **Superconducting RF Technology,**
  - **Conventional Facilities & Siting and Global Systems,**
  - **Accelerator Systems.**

- Each Technical Area Group has a Group Leader who reports to a Project Manager.
- The Group Leader is responsible for soliciting, collecting and interpreting Expressions of Interest (EoI) statements that indicate the contribution a given individual or institution would like to make toward the goals of that Technical Area.

ILC-GDE Organization Chart



Glossary, Names and Institutions

- **AAP – Accelerator Advisory Panel**
  - Chair: Bill Willis (Columbia) / co-Chair Eckhard Elsen (DESY)
- **Expert(s):**
  - Integration Scientist: Ewan Paterson (SLAC)
- **FALC – Funding Agencies for Large Colliders**
  - (RG – Resource Group)
- **GDE – Global Design Effort (for ILC)**
  - Director: Barry Barish (Cal Tech)
- **ILCSC – ILC Steering Committee**
  - Chair: Enzo Iarocci (INFN)
- **Project Managers (PM):**
  - Superconducting RF Technology : A. Yamamoto (KEK)
  - Conventional Facilities & Siting and Global Systems : M. Ross (Fermilab)
  - Accelerator Systems : N. Walker (DESY)
- **Regional Directors (RD):**
  - Americas (AM): Mike Harrison (BNL)
  - Europe (EU): Brian Foster (Oxford)
  - Asia (AS): Kaoru Yokoya (KEK)

SRF Technology – Institutional Management

Regional/Institutional Effort:			Superconducting RF Technology Technical Area Groups:					
Region	Institute	Institutional Managers	Cavity (Process) Lilje	Cavity (Prod./Int.) Hayano*	Cryomodule Ohuchi Carter**	Cryogenics Peterson*	HLRF Fukuda*	ML Integr. Adolphsen
AM	Cornell Fermilab SLAC ANL J-lab	Padamsee Kephart Raubenheimer Gerig Rimmer	Padamsee Champion Kelly	Champion Adolphsen	Champion	Peterson	Larsen	Adolphsen
EU	DESY CERN Saclay Orsay INFN CIEMAT	Brinkmann Delahaye Napoly Wormser Pagani	Lilje	Lilje TBD Prat Pagani	Parma TBD Bedeschi	Tavian		
AS	KEK Korea IHEP RRCAT/BART IUAC VECC	Yokoya Gao Sahni Roy Bhandari	Hayano, Noguchi, Saito	Hayano	Tsuchiya/ Ohuchi	Hosoyama/ Nakai	Fukuda	Hayano/Ohuchi

The GDE Organizational Roles:

- **Project Managers report directly to Project Director**
- **Project Managers are responsible for**
  - setting technical direction and executing the project for realization of the ILC,
  - day-to-day execution
- **Regional Directors and Institutional managers are responsible for:**
  - promoting, funding and authorizing the cooperative program,
  - using a framework consistent with Institutional and Regional priorities
  - periodic review →
- **Project Manager and Regional Director roles are complementary and balanced**

The Organizational structure should serve to facilitate a balance between regional interests and resources and global technical direction

GDE Organization – Practical Aspects

- **Technical objectives are developed by PM with support of Technical Area Groups**
  - Based on *Reference Design Report* Risk Assessment
    - For example: Gradient R&D, electron cloud,
  - PM ←→ RD communication through Central Team (Executive Committee)
  - Using PM-coordinated collaborative teams
- **Institutional objectives and matching Resource plans are developed by RD and Institutional Managers**
  - PM and Technical Area Group Leaders develop and manage detailed objectives within these plans
- ***Process forms the basis for a three-way consensus***
  - *Project Managers*
  - *Regional Directors*
  - *Institutional Managers*

Collaboration with CLIC / CERN

- **Formulated (Barish/Aymar) 11.2007**
  - Established in 02.2008; initially 5 working groups
- **'Exclusive' strategy:**
  - pick and choose efforts with strong commonality; optimize use of resources
  - startup philosophy: choose tasks more likely to succeed
- **Promoting communication / links between the two groups**
  - will facilitate discussion and consensus building between teams
  - improving the credibility of both
- **Common costing methodology / basis is a collaboration priority**

Oversight

- **Two standing Advisory bodies:**
  - PAC: commissioned by ICFA / ILCSC
  - AAP: commissioned by GDE Project Director
- **Accelerator Advisory Panel**
  - Chair: Bill Willis (Columbia) / co-chair Eckhard Elsen (Desy)
  - Panel members linked to Technical Areas to ensure steady communication
    - they receive updates concerning ongoing program
    - they provide advice on strategic direction, etc
  - Formal, tradition-style review annually (April 2009)
- **Regional / Institutional / Programmatic reviews managed through RD and Institutional Managers**
  - e.g. : Annual Americas Regional Team DoE/NSF Review

TD Phase Technical Area Groups:

Table 2.1: TD Phase Technical Areas

	Technical Area		
	1. Superconducting RF Technology	2. Conventional Facilities & Siting and Global Systems	3. Accelerator Systems
Technical Area Groups	1.1 Cavity 1.2 Cavity-Integration 1.3 Cryomodules 1.4 Cryogenics 1.5 High Level RF 1.6 Main Linac Integration	2.1 Civil Engineering and Services 2.2 Conventional Facilities Process Management 2.3 Controls	3.1 Electron Source 3.2 Positron Source 3.3 Damping Ring 3.4 Ring To Main Linac 3.5 Beam Delivery Systems 3.6 Simulations

- **Technical Area Definitions based on:**
  - project cost ‘drivers’ 1/3:1/3:1/3
  - technical risk challenge
  - project plan challenge

TD Technical Area Leaders and Roles

- **The Technical Area Group Leaders (TAGL) are appointed by the Project Managers based on technical knowledge and inter-regional balance.**
- **TAGL are responsible for developing and drafting work packages, including goals, milestones and schedules.**
  - subject to PM approval
  - subject to institutional manager and regional director authorization

Resources:

Basis: *institutional and regional support for science ILC will provide.*

ILC development effort utilizes:

1. **ILC project preparation-specific funding**
   - support for design and cost/risk reduction studies for the TDR
2. **other project-specific funding (XFEL etc)**
3. **generic R&D**
   - support for the development of specific technologies
4. **combinations of the above**

- **Support for the science complements a strong interest in emerging technologies**
  - n. b.: 35% of conference presentations (at Linac 2008) were based on TESLA/JLAB- developed SRF

‘In-Kind’ R&D

- **provides return for regions/institutions investing resources for technical development**
- **To ILC:**
  - Beam Studies
  - Infrastructure usage
  - Engineering and Testing
- **To contributing Institute / Region**
  - Technology transfer between partner ILC institutions
  - Infrastructure development and qualification
  - Community connection mechanisms

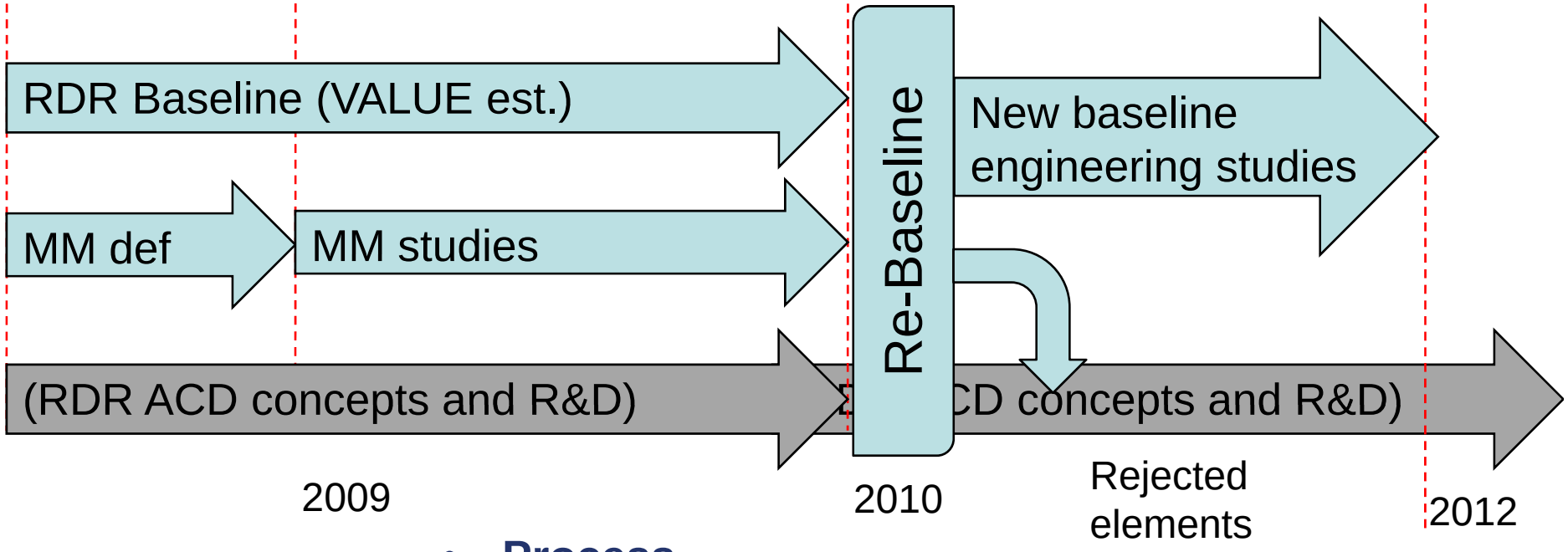
The role of R&D:

- **in support of a *mature, low risk design***
- **take advantage the ongoing, increasing global investment in SRF**
  - the big impact of the ITRP decision
  - Improve performance, reduce cost, challenge limitations, develop inter-regional ties, develop regional technical centers
    - Both a 'project-based' and a 'generic' focus

The ILC has:

- **A *Baseline Design*; to be extended and used for comparison (RDR)**
  - But ready for deployment
- **Research and Development activities on Alternates to the Baseline**
  - Engages the community → venue for cost-saving / risk-reduction actvities
- **Plug – compatibility / modularity policy → flexibility between the above**
  - The critical role of associated projects – XFEL, Project X, SNS, JLab12, ERLs, …
- **Models of 'project implementation'**
  - The transition from R&D to a real project
  - The link between Technical Phase R&D and the project political process

Towards a Re-Baselining in 2010



- **Process**
  - RDR baseline & VALUE element are maintained
    - Formal baseline
  - MM elements needs to be studies/reviewed international
    - Regional balance in the AP&D groups involved
    - Regular meetings and discussions
    - (but top-down control from PM)
  - Formal review and re-baseline process beginning of 2010
    - Exact process needs definition (a PM action item for 2009)
    - Community sign-off mandatory

MM – Minimum Machine

RDR ACD – Alternate Configuration

TD Phase R&D

- **Superconducting RF Technology :**
  - High Gradient ←
  - Cryomodule integration
  - Systems and beam tests ←
  - Main Linac Integration
- **Conventional Facilities & Siting and Global Systems:**
  - Value engineered design → together with Accelerator Systems
- **Accelerator Systems:**
  - Cost Reduction → the 'Minimum Machine'
  - Beam Dynamics → Test Facilities
  - Technical System R&D

High Gradient R&D - Basics

- **Goal:**
  - R & D on material, mechanical forming, surface-preparation process, and vertical testing, with a goal to achieve a field gradient of 35 MV/m at Q0 > 1010 with the yield >90%
    - Consensus of experts – Snowmass 2005 – reaffirmed for RDR
- **Schedule:**
  - High-gradient cavity performance at 35 MV/m according to the specified chemical process with a yield of 50% in TDP1, and with a production yield of 90% in TDP2
    - Based on infrastructure usage projections, funding projections and a simple model of the R&D process
    - updated in early 2008, when 1) JFY 08, 2) USFY 09, 3) ILC-HiGrade (FP7) and 4) XFEL plans were outlined
- **Resources:**
  - Managed regionally (Americas) or institutionally (DESY/KEK)
  - Cavity production → for other projects (c.f. 'plug-compatibility)

High Gradient R&D - issues

- **Regional Participation:**
  - Production vendors (2 EU, 2 AM, 1 AS)
  - Processing centers (2 EU industrial, + institutions listed below)
  - Testing centers at DESY, KEK, FNAL/ANL, JLab and Cornell
- **Infrastructure:**
  - Cavity Production (includes Niobium suppliers)
  - Surface preparation
  - Vertical test
- **Issues:**
  - Process and test standardization and comparative analysis
  - Infrastructure development
    - Critical path
  - Project (XFEL, Project X, KEK ERL) performance specifications different
    - ~25 MV/m – reduced gradient requirements

High Gradient R & D - Strategy

- **Technical Guidance:**
  - Tesla Technology Collaboration (TTC)
  - meets 2/year; published recommendations
  - strong linkage between TTC / ILC
- **Define tools – *cavity diagnostics***
- **Modify infrastructure and work with industrial partners to implement improvements**
- **Define how cavities will be processed and tested**
- **Carry out tests**
  - Database developed (DESY); data recording improvements underway

SRFT Systems and Beam Tests

- **Goal:**
  - Demonstration of ILC-specified SRF Linac performance
    - 9 mA peak current, 31.5 MV/m gradient, 5 Hz repetition rate
    - What are the most important 'system test' *technical* requirements?
    - 2007 study done by 'R & D Board' concluded much could be learned at DESY – FLASH 1GeV SRF Linac
- **Schedule:**
  - 9 mA, 5Hz operation of FLASH /TTF (DESY) in 2009
    - Support from DESY and Euro-XFEL Project
- **Infrastructure:**
  - Full power utilities (Cryogenics, RF, …)
  - Beam operation

SRFT Systems and Beam Tests

- **Regional Participation:**
  - EU – FLASH / TTF (DESY, 2004 -)
  - AM – NML (Fermilab, 2009 -)
  - AS – STF (KEK, 2009 -)
  - All regions support 2008-2010 FLASH testing
- **Resources:**
  - managed institutionally
  - institutional / regional development
- **Issues:**
  - Technical objective coordination

CFS Value Engineering

- **Goal:**
  - Develop and analyze functional requirements as specified by the Accelerator Systems
  - Validate the design based on functional requirements
    - ongoing from RDR
  - Execute the 'Value Engineering' review process
    - focus on the most costly aspects of the design → '*Minimum Machine*'
  - Evaluate results of the review process and recommend decisions
  - Complete TD Phase effort with an updated and improved baseline
- **Resources:**
  - *Limited resources put CFS on the critical path for meeting TDR value engineering priorities by 2010*

ILC GDE CFS Schedule

- **Minimum Machine Design Analysis will be completed in 2009**
  - Priority activity based on cost drivers
- **Process Cooling Water Baseline Design will be established at the ILC 08 Meeting**
- **Status of Underground Tunnel Configuration Review will be Presented at the Accelerator Advisory Panel Review**
  - RDR Twin tunnel w/ regional variants
  - Single tunnel – see Minimum Machine
  - Shallow site (Dubna study)

Beam Dynamics Test Facilities: ATF2 (KEK) & Cesr TA (Cornell)

- **Goals:**
  - Demonstration of compact Final Focus optics and associated beam instrumentation and feedback systems
  - Characterize electron cloud build-up and demonstration of mitigation techniques
- **Schedule:**
  - 2010 for both (stabilization studies at ATF2 2012)
- **Infrastructure:**
  - ATF: Injector/Damping Ring Complex (1997 -)
  - Cesr – adapted for electron cloud tests (2007 -)

Global Resource base 2007-2010: SRF Tech

		FTE-Years						total M&S						
		Cavities	Cryomodule	HLRF	Cryogenics	ML Integ.	**total FTE-Years**	Cavities	Cryomodule	HLRF	Cryogenics	ML Integ.	**total M&S**	
Americas	**Canada**	18					**18**	1050					**1050**	k$
	USA	73	24	68	5	14	**183**	9169	3960	5909	134	362	**19535**	k$
Asia	**China**	12	8	8	4	1	**33**	1371	1371	1371	686	137	**4936**	k$
	India	24	12				**36**	1560	900				**2460**	k$
	Japan	45	6	11	4	5	**72**	19867	4125	4036	1607	9992	**39627**	K$
	Korea	13		5			**18**	1619		264			**1883**	K$
Europe	**EU (CERN)**				1	4	**5**					190	**190**	k$
	France	94					**94**	14785					**14785**	k$
	Germany	51	10	7	7	9	**83**	2506	531			35	**3071**	k$
	Italy	38	8		1	1	**48**	1738	235				**1973**	k$
	Russia	2	20				**22**	20					**20**	k$
	Spain		3				**3**		13				**13**	k$
		370	**90**	**99**	**21**	**34**	**615**	**53685**	**11136**	**11581**	**2427**	**10715**	**89542**	

- **Notes:**
  - XFEL project specifically excluded where possible
    - → Estimate 65% of France FTE / 80% France M&S is XFEL project-related
    - Other EU does not include XFEL
    - DESY XFEL R&D ~ 155 FTE 2007 -2009
  - EU funding includes: CERN, European Commission Research Framework Programme 7 / 6 (5 contracts), National funding agencies (IN2P3, STFC, INFN, BMBF,…)
    - ILC project-specific and Generic R&D
  - Currency conversion based on 01.01.2008

Global Resource base 2007-2010: CF&S and Global Systems

		FTE-Years			total M&S			
		CFS	Controls	total FTE-years	CFS	Controls	total M&S	
Americas	USA	12	18	30	1397	1098	2495	k$
Asia	China		8	8		137	137	k$
	Japan	3	5	8				
	Korea	1	1	2	0.04		0.04	k$
Europe	EU (CERN)	2					0	k$
	France		18	18		451	451	k$
	Germany	3	14	17		92	92	k$
	Italy		4	4		118	118	k$
	Poland		20	20		365	365	k$
	Russia	2		2	58.8		59	k$
	Switzerland		3	3		132	132	k$
	(mixed)		11	11		139	139	k$
		23	102	112	1456	2531	3987	

- **Notes:**
  - 90% of FTE / 65% M&S is in Controls Global System and supports Test Facility activity
  - ‘mixed’ includes EU funding for Test Facility Controls

Global Resource base 2007-2010: Accelerator Systems

		FTE-Years							total M&S							
		Elec. Source	Posi. Source	Damping Rings	RTML	Beam Delivery	Simulations	**total FTE-years**	Elec. Source	Posi. Source	Damping Rings	RTML	Beam Delivery	Simulations	**total M&S**	
Americas	**Canada**			5				**5**			20				**20**	k$
	USA	11	8	28	1	48	16	**113**	617	144	7174	3	3847	190	**11975**	k$
Asia	**China**			12	4	20	2	**38**		69	686	14	27	14	**809**	k$
	Japan	2	7	16		23	4	**52**			6447		3348		**9795**	k$
	Korea			2	2	4	3	**12**			28	28	217	28	**301**	k$
Europe	**EU (CERN)**			2		1	4	**7**			10		3	13	**26**	k$
	France		11		5	12		**27**		573			9		**582**	k$
	Germany		22	3		4	4	**33**		47	10		53	20	**129**	k$
	Italy			17				**17**			441				**441**	k$
	Spain					2		**2**								k$
	Sweden				2	2		**3**								k$
	UK		10	11		85		**106**		70	124		3069		**3263**	k$
		13	**57**	**97**	**14**	**201**	**33**	**415**	**617**	**903**	**14939**	**44**	**10574**	**264**	**27342**	

- **Notes:**
  - Test facilities account for ~80%
    - ATF2 effort regionally balanced
  - UK effort greatly reduced
    - 2009 and 2010 ~ 20% of total
    - Non ILC-specific 09 and 10 R&D (instrumentation etc) not included
  - Positron Source includes R&D on Compton ‘alternate’
  - Currency conversion based on 01.01.2008

Project Meetings

- **Two Plenary meetings / year**
  - one involving entire community; one focused (e.g. AAP review)
  - additional two or three thematic meetings
- **Four week cycle of Technical Area and Project Management tele-conference meetings**
  - Entry level meeting for new partners; connection point for institutional management
- **Monthly published report to the community based on the above**

- **+ Project Manager weekly and Central Team (Executive Committee) weekly telecon**

2008

- **re-plan in January, in response to US / UK funding cuts**
  - shift in emphasis toward R&D priorities; project preparation 'engineering' efforts deferred
  - 'Work-Package' process and related project management tools also deferred
- **US:**
  - P5 panel recommends "…***continued R&D on ILC at roughly the proposed FY2009 level in support of the international effort. This will allow a significant role for the US in the ILC wherever it is built."***
- **UK**
  - Support for key leaders including staff

2008

- **EU**
  - FP7 ‘Preparatory-Phase’, ‘Integrated Activity’ funding
- **Japan**
  - Political support for accelerator research, including that focused on ILC, through formation of ‘Frontier Accelerator Research Promotion Forum’
- **China**
  - ILC SRF R&D approved
- **Common Fund support**
  - used for electronic document management
  - project planning / costing staff
  - administrative staff and communications

2009

- **For the next PAC review:**
  - High Gradient Studies – cavity testing
  - ‘Plug-Compatible’ Global Cryomodule
  - High Power operation at DESY - FLASH
  - ATF2 (Beam Delivery) / Cesr TA (electron cloud) initial results
  - Minimum Machine Design Development
  - Single Tunnel design
- **preparation for the release of a new baseline in 2010**

Summary

GDE Strategy:

- **Develop a ‘Project’ with multi-lateral basis**
  - Building on the consensus achieved with the Reference Design effort
  - Devise a Project Implementation Plan, including cost, schedule and production models – key consensus building effort
- **Do cost/risk reduction R & D**
  - Build in modularity: *‘Plug-compatibility’,* to promote efficient, motivated R & D
- **Design and develop a lower-cost Baseline**
  - ‘Minimum Machine’ and CFS studies
- **Deliver ‘Technical Design’ in 2012 for submission to governments**