International Development Team

IDT WG2 Activities

Benno List, DESY

ILC Europe Meeting

3.6.2021

Pre-Lab Proposal Released

http://newsline.linearcollider.org/2021/06/01/ilc-preparatory-laboratory-proposal-released/

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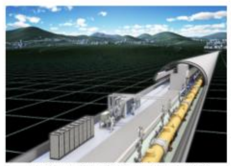
DIRECTOR'S CORNER

ILC Preparatory Laboratory proposal released

Tatsuya Nakada | 1 June 2021

The ILC International Development Team (IDT) was established by the International Committee for Future Accelerator (ICFA) in August 2020, to prepare the ILC Preparatory Laboratory (Pre-lab) that would complete the technical development and engineering preparation for the International Linear Collider project to be ready for construction. During the same period, governmental authorities of interested nations are expected to forge an agreement on the sharing of the cost and responsibilities for the construction and operation of the ILC facility and on the organisational structure and governance of the ILC Laboratory.



Artist's impression of the ILC. Image: Rey. Hori

After ten months of work, the IDT has achieved the first major milestone of completing the ILC Pre-lab proposal, which outlines the organisational framework, an implementation model and work plan of the Pre-lab. Three working groups were the key players and an impressive number of people have been contributing to this effort. Working Group 1 worked on the mandate, governance model, organisational structure and Pre-lab start-up procedure. Working Group 2 identified necessary technical development and engineering preparation work for the ILC accelerator and site construction. Working Group 3 discussed a strategy for developing the compelling ILC physics programme. Then the Executive Board took the responsibility of compiling the document. It was very encouraging to see the growing number of participants in those activities.

The IDT activity now enters the next phase of implementing the steps for establishing the Pre-lab along the lines described in the proposal. The plan for the accelerator technical development and engineering preparation work needs to be further elaborated and people and laboratories with interest and expertise in the work must be identified. The physics community needs encouragement and support for further exploring the physics potential of the ILC and converging towards concrete designs of experiments. Discussion on the Pre-lab start-up process must be initiated among the world key laboratories.

An equally crucial factor now is to understand what kind of process is needed to achieve the establishment of the Pre-lab. Unlike the ILC itself, the Pre-lab activities will be driven at the level of laboratories rather than having a direct involvement of governmental authorities. For the managements of interested laboratories to engage seriously in the discussion of responsibility sharing for the Pre-lab activities, however, a signal from the Japanese government indicating its interest in hosting the ILC and supporting the Pre-lab would be required. In parallel, we will make further effort to gain more support for the ILC worldwide.

We will continue to do our best for the swift realisation of the Pre-lab. Exciting times are head of us all.

Read Full text of Proposal for the ILC Preparatory Laboratory (Pre-lab)

Alternative link (arXiv): https://arxiv.org/abs/2106.00602

ACCELERATOR R&D | ICFA | ILC | JAPAN | PRE-LAB

TATSUYA NAKADA

Tatsuya Nakada (EPFL) is the Chair of Executive Board in the ILC International Development Team.

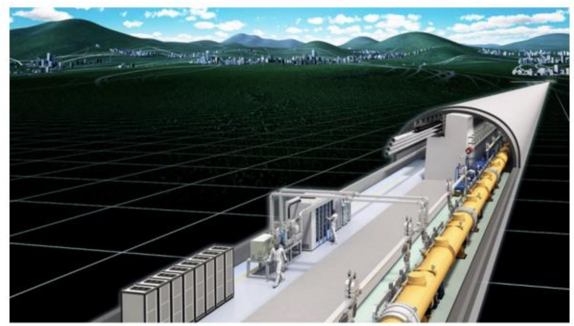
https://www.interactions.org/press-release/ilc-international-development-team-publishes-proposal-ilc

ILC International Development Team publishes the Proposal for the ILC Preparatory Laboratory

1 June 2021 - ILC International Development Team

An international scientific consensus supports an electron-positron Higgs Factory as the highest-priority next collider, and timely construction of the International Linear Collider (ILC) hosted in Japan is strongly supported by the international community.

Today, the international effort to realise ILC in Japan took another step forward with the publication of the document titled "Proposal for the ILC Preparatory Laboratory (Pre-lab)". This proposal is prepared by the ILC International Development Team (ILC-IDT) and endorsed by the International Committee for Future Accelerators (ICFA).



"The IDT has achieved the major milestone of completing this proposal, which outlines the organisational framework, an implementation model and a work plan of the Pre-lab", said Tatsuya Nakada, Chair of the IDT Executive Board and Professor Emeritus at École Polytechnique Fédérale de Lausanne (EPFL) in Switzerland.

All the technical development and engineering design needed for the start of the construction of the ILC laboratory should be completed during the preparatory phase. In the same period, governmental authorities of interested nations are expected to forge an agreement on the sharing of the cost and responsibilities for the construction and operation of the ILC facility and

Proposal for the ILC Preparatory Laboratory (Pre-lab)

International Linear Collider
International Development Team

1 June 2021

Abstract

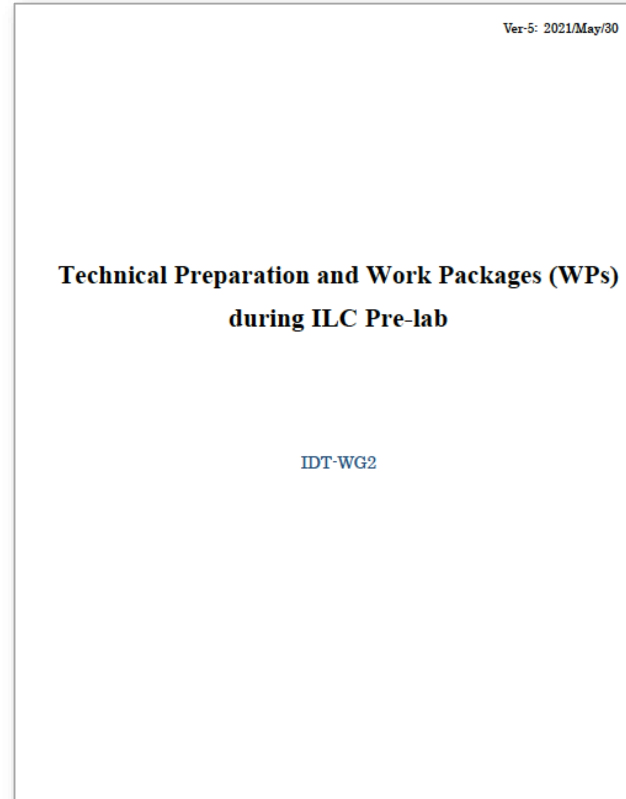
During the preparatory phase of the International Linear Collider (ILC) project, all technical development and engineering design needed for the start of ILC construction must be completed, in parallel with intergovernmental discussion of governance and sharing of responsibilities and cost. The ILC Preparatory Laboratory (Pre-lab) is conceived to execute the technical and engineering work and to assist the intergovernmental discussion by providing relevant information upon request. It will be based on a worldwide partnership among laboratories with a headquarters hosted in Japan. This proposal, prepared by the ILC International Development Team and endorsed by the International Committee for Future Accelerators, describes an organisational framework and work plan for the Pre-lab. Elaboration, modification and adjustment should be introduced for its implementation, in order to incorporate requirements arising from the physics community, laboratories, and governmental authorities interested in the ILC.

1

https://doi.org/10.5281/zenodo.4742043
arXiv:2106.00602

Technical Preparation Plan released

- Addendum to Pre-Lab proposal
- Gives details about 18 Work Packages for Technical Preparation
- For details: see my presentation on Jan 27 https://agenda.linearcollider.org/event/9020/



Ver-5: 2021/May/30

Technical Preparation and Work Packages (WPs) during ILC Pre-lab

IDT-WG2

https://doi.org/10.5281/zenodo.4742018

Pre-Lab Proposal: Accelerator Part

- 4.1 Accelerator
  - Technical preparation activities
    -> detailed in technical preparation plan
  - Engineering design and documentation
  - Timeline
- 4.2 Civil construction and site-related tasks
  - Description of tasks
  - Timeline
- 4.3 Preparation for physics programme

4 Pre-lab work plan

4.1 Accelerator

The ILC accelerator consists of the following domains:

a electron and positron sources,

b damping rings (DRs) to reduce e^- and e^+ beam emittance (a quantity corresponding to the spread of the beam),

c the beam transportation from the damping rings to the main linear accelerators (RTML),

d the main linear accelerators (main linacs or MLs) to accelerate the e^- and e^+ beams using superconducting radio frequency (SRF) technology,

e beam delivery and final focusing system (BDS) to focus and minimize the final beam size, in order to maximize luminosity, and to optimize the machine and detector interface (MDI) in the interaction region where experiments are installed, and

f the beam dumps (Dump), where the beam ends after passing through the interaction region

Common technologies, such as superconducting magnets and vacuum systems, are required by the various domains. Groups that support such technologies will provide specialized technical design and development to all domains requiring their expertise.

The principal accelerator activities of the ILC Pre-lab are technical preparations and engineering design and documentation. These activities will be conducted in parallel with intergovernmental negotiations for the ILC Laboratory.

The deliverables of the Pre-lab accelerator activities, both technical preparations and engineering design and documentation, will be provided as in-kind contributions by member laboratories of the Pre-lab. A work breakdown structure (WBS) defining all Pre-lab accelerator activities is currently being developed. Overall management of worldwide Pre-lab accelerator activities will be provided by the Associate Director for Accelerators, assisted by the Central Technical Office. It is foreseen that the activity in each domain and on each common technology will be led by a manager drawn from one of the member laboratories. Similarly, each technical preparation and engineering design work package will be led by a manager drawn from one of the member laboratories, guided by the domain and common technology managers. The detailed organization chart for Pre-lab accelerator activities will be defined by the Pre-lab Directorate. The ILC Machine Advisory Committee (ILCMAC), in its advisory role to the Associate Director for Accelerators, will monitor technical progress and review the engineering design and documentation.

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Technical Preparation: Work Packages

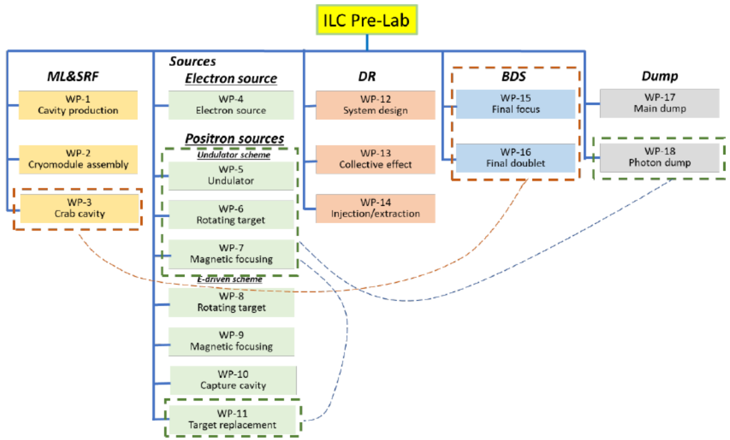


Figure 2: Summary of work packages.

Table 1. List of WPs

1. ML&SRF:	***41.25 MILCU*, 285 FTE-yr***
WP-1	Cavity production
WP-2	Cryomodule assembly, Global transfer and Performance Assurance
WP-3	Crab cavity
2. Electron Source:	***2.6 MILCU, 6 FTE-yr***
WP-4	Electron source
3. Positron Source:	***5.85 MILCU, 15 FTE-yr***
3.1 Undulator scheme:	
WP-5	Undulator
WP-6	Rotating target
WP-7	Magnetic focusing
3.2 e-Driven scheme:	
WP-8	Rotating target
WP-9	Magnetic focusing
WP-10	Capture cavity
WP-11	Target replacement
4. DR	***2.5 MILCU, 30 FTE-yr***
WP-12	System design
WP-13	Collective effect
WP-14	Injection/extraction
5. BDS	***2.2 MILCU, 16 FTE-yr***
WP-15	Final focus
WP-16	Final doublet
6. Dump	***3.2 MILCU, 12 FTE-yr***
WP-17	Main dump
WP-18	Photon dump

* ILCU = 2012 US$ estimate

Accelerator Part: EDR and Timeline

4.1.2 Engineering design and documentation

Preparing the engineering design and documentation for the ILC accelerator is one of the principal missions of the ILC Pre-lab. Whereas the technical preparation activities described above in Subsection 4.1.1 focus on R&D activities that address all open technical issues or update TDR designs for significant advances in technology, engineering design and documentation activities focus on completion of a full engineering design of the ILC, including preparation of the Engineering Design Report (EDR) and all documentation necessary to initiate ILC construction. The engineering design and documentation activities will proceed in parallel with the technical preparation activities. The engineering design builds upon the TDR completed by the ILC Global Design Effort in 2013. It will incorporate the results of the technical preparation activities, as well as design changes since the TDR. It will also reduce uncertainty in the construction plan by scrutinizing cost and schedule risks. The engineering design and documentation activities for the ILC accelerator project will include the following items:

- Engineering Design Report,
- Engineering documentation (specifications, drawings, etc.)
- Work Breakdown Structure (WBS) for ILC accelerator,
- Construction schedule,
- Review and update of material cost estimate and human resource estimate,
- Plans for mass production, transportation, and quality assurance, and
- Preparation for purchase of time critical items,

Engineering design and documentation activities will be organized into work packages based on the Pre-lab WBS, which is initially being developed by the IDT and will be updated by the Pre-lab if necessary. The work will be completed as in-kind deliverables by Pre-lab member laboratories, as for the technical preparation work. A preliminary Pre-lab WBS has been used to estimate the required human resources for engineering design and documentation. This estimate is presented in Subsection 5.1. No significant material resources are foreseen to be required by these activities. The next step for the IDT is to define and distribute work packages. This step is still ongoing but less time-critical than for the technical preparation.

Year	Technical preparation and production readiness (focusing on SRF and e^+ source)	Engineering documentation
1	• Continue cost-reduction R&D for SRF cavities. • Start pre-series production of SRF cavities in cooperation with industry. • Continue e^+ source development.	• Start review and update of TDR cost estimate by an international team.
2	• Complete cost-reduction R&D. • Determine production yield. • Start assembling cavities into cryomodules. • Review e^+ source designs.	• Conduct a review on the progress for technical work and cost estimation by an internal panel.
3	• Demonstrate overseas shipment of cryomodules taking all the safety and legal aspects into account. • Select e^+ source design and start prototyping of critical items, e.g. e^+ target.	• Complete cost estimate and conduct internal and external review on the result. • Complete risk analysis for the technical and cost issues. • Complete a draft for the Engineering Design Report.
4	• Evaluate cryomodules after shipment and demonstrate the quality assurance procedure. • Establish regional organisation for the ILC component production. • Continue prototype work for critical components of the e^+ source, e.g. e^+ target.	• Complete and publish the Engineering Design Report. • Start producing specification documents and drawings of large items for tendering.

Costs and Human Resources

- Part 5: Reference costs and required human resources
  - Separate costs and manpower for
    - Technical preparation
    - Engineering design
    - Civil engineering
    - Central bureau
  - Assumes in-kind contributions
  - Infrastructure costs for test facilities (STF, ATF, etc) not included
  - Central bureau: in Japan, 30 FTE (x 4 years)

Table 2: List of estimated material costs and human resource requirements for deliverables of the technical preparation activities, where ILCU is defined in the text. (Resources for the infrastructure needed for deliverables are not included.)

Domains	Material cost [MILCU]	Human resources [FTE-yr]
Main Linacs (ML) and SRF	41.25	285
Electron Source	2.60	6
Positron Source	5.85	15
Damping Ring (DR)	2.50	30
Beam Delivery System	2.20	16
Dump	3.20	12
Total	57.60	364

Table 3: Estimated human resource requirements for engineering design and documentation.

Item	Human resources [FTE-yr]
Accelerator/Engineering design and integration	75
Sources	35
Damping Ring (DR)	30
Beam transfer system from DR to ML	25
Main Linacs (ML)	60
Beam Delivery System	25
Total	250

Table 4: Estimated civil engineering cost and human resources requirement.

Item	Cost [MILCU]	Human resources [FTE-yr]
Site surveys	22	70
Detailed designs	43	

Table 5: Pre-lab Central Bureau human resource requirement

Item	FTE/Year
Directorate Office	12
Director and associate directors	4
Secretarial support, legal service, communication, safety	8
Administration Office	9
Head	1
International Relation, Finance & Procurement, Human Resources & Travel, Local IT service	8
Central Technical Office	9
Project management and technical coordination	5
Coordination for the common physics and detector needs	2
IT service for Engineering Data Management System	2
Total	30

Accelerator activities at ILC Pre-lab phase

Technical preparations & SRF R&D for cost reduction [shared across regions]

- SRF performance R&D, quality testing of a large number of cavities (~100), fabrication and shipping of cryomodules from North America and Europe (for validating shipping)
- Positron source final design and verification
- Nanobeams (ATF3 and related): Interaction region: beam focus, control; and Damping ring: fast kicker, feedback
- Beam dump: system design, beam window, cooling water circulation
- Other technical developments considered performance critical

~360 FTE-yr (mainly 1st – 3rd year) + infra. for WPs (~130)

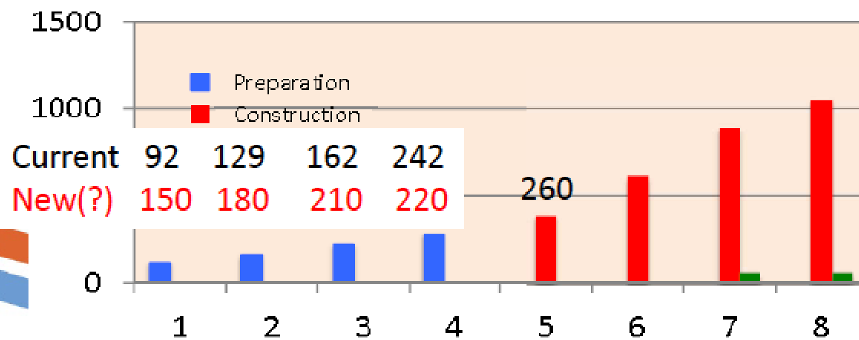
Final technical design and documentation [central office in Japan with a support from other labs]

- Engineering design and documentation, WBS
- Cost confirmation/estimates, tender and purchase preparation, transport planning, mass-production planning and QA plans, schedule follow up and construction schedule preparation
- Site planning including environmental studies, CE, safety and infrastructure (see below for details)
- Review office
- Resource follow up and planning (including human resources)

Engineering design and documentation 100+100+50(Common)~250

Preparation and planning of deliverables [distributed across regions coordinated by the central office]

- Prototyping and qualification in local industries and laboratories, from SRF production lines to individual WBS items
- Local infrastructure development including preparation for the construction phase (including Hub.Lab)
- Financial follow up, planning and strategies for these activities



S. Michizono, IDT WG2 Meeting 1.6.2021

WBS

- The WBS needs to cover all the pre-lab accelerator works
- Our WG2 will not decide on the international sharing (technical WPs, engineering design) . (WG1 will coordinate and each laboratory will decide on the sharing.)
- In other words, the WBS itself will be re-built after the sharing discussion.
- The laboratory in charge of each “column” of the matrix may change.
- Or the sharing of the area system and the technical system will not be consistent at that time.
- So my proposal is to address the WBS based on area systems.

(And depending on the actual sharing, we can re-organize the pre-lab WBS.)

S. Michizono, IDT WG2 Meeting 1.6.2021

WBS: In progress

- 1. Accelerator and technical design integration
  - The management part
  - Entries for all accelerator areas and technical systems (matrix header rows and columns)
- 2. Accelerator area-oriented
  - The engineering part
  - Entries for all accelerator areas (1st level), broken down into technical systems (2nd level)
  - Matrix-style approach

FTEs for WBS and WP structure

WBS		T0	T1	T2	T3a	T3b	T4	T5	T6a	T6b	T7	T8	T9	T10	T11	T12	T13	T14
		Sys. Des. Simul.	Acc. Area specific	Hub/Infra.	Acc-Str. (SRF)	Acc-Str. (NRF)	HLRF	Cryog.	Mag/ PS (SC)	Mag/ PS (NC)	Vac.	Coll. /Dump	Beam Instr.	LLRF/ Cont.	Installation	Sruvey -Align.	Communication(1) Safety, Protection, IT	Communication (2) Acc. Management
A0	ADI																	
A1	Sources		WP4-11									WP18						
A2	DR	WP12-14																
A3	RTML																	
A4	ML				WP1,2													
A5	BDS	WP15, 16			WP3							WP17						

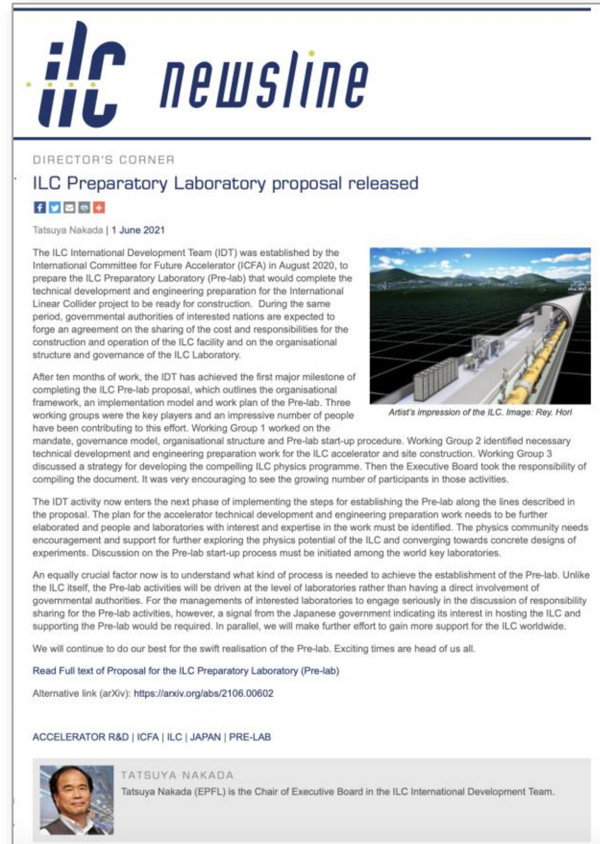
WORK IN PROGRESS

#	Code	FTE	Title		Scoping statement
1	1		Oversight: Accelerator and Technical Design Integration		Overview of the ILC accelerator and technical design integration as a whole
2	1.1		A: Accelerator/Area Design Integration (ADI)		Integrate the accelerator design, coordinate work of the accelerator areas and technical system work packages
3	1.1.0	0.8	A0: ADI Oversight	1.1.1	
4	1.1.0.1			1.1.0.2	Oversight/Supervise the ADI effort during the Prelab phase
5	1.1.1	0.8	A1: Sources	1.1.1	Sources: General discription (or overview ---)
6	1.1.2	0.8	A2:DR	1.1.2	DR: General discription
7	1.1.3	0.8	A3:RTML	1.1.3	RTML: General discription
8	1.1.4	0.8	A4:ML	1.1.4	ML: General discription
9	1.1.5	0.8	A5:BDS	1..1.6	BDS: General discription
10	1.2		T: Technical/Section Design Integration (TDI)		Integrate Technical/ Engineering Design and Quality Management (central and in regional centres) during Prelab phase and prepare Systems Engineering and Quality Management plans with technical solutions for the construction project
11	1.2.0		T0: TDI Oversight= (including Common-2: Tech. Management))		Oversight/Supervise the TDI effort [illegible] the Prelab phase
12	1.2.0.1			Technical Integration management	
13	1.2.1	0	T1: Accelerator Area Specific		
14	1.2.2	0	T2: Hub/Infra-Structure		
15	1.2.3	5	T3a: Accelerating Strcture: SRF		Design and prototype [illegible] components and subsystems
16	1.2.4	0.8	T3b: Accelerating Strcture: NRF		Design and [illegible] NRF components and subsystems
17	1.2.5	0.8	T4: RF Power (HLRF)		De[illegible] and cryo strings (for Main Linac, Bunch Compressors [illegible] Sources)
18	1.2.6	0.8	T5: Cryogenics		De[illegible] system
19	1.2.7	0.8	T6a: Magnet and PS (SC)		[illegible] magnets and power supplies
20	1.2.7.1			Superconducting magnets	[illegible]sign all superconducting magnets
21	1.2.7.2			Magnet power supplies	Design power supply system
22	1.2.8	0.8	T6b: Magnet and PS (NC)		Design NC/PM magnets, kickers and power supplies
23	1.2.8.1			Normal conducting magnets	Design all normal conducting magnets
24	1.2.8.2			Permanent magnets	Design all permanent magnets
25	1.2.8.3			Kickers	Design kicker magnets

Code	FTE	Title		Scoping statement
2		Breakdown: Accelerator Area-Oriented (Preparation)		
2.0		A0: Accelerator Design Integrattion		
2.0.1	7.5	T0: System Design		
2.0.1.1			Optics	Integrate design contribustions from accelerator areas
2.0.1.2			Beam dynam[illegible] tuni[illegible]	Evaluate the beam dynamics of the ILC accelerator
2.0.1.3			Availabilit[illegible]d op[illegible]ations	Determine the expected availability of the accelerator
2.0.1.4			C[illegible]ing	Plan the comissioning of the accelerator
2.1		A1: Sources		Design the electron and positron source systems, with prototypes of critical items
2.1a		A1a: e- source		
2.1a.1	7.0	T0: System Design		
2.1a.1.1			Optics	Design the electron source system from gun to DR injection
2.1a.1.2			Beam dynamics and tuning	Evaluate the beam dynamics of the ILC accelerator
2.1a.1.3			Availability and operations	Determine the expected availability of the accelerator
2.1a.1.4			Commissioning	Plan the comissioning of the accelerator
2.1a.2	6.0	T1: Area Specific		
2.1a.2.1a			WP04: Electron source	Design gun and drive laser
2.1a.3	0	T2: Hub/Ir N/A		
2.1a.4	0.4	T3a: Accelerating Strcture: SRF		Design and prototype the SRF components and subsystems
2.1a.5	0	T3b: Accelerating Strcture: NRF		Design and prototype the NRF components and subsystems
2.1a.6	0.2	T4: RF Power (HLRF)		
2.1a.6.1			Klystrons	Design klystrons for 3GeV driver, 5GeV booster
2.1a.6.2			Modulators	Design modulators for 3GeV driver, 5GeV booster, undulator SC 5GeV
2.1a.6.3			Power Distribution System	Design RF power distribution system for 3GeV driver, 5GeV booster, undulator SC 5GeV
2.1a.7	0.4	T5: Cryogenics		Design cryogenic system

Summary

- Pre-Lab proposal with addendum for technical preparation is finished
- Cost and human resource estimate for Pre-Lab finalised
- Full WBS for Pre-Lab still being worked on
  - Precise structure of work packages will be adapted to reflect result of in-kind constribution agreements



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We will continue to do our best for the swift realisation of the Pre-lab. Exciting times are head of us all.

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