Alternatives in EDR phase
-in case of ILC positron source-

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What is EDR?

- EDR is a snapshot of ILC design at that point; In this context, meaning of EDR is almost same as that of RDR with improved cost estimation and more technical details.
- In fact, rather the process than the document, is important as :
  - **our exercise in a framework of the ILC project management,**
  - **expansion of ILC related efforts.**

What is EDR? (2)

- From a system engineering point of view;
  - **Agreement process (BCD phase)**
    - Define what we want make...ILC, but what is ILC?
    - We have performed this process in the past ILC/GDE meetings.
  - **Project process (RDR and EDR phases)**
    - This process contains modeling, assessment, reconfigure, and design.
    - Those steps are repeated under configuration control.
    - This process is terminated when design is well matured.
  - **Technical process (Mostly post EDR phases)**
    - Technical design.
    - Development.
    - Implementation.

Where are we?

- We are now in transition from RDR phase to EDR phase. In the system engineering terminology, we are in the project process; iterations of modeling, assessment, reconfigure, and redesign.
- EDR contains some technical detail. It covers a part of the technical process, depending on component.
- Then, the iteration of the system optimization is not only inside of the project process, but also in the technical process. It can be considered as one of con-current engineering or Spiral model of system development.
- If EDR is assumed to be an initial technical design before the construction (by M. Ross, May 2), time until the approval can be used to make it a complete technical design: industrialization, prototyping, etc.

In case of Positron

- In our case, there are many ambiguities; Many R&D are required even for the baseline; Philosophy of con-current engineering is very important.
  - **New technology/knowledge are obtained not only by strategic efforts for ILC, but also by other activities.**
  - **The latest knowledge reveals sometimes that our design is too optimistic and unrealistic.**
- If we read our BCD in this context, three schemes described in BCD has each important roll;
  - **Baseline scheme, Undulator, is likely to be possible, but need an amount R&D to give our full confidence.**
  - **Alternative scheme, Laser Compton, has more ambiguities, but tight connections to other disciplines and many improvements are expected.**
  - **Conventional has less ambiguities. If other two schemes are very risky, it is our last candidate.**

General Goals of the Workshop

by N. Walker

- To review current status of global ILC R&D and future plans, including *S*-task force findings both for BCD-related and ACD items, and activities in and around test facilities (both existing and proposed).
- Identify and prioritize critical engineering milestones for EDR phase (cost driven), including integration (and relationship to) the critical R&D milestones.
- To promote and improve collaboration between groups working on ILC related R&D:
  - To encourage a broader participation from active groups around the world
  - To attract new researchers to the field.
- To define the scope of the EDR and consolidate EDR planning:
  - Review project WBS and 'Work Package' structure.
  - Refine proposed schedule, milestones, deliverables etc.
  - Begin process of WP allocation.

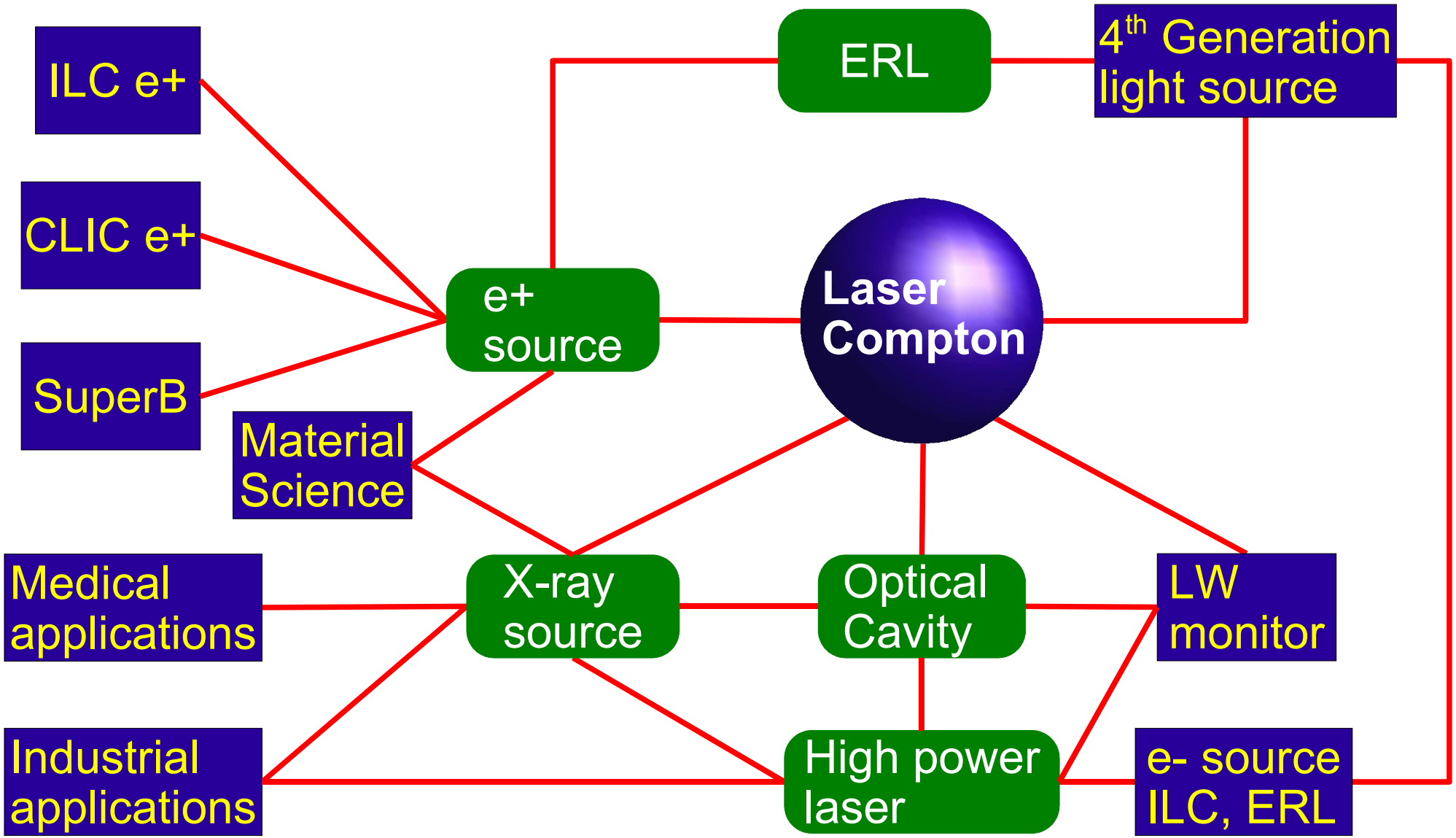
In case of Laser Compton

- Laser Compton as an alternative ILC e+ source is a reasonable choice in following contexts;
  - **It is more attractive than the undulator scheme because of less inter-system dependence, compactness, demonstrable, etc.**
  - **It is still technically ambiguous.**
- From a project point of view, facilitating both base-line and alternative is desirable.
  - **Investment only one way is a big gamble.**
  - **By the definition, the configuration change is a big technical progress and an evolution of project.**
  - **It makes ILC project more technically attractive to outside of ILC community.**

As a Driving Force

- Laser-Compton has a large potential as a future technology. Many common efforts can be shared in a context of various applications.
  - **X-ray/SR sources for industrial and medical applications,**
  - **Laser wire beam monitor,**
  - **Polarized Positron Generation for ILC, CLIC,**
- It is not an extension of existing accelerator R&D; This is a new mode of R&D. State-of-the-art technologies are quickly included with world-wide synergy.
- Then, Laser Compton technology can be a powerful driving force by attracting many researchers, who belongs not to ILC effort. It is one of the best item of EDR promotion.

WWW of PosiPol R&Ds



What shall we do?

(presented in Beijing)

- Summarize our status (Done)
  - **What we have,**
  - **What we are doing,**
- Our first task is to establish a conceptual design, which fully satisfy the ILC specifications. This conceptual design can include technical ambiguities, which will be developed eventually by our/general efforts. (Almost Done)
- Simultaneously , we have to define WPs, which avoid the technical ambiguities and are required to start the full engineering design. (Not fully done)
  - **What, Who, When**

LC e+ System Technical Milestones (M. Kuriki)

- Establish a conceptual design, which is fully compatible to ILC requirements.
  - **Laser**
  - **Optical Cavity**
  - **Electron source(ERL,DR, Linac), which is collision partner of LC.**
  - **Capture optics.**
  - **e+ stacking.**
- R&Ds for the critical items and technologies;
  - **Laser, Optical cavity, e- source, etc.**
- Component prototyping (Maybe, post EDR)
  - **Laser and Optical cavity, electron source, target and capture optics, etc.**
- System Prototyping (Mini-ILC)
  - **By integrating the prototype of the components, mini-ILC e+ source is constructed.**

EDR Milestones

- June 07: EDR Scope definition: design depth and breadth, cost, schedule, staff.
- Dec 07: Complete the conceptual design of the components and system.
- Dec 08: Complete basic R&D.
- March 09: Freeze layout, full component and civil specifications
- June 09: EDR detailed component inventory.
- September 09: Cost review for the configuration change.
- Dec 09: Deliver EDR.
- Jan 10: System and Layout design for the mini-ILC e+ source.
- Jan 11 : Start the construction of mini-ILC e+ source based on Laser Compton.

Work Packages (Laser Compton)

			Work			
			Conceptual Design	R&D	Prototyping	Engineering Desing
Laser Compton	System Design		Many			
	Light Source	Laser Oscillator	KEK,BNL,LAL	KEK,BNL,LAL	KEK, LAL	KEK, LAL
		Laser Amplifier	KEK.BNL,LAL	KEK.BNL,LAL	KEK, LAL	KEK, LAL
		C02 laser	BNL	BNL	BNL	BNL
	Optical Cavity	2-mirrors cavity	KEK	KEK	KEK	KEK
		4-mirrors cavity	LAL	LAL	LAL	LAL
	ElectronSource	Electron Injector	BNL, KEK	BNL, KEK		
		Storage Ring	Kharkov	Kharkov		
		ERL	ERL projects	ERL projects	ERL projects	
	Target	Rotating W-Re				
	Capture Optics	Lithium lens	BINP, Cornell	BINP, Cornell	BINP, Cornell	BINP, Cornell
	Capture RF	NC L-band Acc				
	E+ stacking	e+ stacking	LAL, CERN	LAL, CERN	LAL, CERN	LAL, CERN
	System Integration	Laser + Cavity + e- beam	KEK,BNL,LAL, Hiroshima	KEK,BNL,LAL, Hiroshima	KEK,BNL,LAL, Hiroshima	KEK,BNL,LAL, Hiroshima
		ILC e+ prototyping	KEK, BNL, LAL, IHEP, Hiroshima	KEK, BNL, LAL, IHEP, Hiroshima	KEK, BNL, LAL, IHEP, Hiroshima	KEK, BNL, LAL, IHEP, Hiroshima

WP time line (Laser Compton)

	Year	07			08				09				10			
	Quarter	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q
Laser Compton	System Design															
	Laser Oscillator															
	Laser Amplifier															
	CO2 laser cavity															
	Optical Cavity															
	2-mirrors cavity															
	4-mirrors cavity															
	System Integration															
	Electron Injector															
	Storage Ring															
	ERL															
	Solid target															
	NC L-band Acc															
	SI Laser + Optical Cavity + e- beam															
	ILC e+ Prototyping															

Legend: Conceptual Design, Basic R&D, Engineering Design, Prototyping

In case of Conventional

- It is a part of the BCD, another alternative.
- This scheme also has risks, but it can be manageable.
  - **All of them can be solved by decreasing the positron intensity or multiple positron stations.**
- R&D and prototyping for Conventional could be those for the keep alive source; Most part of R&D for Conventional can be common efforts among different schemes: Capture section, conversion target, Flux concentrator, AMD/OMD, etc.
- It can be also another driving force as same as in case of Laser Compton because Conventional is only a "conventional" way in the accelerator discipline.

Conventional e+ System Technical Milestones (M. Kuriki)

- Establish a conceptual design, which is fully compatible to ILC requirements.
  - **Driving Electron Source (OK)**
  - **Rotating W-Re target (OK)**
  - **Liquid metal target**
  - **Flux concentrator**
- R&Ds for the critical items and technologies;
  - **Liquid target. flux concentrator**
- Component prototyping
  - **Liquid target, flux concentrator, etc.**
- System Prototyping (Mini-ILC)
  - **By integrating the prototype of the components, mini-ILC e+ source is constructed. It can be a prototype of the keep alive source.**

EDR Milestones

- June 07: EDR Scope definition: design depth and breadth, cost, schedule, staff.
- Dec 07: Complete the conceptual design of the components and system.
- Dec 08: Complete basic R&D and freeze layout, full component and civil specifications.
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- September 09: Cost review for the configuration change.
- Dec 09: Deliver EDR.
- Jan 10: System and Layout design for the mini-ILC e+ source.
- Jan 11 : Start the construction of mini-ILC e+ source (keep alive source).

Work Packages (Conventional)

			Work			
			Conceptual Design	R&D	Prototyping	Engineering Desing
Conven-tional	System Design	System Design	KEK, BINP			
	Electron Source	Electron Source	KEK, BINP	KEK, BINP	KEK, BINP	KEK, BINP
	Target	Rotating W-Re				
		Crystalline target	KEK, Thomsk	KEK, Thomsk	KEK, Thomsk	KEK, Thomsk
		Liquid target	BINP, Cornell	BINP, Cornell	BINP, Cornell	BINP, Cornell
	Capture Optics	Flux Concentrator	BINP, KEK	BINP, KEK	BINP, KEK	BINP, KEK
		Lithium lens	BINP,Cornell	BINP,Cornell	BINP,Cornell	BINP,Cornell
	Capture RF	NC L-band Acc	Common	Common	Common	Common
	System Integration	ILC e+ prototyping	BINP, KEK	BINP, KEK	BINP, KEK	

WP time line (Conventional)

	Year	07				08				09				10			
	Quarter	2nd Q	3rd Q	4th Q		1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q	1st Q	2nd Q	3rd Q	4th Q
Conven-tional	System Design																
	Electron Source																
	Rotating W-Re																
	Liquid target																
	Flux Concentrator																
	Lithium lens																
	NC L-band Acc																
	ILC e+ prototyping																

Legend: Conceptual Design | Basic R&D | Engineering Design | Prototyping

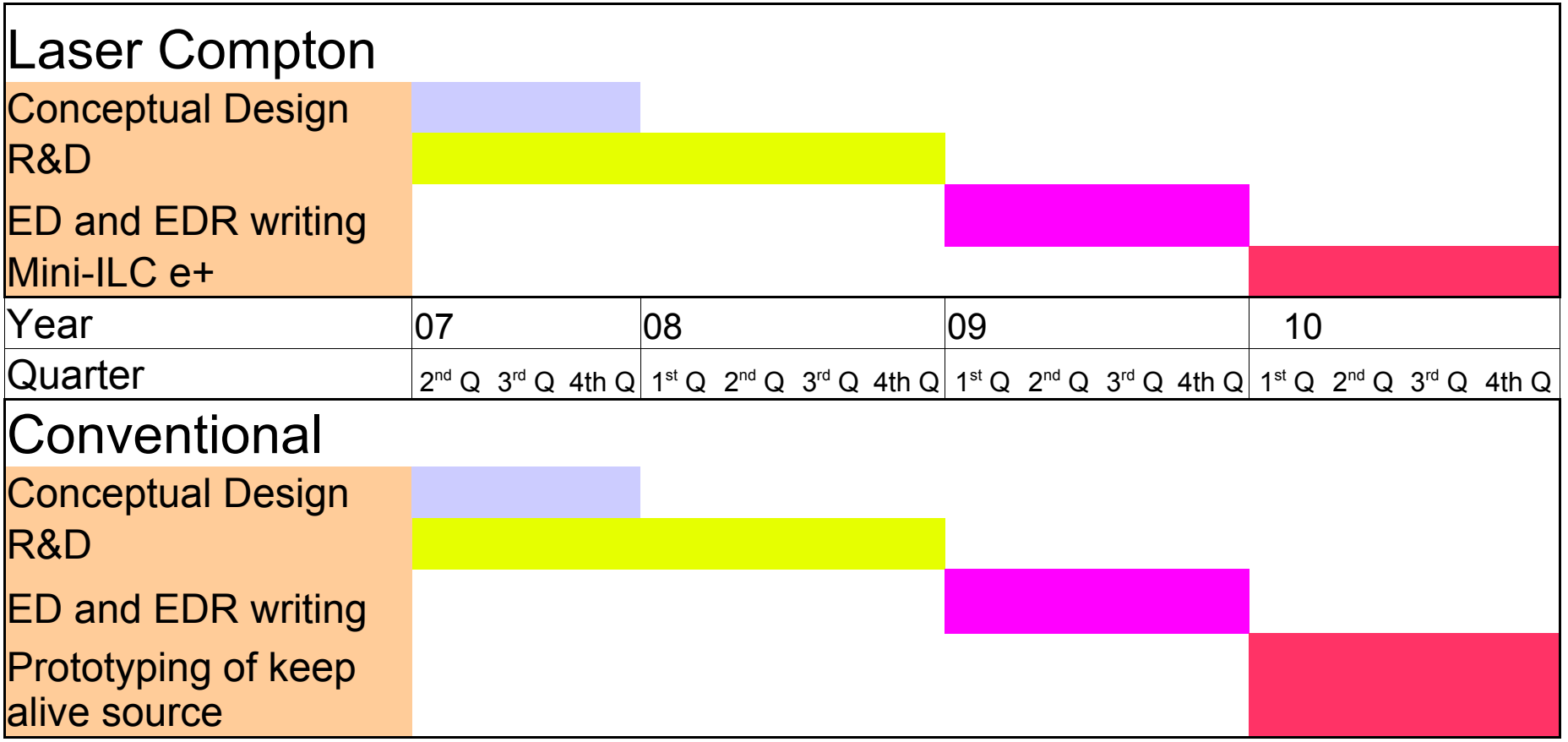
Future Perspective

- LC ILC e+ source will be developed involving many efforts of many different disciplines.
- We can save our resource for R&D effort by this reason, but this synergy is not fully synchronized to ILC effort. They do not care about EDR at all. We have to be careful for the missing pieces, but it is not a serious issue as long as the EDR is not a final technical report.
- Eventually, we have to study seriously the technical risks on the e+ source. Prototyping mini-ILC e+ source dramatically mitigates the technical ambiguities. It should be true for the base-line; The undulator e+ source is our first challenge.

Alternative Treatment

- BCD is under control of CCB (Change Control Board).
- BCD should always show the latest configuration and efforts in EDR phase should consistent to BCD.
- Current rule for baseline and alternative treatment is
  - **Small configuration changes is determined and approved by CCB.**
  - **Major changes are examined by CCB and approved by EC.**
- In EDR phase, not only the change configuration, but also the R&D efforts should be controlled by PMT (Project Management Team).
  - **"R&D is needed into alternative solutions that will mitigate remaining technical risks. Any proposal to adopt an alternative solution as a new baseline must include costs information and a plan for the necessary technical development." (M. Ross, May 2)**

Alternative Time Line Summary



Summary

- Alternative treatment during EDR phase for ILC e+ source is considered. Process of EDR is rather important from a project management point of view.
- Alternative schemes (Laser Compton, Conventional) are very important as driving forces by attracting wide variety of people; This facilitation is one of the purpose of EDR phase.
- R&D efforts can and should be shared with various efforts to save our limited resources, but be careful about deliver time and missing pieces.
- A clear rule for the configuration change and resource management during the EDR phase should be defined. (M. Ross's note is an proposal).

Summary (2)

- According to my first investigation, a set of WPs and its time-line are presented.
- The contents should be refined by the post-process of this WS in the frame-work of EDR regime, but the EDR regime is also going to be established con-currently.
- Post EDR phase is rather important, especially from a technical point of view. The prototyping will mitigate the technical risk dramatically
  - **Mini-ILC e+ source based on LC,**
  - **Prototyping the keep alive source based on Conventional.**