Planning Damping Rings Activities in the Engineering Design Phase

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The EDR Task Force: Charge

- To study two or more possible technical project structures (WBS) for the EDR phase of the ILC.
- The WBS models should be orientated around a central project management structure, led by a single project manager.
- The WBS should break down into individual Work Packages, suitable for distribution to interested parties, who would then take on responsibility for the deliverables of that Work Package.
- The WBS models must have clear lines of responsibility and reporting, up to the top-level management.
- The WBS should naturally support (and drive) the ILC R&D programme, which must be an integral part of the project.

EDR Task Force: Initial thoughts

The primary goal of GDE activities in the Engineering Design Phase of the ILC project will be to advance (i) the technology, (ii) the design and (iii) the construction plans for ILC, to the point where approval for construction can be sought.

In ~2010, an Engineering Design Report (EDR) will be produced: the EDR will explain the capabilities of the technology at that time, will detail the design of the machine and the construction plans, and will present an updated value estimate. The purpose of the EDR will be to facilitate:

1. **formal international negotiations at government level on (a) siting, (b) funding, (c) organization and (d) execution of the ILC project;**
2. **preparations for construction on a timescale consistent with the start of construction in ~2012.**

Preparations for construction will include the production of final engineering designs of critical components, procurement, and (once the site is chosen) site preparation.

EDR Task Force: Initial thoughts

The primary technical output from the activity in the Engineering Design Phase will be an integrated engineering design of the accelerator.

This design must satisfy the energy, luminosity, and availability goals outlined in the ILC RDR, and must also be consistent with the value estimate presented in the RDR.

Types of activity in the ED phase

1. Basic R&D is needed to demonstrate that all major accelerator components can be engineered to meet the ILC performance specifications.
2. 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.
3. An overall design must be produced, with sufficient completeness and detail to allow machine construction to start within 3 years, given project approval and funding.
4. Where several options exist for high-technology components needed in large quantities, a selection between the options must be made to allow focused industrialization efforts.
5. A comprehensive value-engineering exercise must be conducted, aimed at reducing cost and achieving design consistency.

Types of activity in the ED phase

6. A complete value cost estimate for the machine must be provided, including a funding profile consistent with the project schedule. (Site-specific details will not be decided on the timescale of the EDR, and may be excluded or handled separately from other items in the value cost estimate).
7. A project execution plan must be produced, including a realistic schedule. The project plan must include plans for industrialization of high-volume components in each of the participating regions.
8. Designs must be produced for facilities shared between different "area systems", and for site-specific infrastructure. The designs must include the level of detail needed for regions to estimate the cost to host the machine, taking into account local impact, infrastructure needs, and surface and underground footprints.
9. Regions will require information to evaluate project technical and financial risks in support of a bid to host the machine. All necessary information must be provided.

Types of activity in the ED phase

- Damping rings studies in the engineering design phase will involve all the above types of activities to some extent…

- … but the key activities will fall into the categories of:
  1. **Basic R&D**
  2. **R&D into alternative solutions**
  3. **Overall design work**

Goals for this Working Group

We need to consider how the damping rings activities could be structured into Work Packages, taking into account:

- **the deliverables (for the EDR, and the R&D programme…);**
- **the resources likely to be available;**
- **the schedule (target date for the EDR);**
- **existing and proposed activities.**

One approach would be to structure today's discussion around the development of a plan for producing the damping rings section of the EDR, including schedule and resources, and the R&D plan.

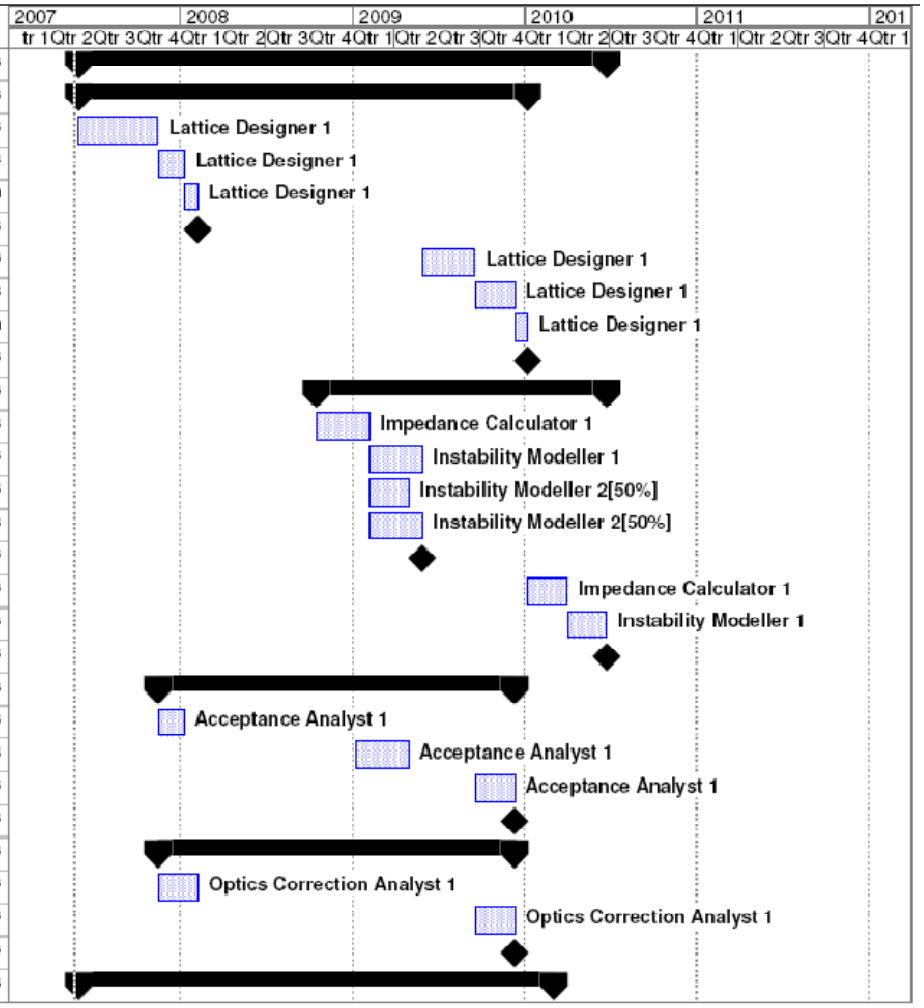
We have to make assumptions about resources and the outcome of the R&D.

Goals for this Working Group

- Once we have a realistic plan (given a set of stated assumptions), we can try to define sensible Work Packages, bearing in mind requirements for reporting and communication.
- The plan, and the Work Package definitions, can then be provided as "input" to the EDR Task Force.
- Whatever we do here will be a first pass, and will need further iterations before firm agreements are made.
- It is expected that ultimately, agreements will be made on deliverables, reporting procedures etc. through a set of Memoranda of Understanding between the GDE and individual laboratories.

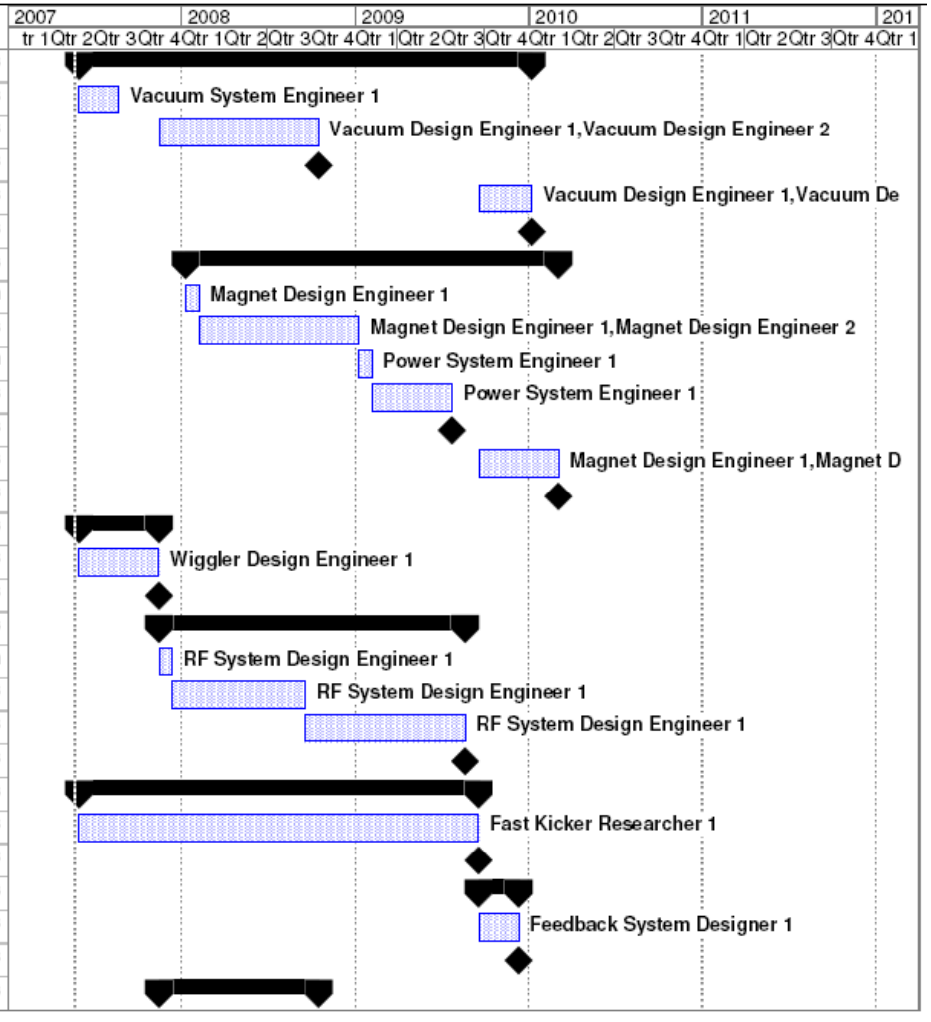
Zeroth-order iteration…

ID	Task Name	Duration
1	**Optics and beam dynamics**	**800 days**
2	**Lattice design**	**680 days**
3	Complete preliminary design of damping rings lattices	6 mons
4	Complete preliminary design of injection/extraction lines	2 mons
5	Complete preliminary design of abort line	1 mon
6	Release damping ring lattice for EDR studies	0 days
7	Complete final optimised design of damping rings lattices	4 mons
8	Complete final designs of injection/extraction lines	3 mons
9	Complete final design of abort line	1 mon
10	Lattice designs finalised and documented	0 days
11	**Impedance and instabilities**	**440 days**
12	Construct impedance model	4 mons
13	Understand impact of single-bunch instabilities	4 mons
14	Understand impact of coupled-bunch instabilities	3 mons
15	Understand impact of injection/extraction transients	4 mons
16	Document instability studies and specify improvements to lattice and v	0 days
17	Finalise impedance model	3 mons
18	Complete studies of beam instabilities	3 mons
19	Beam stability studies completed and documented	0 days
20	**Acceptance**	**540 days**
21	Initial estimates of dynamic aperture	2 mons
22	Understand acceptance limitations	4 mons
23	Complete studies of acceptance	3 mons
24	Acceptance studies documented	0 days
25	**Orbit and coupling correction**	**540 days**
26	Specify orbit and coupling correction scheme	3 mons
27	Finalise orbit and coupling correction scheme	3 mons
28	Correction systems documented and costed	0 days
29	**Technical Subsystems**	**720 days**



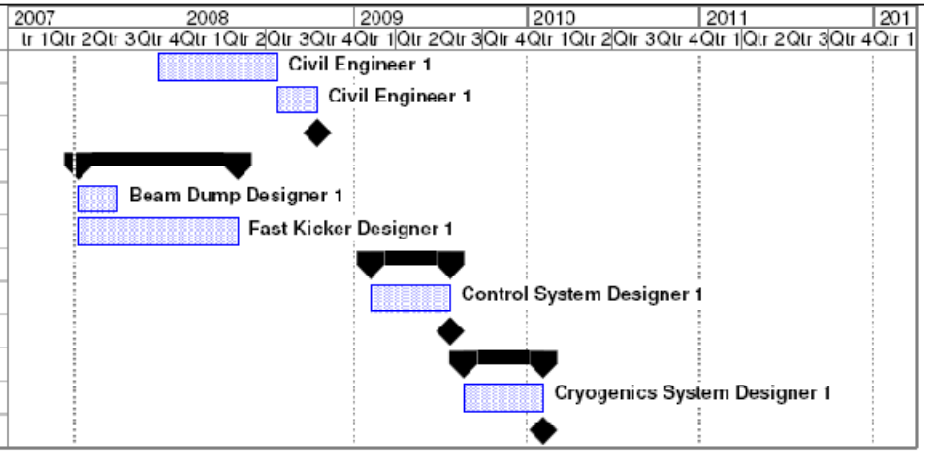
Zeroth-order iteration…

ID	Task Name	Duration
30	**Vacuum system**	**680 days**
31	Specify vacuum system	3 mons
32	Develop technical designs of vacuum system components	12 mons
33	Technical designs of vacuum system components documented	0 days
34	Finalise design of vacuum system components	4 mons
35	Vacuum system technical design documented and costed	0 days
36	**Magnets and power systems**	**560 days**
37	Specify magnets	1 mon
38	Develop technical designs for main magnets	12 mons
39	Specify magnet power supplies, power distribution and cooling system	1 mon
40	Develop designs for power distribution and cooling systems	6 mons
41	Magnet supports documented and costed	0 days
42	Finalise designs of main magnets	6 mons
43	Magnet designs and power supplies documented and costed	0 days
44	**Wiggler**	**120 days**
45	Develop technical design for wigglers	6 mons
46	Wiggler design documented and costed	0 days
47	**650 MHz RF system**	**460 days**
48	Specify RF system	1 mon
49	Technical design of RF cavities	10 mons
50	Finalise RF system technical designs	12 mons
51	RF system documentation and costing	0 days
52	**Injection and extraction systems**	**600 days**
53	Develop injection and extraction kickers	30 mons
54	Demonstrate injection and extraction kicker performance	0 days
55	**Fast feedback systems**	**60 days**
56	Develop technical design for fast feedback system	3 mons
57	Fast feedback systems documented and costed	0 days
58	**Conventional facilities**	**240 days**



Zeroth-order iteration…

ID	Task Name	Duration
59	Design excavations (tunnels and caverns)	9 mons
60	Finalise conventional facilities designs	3 mons
61	Conventional facilities documented and costed	0 days
62	**Abort systems**	**240 days**
63	Develop technical design for abort dump	3 mons
64	Develop technical designs for abort kickers	12 mons
65	**Control systems**	**120 days**
66	Specify control systems	6 mons
67	Control systems documented and costed	0 days
68	**Cryogenics systems**	**120 days**
69	Specify cryogenics systems	6 mons
70	Cryogenics systems documented and costed	0 days



Tasks have complex inter-relations

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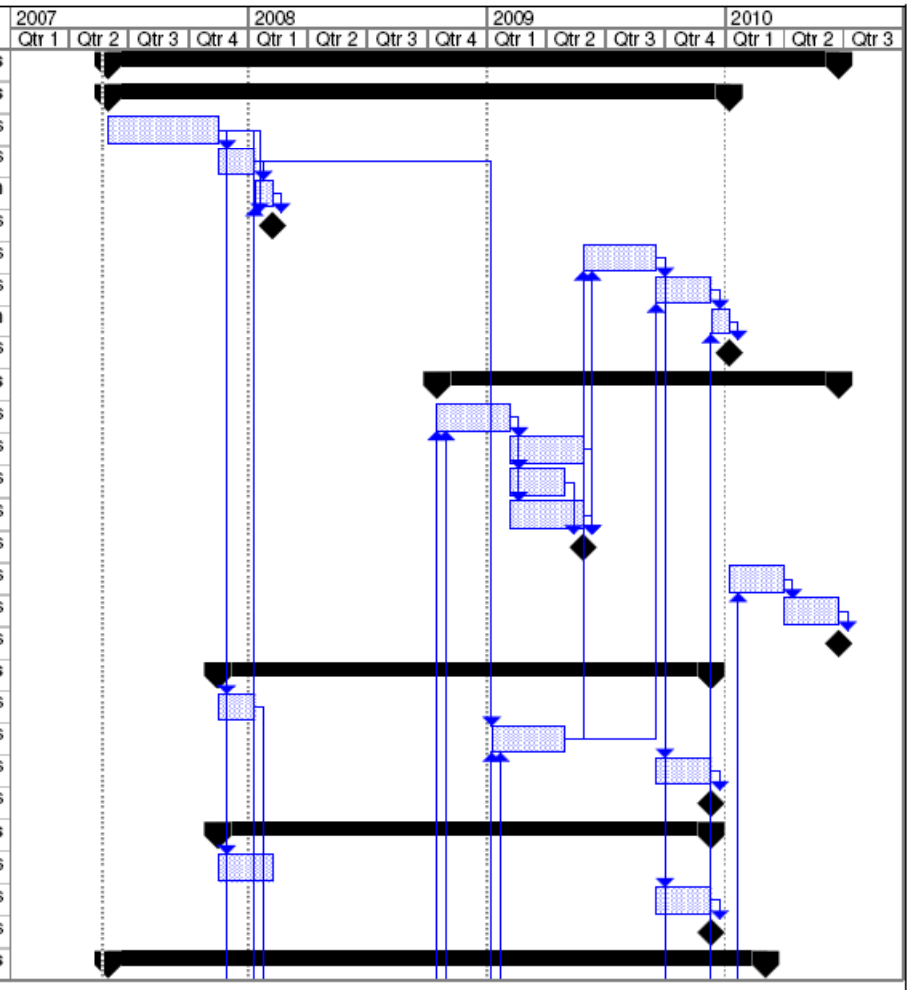

Today's schedule

9:00 – 10:30	Question-and-answer, and open discussion with members of the EDR Task Force. Brief overview of resources and activities.
11:00 – 12:30	Overview of damping rings R&D Plan.
14:00 – 15:30	Develop a plan for damping rings studies in the EDR phase: – **Agree on a list of tasks and deliverables.** – **Make a first pass on resource requirements and schedule.**
16:00 – 18:00	Continue developing a plan for damping rings studies. – **Identify potential investigators;** – **Identify potential Work Packages.** Write up results of the working group discussions. – **Include a statement of the assumptions made (which will be "risks" in the plan for the engineering design phase).**

Resources (possibly) available

	2006		2007		2008		2009		2010	
	FTE	M&S	FTE	M&S	FTE	M&S	FTE	M&S	FTE	M&S
2 Beam Dynamics Studies	**21.9**	**464.0**	**28.6**	**539.2**	**20.4**	**498.8**	**22.9**	**606.5**	**3.5**	**15.0**
2.1 Single-Particle Dynamics	2.7	14.0	5.8	125.4	6.0	63.4	8.6	89.8	1.8	7.5
2.1.1 Lattice Design	*1.3*	*8.0*	*2.1*	*13.1*	*2.1*	*15.4*	*2.8*	*17.7*	*1.8*	*7.5*
2.1.2 Acceptance	*0.4*	*3.0*	*1.3*	*67.3*	*0.8*	*9.6*	*1.3*	*14.8*		
2.1.3 Optics Measurement and Correction	*0.3*	*3.0*	*0.1*	*3.8*	*0.1*	*3.8*	*0.7*	*15.8*		
2.1.4 Low-Emittance Tuning	*0.8*	*0.0*	*2.4*	*41.2*	*3.1*	*34.7*	*3.8*	*41.6*		
2.2 Multi-Particle Dynamics	18.2	444.0	21.8	382.8	13.9	428.7	14.0	510.7	1.8	7.5
2.2.1 Single-Bunch Impedance	*0.5*	*1.5*	*1.9*	*27.2*	*1.4*	*16.2*	*2.0*	*21.4*		
2.2.2 Multi-Bunch Impedance	*0.5*	*0.0*	*0.8*	*13.5*	*0.9*	*13.8*	*1.1*	*16.3*		
2.2.3 Electron Cloud	*8.3*	*283.4*	*9.7*	*202.2*	*3.5*	*251.2*	*5.5*	*324.6*		
2.2.4 Ion Effects	*4.6*	*54.6*	*4.9*	*72.1*	*3.9*	*88.5*	*3.9*	*124.0*	*1.8*	*7.5*
2.2.5 Other Collective Effects	*4.4*	*104.5*	*4.4*	*67.9*	*4.2*	*59.1*	*1.5*	*24.3*		
2.3 Integrated Dynamics Studies	1.0	6.0	1.0	31.0	0.5	6.6	0.4	6.0		
2.3.1 Integrated Dynamics Studies	*1.0*	*6.0*	*1.0*	*31.0*	*0.5*	*6.6*	*0.4*	*6.0*		

Resources (possibly) available

	2006		2007		2008		2009		2010	
	FTE	M&S	FTE	M&S	FTE	M&S	FTE	M&S	FTE	M&S
3 Technical Subsystem or Component Developm	**13.3**	**610.9**	**16.0**	**531.6**	**10.1**	**607.2**	**12.9**	**1202.7**		
3.1 Vacuum System	1.1	0.0	3.0	40.2	2.1	214.3	2.4	314.6		
3.1.1 Vacuum Chamber	*1.1*	*0.0*	*3.0*	*40.2*	*2.1*	*214.3*	*2.4*	*314.6*		
3.2 Permanent Magnets	0.7	1.3								
3.2.6 Damping Wiggler - PM	*0.7*	*1.3*								
3.3 Normal-Conducting Magnets							0.9	11.2		
3.3.3 Quadrupoles							*0.3*	*7.2*		
3.3.8 Magnet Power System							*0.6*	*4.0*		
3.4 Superconducting Magnets	0.9	0.0					0.8	54.0		
3.4.6 Damping Wiggler - SC	*0.9*	*0.0*					*0.8*	*54.0*		
3.5 Kickers	6.7	396.0	5.7	171.6	4.3	226.6	3.9	313.3		
3.5.1 Fast Injection/Extraction Kickers	*6.7*	*396.0*	*5.7*	*171.6*	*4.3*	*226.6*	*3.9*	*313.3*		

Resources (possibly) available

	2006		2007		2008		2009		2010	
	FTE	M&S	FTE	M&S	FTE	M&S	FTE	M&S	FTE	M&S
3.6 RF System	0.2	3.6	1.0	22.0			0.7	25.4		
3.6.1 RF System	*0.2*	*3.6*								
3.6.4 RF Controls (Low-Level RF)			*1.0*	*22.0*			*0.7*	*25.4*		
3.7 Instrumentation and Diagnostics	1.4	60.0	1.8	66.0	2.2	129.6	2.4	409.1		
3.7.2 Beam Position and Phase Diagnostics	*1.2*	*40.0*	*1.2*	*40.0*	*1.4*	*101.2*	*0.7*	*275.4*		
3.7.3 Beam Size and Bunch Length Diagnos	*0.1*	*20.0*	*0.1*	*17.0*	*0.8*	*28.5*	*1.4*	*105.7*		
3.7.5 Other Instrumentation and Diagnostics	*0.1*	*0.0*	*0.5*	*9.0*			*0.3*	*28.0*		
3.8 Feedback Systems	2.4	150.0	4.4	212.0	1.3	20.0	0.8	17.9		
3.8.1 Bunch-by-Bunch Feedback Systems	*2.4*	*150.0*	*4.4*	*212.0*	*1.3*	*20.0*	*0.8*	*17.9*		
3.13 Multiple Systems			0.2	19.8	0.3	16.6	1.0	57.3		
3.13.1 Systems Integration			*0.2*	*19.8*	*0.3*	*16.6*	*1.0*	*57.3*		

Resources (possibly) available

4 Experimental Studies and Test Facilities	**7.4**	**219.1**	**10.3**	**334.0**	**6.7**	**251.1**	**5.1**	**154.0**	**4.5**	**120.0**
4.1 Experimental Studies	3.0	147.0	4.9	177.0	5.0	170.0	4.5	120.0	4.5	120.0
4.1.1 Experimental Studies	*3.0*	*147.0*	*4.9*	*177.0*	*5.0*	*170.0*	*4.5*	*120.0*	*4.5*	*120.0*
4.2 Test Facility Development	4.4	72.1	5.4	157.0	1.7	81.1	0.6	34.0		
4.2.1 Test Facility Development	*4.4*	*72.1*	*5.4*	*157.0*	*1.7*	*81.1*	*0.6*	*34.0*		

Questions for the EDR Task Force

1. What guidelines can we use for identifying potential work packages?

   For example: type of activity and scope, number of participants, location of participants…

   Is "optics and beam dynamics" a work package, or are "lattice design", "impedance modelling" etc. separate work packages? How do we decide?

2. To what extent should work packages be arranged by area system or by technical/global system?

   For example: is "damping ring magnet design" a work package? or is "magnet design" a work package, including design of the damping ring magnets?