A Sample Project Schedule for Cryomodule Design

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September 14, 2007

Cryomodule Design Schedule

- This schedule looks at the cryomodule design process up until a “Ready for Large Scale Production” date
- It creates logical links between tasks and does not impose an “end date”
- Type V becomes ILC-1 (first ILC prototype)
- Think of this as a “tool to help make decisions”, dates and dependencies can change
- Initial Criteria
  - **Include feedback from XFEL, STF, ILCTA into design process**
  - **Allow for a parallel ACD design effort**
  - **Down select to get the best overall design for ILC_1**
  - **Cavity shape decision should be as late as possible and be driven by measured performance (data from test systems)**
  - **Provide for CM Pre-series production (same time est. as XFEL)**

Critical Links

- Define the dates when test results are available
  - **Get schedules for XFEL, STF, ILCTA (Hans, Norihito, Harry)**
  - **These dates DRIVE the schedule (VERY IMPORTANT)**
    - **Building, installing & testing cryomodules takes time**
  - **Important to DEFINE level of tests needed (in a CM operating in a string or just a bench test) => How do you define reliability?**

Realistically:

- FLASH & XFEL will validate Type III+ design
- ILCTA will validate Type IV (low statistics)
- ACD design will be validated at STF-1 & STF-2 (low statistics)

- Type V (ILC_1) Design takes dependencies from
  - **Type IV Design Complete**
  - **Some portion of XFEL Pre-Series Complete**
  - **ILCTA Results Available**
  - **STF-1 Results Available**

Critical Links (Cont'd)

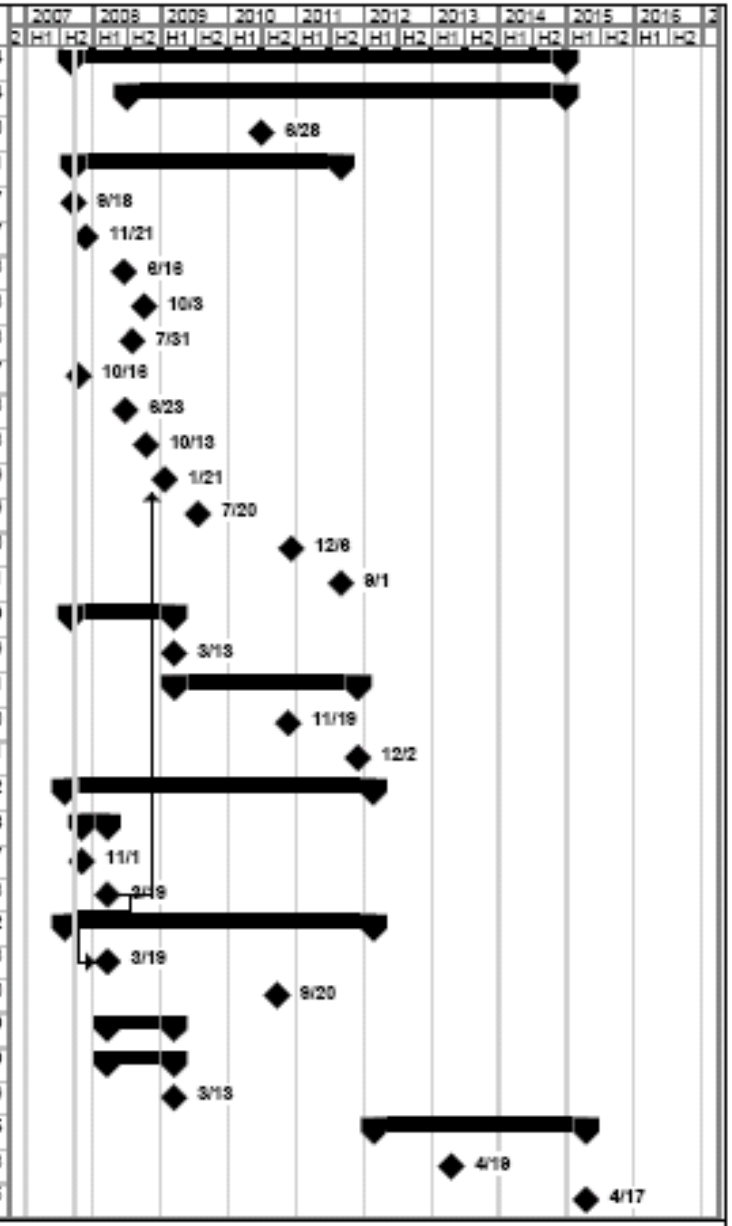
- Cavity Shape Decision
  - **Allow different shapes in CM design model (so decision can be as late as possible)**
  - **Make cavity shape decision when data available: XFEL Pre-Series complete + STF-2 Results available and ILCTA has a full Type IV+ RF Unit**
  - **DRIVES THE "READY DATE" VERY LATE!**
  - **(See later slide for an alternative)**
- Allow ACD Design to go on in parallel
  - **Use KEK STF schedule information for this part of schedule**
- At the very end, move forward with only one design that incorporates best of all worlds

Critical Links (Cont'd)

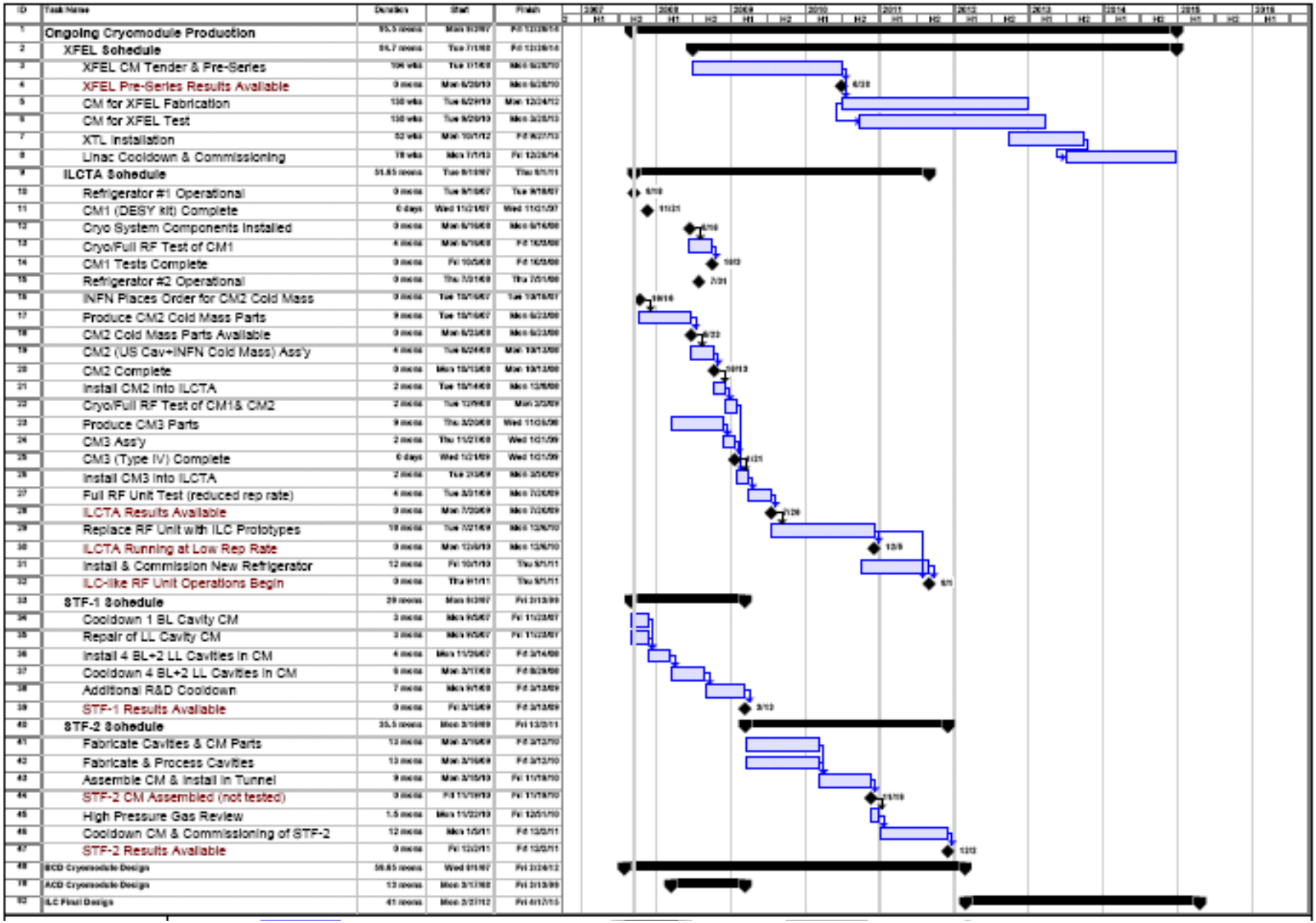
- Industrialization of the Type V design starts as soon as Type IV design is complete
- Pipe size decision & cryogenic design goes quickly
- Able to make decision on Large Grain/Small Grain independent of cavity shape
- If there was considerable "float in the schedule" allow that task more time => people are busy so things take longer
- Many tasks go in parallel meaning lots of people are needed and international participation is required
  - **Must get people to take responsibility for parts of the design and for delivering an evaluation for final decision on time**
    - **Evaluation = specification of parameters + quantification of all alternatives + criteria for validation + decision tree**

Milestone Dates

ID	Task Name	Duration	Start	Finish
1	Ongoing Cryomodule Production	95.6 mons	Mon 8/3/07	Fri 12/26/14
2	XFEL Schedule	84.7 mons	Tue 7/1/08	Fri 12/26/14
4	XFEL Pre-Series Results Available	0 mons	Mon 6/28/10	Mon 6/28/10
9	ILCTA Schedule	61.86 mons	Tue 9/18/07	Thu 9/1/11
10	Refrigerator #1 Operational	0 mons	Tue 9/18/07	Tue 9/18/07
11	CM1 (DESY kit) Complete	0 days	Wed 11/21/07	Wed 11/21/07
12	Cryo System Components Installed	0 mons	Mon 6/16/08	Mon 6/16/08
14	CM1 Tests Complete	0 mons	Fri 10/3/08	Fri 10/3/08
15	Refrigerator #2 Operational	0 mons	Thu 7/31/08	Thu 7/31/08
16	INFN Places Order for CM2 Cold Mass	0 mons	Tue 10/16/07	Tue 10/16/07
18	CM2 Cold Mass Parts Available	0 mons	Mon 6/23/08	Mon 6/23/08
20	CM2 Complete	0 mons	Mon 10/13/08	Mon 10/13/08
25	CM3 (Type IV) Complete	0 days	Wed 1/21/09	Wed 1/21/09
28	ILCTA Results Available	0 mons	Mon 7/20/09	Mon 7/20/09
30	ILCTA Running at Low Rep Rate	0 mons	Mon 12/6/10	Mon 12/6/10
32	ILC-like RF Unit Operations Begin	0 mons	Thu 9/1/11	Thu 9/1/11
33	STF-1 Schedule	20 mons	Mon 8/3/07	Fri 3/13/09
39	STF-1 Results Available	0 mons	Fri 3/13/09	Fri 3/13/09
40	STF-2 Schedule	35.6 mons	Mon 3/16/09	Fri 12/2/11
44	STF-2 CM Assembled (not tested)	0 mons	Fri 11/19/10	Fri 11/19/10
47	STF-2 Results Available	0 mons	Fri 12/2/11	Fri 12/2/11
48	BCD Cryomodule Design	68.86 mons	Wed 8/1/07	Fri 2/24/12
49	Type IV Design	6 mons	Thu 11/1/07	Wed 3/19/08
50	Initial Drafting Pkges Complete	0 mons	Thu 11/1/07	Thu 11/1/07
55	Type IV Design Complete	0 days	Wed 3/19/08	Wed 3/19/08
56	Type V (ILC_1) Design Decisions	68.86 mons	Wed 8/1/07	Fri 2/24/12
57	Begin Type V (ILC_1) Design	0 days	Wed 3/19/08	Wed 3/19/08
77	Type V (ILC_1) Design Complete (w/o Cav Shape)	0 days	Mon 9/20/10	Mon 9/20/10
78	ACD Cryomodule Design	13 mons	Mon 3/17/08	Fri 3/13/09
79	Type ACD Design	13 mons	Mon 3/17/08	Fri 3/13/09
81	Type ACD Design Complete	0 mons	Fri 3/13/09	Fri 3/13/09
82	ILC Final Design	41 mons	Mon 2/27/12	Fri 4/17/15
87	ILC_1 CM Accepted as new Baseline	0 mons	Fri 4/19/13	Fri 4/19/13
89	Ready for Large Scale Production of ILC CM	0 mons	Fri 4/17/15	Fri 4/17/15

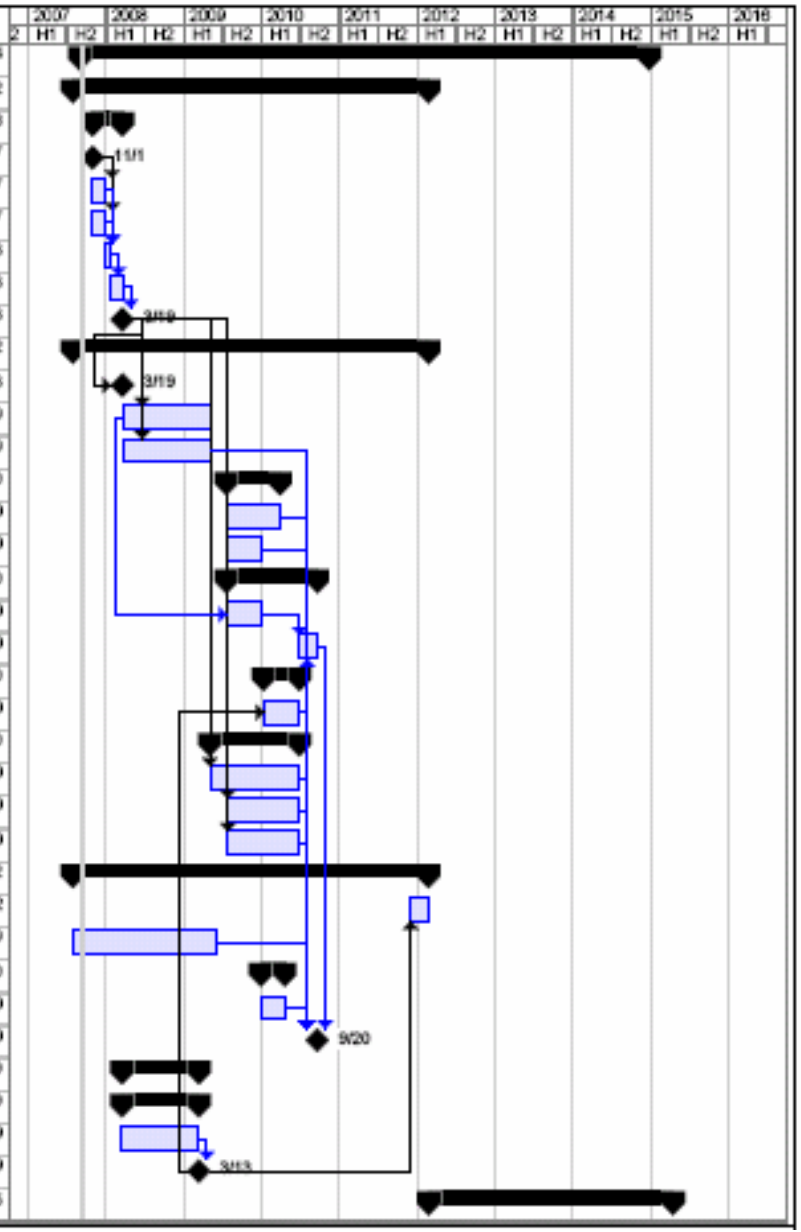


XFEL, ILCTA, STF



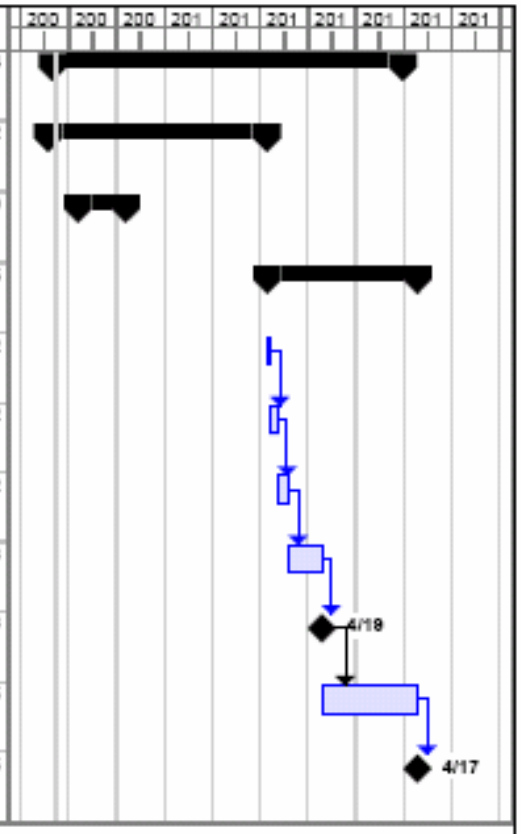
Design Work

ID	Task Name	Duration	Start	Finish
1	Ongoing Cryomodule Production	95.5 mons	Mon 9/3/07	Fri 12/26/14
48	BCD Cryomodule Design	59.65 mons	Wed 8/1/07	Fri 2/24/12
49	Type IV Design	5 mons	Thu 11/1/07	Wed 3/19/08
50	Initial Drafting Pkges Complete	0 mons	Thu 11/1/07	Thu 11/1/07
51	Bid & Select Vendors for Fabrication	2 mons	Thu 11/1/07	Wed 12/26/07
52	Finish Detail Drawings	2 mons	Thu 11/1/07	Wed 12/26/07
53	Final 3D Model Completed	1 mon	Thu 12/27/07	Wed 1/23/08
54	Final 2D Drawings Completed	2 mons	Thu 1/24/08	Wed 3/19/08
55	Type IV Design Complete	0 days	Wed 3/19/08	Wed 3/19/08
56	Type V (ILC_1) Design Decisions	59.65 mons	Wed 8/1/07	Fri 2/24/12
57	Begin Type V (ILC_1) Design	0 days	Wed 3/19/08	Wed 3/19/08
58	Industrialization & DFM of Type IV	15 mons	Thu 3/20/08	Wed 5/13/09
59	Pipe Sizes & Cooling Design	15 mons	Thu 3/20/08	Wed 5/13/09
60	Quad Magnet & BPM Design	9 mons	Tue 7/21/09	Mon 3/29/10
61	Quad Position & Design.	9 mons	Tue 7/21/09	Mon 3/29/10
62	BPM Decision (data - FLASH, ATF, ILCTA'	6 mons	Tue 7/21/09	Mon 1/4/10
63	Helium Vessel Design	15.25 mons	Tue 7/21/09	Mon 9/20/10
64	Ti versus SS Decision	6 mons	Tue 7/21/09	Mon 1/4/10
65	Incorporate Final Tuner	3 mons	Tue 6/29/10	Mon 9/20/10
66	Tuner Design	6 mons	Tue 1/12/10	Mon 6/28/10
67	Evaluate Blade, Ball Screw or Sliding Jack	6 mons	Tue 1/12/10	Mon 6/28/10
68	Coupler Design	15 mons	Tue 5/5/09	Mon 6/28/10
69	Evaluate KEK & Orsay Couplers + DFM	15 mons	Tue 5/5/09	Mon 6/28/10
70	Instrumentaion & Alignment Design	12 mons	Tue 7/28/09	Mon 6/28/10
71	Supports & Transportation Design	12 mons	Tue 7/28/09	Mon 6/28/10
72	Cavity Design	59.65 mons	Wed 8/1/07	Fri 2/24/12
73	Cavity Shape Decision	3 mons	Mon 12/5/11	Fri 2/24/12
74	Grain Size Decision	24 mons	Wed 8/1/07	Tue 8/2/09
75	Magnetic Shielding Design	4 mons	Tue 12/29/09	Mon 4/19/10
76	Inside/Outside Decision	4 mons	Tue 12/29/09	Mon 4/19/10
77	Type V (ILC_1) Design Complete (w/o Cav Sh	0 days	Mon 9/20/10	Mon 9/20/10
78	ACD Cryomodule Design	13 mons	Mon 3/17/08	Fri 3/13/09
79	Type ACD Design	13 mons	Mon 3/17/08	Fri 3/13/09
80	Complete Type ACD CM Design	13 mons	Mon 3/17/08	Fri 3/13/09
81	Type ACD Design Complete	0 mons	Fri 3/13/09	Fri 3/13/09
82	ILC Final Design	41 mons	Mon 2/27/12	Fri 4/17/15



End Game

ID	Task Name	Duration	Start	Finish
1	**Ongoing Cryomodule Production**	86.6 mons	Mon 8/3/07	Fri 12/26/14
48	**BCD Cryomodule Design**	58.66 mons	Wed 8/1/07	Fri 2/24/12
78	**ACD Cryomodule Design**	13 mons	Mon 3/17/08	Fri 3/13/09
82	**ILC Final Design**	41 mons	Mon 2/27/12	Fri 4/17/15
83	Review Existing Designs	1 mon	Mon 2/27/12	Fri 3/23/12
84	Finalize ILC Design Choices	2 mons	Mon 3/26/12	Fri 5/18/12
85	Complete Drawings for ILC_1 CM	3 mons	Mon 5/21/12	Fri 8/10/12
86	Build 3 exact prototypes of ILC_1 CM (international)	9 mons	Mon 8/13/12	Fri 4/19/13
87	**ILC_1 CM Accepted as new Baseline**	0 mons	Fri 4/19/13	Fri 4/19/13
88	ILC_1 CM Tender & Pre-Series	104 wks	Mon 4/22/13	Fri 4/17/15
89	**Ready for Large Scale Production of ILC CM**	0 mons	Fri 4/17/15	Fri 4/17/15



Results and Alternatives

- If you follow the dependencies as described:
- Milestones

ILC_1 CM Accepted as Baseline	**4/19/13**
Ready for Large Scale Production of ILC CM	**4/17/15**

- If you allow the dependencies change:
  - **Decide on a cavity shape after STF-1 results available + STF-2 CM built but not tested + ILCTA running (but NOT new refrigerator => low rep rate) + Type ACD design complete**
- Milestones

ILC_1 CM Accepted as Baseline	**4/23/12**
Ready for Large Scale Production of ILC CM	**4/21/14**

Summary

- What has been presented is just a very rough look at the cryomodule design process up to “Ready for Large Scale Production of ILC CM”
- Take the results as an indication of one scenario
- Changing the dependencies or durations will make the results very different
- Next step is to impose an end date and see how fast things have to go and what dependencies need to be dropped to meet it
- Very important to define the criteria for validation of a new design (upfront) => up to this Technical Group & PMs
  - **# of parts fabricated and tested?**
  - **Hours of bench test / simulated behavior (lifetime test)?**
  - **Requirement to be tested in # of cryomodules?**
  - **Requirement for test with beam?**