ILC FY2005
Electrical R&D Programs
Status Reports Rev. April 11, 2005

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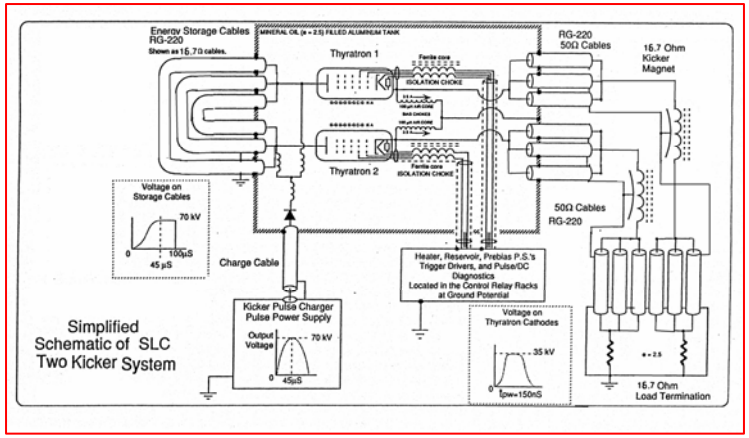
Sang Nam – PLS, Korea

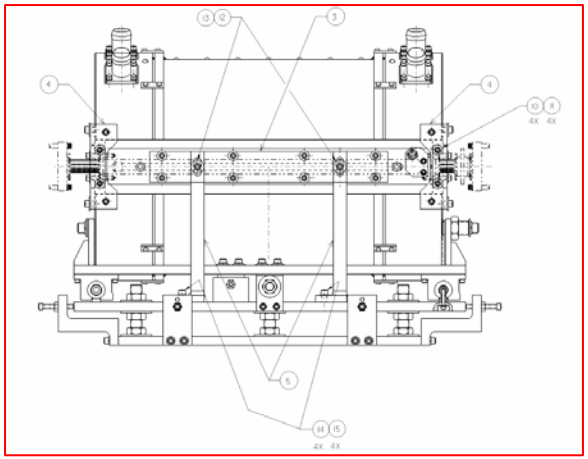
FY2005 Task Summary

1. HA ILC Kicker Development
   a. ATF Extraction Prototype & Testing (Cassel et al)
   b. ILC Induction Prototype & Switch Testing (Cook, Pappas)
2. HA Modulator Evaluation & Development
   a. Evaluations, SNS procurement, operation (Cassel)
   b. New Marx Modulator Development (Leyh)
3. FNAL Modulator IGBT Switch (Cassel/Nguyen)
4. HA Modular Power Supply Development (Bellomo)
5. Diagnostic Processor for Power Systems (Bellomo/Nam, Pohang)
6. Instrumentation Standards for HA Systems (Larsen/Downing)
7. Complete 2-Pack & Decommission 8-Pack (Cassel et al)

1. HA ILC Kicker Development
a. ATF Prototype & Testing
R. Cassel et al

- Use spare north damping ring pulser & NLCTA kicker magnet. Conversion needed:
  - Two outputs 16.7 ohms
  - Modify pulse charger and isolation core
  - Modify shock line and loads

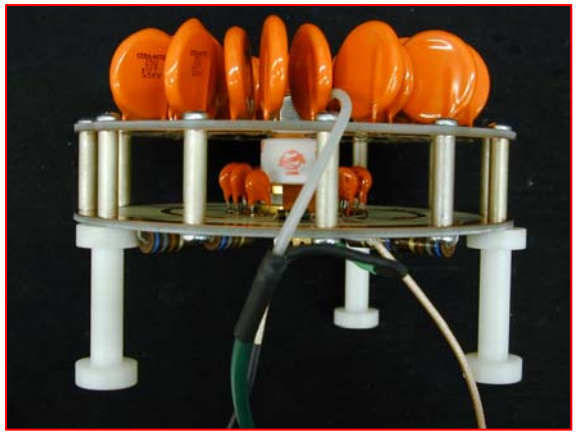


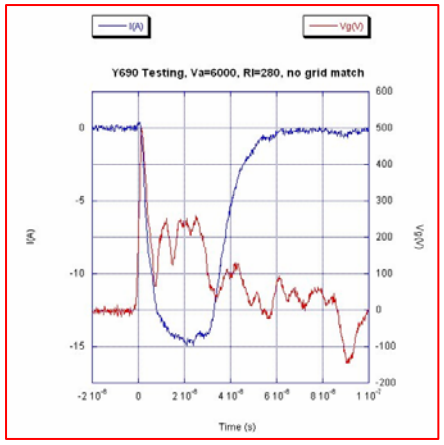


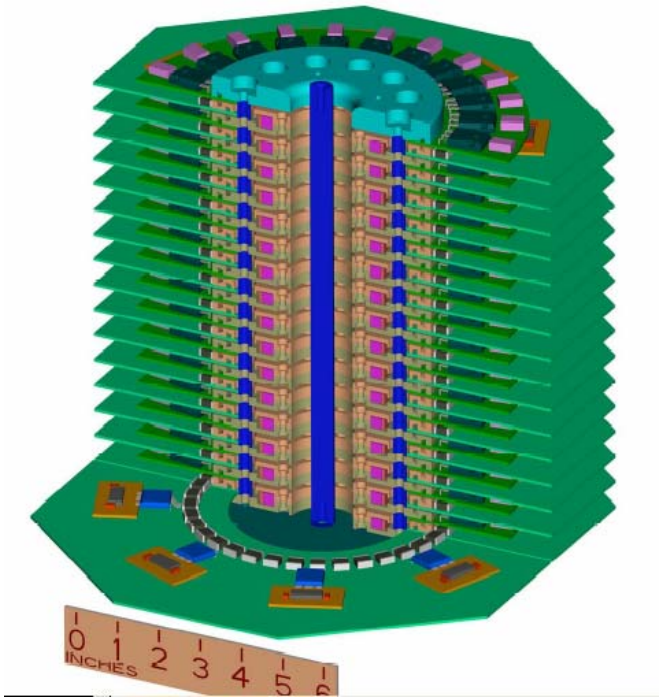
- Status:
  - Kicker magnets high pot tested & under modification
  - Spare pulser operational, replacement of thyratrons underway
  - Most parts fabricated for converting pulser to three cables

1. HA ILC Kicker Development
b. Induction Prototype & Testing
LLNL & SLAC

- LLNL induction kicker for ATF progress (Cook, Brooksby)
  - Ready for test in May at ATF on strip-line
  - Mechanical parts fabricated
  - Driver boards fab'd & cores ordered





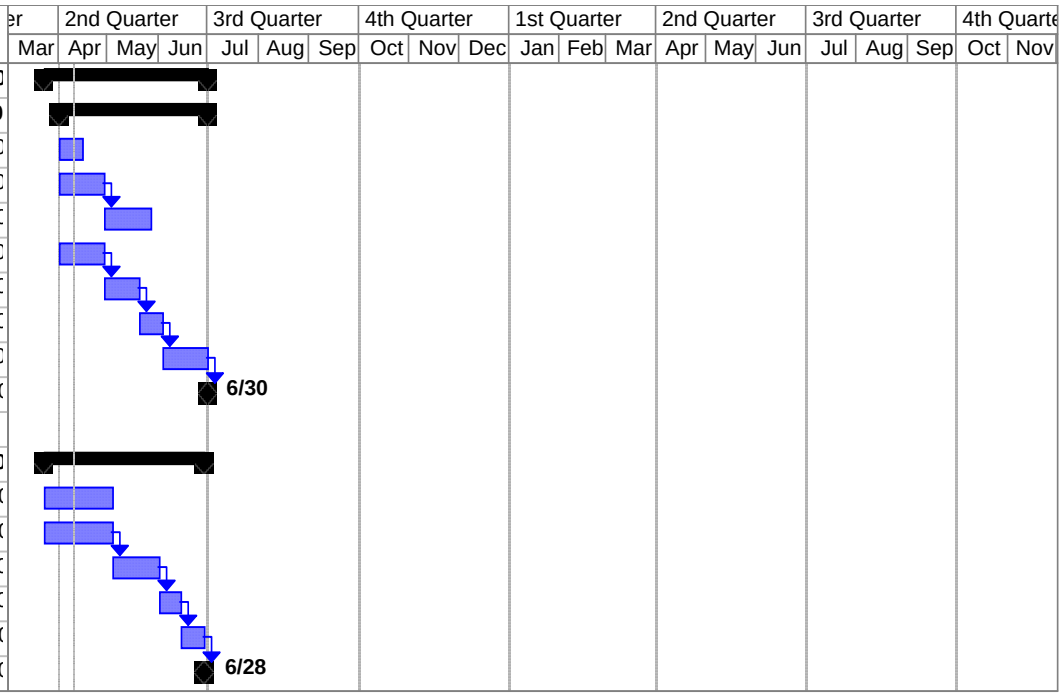


- Experimental vacuum tube switch being evaluated for Tr, Tf at LLNL by C. Pappas

- Other possible kicker pulsers being explored

1a&b. Schedule

ID	Task Name	Duration	Start
111	**HA Kicker Development**	**72 days**	**Wed 3/23/0**
112	**ATF Extraction Proto**	**65 days**	**Fri 4/1/0**
113	Convert design kickers	11 days	Fri 4/1/0
114	Fabricate mods	20 day	Fri 4/1/0
115	Assemble	20 day	Fri 4/29/0
116	Modify Modulator	20 day	Fri 4/1/0
117	Test mod	15 day	Fri 4/29/0
118	System assy	10 day	Fri 5/20/0
119	Test	20 day	Fri 6/3/0
120	Ship to KEK	0 day	Thu 6/30/0
121			
122	**LLNL Induction Proto**	**70 day**	**Wed 3/23/0**
123	Complete stack	30 day	Wed 3/23/0
124	Complete driver boards	30 day	Wed 3/23/0
125	Test driver brds	20 day	Wed 5/4/0
126	Assemble	10 day	Wed 6/1/0
127	Test cmplt unit	10 day	Wed 6/15/0
128	Ship to KEK	0 day	Tue 6/28/0

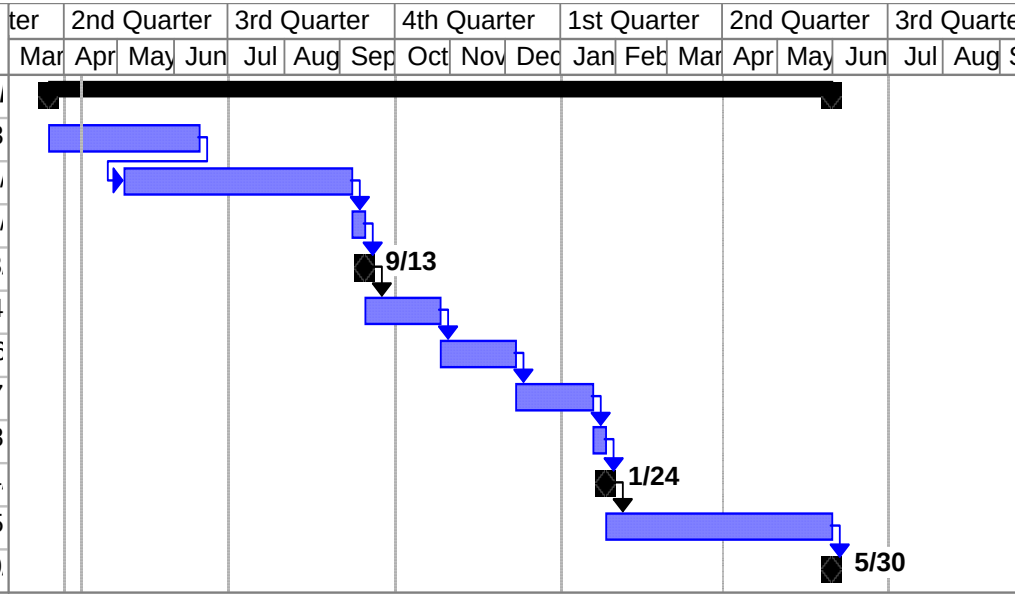


2. HA Modulator Evaluation & Development
a. Evaluations

- Overall goal is *HA Systems Evaluation*
  - General goals document written early FY05
  - Different topologies listed w/ potential advantages:
    - Transmit at HV rather than LV with step-up Xfmr
    - Segmented stack design for fail-soft (higher MTBF)
    - Parallel tunnels for unrestricted access (lower MTTR)
  - Suggest possible future workshop on this topic

2a. Evaluations Plan

ID	Task Name	Duration	Start
130	**HA Modulator Evaluation**	**310 day**	**Wed 3/23/**
131	Establish collaborators	60 day	Wed 3/23
132	White Paper on Study Goals	90 day	Wed 5/4/
133	1st Workshop	5 day	Wed 9/7/
134	Establish & assign tasks	0 day	Tue 9/13
135	Establish HA models	30 day	Wed 9/14
136	Analyze reliability	30 day	Wed 10/26
137	Analyze Availability	30 day	Wed 12/7
138	2nd Workshop	5 day	Wed 1/18
139	Report outline, assignmnts	0 day	Tue 1/24
140	Draft Report	90 day	Wed 1/25
141	Final Draft	0 day	Tue 5/30

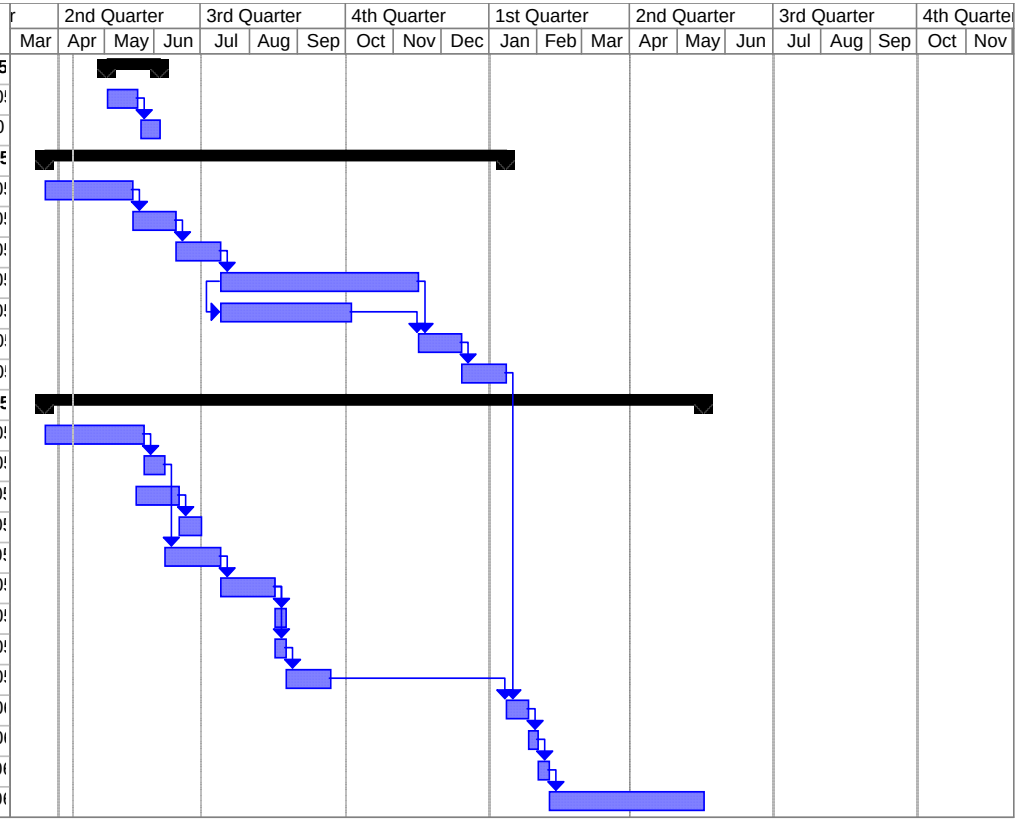


2. HA Modulator Evaluation & Development
a. Evaluations – Cont'd

- Sub-goal is to supply RF source for L-Band testing (SNS Modulator)
- Cassel suggested possibility of "loaner" unit
- Adolphsen organized workshop to learn SNS design
- MOA Agreement in progress to ship test unit from LANL/SNS
  - Package and ship to SLAC within a month
  - Make upgrades per SNS recommendations
  - Obtain technical help from SNS as needed for upgrade
  - Have Anderson and/or Reass witness testing at ESB
  - Goal is full operation of source 5MW tube by end CY2005
  - Further modifications needed for 10MW tube – not scheduled

2a. SNS Schedule

ID	Task Name	Duration	Start
85	**Utilities**	**25 days**	**Mon 5/2/05**
86	Prepare site	15 days	Mon 5/2/0
87	Water plumbing to new location	10 days	Mon 5/23/0
88	**LLRF System**	**210 days**	**Wed 3/23/0**
89	Design	40 days	Wed 3/23/0
90	Build protoypes	20 days	Wed 5/18/0
91	Test in lab	20 days	Wed 6/15/0
92	Procure mfg parts	90 days	Wed 7/13/0
93	Buy instruments	60 days	Wed 7/13/0
94	Assemble in lab	20 days	Wed 11/16/0
95	Test in lab	20 days	Wed 12/14/0
96	**SNS Modulator Procure & Install**	**300 days?**	**Wed 3/23/0**
97	Delivery from LANL to ESB	45 days	Wed 3/23/0
98	Unpack & situate	10 days	Wed 5/25/0
99	Modify 8-Pack Pow Supp	20 days	Fri 5/20/0
100	Test 8-Pack PS Res Load	10 days	Fri 6/17/0
101	Modifications	25 days	Wed 6/8/0
102	Install TH2095 Klystron, magnet P	25 days	Wed 7/13/0
103	Connect DC Power	5 days	Wed 8/17/0
104	Connect water	5 days	Wed 8/17/0
105	Power tests Water Load	20 days	Wed 8/24/0
106	Install LLRF	10 days	Wed 1/11/0
107	Connect TH2095 Klystron	5 days	Wed 1/25/0
108	Test LLRF	5 days	Wed 2/1/0
109	Power tests klystron load	70 days?	Wed 2/8/0



2. HA Modulator Evaluation & Development
b. New Marx Modulator Development – G. Leyh

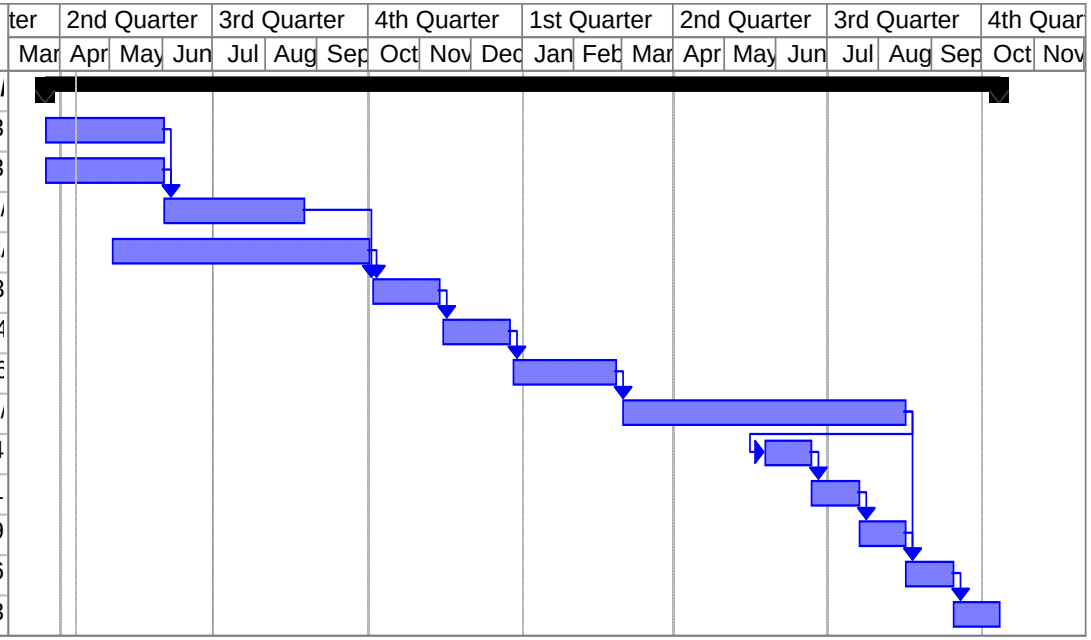
- Design, build, evaluate the 12kV switch. Determine speed, ruggedness and maximum switching rate.
- Evaluate individual cell components for suitability.
- Assemble and test a complete cell. Debug, identify hotspots, test under fault scenarios.
- Design and build the 12kV charging buck regulator, integrate into completed cell.
- Develop the active control system for the staged cells.
- Build a 4-cell stack, test under fault scenarios.
- Develop a complete Marx modulator. Evaluate performance using an L-Band klystron.

2.b. Marx Development Approach

- Start with the highest technical risk items – 12kV switch, energy storage capacitors.
- Assemble, test, debug a complete cell.
- Work towards developing a ‘short stack.’
- Explore stack-level fault scenarios.
- Design, test the active regulation control loop.
- Develop complete modulator, control system, RF station. Integrate with L-Band klystron.

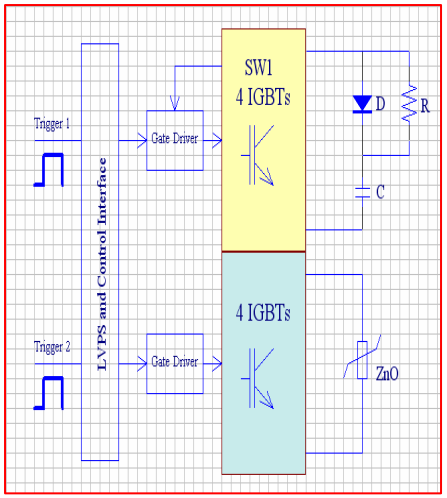
2b. Marx Schedule

ID	Task Name	Duration	Start
143	**HA Marx Modulator Developmen**	**405 day**	**Wed 3/23/**
144	Design, test 12 kV module	50 day	Wed 3/23
145	Evaluate cell components	50 day	Wed 3/23
146	Integrate & Test 12kV cell	60 day	Wed 6/1/
147	Controls Design, proto	110 day	Mon 5/2/
148	Asemble short stack	30 day	Mon 10/3
149	Integrate controls	30 day	Mon 11/14
150	Stack fault testing	45 day	Mon 12/26
151	Construct full stack modules	120 day	Wed 3/1/
152	Assemble B15	20 day	Wed 5/24
153	Integrate controls	20 day	Wed 6/21
154	Connect utilities	20 day	Wed 7/19
155	Test into dummy load	20 day	Wed 8/16
156	Test into klystron	20 day	Wed 9/13

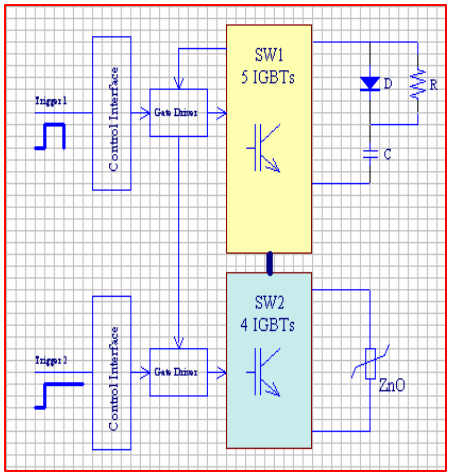


3. IGBT Switch Array for FNAL Modulator Cassel/Nguyen

- Fermi ask SLAC to provide the switch for their ILC type long pulse modulator.
- Cassel et al evaluated proposal and suggested an alternative
- Fermi modified the requirement to increase the MTBF which would double the size and cost of the switch.
- New technical and cost issues not yet resolved.



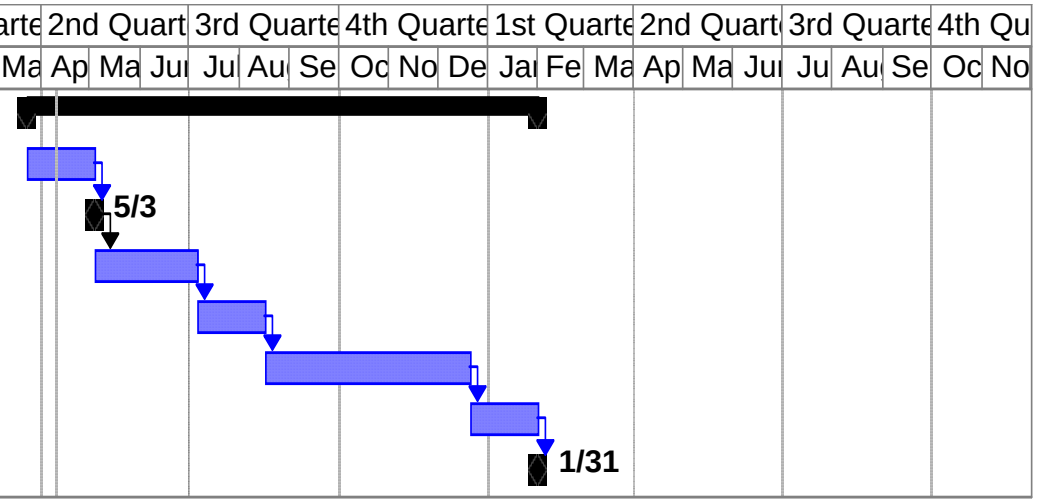
Original Fermi proposal



SLAC proposal

3. IGBT Switch for FNAL

ID	Task Name	Duratic	Start
158	**FNAL IGBT Switch Array**	**225 d**	**Wed 3/2**
159	Design	30 da	Wed 3/
160	Design Review	0 da	Tue 5/
161	Fab proto section	45 da	Wed 5/
162	Test proto	30 da	Wed 7/
163	Fab full switch	90 da	Wed 8/
164	Test	30 da	Wed 12/
165	Deliver	0 da	Tue 1/3

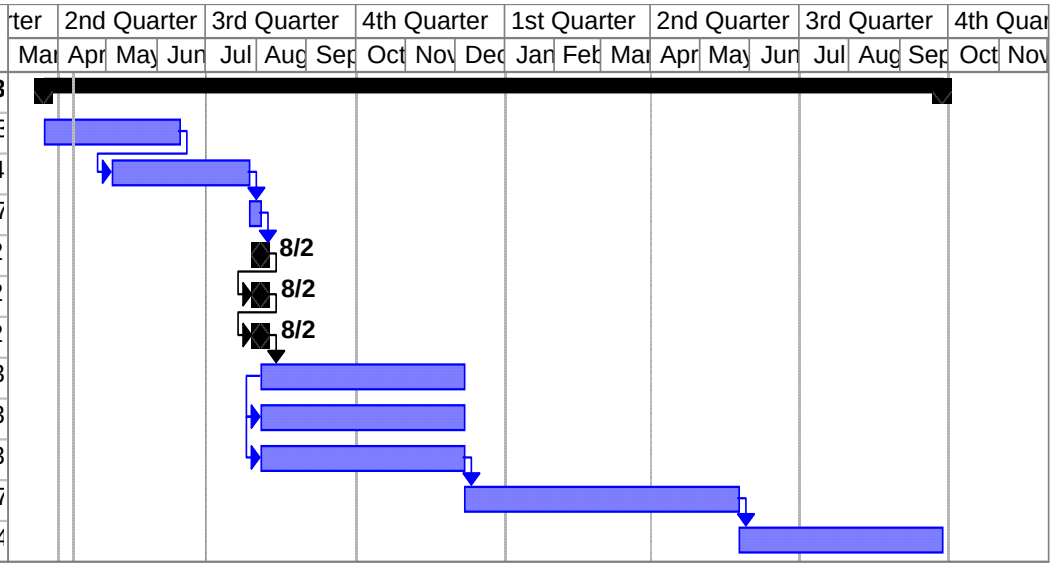


4. HA Modular Power Supply Development - Bellomo

- Goal is to continue earlier studies in 1999-2001 focused on HW power supply strategies
  - Multiple section topologies (higher MTBF)
  - Hot swappable replacement (lower MTTR)
  - 1/N Quick replacement or automated switchover for large bulk string supplies
- Revive SBIR connections to advance modular prototypes in collaboration with industry
- Calculate Availability for various models to aim for overall machine Availability ➡ 1.

4. HA Modular PS Schedule

ID	Task Name	Duration	Start
167	**HA Modular Power Supply Dev**	**395 da**	**Wed 3/23**
168	Recruit Collaborators incl Indu	60 da	Wed 3/23
169	White paper Define HA study	60 da	Wed 5/4
170	1st Workshop	5 da	Wed 7/27
171	Write SBIR solicitations	0 da	Tue 8/2
172	Define HA Conceptual Models	0 da	Tue 8/2
173	Assign tasks	0 da	Tue 8/2
174	Analyze reliability	90 da	Wed 8/3
175	Analyze Availability	90 da	Wed 8/3
176	Specify, Order industrial proto	90 da	Wed 8/3
177	Produce protos	120 da	Wed 12/7
178	Evaluate at multiple locations	90 da	Wed 5/24



5. Diagnostic Processor for Power Systems – Bellomo, Nam (PLS)

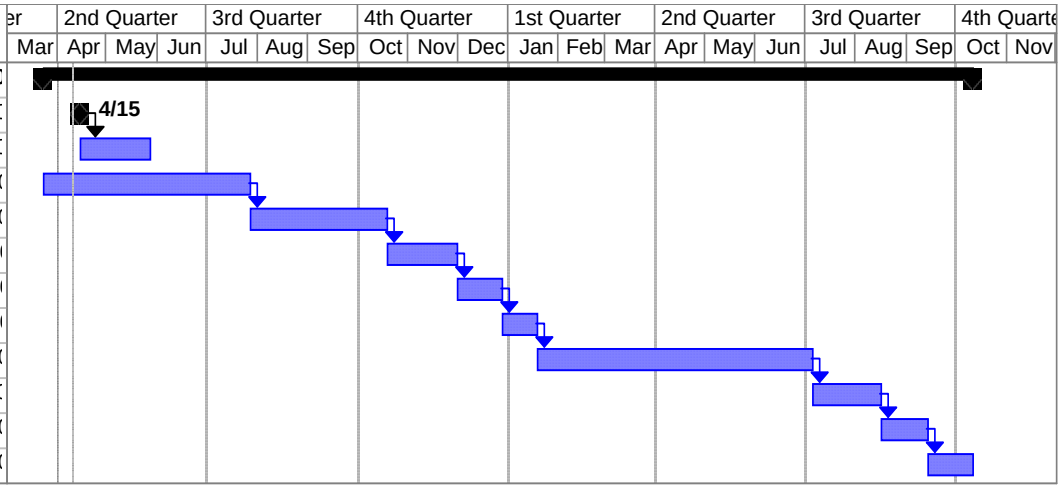
- Background:
  - Work started in FY04 to develop diagnostic controller for new 2-Pack
  - MOU set up with Pohang to collaborate on work via TV meetings, supported by Dr. S. Nam, head Accelerator Dept
- Specification further developed to make useful for variety of diagnostic applications in Modulators, DC supplies, fast kickers, etc.
  - Designed for modular systems
  - Imbed very small board in each card of 2-Pack
  - Monitor fast or slow I,V waveforms, critical DC levels
  - Change voltage levels remotely at card/system level
  - Monitor/Change set points at card/system level
  - Deliver critical timing signals with adjustable delay control each card (esp. important for rise-time preservation in stack
  - Etc.

5. Diagnostic Processor - Cont'd

- Need to revive work that stopped with (a) technology decision and (b) accident
- Long range, diagnostics controller systems are critical to manage HA sub system intervention strategies
- Started examining requirements for Marx modulator compared with earlier design
- Ultimately diagnostics boards can be reduced to rugged imbedded chip/hybrid designs.
- *Collaboration with Pohang continues as Dr. S. Nam is hired for 1 year in ESD to support this and other work.*

5. Diagnostic Processor Schedule

ID	Task Name	Duration	Start
180	**Diagnostic Processor-Power Systen**	**405 day**	**Wed 3/23/(**
181	Reestablish PLS Collaboration	0 day	Fri 4/15/(
182	Revisit specifications for Marx	30 day	Fri 4/15/(
183	Design	90 day	Wed 3/23/(
184	Prototype	60 day	Wed 7/27/(
185	Test at PLS	30 day	Wed 10/19/(
186	Deliver to SLAC	20 day	Wed 11/30/(
187	Evaluate on Marx Cell	15 day	Wed 12/28/(
188	Construct N units for Marx	120 day	Wed 1/18/(
189	Test N Units	30 day	Wed 7/5/(
190	Install	20 day	Wed 8/16/(
191	Full system test	20 day	Wed 9/13/(



6. HA System Instrumentation Standards – Larsen/Downing

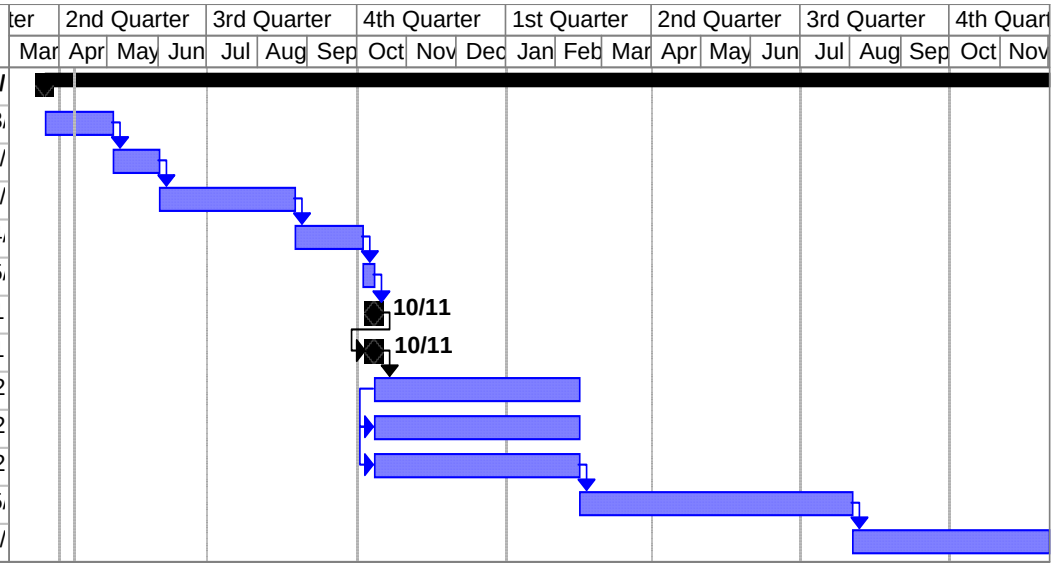
- Goal: Develop new approaches to HA instrumentation for:
  - Accelerator controls and communications
  - Beam instrumentation
  - Detector instrumentation
- How:
  - Hire R. Downing Inc. to help stir technological discussion, collaboration with other labs and industry, guide prototype lab development efforts
- Progress:
  - Wrote joint paper to introduce HA concepts for 2004 NSS (Nov. in Rome)
  - Paper for Real-Time 2005 in progress (June 05)
  - Hiring of Downing Inc. in progress

R. Downing Inc. Statement of Work

- Assist in developing SLAC HA instrumentation work plan.
- Assemble industrial HA instrumentation design information and prepare presentations
- Develop testing plan for HA modular components engineering evaluation
- Develop new HA system concepts for modular instrumentation and networks applicable to accelerator and detectors
- With Collaboration develop new systems concepts for chip and hybrid level imbedded diagnostics
- Develop HA instrumentation system white paper to set future goals. Include cost-benefits of imbedded intelligence approaches. Present to machine and detector physicists setting overall HA design goals.

6. HA Instrumentation Standards Schedule

ID	Task Name	Duration	Start
193	**HA Instrumention Standards**	**445 day**	**Wed 3/23/**
194	Research Industry Devemts	30 day	Wed 3/23/
195	Summary report & presentation	20 day	Wed 5/4/
196	Recruit Collaborators incl Indust	60 day	Wed 6/1/
197	White paper on development go	30 day	Wed 8/24/
198	1st Workshop	5 day	Wed 10/5/
199	Establish goals, assign tasks	0 day	Tue 10/11
200	Write SBIR solicitations	0 day	Tue 10/11
201	Analyze reliability	90 day	Wed 10/12
202	Analyze Availability	90 day	Wed 10/12
203	Specify, Order industrial prototy	90 day	Wed 10/12
204	Produce protos	120 day	Wed 2/15/
205	Evaluate at multiple locations	90 day	Wed 8/2/

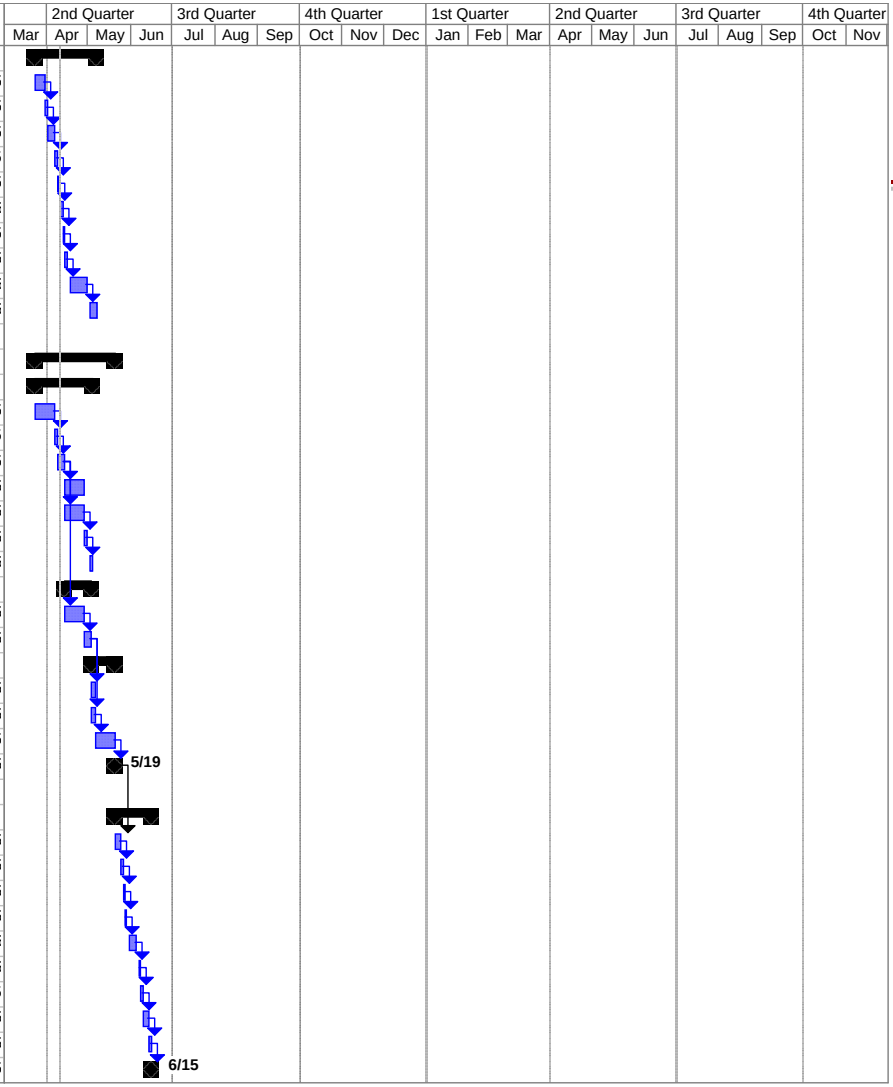


7. 2-Pack & 8-Pack Tasks – Cassel et al

- Plan: To maintain X-Band test capability in ESB SLED system:
  - Complete 2-Pack testing & make ready for move to ESB
  - Install new IGBTs, trim heat sinks, reinstall boards, full power test in water load B15
  - Decommission 8-Pack, move to B15
  - Install 2-Pack to replace 8-Pack; hook up 2 XL4 klystrons
  - Refurbish 8-Pack cells contact areas; drivers with non-Be connectors; make ready for alternate use e.g. 1/2/4/8 Pack configuration.

7. Status

ID	Task Name	Duration	Start
43	**8-Pack Removal ESB**	**33 days?**	**Wed 3/23/05**
44	Develop EWP's	5 days	Wed 3/23/05
45	Approve plan - ES&H	2 days	Wed 3/30/05
46	Clean Be - ES&H	3 days	Fri 4/1/05
47	Remove driver brds to B15	2 days	Wed 4/6/05
48	Drain oil to storage	1 day?	Fri 4/8/05
49	Disconnect 3T Xfmr/Kly	2 days	Mon 4/11/05
50	Remove/ transport to B15	1 day?	Wed 4/13/05
51	Disable 1 pr klystrons	2 days	Thu 4/14/05
52	Bld 2-Pack mating conn	10 days	Mon 4/18/05
53	Install mating hdwe	5 days	Mon 5/2/05
54			
55	**2-Pack Test B15**	**42 days**	**Wed 3/23/05**
56	**Driver Boards**	**30 days**	**Wed 3/23/05**
57	Write EWPs	10 days	Wed 3/23/05
58	Remove Drivers	2 days	Wed 4/6/05
59	Remove heat sinks, IGBTS	4 days	Fri 4/8/05
60	Mill heat sinks	10 days	Thu 4/14/05
61	Mount new IGBTs	10 days	Thu 4/14/05
62	Re-mount heat sinks	2 days	Thu 4/28/05
63	Reinstall	2 days	Mon 5/2/05
64	**Power Supply**	**13 days**	**Thu 4/14/05**
65	Complete Installation	10 days	Thu 4/14/05
66	Test on ResistorLoad	3 days	Thu 4/28/05
67	**System Test**	**13 days**	**Tue 5/3/05**
68	Hook up power, water, load	3 days	Tue 5/3/05
69	Hook up instrumentation	3 days	Tue 5/3/05
70	Full power tests water load	10 days	Fri 5/6/05
71	2-Pack Complete B15	0 days	Thu 5/19/05
72			
73	**2-Pack Move & Install**	**19 days**	**Fri 5/20/05**
74	Dismantle connections B15	2 days	Fri 5/20/05
75	Transport prep	2 days	Tue 5/24/05
76	Transpor t2-Pack to ESB	1 day	Thu 5/26/05
77	Transport Pwr Supply to ESB	1 day	Fri 5/27/05
78	Install & connect klystrons	5 days	Mon 5/30/05
79	Connect utilities	2 days	Mon 6/6/05
80	Connect controls	2 days	Wed 6/8/05
81	Test controls	2 days	Fri 6/10/05
82	Power test	2 days	Tue 6/14/05
83	2-Pack Complete	0 days	Wed 6/15/05



Summary Status

- Progress & Issues:
  - SNS Modulator ship date vague; potential slip
  - Good progress on LLRF definition, cost & schedule plan
  - FNAL switch task not defined; being worked on.
  - Manpower still diverted by arc-flash safety work
  - Schedules slipped ~ 2 weeks so far
  - Working to transition arc flash effort to responsible Conventional Facilities department
  - Marx progress vs. schedule doing well.
  - Instrument Standard devmnt. PO to Downing approved but delayed in SLAC purchasing.
  - MOU to SNS in process – not on critical path