
Hydraulic External Pre-Isolator (HEPI) Overall Installation Plan/Schedule

Dennis Coyne

HEPI Installation Readiness Review

Feb 11, 2004

Design Status

- All mechanical design completed & in production
- Real time control software is ~95% completed
 - » Receiving prototype low noise DAC this week from FDI for interface code testing
 - » Testing control laws ported from dSpace to VME:
 - Basic functionality demonstrated
 - ICS110B ADC code changes for reduced pipeline delay to be tested
- System Identification code nearly completed at LASTI
 - » Developing GDS tools to perform system id functions previously done in dSpace
 - » Have demonstrated safe system excitation with SOS 'canary' on the HAM table
- Control law development
 - » Algorithms/strategies demonstrated with 'reasonable' performance (i.e. > factor of 10 isolation in the 1 to 3 Hz band)
 - » Improvement in isolation at low frequency awaits testing at LLO (incorporating PEPI low frequency compensation design)
 - » Improvement at 'high' frequency (3 to 20 Hz) on the BSC awaits further testing at LLO &/or LASTI (once HEPI actuators re-installed on the BSC chamber)
 - Resonant gain at suspension vertical bounce mode should work
 - Plant inversion of the pier zero for control authority up to ~20 Hz seems difficult
 - Pier stiffening or reaction mass actuators are a last resort

Design Status (continued)

- Electronics

- » RFI-compliant layout completed and all cabling, EMI feedthroughs, connectors ordered
- » All custom electronics (I/O signal conditioning) schematic revision work completed, boards in production/test
- » Optical xmit/rec for interface to the timing system (for RFI compliance) is being prototyped (board due for stuffing soon)
- » re-packaging work nearing completion
- » On-schedule for first (end station) system to be completed by late Feb

Production Status

- Mechanical
 - » 20+ actuators completed now and production rate good (large risk retired)
 - » All servo-control valves & custom nozzles received (but not yet calibrated)
 - » Valve calibration stand nearly completed – hope to start valve calibration soon
 - Diff sensor incompatible with ionic fluid; procuring SS version
 - 1st set to be calibrated by Stanford with mineral oil
 - » Helical, machined springs, brackets, clamps, etc. nearly all completed
 - » All instrumentation (displacement sensors, seismometers) received
 - Order screw up on load cells – looking into rework now
 - » Welded housing and ‘boot’ are late (both expected Dec)
 - Fit check successful (2/4)
 - Expect first set to be received at LLO on or about 2/11
 - » Pump station assemblies nearly completed
 - 1 unit completed & tight; 6 others assembled by small leaks to be fixed
 - » Piping installation
 - Excel started 2/10
 - All piping materials are on-hand
 - Need designs for manifolds (at pump station and at chamber) ASAP
 - Need reservoir delivered ASAP
 - Need flexible shielded lines to actuator soon (1+ week lead time)
 - Schedule is ~8 weeks

Production Status Continued

- Electronics

- » All commercial-off-the-shelf (COTS) components have arrived except:
 - High speed VME intel CPU boards, now expected early Feb
 - Low noise DAC (which frees up LSC Pentek bds for HEPI) received
 - Must undergo LIGO testing, but sufficient Penteks are on hand to begin HEPI
- » Electronic parts kitted and sent to stuffing house – boards being tested in-house as received

- Software

- » Rolf & Alex to install HEPI code and the new DAQ reflective memory network (needed for HEPI) 2/16-27

Remaining Scope

- BSC Pier stiffeners
- ISC Table isolators

Cost Status

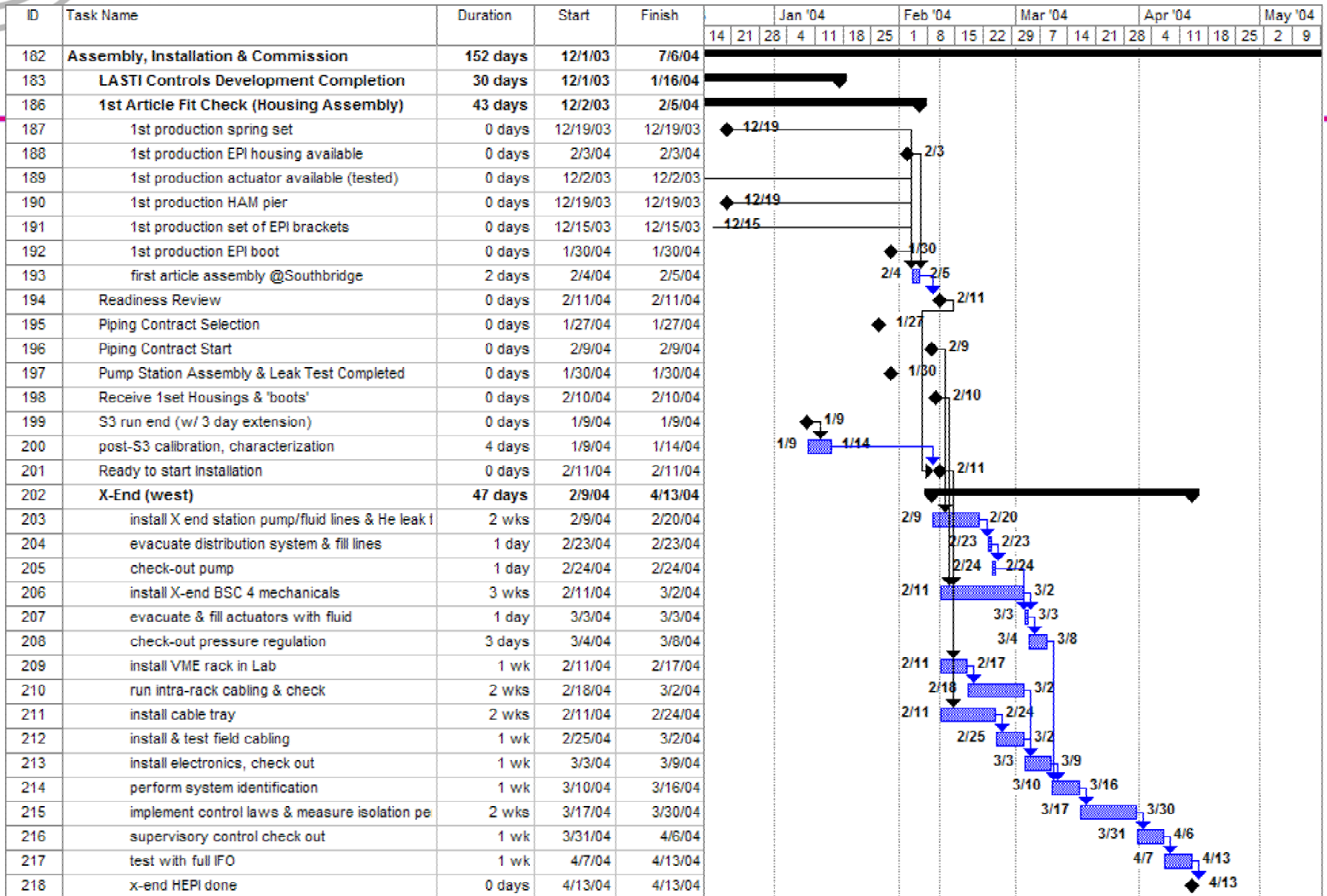
- CCB authorized \$450K less than HEPI request
 - » Hoped for lower electronics cost
 - » Planned for one fewer system at LASTI
- Increased costs:
 - » Premium payment to actuator fabricator to reduce schedule risk
 - » Increased costs due to new machining setup for changes from prototype to production
 - » Increased contract labor support for design and fabrication/installation oversight & consultancy board
 - » Revised DAQ architecture to handle HEPI
 - » Bottom line >~\$150K over CCB allocation; depends on
 - how LLO labor costs are handled
 - final electronics costs)
 - Cost for remaining scope

Installation Plans

- Chambers to remain under vacuum
 - » Have demonstrated installation at LASTI without disturbing the suspension and returning to final alignment/position
 - » Demonstrated system excitation (for system id) without disturbing the suspension
 - » Will monitor suspensions during HEPI installation and re-evaluate if/as needed
- Commissioning on non-HEPI tasks continues in parallel with HEPI
 - » Requires close, daily coordination of HEPI install & commission activities with the rest of detector commissioning
- Sequence is X-end, Y-end, Corner
 - » Electronics infrastructure first, Piping installation next, followed by mechanical and electronics, then commissioning
 - In corner station piping is in parallel with other installation, but has precedence (we should not delay Excel!)
 - » Two installation teams & two commissioning teams (BSC and HAM) in the corner station
 - End stations are training grounds for teams
- Installation procedure written & reviewed
 - » based on LASTI experience
 - » Numerous differences between LASTI & LLO (e.g. CAS removal)



Installation & Commissioning Schedule





Installation & Commissioning Schedule

ID	Task Name	Duration	Start	Finish	Feb '04				Mar '04				Apr '04				May '04				Jun '04				Jul '04				Aug			
					1	8	15	22	29	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	
219	Y-End (south)	47 days	2/23/04	4/27/04																												
220	install Y end station pump/fluid lines & He leak	1 wk	2/23/04	2/27/04																												
221	evacuate distribution system & fill lines	1 day	3/1/04	3/1/04																												
222	check-out pump	1 day	3/2/04	3/2/04																												
223	Install Y-end BSC 5 mechanicals	2 wks	3/3/04	3/16/04																												
224	evacuate & fill actuators with fluid	1 day	3/17/04	3/17/04																												
225	check-out pressure regulation	3 days	3/18/04	3/22/04																												
226	install VME rack in Lab	1 wk	3/3/04	3/9/04																												
227	run intra-rack cabling & check	2 wks	3/10/04	3/23/04																												
228	install cable tray	2 wks	3/3/04	3/16/04																												
229	install & test field cabling	1 wk	3/17/04	3/23/04																												
230	install electronics, check out	1 wk	3/24/04	3/30/04																												
231	perform system identification	1 wk	4/7/04	4/13/04																												
232	implement control laws & measure isolation pe	1 wk	4/14/04	4/20/04																												
233	supervisory control check out	1 wk	4/21/04	4/27/04																												
234	y-end HEPI done	0 days	4/27/04	4/27/04																												
235	Corner Station	92 days	3/1/04	7/6/04																												
236	install VME racks in Clean Storage Rm	2 wks	3/24/04	4/6/04																												
237	run intra-rack cabling & check	4 wks	4/7/04	5/4/04																												
238	install cable tray	2 wks	3/24/04	4/6/04																												
239	install & test field cabling	3 wks	4/7/04	4/27/04																												
240	install electronics, check out	3 wks	5/5/04	5/25/04																												
241	install vertex pump/fluid lines & He leak test	6 wks	3/1/04	4/9/04																												
242	Install BSC 1 mechanical	2 wks	3/17/04	3/30/04																												
243	Install BSC 2 mechanical	2 wks	3/31/04	4/13/04																												
244	Install BSC 3 mechanical	2 wks	4/14/04	4/27/04																												
245	Install H1 mechanical	3 wks	3/3/04	3/23/04																												
246	Install H2 mechanical	2 wks	3/24/04	4/6/04																												
247	Install H3 mechanical	2 wks	4/7/04	4/20/04																												
248	Install H4 mechanical	2 wks	4/21/04	5/4/04																												
249	ITMx	1.5 wks	5/26/04	6/4/04																												
250	ITMy	1.5 wks	6/4/04	6/15/04																												
251	BSC	1.5 wks	6/16/04	6/25/04																												
252	H1	1.5 wks	5/26/04	6/4/04																												
253	H3	1.5 wks	6/4/04	6/15/04																												
254	H2	1.5 wks	6/16/04	6/25/04																												
255	H4	1.5 wks	6/25/04	7/6/04																												
256	HEPI done	0 days	7/6/04	7/6/04																												

HEPI Installation Teams/Responsibilities

- Safety First!
 - » Personnel & Machine safety are paramount
 - » Schedule is important, but safety takes precedence
 - » Any team member can & should stop installation or commissioning if he/she feels there is a credible threat that should be addressed
- Installation leader is Rich Abbott
 - » Rich is the technical monitor on all production contracts; only he can direct the contractors (scope, cost changes)
 - » Joe Hanson supervises the Piping installation and contractor, Excel
 - Ken Mailand supports
 - » Gary Traylor and Harry Overmier lead assembly & installation teams (work together on the first BSC)
 - » Design team members will assist on the installation, especially the first 1 or 2 systems: Oddvar Spjeld, Ken Mason, Myron McInnis, Ken Mailand, Rich Mittleman, ...
 - » Joe Lacour supports as a consultant and troubleshooter – reports to Rich Abbott
 - » Oddvar Spjeld documents the piping installation and as-built modifications to the mechanical design
 - » Katrina Carter performs valve calibration

HEPI Installation

Teams/Responsibilities (continued)

- Commissioning leader is Joe Giaime
 - » Principal scientists leading the commissioning efforts are Rich Mittleman and Pradeep Sarin
 - » Other design team members will assist commissioning efforts: Brian Lantz, Corwin Hardham, Dennis Coyne, ...
- Cognizant Scientist is Brian Lantz
 - » All revisions to designs (as built) must meet Brian, Joe & Dennis's approval and be documented with DCNs
 - » All science/performance issues are to be reviewed/discussed with Brian, Joe and Dennis

Plan for minimal impact on other commissioning activities

- HEPI will be generally a day time activity
 - » leaving seismically quiet periods available for other (noise hunting related) commissioning activities
- Installation work should be planned, if/as possible to end with the optics table in alignment
 - » We don't leave loads hanging from the crane over night
 - » Leave the HEPI payload clamped if there is insufficient time to adjust alignment/position back to original before suspending work for the day
 - Or plan for a long day
- System identification should take advantage of idle periods by using 'automated' start/stop scripts
- Installation should not stretch the schedule
 - » As the installation lengthens, the impact on detector commissioning increases
 - » Adequate time must be given to SEI commissioning
 - » As the installation effort progresses, we'll evaluate whether additional staff, 2nd shift or weekend work is warranted
- If unanticipated, difficult problems arise, we'll consider addressing these at LASTI rather than impact LLO further