Second Report of the
Standing Committee on Upgrade
Installation-to-Physics Commissioning (SC-IPC)

March 5, 2005

1.0 Introduction

In the First Report of the Standing Committee on Upgrade Installation to Physics Commissioning (SC-IPC), dated October 12, 2004 and available at http://d0server1.fnal.gov/projects/run2b/SC-IPC/documents/SC-IPC_First_Report.pdf, the timelines and physicist effort requirements for installation and commissioning to physics of the several elements of the RunIIb upgrade were described and summarized.

Since the First Report the DØ spokespersons have asked the SCIPC to identify and enumerate the physicists expected to be available for the installation and commissioning tasks tabulated in the Report. The SC-IPC working group leaders collected the required information during this past December/January and it is presented herein.

1.1 Evolution of Installation Planning Since the First Report

At the Director's Review of the Upgrade, February 3, 2004, an installation schedule was presented which indicated the Tevatron shutdown for installation would last approximately 14 weeks. Recent evaluation of the required work indicates 13 weeks may be achievable and this is shown in the tables herein. In the First SC-IPC Report the Tevatron shutdown period was envisioned to be approximately 11 weeks. The First Report envisioned a total duration "physics-to-physics" of 21 weeks; the new understanding of the shutdown period extends this duration to an anticipated 24 weeks.

The major contributor to the anticipated lengthening of the shutdown was the growing realization that the installation of the L0 Silicon would surely be more complicated than originally conceived. Much of this realization was prompted by experience gained during the Summer 2004 Shutdown when the detector was opened and the beryllium beampipe was exposed so precision measurements could be made of the clearance between the beampipe and the RunIIa Silicon. The repeated necessary manipulations of the calorimeters and end muon toroids to open, close, bakeout and leakcheck the beampipe spool pieces, plus the complexities of working with precision fixtures in the gaps, strongly indicates that to avoid risk of damage to sensitive components time must be allowed for careful scheduling of appropriate work steps and the use of experienced, unhurried workers.

1.2 Explanation of the Tables

The Installation to Physics Timeline tables originally presented in the First Report are reproduced herein, after modification which reflects the present understanding of the anticipated duration of the shutdown.

In the First Report physicist effort was categorized as "FNAL", or "University" as the schedule categorized the responsibility for a given hardware element, or "Physicst" when it was not so categorized. This distinction is dropped in the revised timeline tables presented herein. To the tables is added a new line which tabulates the numbers of physicists we believe will be available to help with the installation and commissioning tasks each week. A second new line in the tables calculates the difference, an excess or deficiency depending on the sign of the subtraction, of physicist effort we believe will be encountered during the installation period

The term "physicist" as we use it does not differentiate between full-time thesis researcher, postdoc, or senior physicist/faculty member.

We omit a summary table for the Trigsim effort (SC-IPC Working Group 4), since we believe the additional effort required over and above that provided by the Upgrade Project for Trigsim is already in place and functioning adequately.

As in the First Report, for L1 Cal Trig and L0 Silicon, we retain the column labeled "Before" which indicates the effort required to conduct certain "infrastructure" preinstallation/precommissioning activities not explicitly provided by the Upgrade Project itself. The totals in the tables exclude the personnel required for these "Before" tasks.

It has been anticipated that the shutdown for installation will occur after classes at most universities are in session. This has inevitably reduced the number of faculty members that might otherwise have been able to commit to the installation/commissioning tasks.

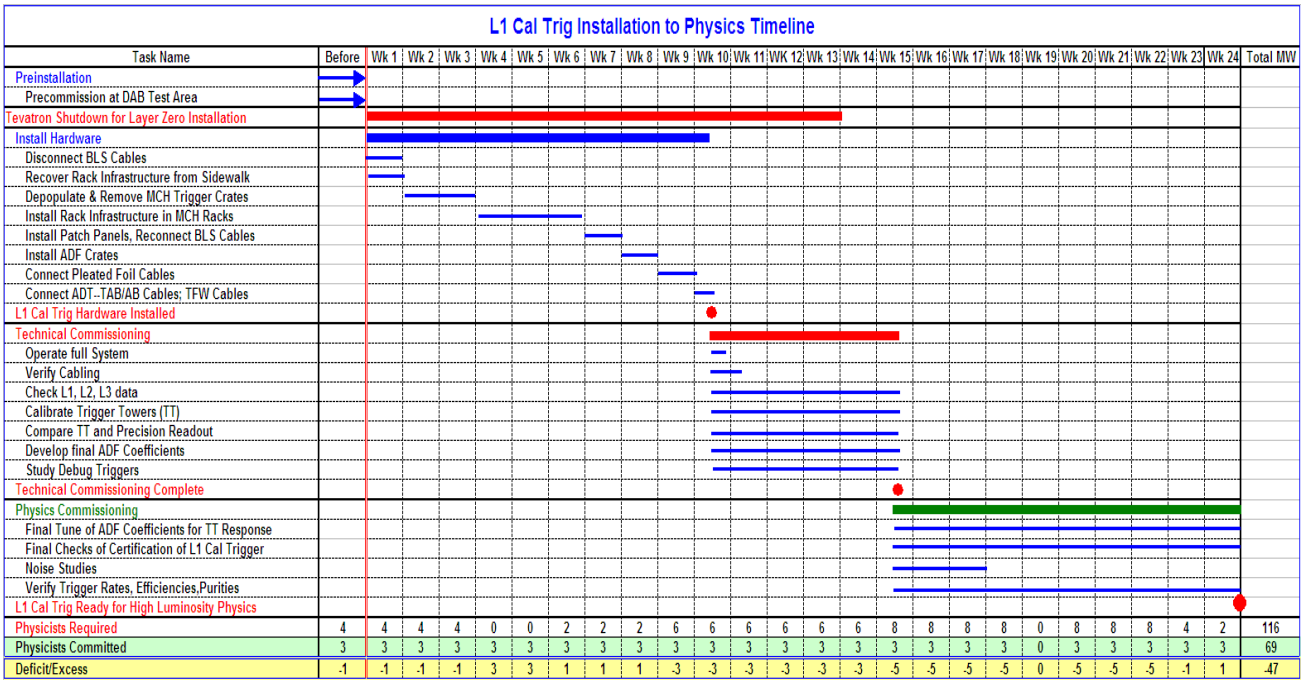
2.0 Installation Effort Timelines

The Installation timelines presented in the First Report showed a gap in the Tevatron shutdown after the L0 silicon was fully cabled and ready to operate, but before the detector was reclosed for physics. During this gap it was assumed the Tevatron might choose to begin tuning up for the resumption of collisions (e.g. on second and third shifts) but the L0 commissioning team would retain the ability to enter the detector to correct a problem with the new hardware. At the end of the gap, the Tevatron would cease operations once again and the detector would be closed. This gap has been eliminated in the present planning on the advice of the Beams Division who indicate they would not find such a "tune-up" period useful and would prefer to begin resumption of collisions only when the detector was fully ready for physics.

All of the timeline tables show zero effort in week 19. This corresponds to the assumption that the customary holiday period at the end of the calendar year will diminish one work week correspondingly. If the actual start of the shutdown positions this holiday late in the installation period when the effort required is essentially all "physicist", then the lost time likely will not extend the end of the commissioning period so strongly.

2.1 Working Group 1: L1CalTrig

Table 1 presents the timeline and effort summary required to take the L1CalTrig from the beginning of installation to the point that it is fully operational in high luminosity physics data-taking. Substantial effort will be required to achieve this in the time indicated. At present only Columbia and UIC post-docs and graduate students have been identified as being available for installation and commissioning. This corresponds to three FTEs (Lammers & Mulhearn at 50%, Johnson and Stone at 100%), shown in the "Physicist Committed" line of the table.



Task Name	Before	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	WK 12	Wk 13	Wk 14	Wk 15	Wk 16	Wk 17	Wk 18	Wk 19	Wk 20	Wk 21	Wk 22	Wk 23	Wk 24	Total MW
Preinstallation																										
Precommission at DAB Test Area																										
Tevatron Shutdown for Layer Zero Installation																										
Install Hardware																										
Disconnect BLS Cables																										
Recover Rack Infrastructure from Sidewalk																										
Depopulate & Remove MCH Trigger Crates																										
Install Rack Infrastructure in MCH Racks																										
Install Patch Panels, Reconnect BLS Cables																										
Install ADF Crates																										
Connect Pleated Foil Cables																										
Connect ADT--TAB/AB Cables; TFW Cables																										
L1 Cal Trig Hardware Installed																										
Technical Commissioning																										
Operate full System																										
Verify Cabling																										
Check L1, L2, L3 data																										
Calibrate Trigger Towers (TT)																										
Compare TT and Precision Readout																										
Develop final ADF Coefficients																										
Study Debug Triggers																										
Technical Commissioning Complete																										
Physics Commissioning																										
Final Tune of ADF Coefficients for TT Response																										
Final Checks of Certification of L1 Cal Trigger																										
Noise Studies																										
Verify Trigger Rates, Efficiencies,Purities																										
L1 Cal Trig Ready for High Luminosity Physics																										
Physicists Required	4	4	4	4	0	0	2	2	2	6	6	6	6	6	6	8	8	8	8	0	8	8	8	4	2	116
Physicists Committed	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	3	3	3	3	3	69
Deficit/Excess	-1	-1	-1	-1	3	3	1	1	1	-3	-3	-3	-3	-3	-3	-5	-5	-5	-5	0	-5	-5	-5	-1	1	-47

Table 1. L1CalTrig Installation to Physics Timeline & Effort Summary

The last line in Table 1 indicates that a persistent deficit of effort totaling an average of more than 2 FTE's for the period must be recruited to add to the L1 Cal team. In fact the effort deficit reaches as many as five physicists during the final critical weeks of physics commissioning.

The "Before" column largely consists of the operation of the test area on the DAB sidewalk. With the individuals identified above, we believe the addition of perhaps two knowledgeable (part time) "shifters" to this precommissioning team will enable it to achieve its goals. These persons can work with the Upgrade Project team to complete miscellaneous minor software packages as effort with the actual hardware on the sidewalk ramps up.

We remind the collaboration that we believe having a core group of dedicated post-docs or experienced graduate students is crucial to get a complex system like the L1cal trigger commissioned with minimum downtime. We believe that experienced faculty will be available for assistance and consulting but we do not count them as contributing to the intensive daily work at DAB during the period.

2.2 Working Group 2: L1CalTrack & L1CTT

Table 2 presents the timeline and effort summary required to take the L1CTT and L1CalTrack from the beginning of installation to the point that it is fully operational in high luminosity physics data-taking.

We identify Grünendahl and the new BU postdoc as two full-time commitments to the CTT effort, plus a total of approximately one Full Time Equivalent (FTE) physicist from the Arizona group (consisting of four physicists each able to contribute part-time to the effort).

As Table 2 shows, L1CTT and L1CalTrk require approximately 1.5 additional physicists during the period to ensure the success of the enterprise. Likely one full-time software-oriented physicist would make the most valuable contribution to the team, with an addition of a hardware-oriented physicst at least part time to assist in the debugging of the hardware components of the two trigger upgrades.

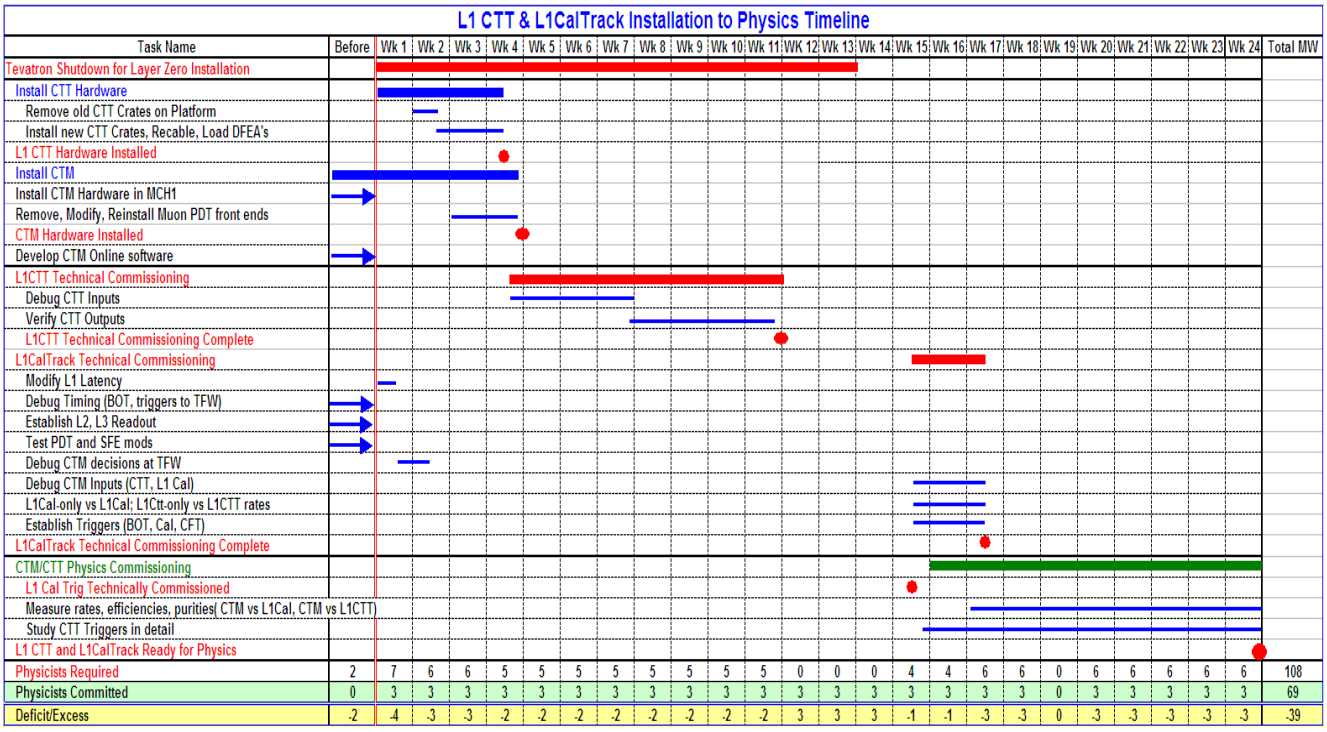


Table 2. L1CTT & L1CalTrack Installation to Physics Timeline & Effort Summary

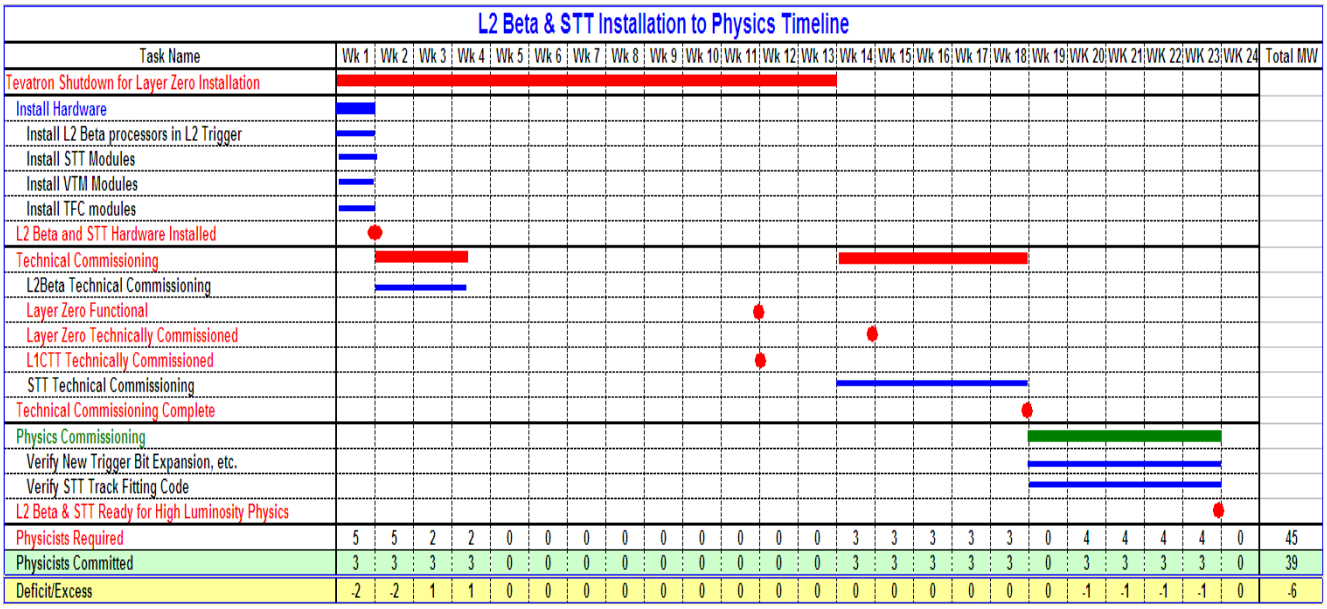
The "Before" column in Table 2 indicates that sustained effort is required before the shutdown begins to complete the preinstallation work needed by L1CalTrack. The indicated deficit of effort must recruited early to ensure that this infrastructure is in place as scheduled.

2.3 Working Group 3: L2 βeta Upgrade & STT

Table 3 presents the timeline and effort summary required to take the L2 βeta and STT from the beginning of installation to the point that it is fully operational in high luminosity physics data-taking.

We believe number of physicists identified for the L2 βeta installation and commissioning is most likely adequate, with two FTEs from Virgina and one FTE from Oklahoma contributing three FTEs total for the duration of the project.

We believe that additional effort will be needed for the L2 STT project. Currently, one FTE from Columbia has been identified (the table obscures the fact that two physicists are needed for the physics commissioning of each of the upgrades) which leads to the need for an additional physicist for STT. We know of no specific commitment for this effort at present from any of the institutions presently contributing to the STT upgrade.



Task Name	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12	Wk 13	Wk 14	Wk 15	Wk 16	Wk 17	Wk 18	Wk 19	WK 20	WK 21	WK 22	WK 23	WK 24	Total MW
Tevatron Shutdown for Layer Zero Installation																									
Install Hardware																									
Install L2 Beta processors in L2 Trigger																									
Install STT Modules																									
Install VTM Modules																									
Install TFC modules																									
L2 Beta and STT Hardware Installed																									
Technical Commissioning																									
L2Beta Technical Commissioning																									
Layer Zero Functional																									
Layer Zero Technically Commissioned																									
L1CTT Technically Commissioned																									
STT Technical Commissioning																									
Technical Commissioning Complete																									
Physics Commissioning																									
Verify New Trigger Bit Expansion, etc.																									
Verify STT Track Fitting Code																									
L2 Beta & STT Ready for High Luminosity Physics																									
Physicists Required	5	5	2	2	0	0	0	0	0	0	0	0	0	3	3	3	3	3	0	4	4	4	4	0	45
Physicists Committed	3	3	3	3	0	0	0	0	0	0	0	0	0	3	3	3	3	3	0	3	3	3	3	0	39
Deficit/Excess	-2	-2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	-1	0	-6

Table 3. L2 βeta and STT Installation to Physics Timeline & Effort Summary

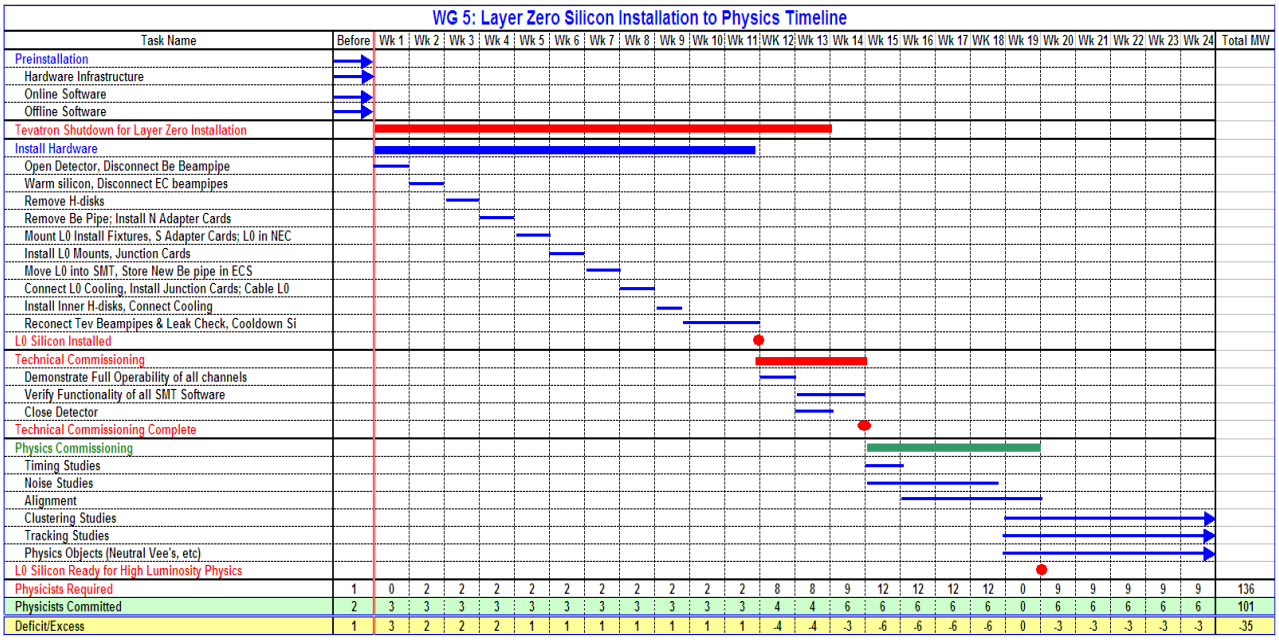
2.4 Working Group 4: Trigsim

The SCIPC notes with approbation DØ's response to its recommendation to appoint a trigger coordinator, a position which has already very favorably impacted the strengthening of the relationships between the current trigger and the new trigger required for RunIIb. Given this high level appointment, and the fact that most of the Trigsim activities are being carried out in preparation for the 2005 shutdown and are therefore not specific to the installation period itself, we have excluded the Trigsim effort from the current report and corresponding Summary Table.

2.5 Working Group 5: Layer Zero Silicon

Table 4 presents the timeline and effort summary for the installation and commissioning of the silicon.

We find that two FTEs from Fermilab and one FTE from Stony Brook will be available for the duration of the hardware installation portion of the task. Additional physicists will be needed for cabling and the technical and physics commissioning phases of the task. We anticipate that sufficient experts can be recruited from the present pool of SMT operating experts for the technical commissioning of L0. Three or four additional experts for alignment studies, clustering, and tracking must be recruited to complete the task. The overall average need is about 1.5 additional physicists.



Task Name	Before	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	WK 12	Wk 13	Wk 14	Wk 15	Wk 16	Wk 17	WK 18	Wk 19	Wk 20	Wk 21	Wk 22	Wk 23	Wk 24	Total MW
Preinstallation																										
Hardware Infrastructure																										
Online Software																										
Offline Software																										
Tevatron Shutdown for Layer Zero Installation																										
Install Hardware																										
Open Detector, Disconnect Be Beampipe																										
Warm silicon, Disconnect EC beampipes																										
Remove H-disks																										
Remove Be Pipe; Install N Adapter Cards																										
Mount L0 Install Fixtures, S Adapter Cards; L0 in NEC																										
Install L0 Mounts, Junction Cards																										
Move L0 into SMT, Store New Be pipe in ECS																										
Connect L0 Cooling, Install Junction Cards; Cable L0																										
Install Inner H-disks, Connect Cooling																										
Reconect Tev Beampipes & Leak Check, Cooldown Si																										
L0 Silicon Installed																										
Technical Commissioning																										
Demonstrate Full Operability of all channels																										
Verify Functionality of all SMT Software																										
Close Detector																										
Technical Commissioning Complete																										
Physics Commissioning																										
Timing Studies																										
Noise Studies																										
Alignment																										
Clustering Studies																										
Tracking Studies																										
Physics Objects (Neutral Vee's, etc)																										
L0 Silicon Ready for High Luminosity Physics																										
Physicists Required	1	0	2	2	2	2	2	2	2	2	2	2	8	8	9	12	12	12	12	0	9	9	9	9	9	136
Physicists Committed	2	3	3	3	3	3	3	3	3	3	3	3	4	4	6	6	6	6	6	0	6	6	6	6	6	101
Deficit/Excess	1	3	2	2	2	1	1	1	1	1	1	1	-4	-4	-3	-6	-6	-6	-6	0	-3	-3	-3	-3	-3	-35

Table 4. Layer Zero Silicon Installation to Physics Timeline & Effort Summary

2.6 Summary

Table 5 summarizes the effort requirements summed for all of the upgrades. On average the additional number of physicists needed is more than five FTEs for the duration of the installation/commissioning period.

Note that even though the *average* number of additional FTEs needed is rather low, the *maximum* number of additional FTEs needed peaks at 14 and is sustained at 12 for several weeks during the later half of the period.

Taking into account additional factors, like the lack of contingency included in the timeline of the schedule shown in Table 5, and the fact that experts in one system will most likely not be able to assist with work on another upgrade system due to the diverse areas of expertise involved, the SCIPC considers that a more conservative estimate for the average number of additional physicists needed during the shutdown is perhaps 10FTEs peaking at as many as 15FTEs.

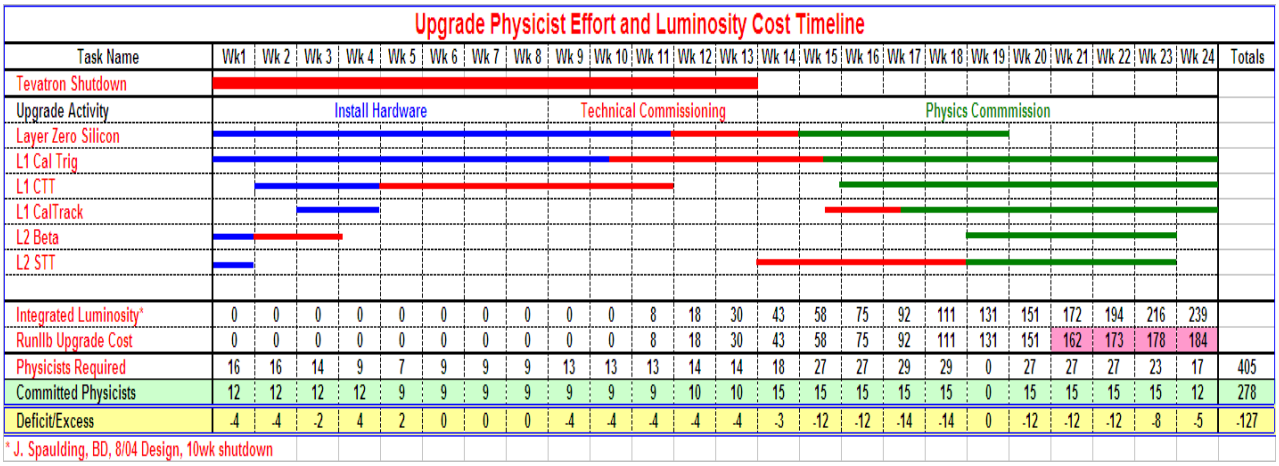


Table 5. Installation to Physics Timeline & Effort Summary

Table 5 also shows the luminosity cost of the upgrade now that the physics-to-physics duration is forseen as 24 weeks. While the cost is large by historic standards (it exceeds that of all of Run 1), it is only 16% of that expected to be delivered during the 2006 year (1113 pb^{-1}) and SCIPC believes the overall cost to the experiment will be higher if this expenditure is not made at the appropriate time.

3.0 SC-IPC Recommendations

The SCIPC believes that the collaboration faces significant recruitment needs to ensure that appropriate expertise is in place to ensure the timely return of the detector to high-luminosity physics data-taking.

The collaboration has identified significant new management resources (e.g. L0 software leadership, Trigger software development leadership, L1 Cal Precommissioning leadership). It must move promptly and decisively to exploit these resources to recruit the needed physicist effort now that will underpin the success of the RunIIb Upgrades. Each institution must be encouraged to contribute towards the new talent required and each contributor should make every effort to involve those who can become the knowledgeable experts of the future in the operation of the detector.

The SCIPC also believes that the collaboration should schedule installation readiness assessments for each of the upgrade elements, to ensure that the optimum time is chosen for the installation shutdown and not a moment of it is wasted. The timing of these assessments can vary according to the varying complexity of each of the upgrade elements, and the composition of the teams charged with making the assessments should include individuals experienced in the commissioning of new hardware and software, as well as those not directly involved in the upgrade fabrication efforts themselves.