July 9, 2002

The following contains the CDF responses to the Comments and Recommendations made by the Director's Review of 16-18 April, 2002. The Comments and Recommendations are repeated here, followed by the CDF response, in italics.

1.2. **Scope of the Proposed Upgrades**

1.2.2 Comments

- We commend and thank the D0 and CDF collaborations for their hard work in defining and presenting their plans for Run 2b.
- Reduction of the long period of time needed to achieve silicon functionality after installation in Run 2a is insufficiently addressed in the plans for Run 2b. For CDF, it appears that insufficient systems testing was performed for Run 2a, and for D0 it appears that schedule slip resulted in the completion of tasks during inconvenient Run 2a access periods.

The schedule showed used six months for the installation, which we were advised was one of the constraints of Run IIb. This schedule gives inadequate time for testing, which everyone agrees. We will show a longer installation schedule in the future.

- The D0 silicon scope is slightly larger than that of CDF, because a smaller sensor pitch was chosen by D0. The smaller pitch is desired due to a difference in capability between the outer tracking systems.
- The D0 low-mass jumper cables are outside the stave assembly. The CDF silicon bus cables are inside into the stave assembly, presenting significant risk for noise issues, while allowing a clean assembly package.

This will be tested in the prototype stave.

- The sensor, SVX4, and the hybrid programs appear well planned, and the plans have profited from prior experience.

- The silicon stave concept is new, and presents risks for a variety of unforeseeable problems.

- The stave cooling is generally more challenging than used in previous detectors, and presents a variety of risks.

1.2.3. Recommendations

- Develop plans to insure that the Run 2b silicon detectors are more fully functional at the time of installation then were the Run 2a silicon detectors.

The schedule showed used six months for the installation, which we were advised was one of the constraints of Run IIb. This schedule gives inadequate time for testing, which everyone agrees. We will show a longer installation schedule in the future.

- Understand differences in silicon sensor testing plans between CDF and D0: one of the experiment is under(over)estimating the amount of work that is needed.

- Explore more common effort in stave cooling design and prototyping.

Various options have been discussed. Both groups are well aware of the developments within the other.

1.3 **Total Project Cost Estimates**

1.3.2 Comments

The Projects might be well advised to:

- Use the FY instead of the CY – since BA arrives with the FY.

We used FY in all the schedules we showed.

- Be very explicit in the WBS cost rollup = FY02$. Then add contingency in that metric and then escalate to AY$. This should avoid confusion on the part of the reviewers.

This is the approach we took.

- Show the Resource Sheets – with all indirect costs (~ 2x of straight salary at FNAL) included up front as the "cost of doing business".

We will show the resource sheet in the future. We did not realize there was interest in it.

- Adopt an agreed upon template for both Projects of resource costs for FNAL techs and engineers and a generic "university" also.

Common resource names have been agreed upon between the two projects, and common rates will be used in the future.

- Only show AY$ at L2 and above. Invoices and BA are in AY$ and you want to use a consistent metric.

This is what we did, and we will continue.

- Adopt a consistent and Project wide contingency methodology and evaluate all task (labor and M&S) contingencies at the lowest level appearing in the WBS. Do not put in "hidden" contingency. There is now a labor contingency of 50% explicitly, with another factor which is hidden. This is not transparent. A better procedure is to reduce the task duration keeping resources fixed. In that way explicit slack time is generated which can be tracked.

Hidden contingencies have been removed

- Report only on a total project contingency. That is to avoid the perception that there is a distinct/explicit, say, L2 contingency.

This is at odds with other request, where we have been asked to identify the contingency for each Level 2 subproject. For example, see section 1.3.3 below.

- Escalate the base cost + contingency instead of adding contingency in AY$ at the end. The contingency is estimated as applied to FY02$ tasks.

This distinction is unclear.

- The total costs in AY$ as a function of FY at L2 is a useful plot. The total "resources" = Techs + Engineers + Physicists (FTE) as a function of FY is also a useful plot.

We will show these in the future

1.3.3 Recommendations

- Show only the TPC, not separate M&S and Labor.

We are almost always asked for this detail.

- Review the schedule and make sure that all tasks, e.g. non – U.S. are explicitly part of the schedule.

This has always been true.

- Load the schedule with **ALL** the resources needed to bring the Project to a successful conclusion – graduate students, postdocs, professors, foreign contributions, etc.

This is our approach. Any omissions are accidental.

- Explicitly label a task as R&D or Project, including all tasks in the schedule.

New schedule versions have this explicitly labeled.

- Agree on base labor costs and indirects between CDF and D0.

We will do this.

- Supply a Resource sheet containing all labor indirects as the "cost of doing business".

Our labor rates include salary plus paid time off. Other indirect costs have not been included, but are added in later.

- Same for M&S – indirects in the BOE.

We prefer to add indirects later, not in the schedule. We prefer the schedule costs to track cost estimates and requisition values.

- Assess contingency for those uncosted resources (base program) which have significant risk at the lowest task level.

Greater detail will be provided for the contingency estimates in the future.

- Present a detailed Basis of Estimate with vendor quotes, engineering estimates, etc. This document should not be electronic

This will be done.

- The BOE should be mapped with the WBS structure so that reviewers can "drill down" transparently.

This will be done.

- Apply contingency at the lowest level WBS task for both labor and M&S.

This will be done.

- Add tasks describing the operation of a "Project Office" sufficient to allow for proper management of the Project, e.g. tracking, reporting, SOW, MOU, procurement, etc.

We have people called out in the Administration schedule, but not the individual activities. This is a lot of detail, with little gain for it.

- The schedules have many tasks that are dependent on timely issue of P.O.s. Need to have a buyer identified from purchasing and assigned as a member of each project team. One buyer for both could be acceptable.

We will explore this, but it may not be practical at Fermilab.

- Procurement needs to be shown on the project organization chart.

We will explore this, but it may not be practical at Fermilab.

- Make sure the MOU and SOW and Monthly Reports and other documents are derived from the Project file so that it is the unique source to define the Project and all other items are derived from it.

The MOU, SOW, and Monthly reports will all use the WBS defined in the Project file.

- The Committee has examined the cost estimates and has arrived at the following table.

	Items	Project Estimate				Committee Estimate			
		Base	Cont. %	Cont. $	Total	Base	Cont. %	Cont. $	Total
D0	Silicon Tracker	$15,539,082	42.5%	6,603,769	$22,142,852	$15,089,082	60%	$9,053,449	**$24,142,532**
	Level 1 Calorimeter	$1,753,596	28.4%	498,340	$2,251,936	$1,753,596	30%	$526,079	**$2,279,675**
	Level 1 Cal/Track Match	$264,116	32.0%	84,559	$348,676	$264,116	40%	$105,646	**$369,762**
	Level 1 Track Trigger	$980,125	45.2%	442,967	$1,423,093	$980,125	70%	$686,088	**$1,666,213**
	Level 2b	$108,305	45.5%	49,307	$157,612	$108,305	50%	$54,153	**$162,458**
	Level 2 STT	$514,786	42.2%	217,078	$731,864	$514,786	50%	$257,393	**$772,179**
	Online	$656,686	36.1%	237,032	$893,718	$656,686	50%	$328,343	**$985,029**
	Project Office					$500,000	50%	$250,000	**$750,000**
	Total	$19,816,697	41.0%	8,133,052	$27,949,749	$19,866,697	57%	$11,261,151	**$31,127,848**
CDF	Silicon Detector	$12,472,938	44%	$5,454,147	$17,927,085	$12,472,938	60%	$7,483,763	**$19,956,700**
	Central Preshower	$805,503	34%	$272,835	$1,078,338	$805,503	35%	$281,926	**$1,087,429**
	Event Builder	$509,815	56%	$286,947	$796,762	$509,815	35%	$178,435	**$688,251**
	Electromagnetic Calorimeter Timing	$208,051	0%	$0	$208,051	$208,051	50%	$104,026	**$312,077**
	Installation	$683,889	30%	$205,167	$889,055	$683,889	50%	$341,944	**$1,025,833**
	Administration	$517,424	45%	$232,664	$750,088	$517,424	50%	$258,712	**$776,137**
	Total	$15,197,620	42%	6,451,760	$21,649,380	$15,197,620	57%	$8,648,806	**$23,846,426**

- 60% of the base estimate. This level of contingency is in line with past Run IIa experience and the planning of US LHC experiments.
- The base cost of D0 Si was reduced to account for recent vendor quotes.
- The L1 track trigger for D0 was thought to be not fully defined, and therefore a 70% contingency was assigned. Subsystems which were not presented were assigned a 50% contingency. They should be internally reviewed prior to the Lehman review.
- The CDF event builder appeared to be largely a commercially supplied device. Therefore a 35% contingency was assigned to this subsystem.

1.4 Schedule

1.4.2 Comments

- The committee was impressed at the level of detail and effort that both groups has put into the review materials. It is clear that a

great deal of work has gone into this effort and the committee thanks them for presenting detailed project plans.

- The committee felt that the current schedules presented were unrealistic for the defined scope of each project. At the current time, the committee felt there was a risk of up to a year slip in the detector available date.

The schedules are being modified to contain explicit schedule contingency. The completion date will be chosen to be approximately one year beyond the date shown at the review.

- There are areas of schedule risk that should be noted and alternative strategies developed. These are;
    - SVX4 chip, hybrids, and stave development. Be sure to include adequate time for testing and integration.

Schedule contingency will be added here, on top of the testing time.

    - Coordination of parts flow and assembly at SiDet. This must be carefully monitored to reduce cost and schedule inefficiencies and optimize the efforts on each project, particularly during the peak loading at SiDet (FY03-FY04).

We are aware of this potential problem, and will attempt to mitigate it.

    - Assembly, installation, and pre-beam commissioning of each silicon detector must be sufficiently staffed with post-docs to ensure that the system integration efforts occur before installation.

We agree.

- An integrated master schedule is needed to fully understand the critical path for the whole project and the overall resources

necessary to meet the completion milestones. This integrated master schedule will also help to see what is just off the critical path for the entire project as well as each L2 subsystem.

The schedule is very uneven. The critical path is defined by the silicon detector construction, and none of the other projects come close to the critical path.

- The committee is concerned about the current status against the schedule as both projects have not requested resources at the levels called for in the project files. This implies that the schedule is currently slipping from the current projection.

Schedules will be statussed in the future.

- Look for opportunities to advance the engineering design and production efforts whenever possible to improve slack against the baseline schedule.

We will do this.

- The committee is concerned that the pre-beam commissioning time needed for Run IIb is lower by ~3 months from that experienced in Run IIa. System integration must not be sacrificed for installation first with testing and integration later.

The schedule showed used six months for the installation, which we were advised was one of the constraints of Run IIb. This schedule gives inadequate time for testing, which everyone agrees. We will show a longer installation schedule in the future.

- Procurement of key components must be placed with sufficient time to ensure that all parts are available for the SiDet production teams. This effort should be coordinated between both groups to

- The committee urges both groups to consider the use of common components and procurement along with design strategies for each project whenever feasible. This will allow economies of scale to be employed resulting in a simpler assembly process and less schedule risk.

This is being done whenever possible.

1.4.3 Recommendations

- For both the CDF and D-0 schedules, review the project at the lowest WBS level remove slack and show baseline efforts only. This baseline effort should be what you really want to measure your progress against. Schedule contingency (slack) should be called out explicitly either by a gap in tasks versus fixed milestones or as an explicit slack task.

This is being implemented now.

- The committee urges both D-0 and CDF to consider project scope based upon physics AND schedule. A well-built detector installed and commissioned late may be of little value in the LHC era.

We are aware of this.

- Present one-page critical path (summary sheet) schedules for each subsystem and also for each project. All tasks should be measured using base efforts with no 'hidden' float. Schedule contingency should be shown explicitly as float.

This is being implemented now.

- The committee urges both D-0 and CDF to begin monthly statusing of their projects using earned value measurements as a way to coordinate its efforts as well as determine its current progress. Milestones should be tracked and reported against with variances (baseline vs actual) noted.

Earned value calculations are in progress, but may not be ready by the next review.

- Present time-phased resource plots for all FTE's (post-docs, engineers, technicians, etc.) for each subsystem as well as for each total project. Common metrics and formats should be used across projects. Use fiscal year divisions to agree with funding support.

We will show this in the future.

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1.5 Management Considerations

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1.5.2 Comments

- Acquisition Execution Plan : Draft appears to be in a good shape.

  This has been submitted to DOE (late June 2002).

- Contingency Analysis : The overall guidance either should be followed with a very few exceptions or should be eliminated if a large fraction of tasks being treated as exceptions.

  We have many exceptions to our guidance, so we may drop it altogether.

- Schedule Float : A couple of tasks were identified as possibly having a "built-in & hidden" schedule float.

  Hidden float has been made explicit.

- Common Project : Given the technical difficulties and extremely tight schedule for both Silicon projects, and their importance to the Run2b physics program, the collaborating effort should continue to be encouraged and pursued, especially in the areas of resource planning.

- Project management tools : For the CDF and D0 upgrades to be successful, the schedule must be carefully monitored by management with the ability to respond to problems quickly while they are small and do not erode the master schedule.

1.5.3 Recommendations

- Acquisition Execution Plan : Finalize the draft before the DoE baseline review.

  Done.

- Contingency Analysis : Describe the overall guidance in a consistent way with the methodology used by the subprojects.

  We have many exceptions to our guidance, so we may drop it altogether.

- Schedule Float : Remove the "built-in & hidden" schedule floats but rather show them explicitly, perhaps similar way as showing overall contingency for the project cost.

Hidden float has been made explicit.

- Common Project : Projects together with the PPD management and directorate should give a careful evaluation of the laboratory resource availability for silicon detector construction.

  This has been discussed at great length with the PPD, and we are trying to resolve our needs against the available resources.

- Project management tools : The committee strongly urges that the CDF and D0 groups begin to status their resource-loaded schedules and use the measured progress and management tools to understand where future problems and risks might arise.

  This process has begun.

- The Fermilab directorate should manage these upgrades in an active, aggressive manner. This would include monthly reports with presentations showing milestone status, resources expended and progress achieved.

1. CDF Specific Items

3.2 Scope of the Proposed Upgrades

3.2.2 Comments

- The successful operation of full stave prototypes appears prominently in the testing plans, and we believe this effort is critical to the success of this silicon project.

- The CDF Event Builder, CDF Preshower, and CDF EM Timing projects

display an absence of integration into the CDF project management system.

We have streamlined the Level 2 organization, and will work to unify the group better.

- Scope increases for the COT, L2 Trigger, and TDCs were mentioned.

This will be well defined by the next review.

3.2.3 Recommendations

- Develop feasible baselines for the CDF Event Builder, CDF Preshower, and CDF EM Timing projects, with the inclusion of all resources, including both labor and M&S regardless of funding source.

This will be well defined by the next review.

- Integrate the CDF Event Builder, CDF Preshower, and CDF EM Timing projects into the CDF project management system.

This will be done.

- Either eliminate or fully develop scope increases by the time of the Lehman review.

This will be well defined by the next review.

3.3 Total Project Cost Estimates

3.3.2 Comments

- Add contingency column to the lowest level WBS printout so that

reviewers can see contingency at the lowest level.

This was contained in our WBS dictionary at the lowest level. It will appear in a different format in the future, as specified by the earned value calculator.

3.3.3 Recommendations

- Remove the SiDet explicit contingency of 250 k$. Put it in the overall contingency if appropriate.

  Done.

- The CDF Installation schedule has no M&S costs. It was stated that operating would pay for any materials. If the materials are need to complete the project the cost should be included in the project.

  This is being reviewed, and will be corrected.

- Check the rollup from the lowest WBS costs to the top level for consistency. This should not be done by hand, but with a dedicated macro.

  This will be done.

- Re -evaluate the installation tasks and costs, since this effort is short w.r.t. D0 yet it entails a rollout (3 months alone).

  The roll-in and roll-out is understood very well, and we stand by those estimates. Commissioning the silicon detector is poorly understood. Future installation schedules will contain extra time for commissioning.

3.4 Schedule

3.4.2 Comments

- CDF presented a ~6month installation schedule which may be tight considering ~6 weeks are required for the detector roll-out and 6 more to roll-in. D-0 estimates ~7.5 months with no rollout.

The schedule showed used six months for the installation, which we were advised was one of the constraints of Run IIb. This schedule gives inadequate time for testing, which everyone agrees. We will show a longer installation schedule in the future.

3.5 Management Considerations

3.5.2 Comments

- Management Structure : This magnitude of project will require a sizable team of project management office in order to keep up with the tracking and reporting of the aggressive schedule.

  Two additional people have been added to the group.

- Project Documentation : There are existing PEP & PMP and multi-year MOU & annual SOW document templates from CMS Project and NuMI/MINOS Project. CDF management should take a look at these existing and working document and see what can be adopted in order to simplify and make more functional.

  MOU and SOW templates from CMS have been adopted for CDF. Drafts of the PEP and PMP exist and available for review.

- Risk Analysis : There are a number of areas with technical, cost or schedule uncertainties which might benefit by conducting a risk analysis.

  A formal risk analysis technique will be employed.

- Cost tables in the subproject talks should not include the contingency under "total cost". Contingency belongs to the Project Manager, not to the each subsystem.

  This is at odds with other request, where we have been asked to identify the contingency for each Level 2 subproject. For example, see section 1.3.3 above.

3.5.3 Recommendations

- Management Structure : The organization should to be strengthened in the following areas
  - The project and the collaboration should work with the laboratory management in order to clearly define the project management structure, especially related to Fermilab management.

    We meet with the laboratory management regularly.

  - Project office needs to be established with an adequate staffing as soon as possible.

    Two additional people have been added to the group.

- Project Documentation : **Final draft of PEP and a reasonable shape MOU example or template should be produced by May 15.** Take a look at examples of PEP (PMP) and MOU, SOW from existing

construction projects at Fermilab and try to simplify these documents. The content should be clear, brief, and get to the point on exactly what you are going to do.

All these documents exist in draft or template form, and can be found on the CDF Run IIb public web page.

- Risk Analysis : Conduct project wide risk analysis for the areas which have technical, cost or schedule uncertainties.

  A formal risk analysis technique will be employed. The method we will use is described in the PMP.