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6 January 2000

To: Mike Shaevitz, Fermilab Directorate
From: Peter H. Garbincius, Chairman, D0 Review Panel
Subject: Report on Review of D0 Installation and Commissioning, 7-8 December 1999

As you requested, a panel consisting of Dennis Theriot, Jim Strait, Aesook Byon-Wagner, Don Hartill, Margaret Votava, Jim Siegrist, Jim Krebs, Dave Pushka, and myself, reviewed the D0 plans for installation and commissioning. Our charge was to determine the likelihood of D0 being able to attain the scheduled date of 1 March 2001 for beginning of operations for collider physics, given the caveat that the D0 sub-system components for the upgrade are ready according to the current baseline schedule.

After presentations by the D0 managers and project leaders, we broke into three sub-panels for more specific discussion with the D0 experts. The sub-panel reports follow:

Electronics/DAQ/On-Line/Trigger (D.Hartill, M. Votava, A. Byon-Wagner)

The electronics and DAQ are generally in good shape. There is some concern about the manpower and schedule for the printed circuit board production and testing for the muon, calorimeter, and tracking systems. The DAQ hardware schedule is back-loaded where the high tech components arrive at the end. The schedules for the trigger, VRC, SB, and ETG are very tight.

The status of the muon electronics was presented and discussed only with this sub-panel. It appears that the muon board production will not be completed until August, 2000, leaving little time for individual board check-out and integrated system testing. Two members of the PNPI group have been denied B-1 visas. One of these members is responsible for the redesign and final pre-

production testing of one of the key VME boards for the muon electronics. It is not apparent to this sub-panel that the re-assignment of these tasks has been adequately accomplished.

There did not appear to be an adequate plan for continued support of the field programmable gate arrays. We recommend that a long range plan for maintenance of custom electronics after installation be developed.

Currently, a part-time graduate student from NIU is responsible for providing an NT release for the Level III software. The importance of this function for the DAQ system dictates that this service needs to be provided as part of the infrastructure support for on-line computing at D0. D0 hired this contract person because milestones were missed due to lack of this service, but this support should be transitioned to a more stable support structure.

D0 has designed computer security into their data acquisition software for the real DA; however, we believe more attention should also be paid to the development and test stand machines. The commissioning schedule is very tight. If a given machine were removed from the network for a week because of a security breach, it could have a serious impact on that sub-detector's deliverables.

There are several key people at D0 (not only on the electronics side) whose long term absence would seriously affect the roll-in date. This is unavoidable because of the extremely specialized expertise needed for some jobs. D0 management should identify these critical assignments and insure that adequate expertise can be maintained through installation and commissioning.

It was noted that high bandwidth diagnostic and specialized test equipment was not sufficiently available for testing, installation, and commissioning activities commencing at this time.

We recommend a person with an electronics/DAQ background to lead this commissioning effort under Jon Kotcher. This person's responsibility would include coordinating the schedules for horizontal DAQ integration.

Detector Installation, Commissioning, and Infrastructure

(P. Garbincius, J. Siegrist, J. Krebs, D. Pushka)

We note that the new schedule is a good start. Due to the complexity in terms of manpower, space, utilities, time, etc., we recommend expanding the schedule to include more details and finer time structure.

There are concerns in terms of progress on some of the infrastructure sub-systems, namely engineering and technician availability for the silicon cooling and muon gas system installations, both of which are major factors in the perceived manpower need peak in early year 2000. We are discouraged over the lack of specification of electrical power distribution needs on behalf of the forward muon detector systems. This information has to be supplied immediately in order for power to be available when required by the forward muon systems. D0 management must continue to monitor, prioritize, and optimize its overall manpower pool on a weekly basis. We encourage continued use of make-buy considerations in optimizing the D0 manpower situation in terms of using external (non-Fermilab) engineering, assemblies, and lower-skilled manpower, if available, if appropriate, and if affordable within the D0 budget.

D0 is justifiably concerned over the current schedule in which platform moves preclude the availability of Liquid Helium in the November to mid-December 2000 time scale. This very likely will severely limit the checkout and commissioning of the VLPC readout of the Fiber Tracker systems. We are encouraged by D0's identification of this problem and their investigation of possible work-arounds to this potentially very disruptive occurrence. We also recommend continued study of the installation and commissioning schedule to understand if any additional conflicts can be anticipated and also to optimize use of manpower.

We recommend the (re-)institution of a "Hall Crew" who would report to the Associate Project Manager for Installation and Commissioning and to the Project Engineers, and who would supervise, facilitate, and participate in the installation of both the infrastructure and individual sub-systems. This group needs to be adequately staffed and committed through the installation and

commissioning and into the early operations phases. They would provide the constant factor in the planning, installation, and safety activities and thus represent a continued institutional memory. Such a group did exist and supported the previous Run I installation and commissioning but have largely been re-assigned to sub-system fabrication activities. Such experience should be utilized again.

It appears that Fermilab will be unable to accommodate the additional D0 manpower request of 14-15 engineers, technicians, and designer for installation and commissioning activities in early year 2000, which arose from initial evaluation of this resource-loaded schedule. It appears that global manpower optimizations are now needed: within D0, by Fermilab and by the collaborating D0 institutions with respect to both production and installation/commissioning needs; within the Fermilab Particle Physics Division, with respect to continued support of installation and commissioning at D0 by the fabrication/production groups, if they possess the appropriate skills; and within Fermilab as a whole.

Management/Schedule/Manpower (D. Theriot, J. Strait)

The current installation plan represents a good first pass. A structure is in place that can be refined in the future as the schedule changes and evolves.

The time estimates are probably the least accurate information contained in the plan. Inaccurate time estimates on the production side can change delivery dates and thus change the order of installation sequences. But more probably, the time estimates are poorest for the installation processes themselves. The basic plan of depending on the subsystems for the main installation manpower is good thus covering the manpower requirements for any stretch out; however, the different groups may stumble over one another as the tasks pile up causing shortages in floor space, crane usage, DAQ support, etc.

The largest current need for manpower is in the area of mechanical infrastructure. The estimated needs are for three mechanical engineers and one designer for design and planning and eleven mechanical technicians. It is probably too late for new hires to fill the engineering and

designer slots, so they will probably have to be filled by reassigning FNAL personnel. First, in order of preference, would be to find additional engineers from outside the D0 project; second, to transfer these design tasks to the appropriate subsystem if the engineering skill exists there. Most competent engineers are capable of both supervising a production task and designing a new system at the same time. A third alternative is for the D0 project management to assign these tasks to an engineer currently assigned to the D0 project who has the necessary skills and time regardless of his subsystem assignment (i.e. simply draft them). The technician needs should be met first by looking within the D0 project and optimizing the utilization of current manpower; for example, many of the technicians originally assigned to the DAB are now involved in production tasks and their skills may now be more sorely needed to handle installation tasks. PPD may be able to furnish help. Contract personnel can be hired for some of the unskilled tasks such as laying cable if proper supervision is available. T&M personnel may be suitable to perform some of the tasks.

Lacking from the manpower estimates was the manpower needed to cover the transition from installation to full operations. Installation lasts fifteen months and some of the systems once they are installed must be kept in operation in order to support follow on installation tasks. It is suggested that a date for 'Start of Operations' be picked and that all manpower estimated be extended to that date.

The installation group needs more physicists to handle integration issues. They would furnish liaison between the installation group and the subsystems on gas needs, pipe locations, AC power outlets, etc. Some of the subsystems are not supplying information in a timely fashion to the installation group so that the work can be organized and executed efficiently by the engineers. Resource loading in the installation schedule should include the following: manpower, crane usage, floor space, DAQ support, and time-shift assignments. These can be kept up to date by forming an Installation Task Force consisting of the 'Commissioning Cabinet', the Project Engineers, and the DAB Floor Manager which would have a weekly meeting to keep everyone up to date and informed. The responsibilities and authority of the Installation and Commissioning Manager and the Project Engineers should be clearly defined and understood by all members of D0. Once any subsystem is at the DAB, these persons should be in charge. The assembly area is congested and could be very dangerous if proper procedures are not followed.

On the project management side, the installation milestones should be integrated into the reportable milestones list. Currently, the reportable milestones for installation show only the delivery of a subsystem to DAB and the completion of commissioning of that subsystem with no intermediate steps that would allow tracking by the PMG. Secondly, the Installation Group should look into developing some project management tool that would more clearly show the connections and interactions between the various subsystems once the installation starts. A network chart such as a PERT chart does this more clearly than a GANTT chart although there may be other tools. Lastly, the Installation Group needs to look into load-leveling the installation tasks; they also need to look into squeezing some of the schedule contingency out of the subsystems and putting it into the installation schedule contingency. The current three week schedule contingency is not adequate for a schedule that is supposed to last fifteen months.

Overall, there are no 'show stoppers', but the schedule is very tight. Both care and good planning are needed if the schedule is to be met.

Summary

We thank the D0 Upgrade Project, and its leaders (H. Weerts, M. Tuts, J. Womersley, H. Montgomery, and especially its installation and commissioning coordinator J. Kotcher) for their hospitality and openness in discussing their plans for installation and commissioning. It is acknowledged and we are impressed that these detailed plans have only recently been formulated. We especially appreciate D0's frank discussion of potential problem areas and concerns, some of which were noted by this review panel, but many had been already self-identified by D0. We believe that the D0 Upgrade Project has a good grasp of the installation and commissioning problems they are facing and have shown a commitment to attack and to overcome these problems.

The singular question before this review panel was whether D0 could meet the installation and commissioning schedule deadline of 1 March 2001. Our answer is "Maybe". At this time, we do not identify any item that will definitely cause that milestone to be missed. However, we note that

the schedule is very tight. There is very little, if any, float or time contingency included for the installation and commissioning. The late delivery, testing, commissioning and systems integration of certain electronics components could very well jeopardize meeting this milestone. We also note that other electronics components could be installed as access became available after detector roll-in. Finally, meeting this deadline must assume that the solution of the recently identified additional manpower-need peak in early year 2000 for installation of various infrastructure systems be accomplished without unacceptable impact on the progress of sub-system fabrication and production.

During the review, there was some discussion of producing a fall-back plan for de-scoping the installation and commissioning phase if schedule problems occur. This was recommended by two Lehman Reviews of D0 in June, 1999 and November, 1999. Since it is not yet foreseen that any of the upgrade subsystems would fail to meet the 1 March 2001 deadline, this review panel feels that consideration of such de-scoping is inappropriate at this time. Immediate planning effort would be better spent in addressing manpower optimizations.

The viability of the 1 March 2001 deadline for collider experiment operations will require constant vigilance on the part of the D0 and Fermilab management. It would appear that the frequent D0 PMG may be the appropriate vehicle for oversight for the progress of these installation and commissioning activities, especially if there is positive progress. However, if serious concerns remain after 6 months, an additional review of this scope may be warranted. Please let us know if you require further discussion or clarification.

For the review panel,

Sincerely,

Peter H. Garbincius, Chairman

cc: M. Witherell, K. Stanfield, T. Yamanouchi,
D. Hartill, M. Votava, A. Byon-Wagner, J. Siegrist, J. Krebs, D. Pushka, D. Theriot, J. Strait

D0 Installation and Commissioning Review

December 7-8, 1999

Summary of Recommendations

(added 14 February 2000)

Electronics, DAQ, On-Line, and Trigger

- * Assign replacements for lost manpower for muon electronics testing;

- * Develop a long range plan for support and maintenance of custom electronics, field programmable gate arrays, NT/Level 3 software, etc.;

- * Establish infrastructure support for on-line systems and programming, make these systems easy for commissioning team to use;

- * Appoint an electronics commissioning coordinator reporting to the Associate Project Manager for Installation and Commissioning;

- * Provide adequate test equipment (scopes, logic analyzers, etc.) through the installation and commissioning phases;

- * Ensure there is appropriate backup personnel for key areas of expertise.

Detector Installation, Commissioning, and Infrastructure

- * Setup global manpower optimization including Fermilab, the D0 collaboration, and contract personnel;

- * Include manpower resources in planning and tracking of tasks;

- * Ensure infrastructure specifications and requests are presented early enough, in a timely manner;
- * Develop expanded, more detailed schedule, milestones and time structure;
- * Continuously study, track, modify installation and commissioning schedule to prevent conflict;
- * Develop, if possible, installation plans that will not preclude the timely availability of liquid Helium for commissioning of the VLPCs.

Management, Schedule, and Manpower

- * Define clearly the responsibilities of the Installation and Commissioning Manager and the Project Engineers so they are understood by all members of D0;
- * Identify and assign additional manpower for mechanical infrastructure;
- * Develop manpower plan through commissioning and "start of operations";
- * Develop a "resource loaded" installation and commissioning schedule, level manpower loads, improve time estimates, develop time contingency/float, and optimize interaction between subsystems; include all relevant resources such as manpower, crane, floor space, etc.
- * Create an Installation Task Force to handle integration and coordination issues, including both daily and long-term planning and scheduling;
- * Establish an installation "Hall Crew" with "Floor Manager" to provide expertise, coordination, and internal ES&H oversight and to accumulate experience and maintain corporate memory for these activities;
- * Develop installation and commissioning milestones for planning and tracking;

* Utilize visual networking tools (for example, PERT chart) to clearly show and monitor connections and interactions between all installation and commissioning activities;

* Organize tasks and activities to add, if possible, contingency time or float; the current D0 schedule is too crowded to generate confidence that the March 1, 2001 deadline will easily be met.

- end of Summary of Recommendations